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COVID-19 PANDEMIC'S IMPACTS ON CHINA'S ENERGY SECTOR: A PRELIMINARY ANALYSIS

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Key Takeaways

The novel coronavirus (COVID-19) pandemic is inflicting high human costs in China and around the world. The stringent quarantine measures imposed by the Chinese government have severely affected the country's economic activity, with profound energy and climate implications:

- According to official Chinese government statistics, in the first quarter (Q1) of 2020, China's gross domestic product (GDP), national energy consumption, and national power demand declined by 6.8 percent, 2.8 percent, and 6.5 percent year over year (YOY), respectively. In April, national power demand increased slightly by 0.7 percent YOY, indicating that the Chinese energy economy is rebounding.
- Given the many known unknowns about COVID-19 and the fluid situation in different parts of the world, the shape of economic recovery in China is highly uncertain; thus, it is premature to accurately quantify COVID-19's impacts on China's energy sector. Instead, a possible range of China's national energy and power demand in 2020 is reported as the following: in the optimistic-case scenario, assuming that economic activity ramps up during the second half of 2020 in both China and around the world without widespread resurgence of COVID-19, China's national energy consumption in 2020 is estimated to grow 0.9 percent YOY, with national power demand in 2020 increasing by 1.2 percent YOY. In a much more pessimistic scenario released by the International Energy Agency (IEA), China's national energy consumption in 2020 is projected to decline by more than 4 percent YOY, with national power demand in 2020 dropping by about 3 percent YOY.
- COVID-19 is expected to have substantial impacts on China's forthcoming 14th Five-Year Plan (FYP) for energy. Against the backdrop of rising anxieties over economic growth and energy security among Chinese decision makers, upgrading China's climate ambitions will be politically challenging. In addition, diminishing coal's role in China's energy mix will be more difficult, with potential long-term detrimental impacts on global carbon emissions and prospects for China's renewable development.
- From a Chinese cultural perspective, a crisis as significant as the COVID-19 pandemic is often not only perceived as a threat (*wei*); it may also be treated as an opportunity (*ji*)—or *wei ji*. Instead of relying on energy-intensive infrastructure and heavy industry

investment to achieve short-term economic gains, Chinese decision makers should double down on efforts for the clean energy transition, aiming to better balance short-term political targets with long-term strategic goals. If this occurs, China possesses great potential to become a true global leader in clean energy investment and the low carbon economy in the post-coronavirus world.

Introduction

Against the backdrop of a prolonged US-China trade war, rising debt level, and cooling domestic demand, the Chinese economy grew 6.1 percent in 2019, 4.6 percent lower than in 2010 and the slowest pace in nearly three decades.[1] Due to increasingly lower expectations, including concern for a potential hard landing of the Chinese economy caused by the trade war, the Year of the Rat (the 2020 Chinese Lunar New Year, which began on January 25, 2020) was off to a good start for China. The US-China phase one trade deal signed on January 15, 2020, temporarily lowered geopolitical pressure imposed on Beijing, and a largely positive market sentiment supported a stabilizing prospect of the Chinese economy, with Morgan Stanley in December 2019 and the International Monetary Fund (IMF) in January 2020 projecting Chinese GDP would grow 6 percent in 2020.[2]

As the world's largest energy consumer and power producer, China's national energy consumption increased 3.3 percent in 2019. Meanwhile, the continuous electrification of the Chinese economy led to 4.5 percent YOY growth of power demand last year.[3] Without a global health crisis, based on a hybrid energy economy modeling tool,[4] the author estimated that China's national energy consumption and power demand would increase by 3 percent and 4.5 percent, respectively, in 2020.

Unfortunately, the Year of the Rat was soon marred by COVID-19, which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The unprecedented lockdown starting in Wuhan, the epicenter of the COVID-19 outbreak and capital city of Hubei province, on January 23, and the World Health Organization's subsequent declaration of COVID-19 as a public health emergency of international concern on January 30 and as a global pandemic on March 12, led to severe effects on economic growth, energy demand, and energy policy orientation in China and beyond.

At the time of writing this preliminary analysis, the first wave of the COVID-19 outbreak in China was largely under control by early March from the perspective of daily new infections, but SARS-CoV-2 had unfortunately spread rapidly in the rest of the world. As a result of the ongoing pandemic, the IMF projected on April 14 that the global economy would contract sharply by 3 percent in 2020, much worse than during the 2008–2009 financial crisis. Meanwhile, Chinese economic growth in 2020 was downgraded significantly from 6 percent to 1.2 percent under the IMF's baseline scenario.[5]

This commentary describes the evolution of the Chinese energy economy and assesses COVID-19's impacts on the Chinese energy sector with traditional economic and energy statistics as well as alternative indicators, including air pollution indexes. It then evaluates how COVID-19 may affect China's existing and forthcoming Five-Year Plans (FYP) for energy, which play a central role in guiding the country's energy development. Finally, this preliminary analysis concludes with some politically plausible recommendations coupled with suggestions for follow-up studies.

Impacts on China's Energy Sector

In Q1 2020, all major economic indicators in China were deeply negative: industrial production fell by 8.4 percent YOY, retail sales by 19 percent, and fixed-asset investment by 16.1 percent. Consequently, China's GDP has declined by 6.8 percent YOY.[6] The last time China reported an economic contraction was more than four decades ago, at the end of the Cultural Revolution in 1976.

The effect of this decline in economic activity on energy use is highly asymmetrical and depends on the pattern of specific energy end use. Traditional relationships between economic growth and energy demand have been broken due to the unique nature of a pandemic-driven shock. Some energy uses in China, like residential power demand and online shopping's delivery service, are even more pronounced. Others, most notably aviation jet fuel, have collapsed far more steeply than the decline of GDP. While China's national energy demand in 2020 is projected by the IEA to decline by more than 4 percent YOY,[7] recent statistics released by the National Bureau of Statistics of China (NBS) and uncertainty associated with the shape of China's economic recovery indicate that it may be premature to accurately quantify COVID-19's effects on China's energy sector. While the IEA claims that China's energy demand in Q1 2020 declined by over 7 percent YOY, a similar rate reported by the NBS is only 2.8 percent.[8] Nevertheless, given cyclic and drastic revisions to China's energy statistical reporting in the new millennium, uncertainty exists about whether the IEA has accurately estimated China's energy landscape in Q1 2020. For further detail, please refer to Box 1 in the later part of this analysis.

Overview of Chinese Energy Economy Between Two Coronavirus Outbreaks

To better understand COVID-19's effects, it is necessary to begin with a clear understanding of China's energy sector. Similar to COVID-19, the SARS outbreak that originated in mainland China in 2003 is also caused by a coronavirus; therefore, it is natural to compare economic and energy implications of SARS with COVID-19.

While 17 years have passed since the 2003 SARS outbreak, figure 1 indicates that the size of the Chinese economy and energy market have grown substantially. In 2009, China surpassed not only Japan as the world's second largest economy but also the United States as the largest energy consumer. Meanwhile, the Chinese economy became increasingly service oriented, with energy-intensive industry accounting for less than 39 percent of GDP in 2019, compared with 46 percent in 2003. Though China has become the world's largest clean energy market, coal still plays a dominant but less important role in China's energy mix, accounting for 58 percent of energy consumption in 2019.

While COVID-19 is much more contagious than SARS, it is less deadly if health systems are not overwhelmed. Further, the SARS outbreak was primarily concentrated in greater China, which accounted for 92 percent of global cumulative infections.[9] In comparison, the geographic coverage of COVID-19 is much more global. Nevertheless, the following lessons drawn from the 2003 SARS outbreak should still be relevant in analyzing COVID-19's effects on China's energy sector:

1. The 2003 SARS outbreak was not entirely contained by human intervention; it suddenly disappeared in summer 2003, with higher temperatures considered a key factor in eradicating the virus. SARS-CoV-2 appears to be increasingly unlikely to follow the similar seasonal pattern of many viral respiratory diseases, including influenza and SARS, which fade when the northern hemisphere warms up, so COVID-19's impacts on China's energy sector is expected to be much more profound.

2. After the SARS outbreak, it took more than one year for China's quarterly GDP growth rate to rebound beyond the pre-outbreak level. As a result, expectations are that any economic rebound in 2020 would struggle to exceed the 6 percent growth in China's GDP seen in Q4 2019.

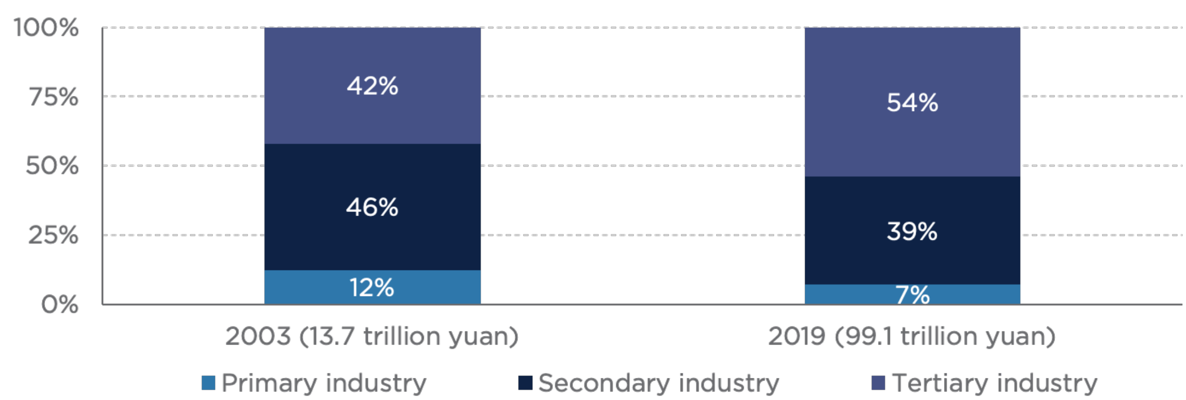
3. The SARS outbreak hit the service sector harder than more energy-intensive industries. As the Chinese economy becomes increasingly service oriented, with the share of the service sector as a percentage of GDP rising from 42 percent in 2003 to 54 percent in 2019, COVID-19 is expected to have a more severe impact on China's economic activity than energy consumption.[10]

As the world's largest power market, China ranks first globally in terms of coal-fired, hydro, wind, and solar power capacity, and the country is also the third largest nuclear power economy after the United States and France. In 2019, China's coal-fired power capacity stood at 1,045 gigawatts (GW), the equivalent of nearly half the global total and more than 90 percent of China's thermal capacity, accounting for 52 percent of national power capacity and 62.3 percent of national generation. In comparison, gas-fired power capacity reached 90.2 GW, representing 8.6 percent of national power capacity and 3.2 percent of national generation.[11]

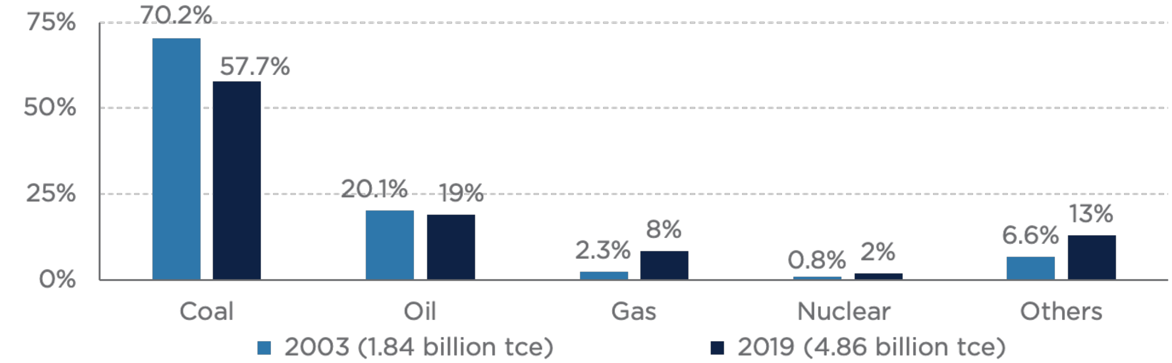
On the demand side, industrial activity and transport dominate final energy consumption. As overcapacity is a serious concern in China's energy sector, the trajectory of the Chinese energy economy is expected to be largely demand driven in the months to come, with the industrial activity level and transport turnover key to analyzing COVID-19's effects on China's energy sector.

Figure 1: Evolution of Chinese energy economy since 2003

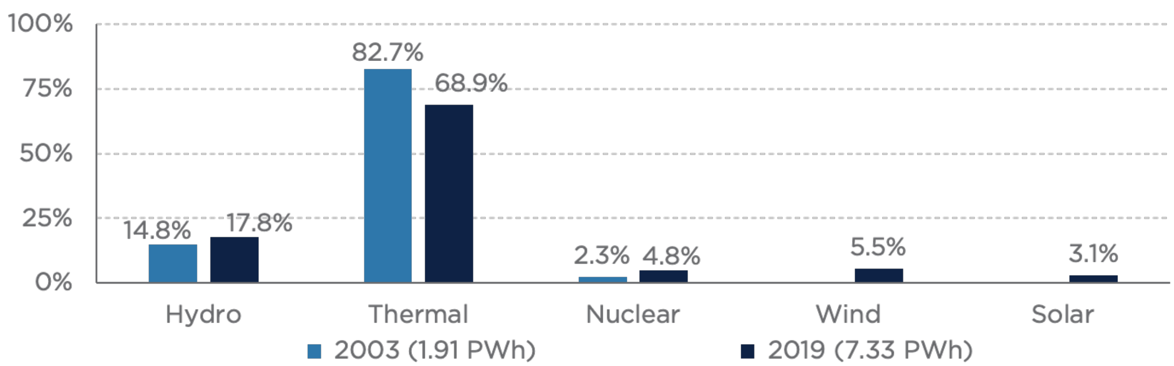
Economic structure change



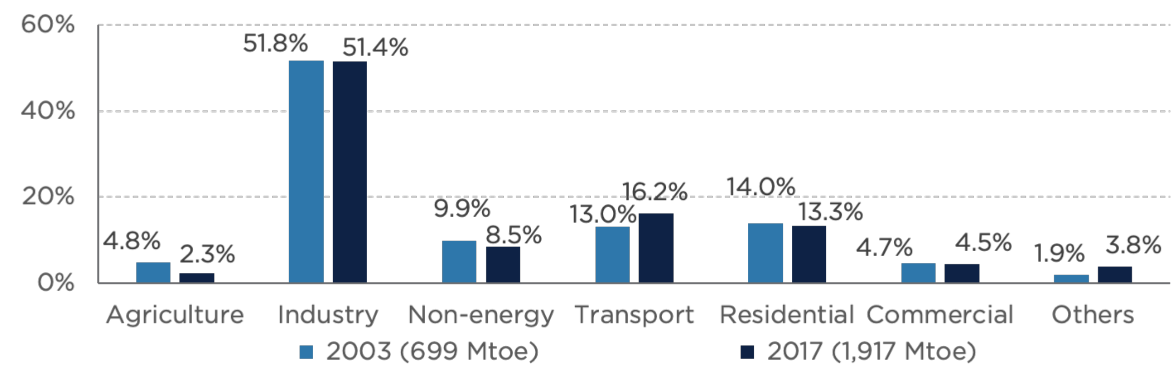
Energy mix change



Power generation mix change



Final energy consumption mix change



Sources: NBS online database, Wang Qingyi China's energy statistics 2020, IEA World Energy Balance 2019. Notes: 1) Primary industry, as defined by the NBS, includes agriculture, forestry, animal husbandry, and fishery; secondary industry includes mining, manufacturing, power, heat, gas and water supply, and construction; tertiary industry is the service sector. 2) China's energy statistical reporting is not entirely compatible with countries in the Organisation for Economic Co-operation and Development, with adjustment necessary especially for the transport sector—so the final energy mix is based on China's energy balance tables adjusted by the IEA. In addition, waste energy has been subtracted from the IEA data set to be compatible with NBS statistical reporting practices. 3) PWh stands for petawatt-hour.

Power Sector—the Most Reliable Gauge of the Chinese Energy Economy

Economists and statisticians strive to measure and track economic growth, and the most well-known and frequently tracked is GDP. Nevertheless, limitations and biases are well known in the GDP calculation, which is prone to distortion. As the electrical power transmission grid connects power generation and end users in a constantly metered and balanced mode, electricity industry indicators—especially power consumption—are considered particularly useful to track economic growth. For example, the Keqiang index is an economic measurement index that tracks the progress of the Chinese economy using three indicators, including power consumption. It is reportedly preferred by Chinese premier Li Keqiang as a better economic indicator than GDP.[12]

In 2019, China's power consumption increased 4.5 percent YOY, reaching 7,226 terawatt-hours (TWh), with a sectorial breakdown as follows:

1. Primary industry (i.e., essentially agriculture): 1.1 percent of national total, with YOY growth at 4.5 percent
2. Secondary industry (i.e., essentially industry): 68.3 percent (67.1 percent for industry) of national total, with YOY growth at 3.1 percent (2.9 percent for industry)
3. Tertiary industry (i.e., service): 16.4 percent of national total, with YOY growth at 9.5 percent
4. Urban and rural residential sector: 14.2 percent of national total, with YOY growth at 5.7 percent[13]

According to the National Energy Administration, China's national power consumption during the first two months of 2020 dropped 7.8 percent YOY, followed by a 4.2 percent YOY reduction in March. Consequently, China's national power consumption in Q1 2020 declined 6.5 percent YOY, compared with a 5.5 percent increase in Q1 2019. In other words, China's national power consumption in Q1 2020 is even lower than in Q1 2018. In April 2020, China's national power consumption increased slightly by 0.7 percent YOY, indicating the economy is rebounding. The detailed breakdown by sector is as follows:

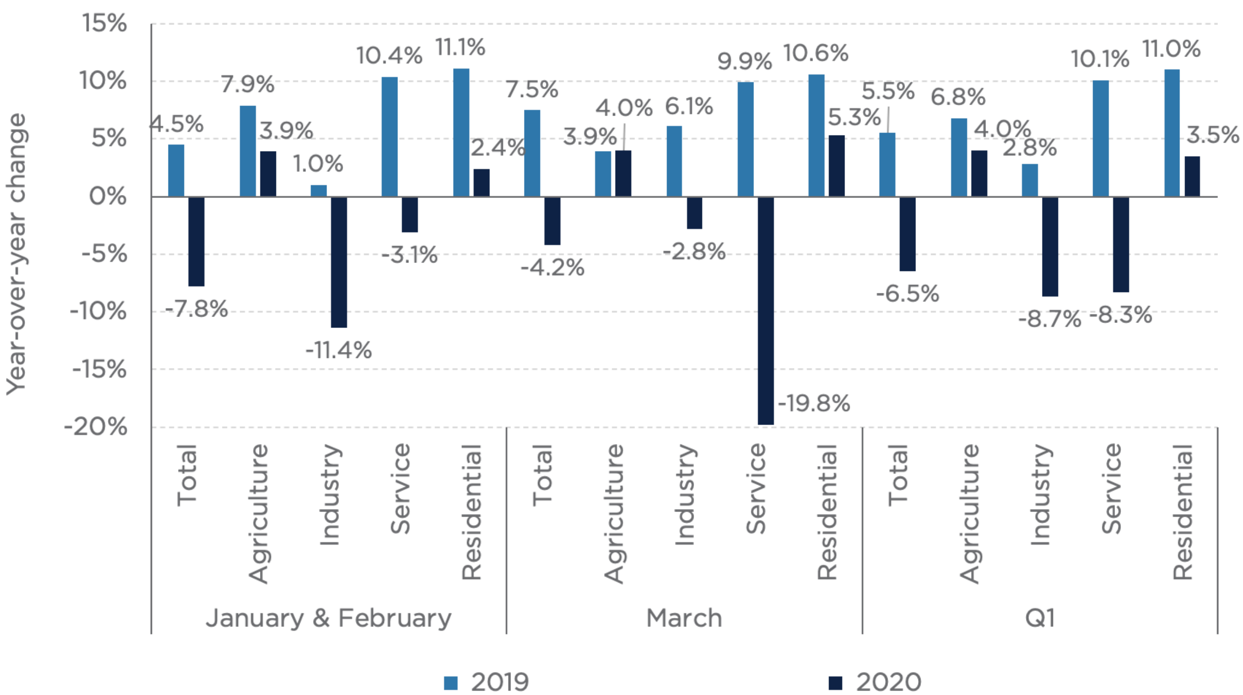
1. Power consumption by agriculture grew 4 percent YOY in Q1 2020, compared with a similar rate of 6.8 percent in 2019. As agriculture accounts for only 1.1 percent of national power consumption, its overall contribution is limited.
2. Power consumption by industry declined drastically by 11.4 percent YOY during the first two months of 2020, followed by a much more modest demand reduction at 2.8 percent YOY in March. Overall, power consumption by industry in Q1 2020 declined 8.7 percent YOY, compared with an increase of 2.8 percent in 2019. As energy-intensive manufacturing processes often operate around the clock, their utilization rate reduction during the outbreak could be relatively easily compensated for by catching up production once downstream demand rebounds, which is evidenced by the fact that power consumption by industry in April 2020 increased 1.5 percent YOY. Since industry accounts for nearly 70 percent of national power consumption, to what extent industrial activity may further recover during the rest of the year will largely

determine China's power demand trajectory in 2020. Since a significant portion of China's manufacturing activity is export oriented, economic recovery in other parts of the world is also a key factor in this regard.

3. Power consumption by service declined 3.1 percent YOY during the first two months of 2020, followed by a deep dive of a 19.8 percent YOY demand reduction in March, and a slump of 7.8 percent YOY demand in April. As the Chinese economy becomes increasingly service oriented, its share of annual power consumption growth stood at one-third of the national total last year. Since the COVID-19 outbreak hits the activity level of the service sector much harder than that of industry, power consumption by service is expected to be more difficult to recover than for industry.

4. Power consumption by the residential sector grew 2.4 percent YOY during the first two months of 2020, followed by a 5.3 percent and 6.5 percent YOY increase in March and April, respectively. As millions of Chinese people are forced to stay home during the outbreak, power consumption by the residential sector still increases due to more intensive cooking, space heating, and entertainment activities, which have partially compensated for demand reduction in the service sector.

Figure 2: Change in power consumption by sector



Sources: China Electricity Council online database and National Energy Administration power sector statistics for Q1 2020, accessed April 24, 2020, http://www.nea.gov.cn/2020-04/23/c_139002144.htm. Note: NBS often reports combined January and February data to avoid abnormalities that might be caused by the Chinese New Year vacation.

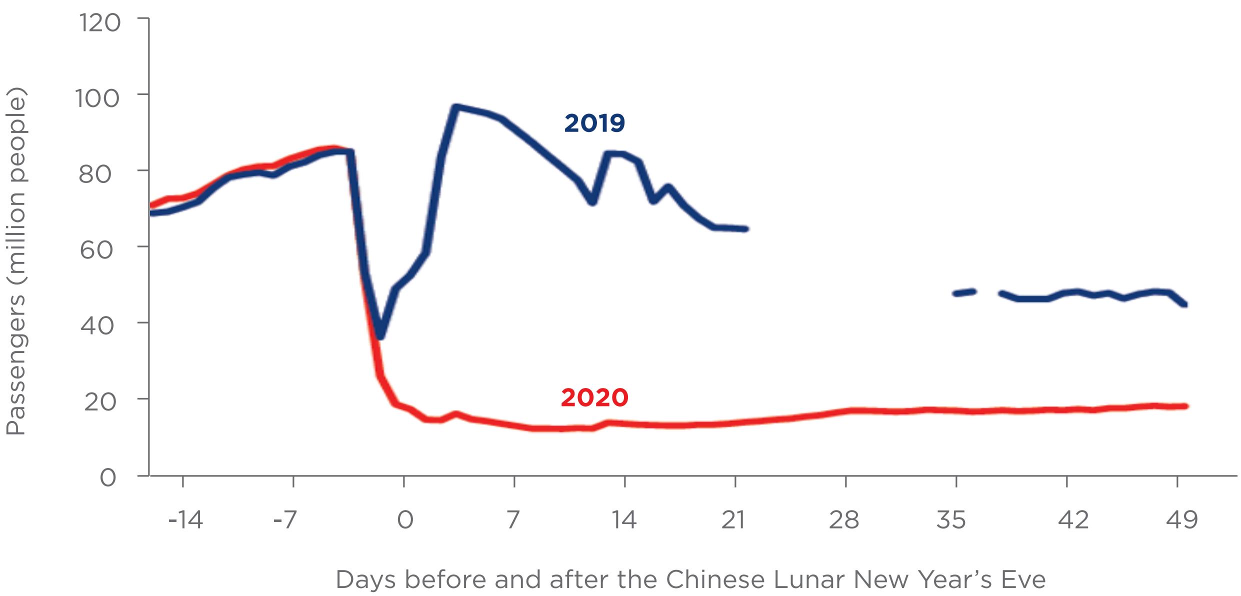
According to the China Electricity Council (CEC), the industry body representing China's power sector, China's power consumption in Q2 2020 is expected to be 9 percent higher than in Q1 2020. As a result, China's power consumption in the first six months of 2020 is projected to decline by only 1.5–2.5 percent YOY. National power consumption in 2020 is estimated to increase by 2–3 percent YOY.[14] In comparison, in a much more pessimistic scenario prepared by the IEA, China's national power consumption in 2020 is projected to decline by about 3 percent YOY.[15] Finally, in the optimistic-case scenario—assuming that economic activity ramps up during the second half of 2020 in both China and around the world without a widespread resurgence of COVID-19—China's national power consumption in 2020 is projected by the author to grow by 1.2 percent YOY.

Passenger Transport—the Weakest Link of the Rebounding Chinese Energy Economy

On January 23, the Chinese government imposed a lockdown in Wuhan and other cities in Hubei province in an effort to stop the spread of COVID-19 at the epicenter. This was the first known instance in modern history of locking down a major city of as many as 11 million people. By January 29, as COVID-19 had spread to all 31 provincial-level administrative regions in mainland China, emergency responses imposed by various authorities suspended many interregional bus, railway, and flight services. Millions of Chinese were locked within different parts of the country, and passenger transport in China was hit particularly hard.

Passenger transport for Chinese New Year's Eve (*chun yun*), considered the largest human migration on the planet, started with millions of Chinese people heading to their hometowns to celebrate the Spring Festival, but their return journey was unfortunately disrupted by the COVID-19 outbreak. Figure 3 shows that passenger transport in China has had great difficulty rebounding. Nearly 20 percent of passengers leaving their residential cities for the 2020 Spring Festival were still unable to return by March 18. In February 2020, passenger turnover by highways, railways, waterways, and airlines in China declined by 87.7 percent, 86.4 percent, 85 percent, and 83.1 percent YOY, respectively, followed by similar levels of slump of 71.6 percent, 69.3 percent, 75.8 percent, and 73.9 percent YOY in March 2020.

Figure 3: Covid-19 impact on China's passenger transport on a lunar calendar basis



Source: Ministry of Transport, adapted from Huatai Securities (2020), passenger transport daily update, March 19, 2020.
Note: Chinese New Year's Eve in both 2019 (February 5, 2019) and 2020 (January 25, 2020) are set as zero. The blue line is interrupted where no data is available.

To make matters worse, restrictions imposed on interregional and especially international travel could not be easily lifted, even after the first wave of the COVID-19 outbreak was largely under control. Due to rising concerns for asymptomatic cases of COVID-19, before the Wuhan lockdown was lifted on April 8, the Hubei provincial government mandated that certain quarantine measures across the province at the community level remain in place. In addition, residents in Hubei in general and Wuhan in particular were advised to avoid long-distance travel if possible, and traveling outside Hubei and especially Wuhan is still subject to special screening and electronic surveillance measures.[16]

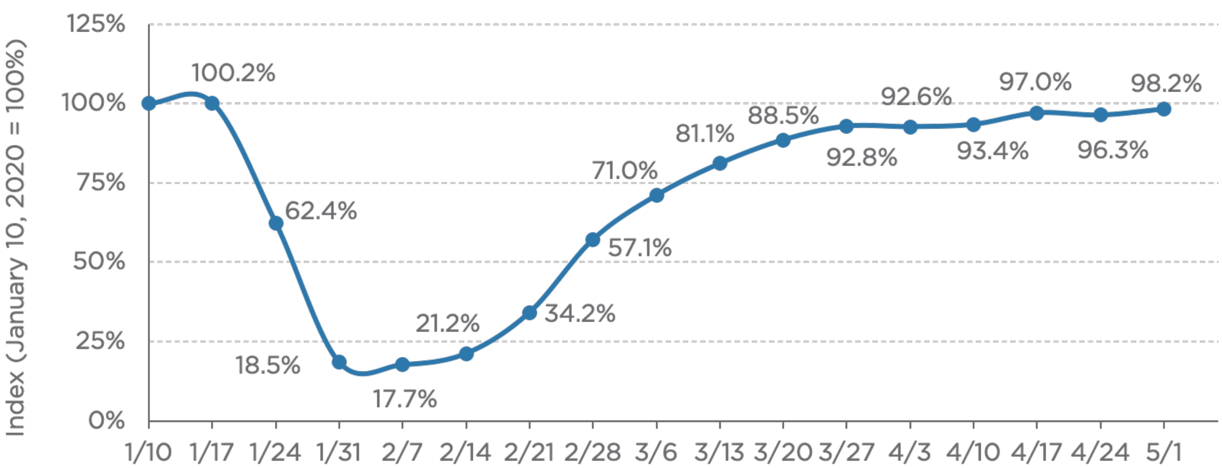
Similarly, Beijing, the capital of China with a population of 22 million people, imposed a strict 14-day quarantine on people arriving from other parts of China, even if they tested negative for COVID-19. In addition, starting April 12, travelers who visited Beijing were required to provide negative coronavirus test certificates issued within 7 days of their arrival. These measures virtually walled off China's capital city from the outside world in terms of passenger transport.[17] Even after the municipalities of Beijing and Tianjin, as well as neighboring Hebei province, lowered their COVID-19 emergency response from level I to level II starting April 30, residents in some cities in northeast China, along with Wuhan and Guangzhou, are still subject to interregional travel restrictions, including mandatory COVID-19 test requirements.[18]

Given the risk-aversion mentality of Chinese officials at both central and local government levels and the pandemic's prolonged effects on China's passenger transport, economic recovery in large parts of China is expected to be longer than would otherwise be the case, with profound implications for China's energy consumption, especially oil demand.

As a significant portion of China's workforce was restricted from interregional moving, Sinolink Securities estimated that only 30 percent of Chinese truck drivers were able to get back to work by February 23.[19] As a result, cargo turnover by highway declined by 39.4 percent YOY in February and 11.7 percent in March,[20] with detrimental impacts on China's sophisticated supply chain in Q1 2020.

Figure 4 shows that since then, China's truck freight activity intensity has rebounded strongly, which could be largely explained because (1) the Chinese authority waived road and expressway toll fees nationally from February 17 until May 6, (2) industrial activity ramped up stronger than expected in March and April 2020, and (3) consumers have relied more heavily on online shopping, leading to higher demand for road-based delivery service.

Figure 4: China's truck freight activity intensity index



Source: Sinolink Securities, satellite-based special analytic report, accessed May 12, 2020.
Note: Indexation is based on satellite image big data analytics, with China's truck activity intensity on January 10, 2020, set as 100 percent.

In February 2020, cargo turnover by airlines and waterway declined 19.4 percent and 16.5 percent YOY, respectively. In March, cargo turnover by airlines dropped further by 23.3 percent YOY, and cargo turnover by waterway rebounded quickly but still declined by 6.1 percent YOY. In February 2020, cargo turnover by railway increased slightly by 3.8 percent YOY, which reflects the fact that railway is often dedicated to bulk commodity transport such as coal and coke and thus is more resilient during a pandemic. Nevertheless, cargo turnover by railway in March declined by 5.2 percent YOY, which suggests that downstream demand for bulk commodities in China may encounter difficulties in stabilizing against the backdrop of the COVID-19 pandemic.[21]

Given transportation's importance to Chinese oil demand, the unprecedented nationwide mobility restrictions starting in late January were estimated by the IEA to result in a decline of more than 13 percent in China's Q1 2020 oil demand compared with Q1 2019.[22]

Gauging Energy Sector Impacts Through an Air Pollution Lens

Many parts of China, especially major urban centers, are well known for being choked by smog because of intensive energy combustion, rising motor vehicle use, and pollutants originating from adjacent regions. The COVID-19 outbreak started to eliminate traffic congestion in major cities, reduce industrial activity, and empty office buildings across China; it is legitimate to use pollution levels as a gauge of the associated impacts on the energy sector.

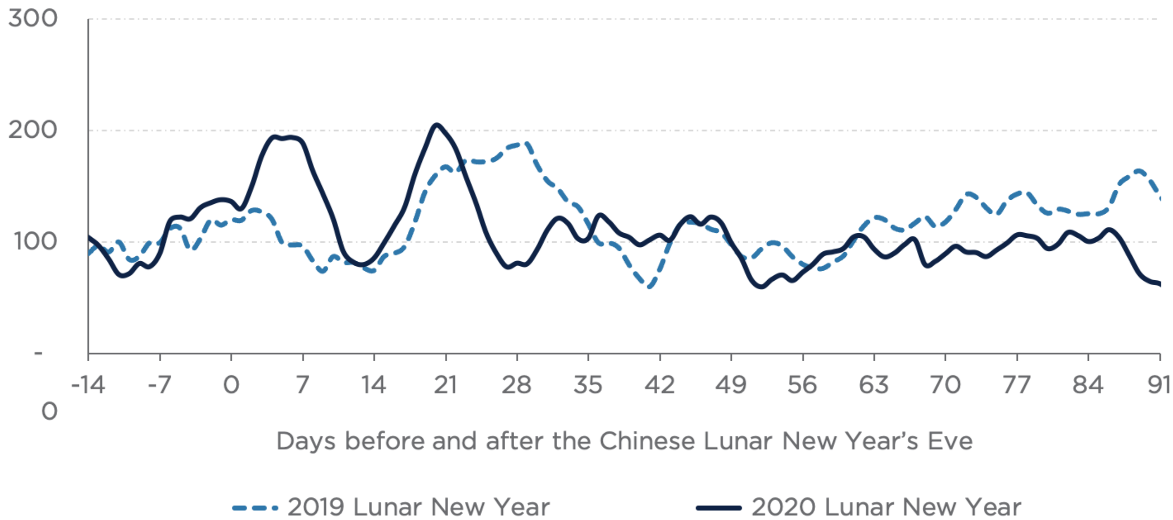
At the national level, National Aeronautics and Space Administration (NASA) and European Space Agency (ESA) pollution monitoring satellites have detected significant decreases in nitrogen dioxide (NO_2) over China since the inception of the COVID-19 outbreak. In a preliminary analysis, NASA researchers compared NO_2 values detected by satellites from February 10 to 25 during the quarantine with the average amounts detected at this time of year from 2005 through 2019. In 2020, NO_2 values in eastern and central China were 10 percent to 30 percent lower than what is normally observed for this time period.[23] Since NO_2 is primarily emitted by motor vehicles, power plants, and industrial facilities, the aforementioned analysis suggests that COVID-19 has significantly dented activity levels in transport, power generation, and industry across China. Using data from the ESA's Copernicus satellite, NO_2 concentration in China dropped from late January until early March, when it began to increase again, which is consistent with when the first wave of COVID-19 in most of China was largely under control.[24]

Figure 5 indicates that counterintuitively, at the regional level in Beijing, concentration of particulate matter that has a diameter of less than 2.5 micrometers (PM2.5) during the first three weeks of the 2020 Chinese Lunar New Year did not improve compared with the same period in 2019. According to the Beijing municipal government, local sources accounted for only two-thirds of Beijing's PM2.5 emissions, with the remaining from adjacent regions. In addition, motor vehicles, dust, industry, the residential sector, and coal combustion accounted for 45 percent, 16 percent, 12 percent, 12 percent, and 3 percent, respectively, of local PM2.5 emissions.[25]

During the COVID-19 outbreak, local sources were apparently not the primary driver underlying poor air quality in Beijing. Apart from unfavorable weather conditions, pollutants originating from adjacent regions were considered another key source, as the latter may have contributed 55–75 percent of PM2.5 emissions on heavily polluted days.

To better understand COVID-19's effects, the below hypothesis is assumed to explain relative changes in Beijing's seven-day moving average PM2.5 concentration between 2019 and 2020 on a lunar calendar basis: after Wuhan's lockdown beginning January 23, heavy industrial operations in Beijing's adjacent regions did not take an immediate hit. Coupled with unfavorable weather conditions, Beijing encountered more severe air pollution during the first three weeks of the 2020 Chinese New Year compared with a similar period in 2019. Nevertheless, downstream demand slump caused by COVID-19 eventually led to air quality improvement starting from the fourth week. Since then, the government has made tremendous efforts to encourage a restart of manufacturing activity. Nevertheless, even assisted with the political willingness to loosen environmental enforcement,[26] air pollution in Beijing has never exceeded the 2019 level in a sustained period, and it even became consistently lower starting from the beginning of the third month of the 2020 Chinese New Year, which indicates that the manufacturing industry has been unable to quickly ramp up output as a result of sustained downstream demand weakening.

Figure 5: Beijing's 7-day moving average PM2.5 concentration in 2019 and 2020 on a lunar calendar basis



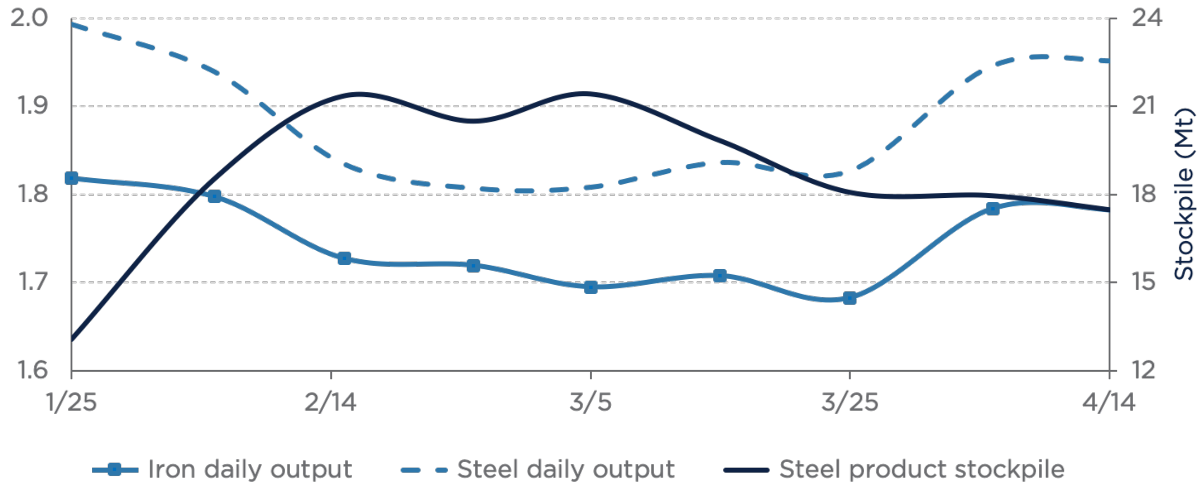
Source: Air Quality Historical Data Platform, accessed May 1, 2020, http://aqicn.org/data-platform/register.
Note: Chinese New Year's Eve in both 2019 (February 5, 2019) and 2020 (January 25, 2020) are set as zero.

Effects on Industrial Activity

Since energy-intensive and pollution-prone iron and steel manufacturing is an important economic activity in Beijing's adjacent regions and beyond, it is selected to gauge how COVID-19 may affect China's energy-intensive industrial activity. During the Chinese Spring Festival vacation, operations of small- and medium-sized enterprises, whether they belong to the industry or service sector, are prone to complete shutdown. In comparison, heavy industrial activity such as iron and steel, cement, and metal smelting may operate continuously.

During the 10-day period when Wuhan was quarantined beginning January 23, daily output of key Chinese iron and steel enterprises was still slightly higher than the previous 10-day period, which was estimated to be significantly higher than the output level during the similar period in 2019. Figure 6 indicates that COVID-19 led to a 5.4 percent reduction of daily iron output and 9.3 percent reduction of steel output by the end of February. As demand in the downstream sectors was continuously severed by the epidemic, the product stockpile of iron and steel manufacturers increased over time. Once the first wave of COVID-19 was largely under control in early March, downstream demand recovery led to a rebound of daily iron and steel output, coupled with a decline of the steel product stockpile.

Figure 6: 10-day average iron and steel production level and stockpile of key Chinese steel enterprises



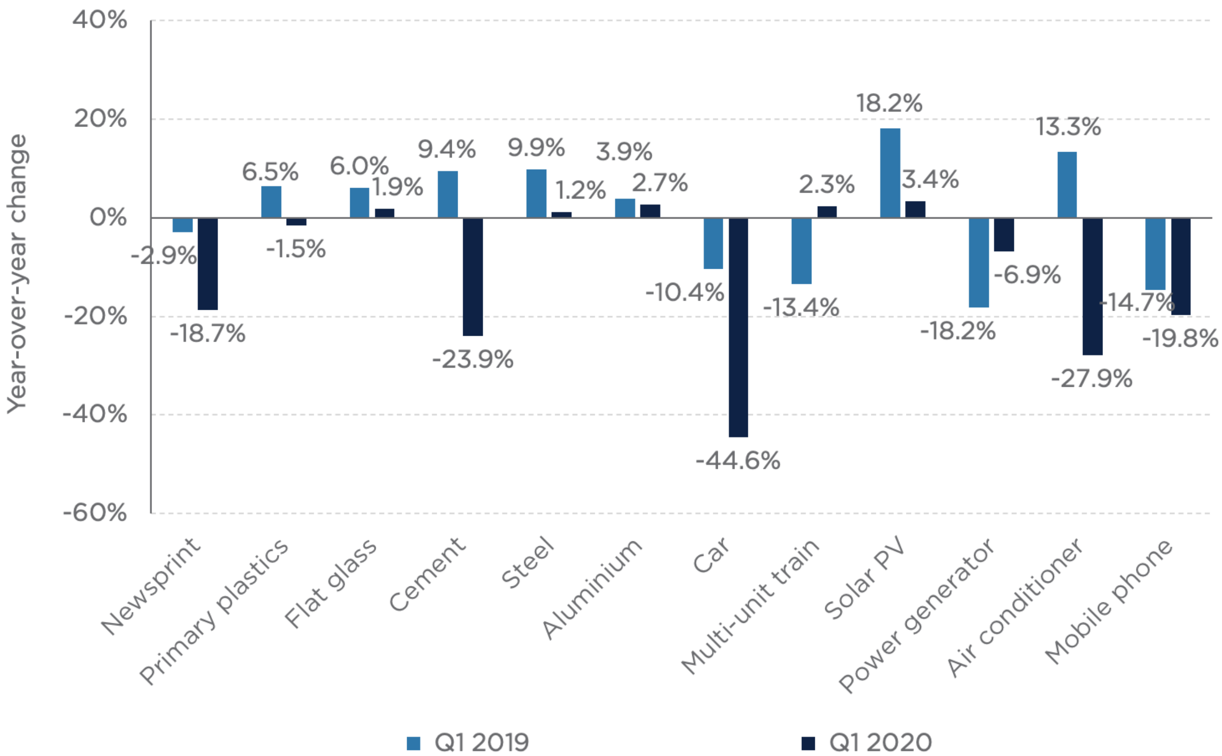
Source: China Iron and Steel Association, accessed May 1, 2020, http://www.chinaisa.org.cn/gxportal/xfgl/portal/index.html.
Note: No iron stockpile data is available.

In sum, heavy industrial manufacturing activity in China may not necessarily be severely disrupted by COVID-19. Nevertheless, demand weakening in the downstream sectors and stockpile buildup translated into increasingly lower output growth, which may partially explain frequent smog outbreaks in Beijing during the first three weeks of the Chinese Lunar New Year and air quality improvement thereafter. Further, as illustrated by the difficulty encountered by the Chinese iron and steel manufacturers in terms of rebounding daily output beyond pre-crisis levels so far, energy consumption and associated emissions of the Chinese manufacturing industry are likely to be dented substantially by COVID-19 in 2020.

Figure 7 lists the YOY change of output of selected industrial products in China. While YOY production growth rates of all the selected industrial products in Q1 2020 were lower than those in 2019, some energy-intensive products such as flat glass, steel, and aluminum still witnessed positive YOY growth. In comparison, output of cement and selected consumer products declined sharply. As construction activity and domestic consumer product demand recover once the COVID-19 outbreak is under control, the pandemic's impact on energy consumption by industry is expected to be less severe compared with the service sector, which is evidenced by the fact that power consumption by industry in March 2020 declined by only 2.8 percent YOY, which was a substantial improvement compared with a similar rate at -11.4 percent YOY during the first two months of 2020.

In Q1 2020, output of solar photovoltaic (PV) panels in China grew by only 3.4 percent YOY, compared with 18.2 percent YOY in 2019. Nevertheless, this aggregate indicator hid the fact that output of solar PV panels in China rebounded strongly from a 6.4 percent YOY reduction during the first two months of 2020 to 13.8 percent YOY growth in March 2020. Given the importance of renewable development to China's energy transition and global climate agenda, COVID-19's effects on renewables will be discussed in detail later.

Figure 7: Change in output of selected industrial products, Q1 2019 and Q1 2020



Source: NBS Database.
Note: Recent monthly data are preliminary and are subject to subsequent revisions and adjustment by the NBS.

Effects on Compliance with 13th FYP Targets

While planning is a key characteristic of centralized Communist economies, a plan established for the entire country normally contains detailed economic development guidelines for all regions, and China's FYPs are a series of such economic development initiatives. As China has transitioned from a planned economy before 1978 to an increasingly market-oriented one, the name for the 11th FYP was officially changed from *plan to guideline*. Nevertheless, it is still commonly referred to as a *plan*.[27]

China's 13th FYP, issued in March 2016, set out the objectives and overarching principles of the country's continued economic and social development between 2016 and 2020. Under the overarching guidelines, detailed plans for each sector were prepared by relevant government departments. The 13th FYP for energy was issued by the National Development and Reform Commission (NDRC) and National Energy Administration in December 2016, coupled with 14 dedicated subsector plans to cover coal, oil, gas, and power, among others. Table 1 details major energy-related 13th FYP targets, with 2015 as the baseline year, coupled with the most recent available statistics for 2019 to benchmark against targets set for 2020.

Energy production targets against the backdrop of rising energy security anxiety: In 2015, fossil fuels dominated China's energy sector, accounting for 86 percent of primary energy production. Since then, primary energy production increased by 2.3 percent annually, reaching 3.97 billion metric tons of coal equivalent (Gtce) in 2019. As the 13th FYP target is only 0.7 percent higher than the 2019 production level, it is still possible that China will meet the 13th FYP target for primary energy production, especially considering that rising energy security anxiety aroused by both the US-China trade war and COVID-19 favors domestic production against energy imports.

Table 1: Progress in 2019 against major energy-related targets in 13th FYP

Category	Indicator	Unit	2015	2019	2020 Target
Energy Production	Primary energy production	Gtce*	3.62	3.97	4
	Coal output	Gt	37.5	38.5	39
	Oil output	Mt	215	191	200
	Gas output	bcm	135	176.2	207
Power Sector	Installed power capacity	GW	1525	2011	2000
	Coal-fired power capacity	GW	900	1045	< 1100
	Nuclear capacity	GW	27	48.75	58
	Hydro capacity	GW	296.5	356.4	340
	Hydro generation	TWh	1112.7	1301.9	1250
	Wind capacity	GW	130.75	210.05	210
	Wind generation	TWh	185.6	405.7	420
	Solar capacity	GW	43.19	204.68	110
	Solar generation	TWh	39.6	223.8	150
	Share of nonfossil power capacity	%	35	40.8	39
	Share of nonfossil power generation	%	27	31.1	31
	Share of coal power generation	%	49	49.9	55

Energy Consumption	Primary energy consumption	Gtce	4.3	4.86	< 5
	Coal consumption	Gt	3.96	3.93	4.1
	Power consumption	PWh	5.69	7.23	6.8–7.2
	Share of nonfossil energy consumption	%	12	15	15
	Share of natural gas consumption	%	5.9	8.4	10
	Share of coal consumption	%	64	57.7	58
Other	Energy self-reliance rate	%	84	81.7%	> 80
	Energy intensity reduction	%		-17.8	-15%
	Carbon intensity reduction	%		-18.4	-18

Source: NDRC and National Energy Administration (2016) 13th FYP for energy and NBS Database.
*Note: *1 tce = 29.31 GJ*

In the upstream fossil fuel industry, COVID-19's effects differ across sectors. Since 2015, national crude oil output in China declined for three consecutive years, reaching 189 metric tons (Mt) in 2018. Following the beginning of the US-China trade war in early 2018, the Chinese leadership's rising energy security anxiety prompted Chinese national oil companies (NOC) to double down on domestic upstream exploration and production activities. Nevertheless, China's relatively unfavorable resource endowment and high production costs kept the 2019 output at 191 Mt, only 1 percent above the 2018 level. In Q1 2020, oil production by industrial enterprises above state designated scale increased modestly by 2.4 percent YOY, followed by a 0.9 percent YOY increase in April. Considering the low oil prices of the international market, Chinese NOCs are expected to lack sufficient incentives to meet the 13th FYP oil production target of 200 Mt.

During the 13th FYP period, the National Energy Administration planned to increase gas output from 135 billion cubic meters (bcm) in 2015 to 207 bcm in 2020, the equivalent of 9 percent annual growth. However, due to slower than expected progress of both conventional and shale gas development, China's gas output in 2019 was 15 percent below the 13th FYP target. In Q1 2020, gas output by industrial enterprises above state designated scale grew 9.1 percent YOY, followed by a more impressive 14.3 percent YOY growth in April. Due to demand weakening caused by COVID-19, China's gas imports during the first four months of 2020 increased only 1.5 percent YOY. As a result, Chinese NOCs are unlikely to meet the 13th FYP gas production target against the backdrop of the COVID-19 pandemic.

Power sector targets have largely been achieved: By the end of 2019, the Chinese power sector had already met the majority of the 13th FYP targets. For instance, while the 13th FYP target for installed power capacity is 2,000 GW, China's installed power capacity in 2019 had already reached 2,011 GW, 0.6 percent higher than the target. As the largest clean energy market, China has performed exceptionally well in renewable power development. While the 13th FYP for solar capacity is only 110 GW, the installed capacity in 2019 almost doubled the level of the 13th FYP target.

Of course, there are a few exceptions in the power sector. One noticeable exception is the share of coal for power generation. China accounts for around half of global steel and cement output, and the Chinese government's goal to increase the share of coal for power generation over time is counterproductive in terms of transitioning the Chinese economy away from a high-carbon development pathway. Given the significant gap between the status quo and the 13th FYP target, it is recommended that this specific target should be entirely abandoned in China's 14th FYP for energy.

Energy consumption targets differ across sectors: In 2019, China's national energy demand reached 4.86 billion tce. To meet the 13th FYP target of national energy consumption at no more than 5 billion tce, the growth rate of national energy consumption in 2020 should be below 2.9 percent YOY. Given the COVID-19 pandemic's severe impacts on China's economic development, especially manufacturing activity, China is expected to be able to meet the 13th FYP target for national energy consumption.

Due to the ongoing electrification of the Chinese economy, China's national power consumption grew strongly at 6.2 percent annually during the 13th FYP period, reaching 7,226 TWh in 2019, which is slightly higher than the national power consumption ceiling of 7,200 TWh set for 2020. In Q1 2020, China's national power consumption declined by 6.5 percent YOY. Unless national power consumption declines by more than 0.4 percent YOY in 2020, China will overshoot the 13th FYP target for national power consumption.

China has led the world in clean energy investment, and nonfossil fuel development, especially renewables, has been impressive during the 13th FYP period—China has already met the 13th FYP targets for both the share of nonfossil energy consumption and share of coal consumption in the national energy mix. Nevertheless, due to disappointing progress of domestic conventional and shale gas development, and relatively high natural gas prices in the international market until recently, national gas consumption during the 13th FYP period has not grown as strong as planned. The share of gas consumption in the national energy mix reached only 8.4 percent in 2019, which is significantly lower than the 13th FYP target of 10 percent. So China will be unable to meet the 13th FYP target for the share of natural gas in the national energy mix.

Effects on 14th FYP

According to past practices, China's overarching 14th FYP for economic and social development between 2021 and 2025 will be finalized and approved in early 2021, followed by more detailed sectorial plans over the next year, with the 14th FYP for energy and other energy subsectors most likely to be released during winter 2021–2022. The stakeholder consultancy, scoping, and drafting process has already been started within the government system, with many Chinese think tanks, research centers, and academic institutions tasked with study projects in support of the planning process.[28] Given COVID-19's severe effects on China's economic activity in general and energy development in particular, Chinese decision makers' political priorities are undergoing drastic adjustment, with profound implications for China's 14th FYP for energy.

As indicated in Box 1, it is important to focus attention on relative changes and trends of China's economic activity and energy consumption instead of on absolute numbers listed in this preliminary analysis.

Box 1: Statistical Reporting Is the Achilles' Heel of FYPs in China

In November 2019, China revised up its nominal 2018 GDP by 2.1 percent to 91.93 trillion yuan, keeping it on track to achieving its goal of doubling the size of its economy between 2010 and 2020. While China's fourth National Economic Census conducted in 2018 reportedly included "richer" data points that showed more business entities and a bigger total asset base in 2018 than assumed under earlier GDP estimates, the drastic adjustment of China's 2018 GDP—with revisions ranging from 29 percent downward for Tianjin municipality to 16.8 percent upward for Yunnan province—indicates that the Chinese central government is using tremendous effort to improve the quality of statistical reporting at the local level.[29]

Similar revisions also occurred to energy statistical reporting in the past. After China's first three rounds of the National Economic Census were conducted in 2004, 2008, and 2013, the NBS drastically revised China's national energy balance tables, especially coal-related data. For example, China's national coal output in 2000, an issue of immense importance for China's energy planning in the new millennium, was raised by 39 percent after the first two rounds of the National Economic Census. Following the third round of the National Economic Census, it was reported that China had been burning up to 17 percent more coal per year than previously disclosed by the government.[30]

While 2010 is the baseline year of the 12th FYP period, the third National Economic Census led to substantial revisions of major energy statistical indicators for 2010, as indicated in table 2. Not surprisingly, if China's cyclic revisions of key energy statistics witnessed in the past two decades could not be fundamentally improved, the merit of FYPs to China's energy development will become increasingly questionable in the long run.

Table 2: Third National Economic Census's impacts on selected statistical indicators for 2010

Indicator	Unit	Original data	Revised data	Discrepency
Energy consumption	Mtce	3,249	3,606	11%
GDP	billion yuan	40,120	40,890	1.9%
Energy intensity	tce/million yuan	81	88	8.9%
Energy production	Mtce	2,969	3,121	5.1%
Coal production	Mt	3,235	3,428	6%
Nonfossil fuel production	Mtce	280	325	16%
Nonfossil fuel as % of national energy consumption	%	8.6	9.4	9.3%

Sources: State Council of the People's Republic of China (2013) 12th FYP for Energy, NBS (2016) China Energy Statistical Yearbook 2014.

Upgrading China's Climate Ambitions Becomes Politically Challenging

China's status as the world's leading greenhouse gas emitter is a relatively recent phenomenon. The country's emissions ranged from negligible to modest during most of the 20th century, and only began to rise sharply in the new millennium as its economy took off. China overtook the United States as the leading carbon emitter around 2006, but its cumulative carbon emissions since the Industrial Revolution are about half those of the United States.[31]

International climate change negotiations have long been marred by a north-south split, with China positioning itself as part of the developing country bloc. Consequently, China not only cares about the views of developing countries on its climate policies but also would like to be perceived as an ally of developing countries in the fight against climate change. Further, rising climate awareness of Chinese experts and key officials, market opportunities in clean energy technologies, pressure to control widespread air pollution, and concerns about climate vulnerabilities have gradually made China increasingly proactive in both domestic mitigation and adaptation efforts and international climate negotiations.

Under the Paris Agreement reached in December 2015, China formally committed to reach its peak national carbon emissions around 2030, to cut its carbon emissions per unit of GDP by 60–65 percent from 2005 levels by 2030, and to increase the share of nonfossil fuels to 20 percent. China's Paris Agreement nationally determined contributions (NDCs) were announced ahead of the 13th FYP cycle, and they were subsequently incorporated into China's 13th FYP for greenhouse gas emissions control. More specifically, the State Council of the People's Republic of China mandates that China should reach its peak national carbon emissions around 2030, aiming to achieve the target earlier than later. Meanwhile, China planned to reduce national carbon intensity per unit of GDP by 18 percent between 2015 and 2020.[32]

While the leadership role jointly played by the Chinese government and the Obama administration was key to the successful conclusion of the Paris Agreement in 2015, China did not specify at what level its national carbon emissions would peak, and further upgrading of China's climate ambitions is widely considered key to moving the global climate agenda forward thereafter.

Unfortunately, following the Trump administration's June 1, 2017, announcement of its intention to withdraw from the Paris Agreement, China suddenly faced significantly less international pressure in the climate arena. After the outbreak of the US-China trade war in early 2018, the priority of climate change in China was downgraded, which is evidenced by the fact that the climate change portfolio was transferred from the politically powerful NDRC to the newly established Ministry of Ecology and Environment. Of course, China's climate actions have been inevitably affected by the above bureaucratic revamp.

Since then, the European Union has still been serious about upgrading its own climate ambitions, aiming to achieve carbon neutrality by 2050. It nevertheless relied too much on moral persuasion instead of a transactional political deal (e.g., being more open minded about China's Belt and Road Initiative in exchange for China's willingness to further upgrade its climate ambitions) to lobby the Chinese government. Consequently, the EU-China climate collaboration in recent years has not resulted in politically significant outcomes.

Because of the ongoing COVID-19 pandemic, the 26th United Nations Climate Change Conference, originally scheduled for November 2020 in Glasgow, Scotland, has been pushed to November 2021. As the world considers COVID-19 the most urgent global challenge, the momentum behind addressing climate change, which is a more remote but profound threat, has inevitably been lost to some extent. Meanwhile, the window of opportunity for upgrading China's climate ambitions has been largely closed, at least during the rest of 2020. As a result, climate-related targets in China's 14th FYP are likely to be less ambitious than would otherwise have been the case.

If China's Paris Agreement climate ambitions were upgraded ahead of 2020, a most likely commitment by the Chinese government could be to reach China's peak national carbon emissions earlier than 2030. No matter whether an absolute peaking level were committed or not, the room for greenfield coal-fired power capacity additions would have been drastically squeezed under such a scenario, and the future of coal in China should have been much less uncertain.

The Future of Coal in China Is Brightened by Rising Anxieties over Economic Growth and Energy Security

Coal is the most carbon-intensive fossil fuel and accounted for 58 percent of China's primary energy consumption in 2019. Coal-fired power plants, which burn about half of all coal used in the country, currently provide 52 percent capacity and 62 percent generation in the power mix. As coal-fired power plants in China alone represent more than 11 percent of global carbon emissions, their future in China is a key climate policy challenge.[33]

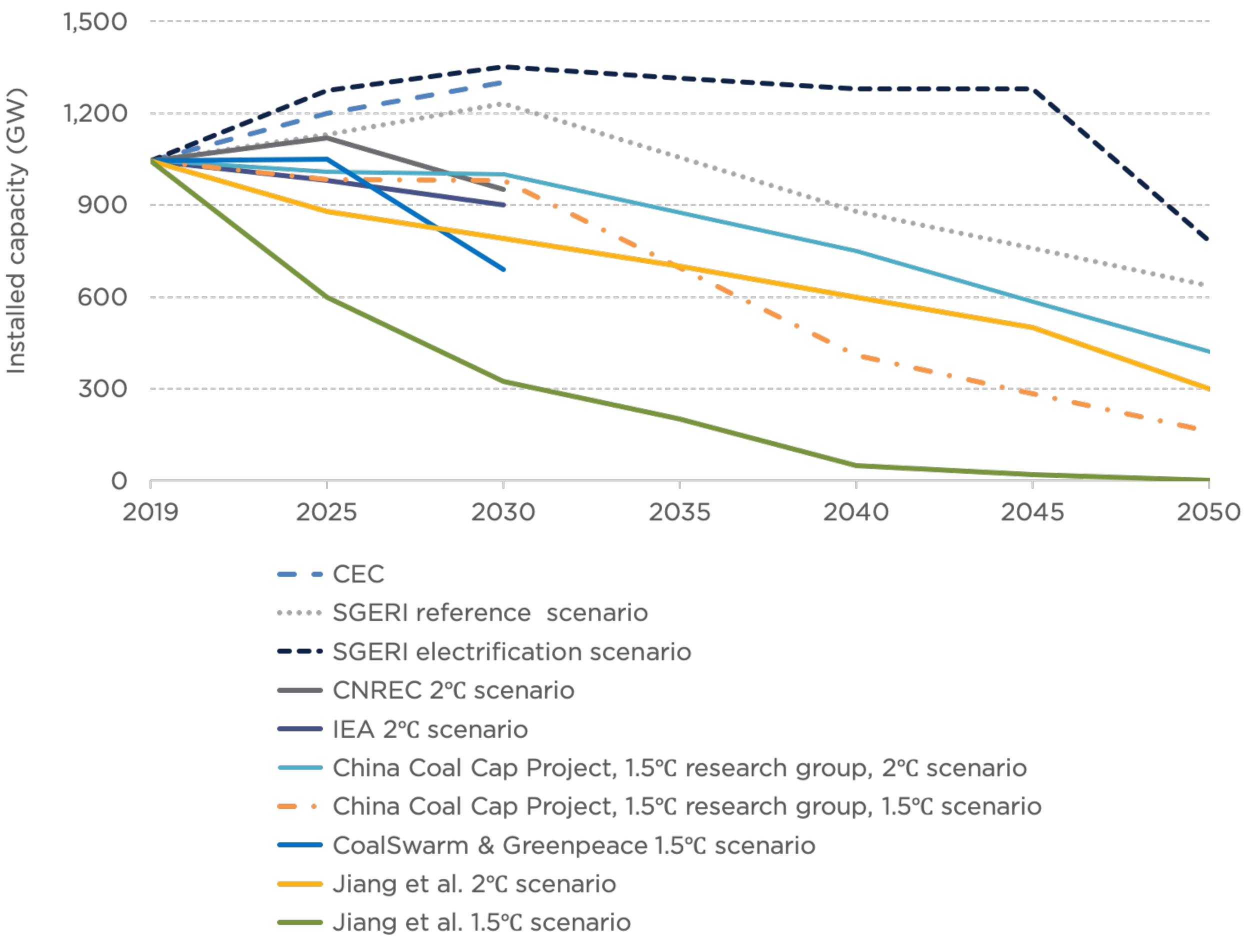
Before the COVID-19 outbreak in early 2020, coal-fired power overcapacity had already become a serious policy concern, as average Chinese coal-fired power plants sit idle for about half the time annually. It is reported that more than 50 percent of coal-fired power plants in China operated at a financial loss in 2019, with some even going bankrupt.[34]

From a corporate bottom line perspective, enterprises are unlikely to invest in coal-fired power plants when severe overcapacity has already undermined financial viability of such projects. Nevertheless, China's economic system is based on abundant and cheap capital being made available to the state-owned sector with relatively limited concern for economic viability.[35] As long as the investment is broadly aligned with FYPs, approval of financially questionable projects is still politically possible at the local level. This largely explains why the capacity addition of coal-fired power plants still stood at 29.9 GW in 2019, since China's coal-fired power capacity at 1,045 GW by the end of 2019 had not yet exceeded the 13th FYP target at 1,100 GW.[36]

Given the importance of FYPs to guide energy project approval, key Chinese power sector stakeholders have actively lobbied the central government to substantially increase China's coal-fired power capacity by 2030. For instance, the CEC recommended that coal power capacity should peak at 1,300 GW in 2030, with the State Grid Energy Research Institute (SGERI) promoting even higher capacity addition under its electrification scenario. China committed to reaching its peak national carbon emissions around 2030, and such power industry backed proposals are actually compatible with China's Paris Agreement NDCs, which again illustrates the detrimental environmental implication associated with the lost opportunity of upgrading China's climate ambitions ahead of the 14th FYP cycle.

Figure 8 indicates that to promote low carbon development and a clean energy transition, various international and Chinese stakeholders have also proposed alternative scenarios with a drastic coal-fired power capacity reduction over time. Given the magnitude of carbon emissions associated with the wide range of projections, the 14th FYP target for coal-fired power capacity in China is widely regarded by the international community as one of the stickiest climate policy challenges.

Figure 8: Diverse trajectories of coal-fired power in China



Sources: Li Siyang, Han Sulin, and Xu Peiyu, "A Critical Juncture of the Future of Coal-Fired Power," Caijing Magazine, 2020, https://kuaibao.qq.com/s/20200121A0KU5O00; SGERI scenarios, accessed April 20, 2020, http://www.cec.org.cn/xinwenpingxi/2019-04-10/190173.html.
Note: Baseline years of all projections have been adjusted to 2019.

There is increasing uncertainty regarding a drop that could occur in overall coal consumption for 2020 as a result of the COVID-19 pandemic. As China looks to reignite economic activity, resurgence in coal and carbon emissions might occur if, once again, China looks to spur growth using its abundant and affordable coal. The reported approval of nearly 9,960 MW of new coal power plants in Q1 2020, as compared with a similar level of approval for all of 2019, is an alarming signal in this regard.[37]

COVID-19 has taken a heavy toll on global oil prices, which has severely undermined financial feasibility of coal chemical projects. Nevertheless, when China's first draft Energy Law was posted to solicit public comments on April 10, it contained a clause stating that China should properly promote development of coal-based fuels and coal chemical feedstock.[38] Not surprisingly, under an extremely unfavorable market condition, a final investment decision was announced in 2020 for various coal chemical projects. The most noticeable example was a 1.8 Mt/annum coal-to-ethylene glycol plant in Yulin, Shaanxi. With construction work started on April 2 and a price tag of 125 billion yuan, it is the largest coal chemical project under construction in the world.[39]

In sum, against the backdrop of rising anxieties about economic growth and energy security among Chinese decision makers, coal's role in China's energy mix is brightened, with potential long-term detrimental impacts on global carbon emissions and prospects for China's renewable development. As a result, how like-minded international stakeholders may team with Chinese partners to counterbalance the imminent risk of relying on carbon-intensive coal to prop up economic growth, especially at the local level, becomes increasingly urgent.

Prospect of Renewables Is a Two-Sided Story

China leads the world throughout the renewable value chain. By the end of 2019, China's installed renewable capacity of 794 GW ranked as first in the world and included 356.4 GW of hydro, 210.1 GW of wind, 204.7 GW of solar, and 22.5 GW of bioenergy.[40] Meanwhile, Chinese manufacturers dominated the photovoltaics (PV) supply chain by producing 67 percent of global polysilicon output, 98 percent of wafers, 83 percent of PV cells, and 77 percent of PV modules.[41] In addition, among the top 10 global wind turbine manufacturers in 2019, six of them were Chinese companies.[42]

China's success in renewable development could largely be explained by concerted government supports, especially generous though gradually diminishing subsidies, economy of scale associated with the enormous size of the Chinese power market, urgent need for air pollution control, and momentum from Paris Agreement NDCs. In particular, China's favorable regulatory regime for renewable development is well summarized by the country's first draft Energy Law:[43]

1. The state positions renewables as a priority area for energy development and formulates mandatory annual and FYP renewable targets that are enforceable at both national and provincial levels.

2. The state has established a renewable portfolio standard that mandates a minimum share of renewable power consumption at the provincial level.

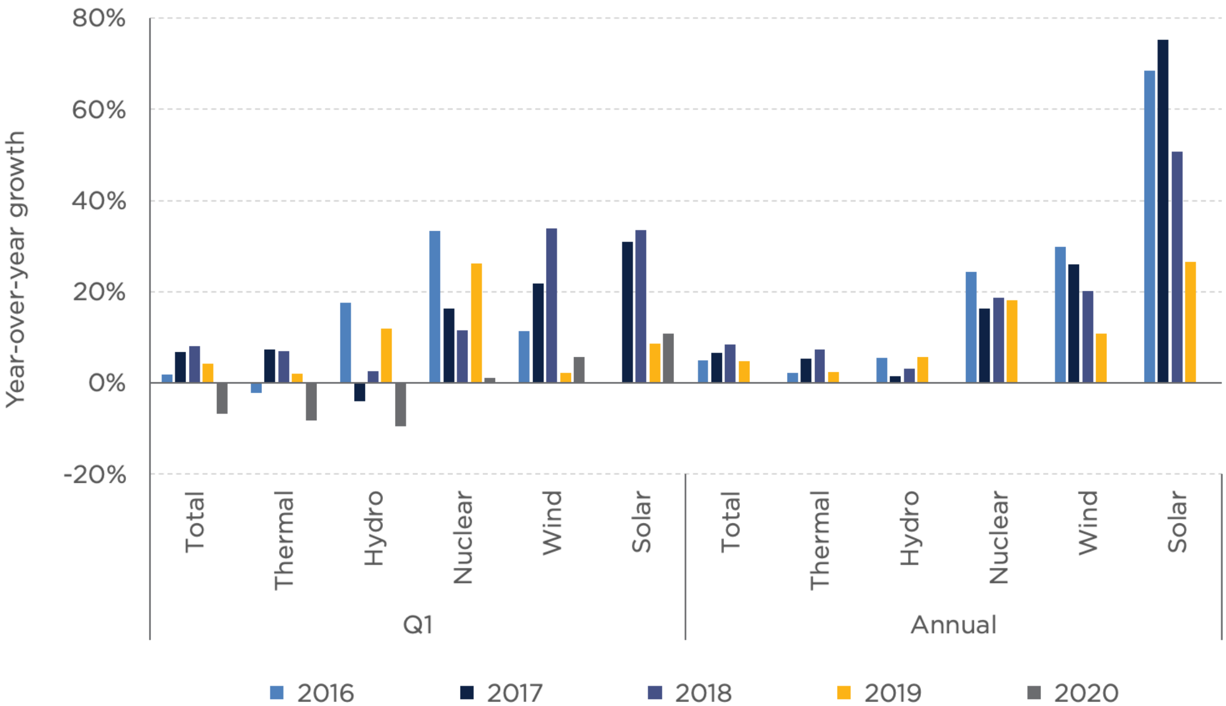
3. The state formulates relevant fiscal, financial, and pricing policies in support of development and use of renewable energy.
4. The state encourages development of a wide range of renewables, including hydro, wind, solar PV, geothermal, solar heat, and marine energy. The state encourages development of renewables in both urban centers and rural areas and aims to establish distributed energy systems with integrated energy development.
5. The state implements preferential dispatching of renewables and ensures guaranteed acquisition of renewable power generation in accordance with the plan. Grid companies should establish energy conservation and low carbon-oriented dispatching systems.

While some of the above clauses still encounter resistance from vested interest groups, significant progress has nevertheless been made to move China's renewable development agenda forward during the 13th FYP period. As a result, the national wind curtailment rate in China declined rapidly from 17 percent in 2016 to 4 percent in 2019. Similarly, the national solar curtailment rate was lowered substantially from 12.6 percent in 2015 to 2 percent in 2019,[44] with the caveat that the above progress was partially achieved by the National Energy Administration's restrictions on permitting greenfield renewable projects in regions with high curtailment rates.

Though demand weakening caused by COVID-19 led to a 6.8 percent YOY reduction in national power production in Q1 2020, figure 9 shows that wind and solar power generation increased by 5.7 percent and 10.9 percent YOY, respectively, which are 3.5 percentage points and 2.3 percentage points higher than in Q1 2019. The unexpected performance of solar and wind power generation suggests that policy-driven changes to dispatch rules and a push to invest in state-of-art transmission infrastructure in recent years are indeed resulting in a more favorable environment for renewables.

Because of a dry season in early 2020, hydropower output dropped significantly by 9.5 percent YOY in Q1 2020, followed by a 9.2 percent YOY reduction in April. Since minimum shares of renewable power consumptions are imposed across the country, hydropower generation is expected to catch up during the rest of the year. Given the impacts on national power demand by the ongoing pandemic, preferential dispatching of renewables in 2020 is expected to be largely achieved at the expense of thermal power generators, especially coal-fired plants.

Figure 9: Growth of power generation by fuel in China during the 13th FYP period for Q1 and the whole of each year



Sources: NBS Database, CEC Database.
Note: Q1 data are from NBS, which are based on enterprises above designated scale; annual data are from CEC, which are based on power plants with capacity greater than 6 MW.

Considering the disruption on the domestic and international wind supply chain, the China Wind Energy Association downgraded its onshore wind forecast for the Chinese market from up to 35 GW to 20–25 GW in 2020.[45] In comparison, as the Chinese government has already pushed some PV projects that had been planned for 2020 into 2021, BNEF lowered its forecast for China's newly installed PV capacity in 2020 to 26–37 GW, which is significantly lower than similar projections by other institutions ranging from 40 GW to 54.5 GW.[46]

Renewables have already been positioned as a priority area of energy development in China; preferential dispatching of renewables coupled with a renewable portfolio standard is expected to be beneficial for renewable generators to compete against thermal power plant operators if enforcement could be strictly implemented. Against the backdrop of diminishing government subsidies and the ongoing COVID-19 pandemic, both risks and opportunities exist for renewable development in China. During the 14th FYP period, if coal-fired power capacity further increases, as proposed by some Chinese power industry stakeholders, the potential for renewable development in China will be inevitably suppressed. In comparison, if renewables could achieve grid parity across China in the near future, coupled with further elimination of barriers that prevent grid integration of variable renewables by deepening China's ongoing power sector reform, the window of opportunity will then be opened to substantially increase renewables' share in China's energy mix starting from the 14th FYP period.

Inland Nuclear Reactor Permitting Becomes Even More Remote

Before the Fukushima Daiichi nuclear accident in March 2011, China's installed nuclear capacity was only 10.8 GW.[47] With the world's most ambitious nuclear construction plan unfolding, some in China had envisioned a more than 100 GW installed nuclear capacity target by 2020. Nevertheless, after the Fukushima Daiichi nuclear accident, the State Council of the People's Republic of China promptly suspended approval of new nuclear power plants pending changes in safety standards. As a result, China's 13th FYP nuclear power target in 2020 was eventually set as 58 GW. Following a drastic tightening of safety standards, only the so-called third generation nuclear reactors are allowed to be constructed in mainland China. The Chinese nuclear power industry encountered great difficulties in building the first four American AP-1000 reactors and two French EPR reactors, so China's installed operational nuclear capacity reached only 48.75 GW by the end of 2019. According to the CEC, China's installed nuclear capacity is projected to reach 53 GW by the end of 2020, significantly lower than the 13th FYP target.[48]

Given the low carbon nature of nuclear power, a drastic expansion of China's nuclear power fleet has been actively promoted by some stakeholders and analysts as an indispensable component of low carbon development in China. To explore how a clean energy transition in China may be compatible with the Paris Agreement climate goals, Jiang et al.[49] conclude that nuclear power needs to play an important role. To prevent global average temperatures from rising more than 2°C (or 3.6°F) above what they were just before the dawn of industrialization, China's installed nuclear capacity is projected to reach 430 GW by 2050. Under a more ambitious 1.5°C scenario, China's installed nuclear capacity needs to rise further to 554 GW by 2050. In comparison, installed capacity of the global nuclear fleet stood at only 399 GW in 2019.[50]

Unfortunately, unlike other major nuclear power economies, such as the US and France, where the majority of nuclear power reactors were built inland, China allows construction of nuclear reactors only along its coastal line. Due to plant siting–related restrictions in China's populous coastal provinces, any nuclear installation target beyond 150 GW has an implicit assumption that inland nuclear reactor construction should be permitted by the State Council of the People's Republic of China.

As COVID-19 has exaggerated overcapacity in China's energy sector in general and thermal power generation in particular, the necessity of inland nuclear reactor permitting during the 14th FYP period has inevitably become questionable from the perspective of supply and demand balance. To make matters worse, as illustrated in Box 2, a public health catastrophe originated in Hubei, which is not only the center of China but also the proposed site of several inland nuclear power plants and has ripple effects across all of China. Consequently, during the post-coronavirus soul-searching process, both Chinese leadership and energy policy analysts are likely to raise the following questions:

- Are transparency and safety culture in China robust enough to prevent a small incident escalating into a major catastrophe?

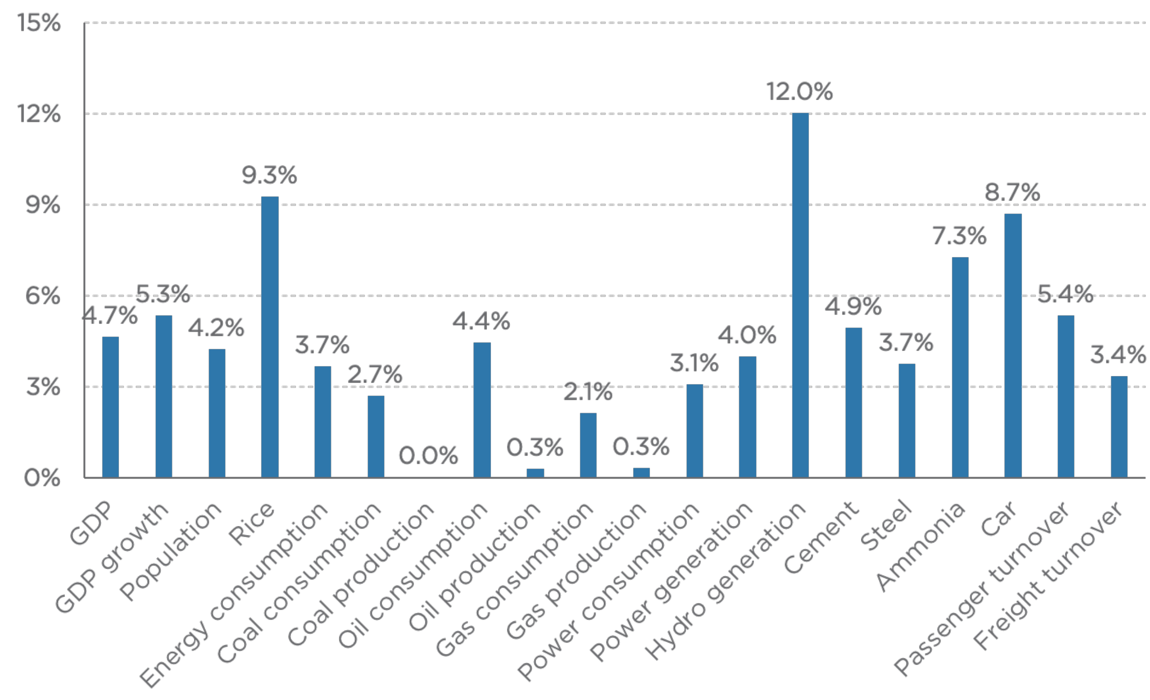
- Under an extremely low-probability but high-risk scenario, will the Chinese political establishment be able to withstand shock waves generated by a radioactive industrial catastrophe in inland China?

Answers to these questions and actions to address them are expected to have profound implications for not only the prospect of a nuclear renaissance in China but also the role of nuclear power in the global energy transition.

Box 2: Implications of a Slower-Recovering Hubei Province

Since the COVID-19 outbreak lingers longer in Wuhan than other parts of China, Hubei province inevitably has become the most politically sensitive region in China to balance the conflicting goals of eradicating the COVID-19 outbreak with continuous restrictions and kicking off economic activity in a timely fashion to maintain social stability. Though the first wave of COVID-19 in China was largely under control starting in early March, the lockdown in Hubei province was not lifted until March 25, with the lockdown in Wuhan ending as late as April 8.

Figure 10: Hubei province as percentage of China



Source: NBS Database; Hubei Bureau of Statistics, accessed April 24, 2020, http://tjj.hubei.gov.cn/.
Note: GDP and GDP growth are based on 2019 data, all energy consumption numbers are based on 2017 data, with the remaining indicators based on 2018 data.

From an energy perspective, Hubei is not a major energy producer except for hydropower generation. In 2018, Hubei produced almost no coal, and only 0.3 percent of both national oil and gas output. Hubei is a major energy importing province, with the exception that the province is a net power exporter, as a significant portion of its hydropower is transferred to other parts of the country.

Hubei is a major car and car parts manufacturing hub, accounting for 8.7 percent of national passenger car production. Given the complicated supply chain in global car manufacturing, Hubei's slow recovery will have ripple effects beyond China. Hubei's capital city, Wuhan, sits right in the middle of China with the Yangtze River flowing through it, and the city has long been nicknamed the "transport gateway to many Chinese provinces" (*jiu sheng tong qu*). So, a longer than usual economic stagnation in Hubei is expected to have severe impacts on transport turnover in the entire of China, leading to lower national oil consumption.

In sum, a slower recovery of economic activity in Hubei will have little effect on China's energy production; nevertheless, as the province has a larger than usual footprint on China's transport and car manufacturing, a prolonged economic slowdown in Hubei will not only have a larger than usual ripple effect throughout the Chinese oil market but will also cast a shadow on the prospect of massively building energy infrastructure inland with potentially catastrophic impacts under the worst-case scenario.

Conclusions

COVID-19 is inflicting high human costs in China and around the world. The stringent quarantine measures imposed by the Chinese government have severely affected the country's economic activity, with profound energy and climate implications. COVID-19's impacts on China's energy sector could be illustrated by the following numbers:

1. In Q1 2020, China's GDP drastically declined by 6.8 percent, which was the first reported economic contraction since 1976.

2. In the energy production segment, China's national coal production declined slightly by 0.5 percent YOY in Q1 2020, followed with 6 percent YOY growth in April. Due to the central government's emphasis on self-reliance to alleviate energy security risks associated with rising oil and gas imports, national oil and gas production during the first four months of 2020 increased 2 percent and 10.3 percent YOY, respectively. Nevertheless, fossil fuel imports still grew by 26.9 percent YOY for coal, 1.7 percent YOY for oil, and 1.5 percent YOY for gas.

3. In the energy transformation segment, national power production declined 6.8 percent YOY in Q1 2020, with thermal power output dropping even deeper, at 7.5 percent YOY. In April, national power production increased slightly by 0.3 percent YOY, with thermal power output growing by 1.2 percent YOY. In comparison, petroleum refinery throughput

in Q1 2020 decreased by 4.6 percent YOY, followed by 0.8 percent YOY growth in April.

4. In the energy consumption segment, power consumption decreased by 6.5 percent YOY in Q1 2020, followed by 0.7 percent YOY growth in April. Final energy consumption by industry in Q1 2020 declined by 4.3 percent YOY. Finally, national energy consumption in Q1 2020 decreased by 2.8 percent YOY.

5. Due to worldwide demand weakening because of the COVID-19 pandemic, substantial stock buildup occurred not only for oil and gas but also coal in China, leading to significant price reductions for all fossil fuels. More specifically, since the unprecedented Wuhan lockdown, prices of thermal coal for power generation, crude oil future traded at the Shanghai International Energy Exchange, and spot LNG cargo in China declined by 21 percent, 49 percent, and 23 percent, respectively, by April 30.[51]

As the pandemic is still unfolding in large parts of the world, and there are many unknowns about its nature, including the exact origin of the virus, the spread and lethality of the epidemic, and the seasonal pattern of the virus, it is premature to accurately quantify COVID-19's impacts on China's energy sector in detail. Nevertheless, based on limited availability of recent data, in the optimistic-case scenario, China's national energy consumption in 2020 is projected by the author to grow by 0.9 percent YOY, with a similar rate for national power consumption estimated at 1.2 percent YOY. In comparison, China's national power consumption in 2020 is projected by the CEC to grow by 2–3 percent YOY. In the case of a widespread resurgence of COVID-19, or in the absence of an appropriately designed stimulus package, a hard landing of the Chinese economy—the equivalent of negative growth of annual energy and power demand—cannot be ruled out for now. For example, China's national energy consumption in 2020 is projected by the IEA to decline by more than 4 percent YOY, with national power demand in 2020 dropping by about 3 percent YOY.

Though China's carbon emissions in 2020 will be substantially dented by COVID-19—with China's fossil fuel carbon emissions during the first four months of 2020 estimated to decline by around 2.6 percent YOY[52]—this will be expected to be short lived if decision makers are tempted to switch back to carbon-intensive fossil fuels to prop up economic activity. To avoid a common trap of advancing short-term economic gain at the expense of environmental integrity, a green stimulus package is in urgent need to steer China's economic recovery in an environmentally sustainable direction.

From a Chinese cultural perspective, a crisis as significant as the COVID-19 pandemic is often not only perceived as a threat (*wei*); it may also be treated as an opportunity (*ji*)—or *wei ji*. Instead of relying on energy-intensive infrastructure and heavy industry investment to achieve short-term economic gains, Chinese decision makers should double down on efforts for the clean energy transition, aiming to better balance short-term political targets with long-term strategic goals. If this occurs, China possesses great potential to become a true global leader in clean energy investment and the low carbon economy in the post-coronavirus world.

A wide range of energy research activities is expected to be carried out to thoroughly examine COVID-19's effects, and the Chinese government should consider making more detailed energy data available in a timely fashion beyond government-affiliated analysts—

otherwise, the quality of relevant research products is likely to be poor, with negative effects on China's own crisis responses.

Reliable statistical reporting is the basis of sound and sensible decision-making in the energy sector and beyond. While the author would like to applaud the tremendous efforts made by the NBS to improve the quality of statistical reporting in China, it seems that the central government has so far been unable to entirely eliminate the root causes leading to statistical distortion at the local levels. Given the political, economic, and environmental significance of this issue, it is recommended that a dedicated follow-up study on energy statistical reporting in China be conducted in the foreseeable future.

Finally, once more data and research findings become available, this preliminary analysis may be updated to better inform the international community about COVID-19's impacts on China's energy sector.

Notes

1. NBS Database, accessed April 6, 2020, http://data.stats.gov.cn/english/.
2. IMF World Economic Outlook, January 2020, https://www.imf.org/en/Publications/WEO/Issues/2020/01/20/weo-update-january2020; Morgan Stanley 2020 Macro Economic Outlook: Calmer Waters Ahead, accessed April 6, 2020, https://www.morganstanley.com/ideas/global-economic-outlook-2020.
3. CEC Database, accessed April 6, 2020, http://www.cec.org.cn/nengyuanyudianlitongji/hangyetongji/.
4. Jianjun Tu, Mark Jaccard, and John Nyboer, "The Application of a Hybrid Energy-Economy Model to a Key Developing Country—China," *Energy for Sustainable Development* 11, no. 1 (March 2007): 35–47.
5. IMF World Economic Outlook, April 2020, https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-april-2020.
6. NBS Database.
7. IEA Global Energy Review 2020.
8. Liu Wenhua, "Energy Supply Is Abundant, with Energy Structure Continuously Optimized," accessed April 27, 2020, http://www.stats.gov.cn/tjsj/zxfb/202004/t20200419_1739672.html.
9. WHO Situation Updates—SARS, https://www.who.int/csr/sars/archive/en/.
10. NBS Database.
11. CEC 2019–2020 National Power Supply and Demand Analysis and Outlook, accessed April 24, 2020, http://www.cec.org.cn/guihuayutongji/gongxufenxi/

dianligongxufenxi/2020-01-21/197090.html.

12. "Keqiang Ker-Ching: How China's Next Prime Minister Keeps Tabs on Its Economy," Economist December 9, 2010.

13. CEC Database.

14. Report on analysis and outlook of national power supply and demand in the first quarter of 2020, accessed May 2, 2020, http://www.cec.org.cn/guihuayutongji/gongxufenxi/dianligongxufenxi/2020-04-26/201538.html.

15. IEA Global Energy Review 2020.

16. "After the Lockdown Is Lifted, Who Are Allowed to Leave Wuhan," accessed April 24, 2020, https://www.sohu.com/a/386621707_349061.

17. "At Beijing Hotels, Negative Tests to Be Required, accessed April 24, 2020, https://www.chinadaily.com.cn/a/202004/10/WS5e9068f8a3105d50a3d15673.html.

18. "Passengers from Certain Parts of China Will Need COVID-19 Negative Test Certificate before Entering Hainan," accessed May 1, 2020, https://news.sina.com.cn/c/2020-04-30/doc-iirczymi9236234.shtml.

19. Sinolink Securities (2020) Sinolink return to work big data daily update, February 27, 2020.

20. NBS Database.

21. NBS Database.

22. IEA, "Global Energy Review 2020: The Impacts of the Covid-19 Crisis on Global Energy Demand and CO_2 Emissions," International Energy Agency, Paris.

23. "Airborne Nitrogen Dioxide Plummets over China," accessed April 6, 2020, https://earthobservatory.nasa.gov/images/146362/airborne-nitrogen-dioxide-plummets-over-china.

24. "Satellite Images Show Resurgence of Air Pollution over China," accessed April 24, 2020, https://www.ctvnews.ca/health/coronavirus/satellite-images-show-resurgence-of-air-pollution-over-china-1.4861849.

25. "Beijing Reported New Round of Analysis of PM2.5 Emissions Source Contribution," accessed April 6, 2020, http://www.xinhuanet.com/politics/2018-05/15/c_1122832062.htm.

26. "Opinions of the State Council of the People's Republic of China Regarding Implementation of Measurements to Tackle COVID-19 Pandemic-Related Impacts and to Stabilize Employment," accessed May 2, 2020, http://www.gov.cn/zhengce/content/2020-03/20/content_5493574.htm.

27. Kevin Jianjun Tu, *Industrial Organization of the Chinese Coal Industry*, 2011, https://pesd.fsi.stanford.edu/publications/industrial_organization_of_the_chinese_coal_industry.

28. Lauri Myllyvirta, Shuwei Zhang, and Xinyi Shen, "Analysis: Will China Build Hundreds of New Coal Plants in the 2020s?" 2020, https://www.carbonbrief.org/analysis-will-china-build-hundreds-of-new-coal-plants-in-the-2020s.

29. Comprehensive Analysis of 2019 Economic Data, accessed May 15, 2020, https://xueqiu.com/1196085864/140107238; "GDP Revisions Put China on Target to Double Economy, but Data Doubts Remain," accessed May 15, 2020, https://www.reuters.com/article/us-china-economy-gdp/gdp-revisions-put-china-on-target-to-double-economy-but-data-doubts-remain-idUSKBN1XW04C.

30. NBS China Energy Statistical Yearbook (various years); Chris Buckley, "China Burns Much More Coal than Reported, Complicating Climate Talks," accessed May 15, 2020, https://www.nytimes.com/2015/11/04/world/asia/china-burns-much-more-coal-than-reported-complicating-climate-talks.html.

31. David Sandalow, *Guide to Chinese Climate Policy*, 2019, https://energypolicy.columbia.edu/sites/default/files/file-uploads/Guide%20to%20Chinese%20Climate%20Policy_2019.pdf.

32. State Council of the People's Republic of China, *13th FYP Action Plan for Greenhouse Gas Emissions Control*, 2016, http://www.gov.cn/zhengce/content/2016-11/04/content_5128619.htm.

33. NBS Database, CEC Database, and the author's own calculation.

34. "The Contraction between Speed Up of Power Market Construction in 2019 and Widespread Financial Losses of Coal-Fired Power Enterprises," accessed April 6, 2020, http://news.bjx.com.cn/html/20200119/1037641.shtml.

35. Lauri Myllyvirta, Shuwei Zhang, and Xinyi Shen, "Analysis: Will China Build Hundreds of New Coal Plants in the 2020s?" 2020, https://www.carbonbrief.org/analysis-will-china-build-hundreds-of-new-coal-plants-in-the-2020s.

36. CEC Database.

37. "Permitting of Coal-Fired Power Plants Is Relaxed, Total Capacity Approved in the First Quarter of 2020 Is the Equivalent of 2019," accessed April 24, 2020, http://companies.caixin.com/2020-04-23/101546100.html.

38. "National Energy Administration Seeks Public Comments for Draft Energy Law," accessed April 20, 2020, http://www.nea.gov.cn/2020-04/10/c_138963212.htm.

39. "With Total Investment of 125 billion Yuan, the Largest Coal Chemical Project under Construction Started Construction Work," accessed May 2, 2020, https://3g.163.com/3g/article_cambrian/FAR1T89P0536ATH1.html.

40. "National Energy Administration: National Renewable Capacity Reached 794 GW by the End of 2019," accessed April 6, 2020, http://energy.people.com.cn/n1/2020/0307/c71661-31621377.html.

41. "PV in 2020: Drastic Transformation Is Destined to Come," accessed April 20, 2020, https://chinapower.org.cn/detail/173661.html.

42. "Vestas Still Rules Turbine Market, but Challengers Are Closing In," accessed April 20, 2020, https://about.bnef.com/blog/vestas-still-rules-turbine-market-but-challengers-are-closing-in/.

43. "National Energy Administration Seeks Public Comments for Draft Energy Law," accessed April 20, 2020, http://www.nea.gov.cn/2020-04/10/c_138963212.htm.

44. "Both Wind and Solar Curtailment Rates Declined in 2019," accessed April 6, 2020, http://companies.caixin.com/2020-02-29/101522070.html.

45. "GWEC (2020) Wind Industry and COVID-19 Update: Impact in China," accessed April 8, 2020.

46. "PV in 2020: Drastic Transformation Is Destined to Come," accessed April 24, 2020, https://chinapower.org.cn/detail/173661.html.

47. CEC Database.

48. "CEC Claims that China's Installed Nuclear Capacity Is Expected to Reach 53 GW by 2020," accessed April 6, 2020, https://finance.sina.com.cn/7x24/2019-04-02/doc-ihtxyzsm2537393.shtml.

49. Kejun Jiang, Chenmin He, Xiangyang Xu, Weiyi Jiang, Pianpian Xiang, Hong Li, and Jia Liu, "Transition Scenarios of Power Generation in China under Global 2°C and 1.5°C Targets," *Global Energy Interconnection* 1, no. 4 (October 2018): 477–486.

50. "Nuclear Power in 2019," accessed May 2, 2020, https://www.iaea.org/newscenter/news/preliminary-nuclear-power-facts-and-figures-for-2019.

51. Thermal coal prices: http://www.cec.org.cn/guihuayutongji/zhongguodianmeicaigoujiagezhishuCECI/index.html; crude oil prices: http://www.ine.cn/; LNG prices: https://www.sci99.com/targetprice/products/lng/, accessed May 1, 2020.

52. Corinne Le Quéré et al., "Temporary Reduction in Daily Global CO_2 Emissions during the COVID-19 Forced Confinement," Nature Climate Change, 2020, https://doi.org/10.1038/s41558-020-0797-x.

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