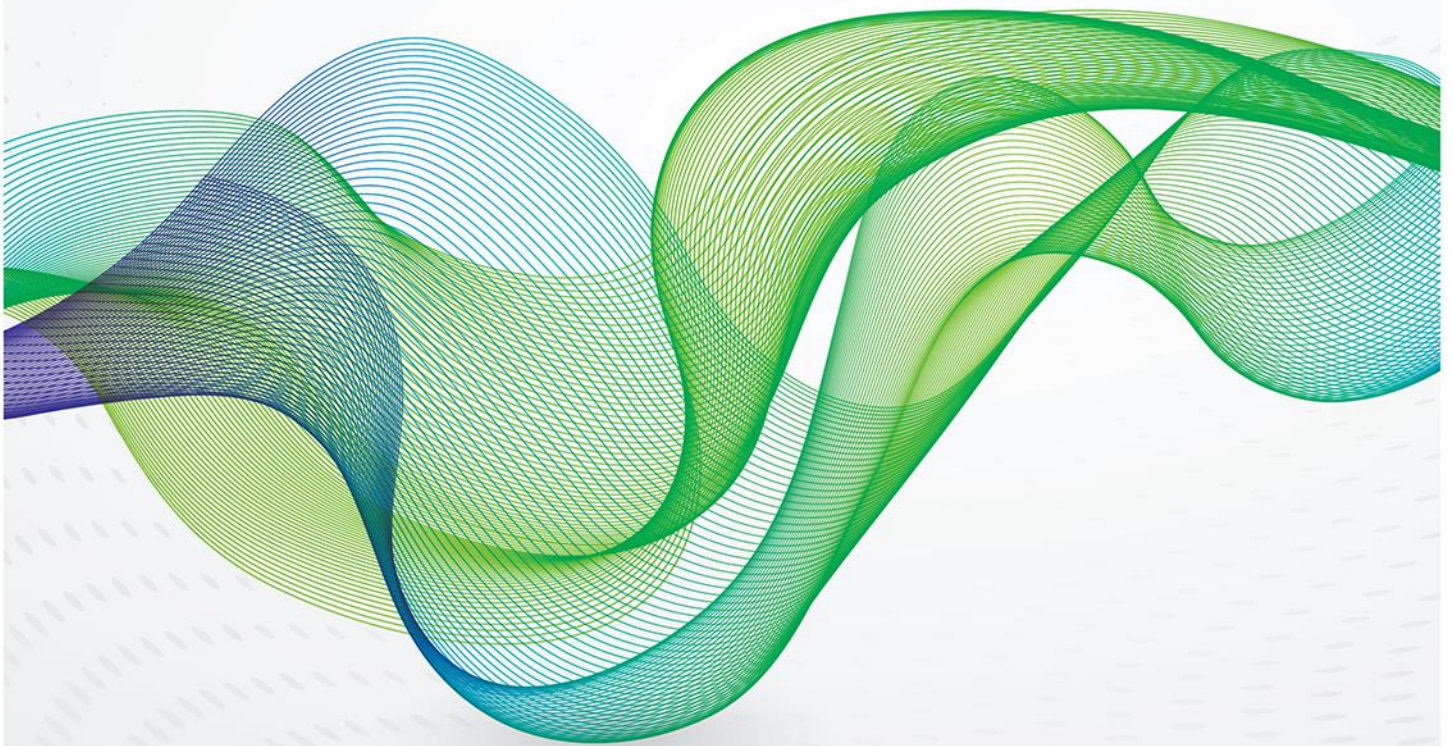




THE OXFORD
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Glimpses of China's energy future



OXFORD ENERGY COMMENT

Michal Meidan



Summary

China's largest oil and gas major, China National Petroleum Corporation (CNPC), released its 2050 outlook in late August. This coincided with preliminary work currently being undertaken by domestic think tanks, state-owned enterprises, and ministries ahead of the 14th Five-Year Plan (FYP). The FYP will run from 2021 to 2025 and will be approved by China's top legislature in early 2021, after which sectoral and regional plans will be published based on its principles and targets. The National Energy Administration (NEA), China's de facto energy ministry, will draw up a 14th FYP for energy.

The CNPC report is by no means a binding document, but it is informative as it reflects how the fossil fuel industry in China is thinking about the country's energy future. Importantly, the baseline scenario remains one of ongoing energy demand growth through to 2040, with even the most environmentally-progressive scenarios pegging 2050 energy demand at 2035 levels. Yet according to China's National Renewable Energy Center, in order for China to reduce CO₂ emissions to support the Paris Agreement goals (limiting global temperature rise to below 2°C), primary energy demand in 2050 would need to fall below 2017 levels.

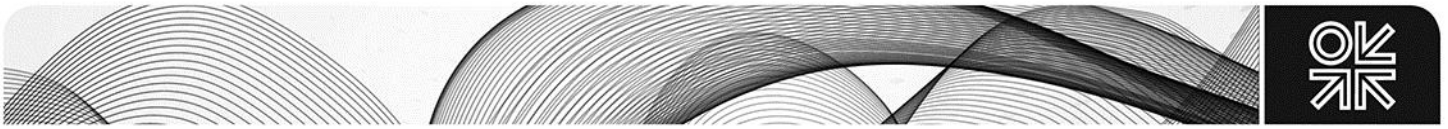
CNPC expects the country's oil demand to peak in 2030 (although gasoline demand in transport peaks sooner), suggesting anywhere from 2 million barrels per day (mb/d) to 3 mb/d of incremental oil demand over the next decade, or half the growth rates seen over the past decade. Gas demand continues to rise through the forecast period, suggesting a 300 billion cubic metre (bcm) increase in demand over the next 20 years, roughly on a par with the growth rates seen over the past two decades. But combined, oil and gas are still expected to account for a third, at most, of China's primary energy mix.

The biggest question for China, therefore, remains the share of coal in the energy mix. According to the CNPC forecast, even though coal's share will continue to fall, it will still account for a third of primary energy use in 2050. Indeed, while in many developed countries decarbonisation is synonymous with electrification, in China it is the crux of the challenge given the predominance of coal in power generation. As the country's economic structure is shifting away from industry toward consumer-based demand, CNPC expects a 40 per cent electrification rate of energy end uses. Powering the rising urban population will therefore be China's main priority and coal will remain a viable option.

To be sure, CNPC, much like the Chinese government, explores in their report a progressive environmental scenario, dubbed the 'Beautiful China' scenario, in which electrification rates rise to as much as 50 per cent of energy end uses, while the share of coal in power drops to a third in 2035, and to under 10 per cent in 2050. But coal is by no means unanimously viewed as the climate villain in China. Not only is it an important source of government tax revenue, but the coal industry is also a powerful stakeholder that contributes to employment and secure energy supplies. There are certainly advocates of more assertive efforts to phase out coal within China. How they fare in the national debate about the country's energy priorities over the next 12–18 months will be critical to China's energy pathways in the 14th FYP and beyond.

The CNPC report's key findings

Much like global majors, CNPC produces an annual forecast of energy demand by commodity and sector out to 2050. Unlike some of its peers, however, given that it is a state-owned company, its forecasts tend to be informed by political priorities. They, in turn, serve as a base for policy planning. Interestingly, in the 2019 outlook the macroeconomic fundamentals remain unchanged from last year's forecast, despite the ongoing US–China trade war. Arguably, the near-term macroeconomic headwinds may be irrelevant for the longer-term outlook, especially if the trade war is resolved –



although we do not think this is likely to be the case.¹ But maintaining an assumption of 6.7 per cent GDP growth through to 2020 seems overly optimistic and could therefore suggest an inflated baseline. More fundamentally, the report highlights that even though China is pushing forward assertively with renewables, coal will remain a key component in fuelling China's economic growth over the medium and long term. And as a result, both its primary energy demand and coal use forecasts (Figure 1) are higher than in BP's latest outlook (Figure 2). According to CNPC's report:

- China's primary energy demand is expected to peak between 2035 and 2040 at close to 4 billion tonnes oil equivalent (btoe), higher than the 2018 forecast (3.9 btoe).
- Oil demand is expected to peak in 2030 at 705 million tonnes (mt, or 16.5 mb/d), with transport demand peaking in 2035 (jet fuel use peaks later than gasoline), but petrochemical demand grows through to 2050.
- China's gas demand continues to increase, reaching 610 bcma and 690 bcma in 2035 and 2050 respectively, although CNPC has revised down its 2025 and 2030 demand forecasts from their 2018 levels. Looking ahead, gas use is driven by the residential and power sectors. But with domestic production only expected to account for around half of demand, China's import dependence is expected to reach around 50 per cent.
- Electrification remains a key trend in China, with the outlook pegging power demand in 2050 at 12.2 trillion kilowatt hours (kWh), lower than the 12.3 trillion kWh forecast last year. At the same time, coal is set to lose ground to renewables faster than in the 2018 outlook, although it is still expected to account for 40 per cent of power generation in 2035. Between 2035 and 2050, technological gains will support the uptake of non-fossil fuels, which by 2050 should account for 58 per cent of power generation.

Figure 1: CNPC energy demand forecast, btoe

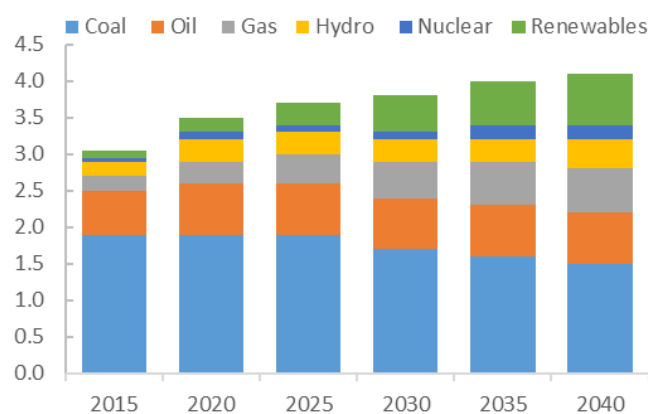
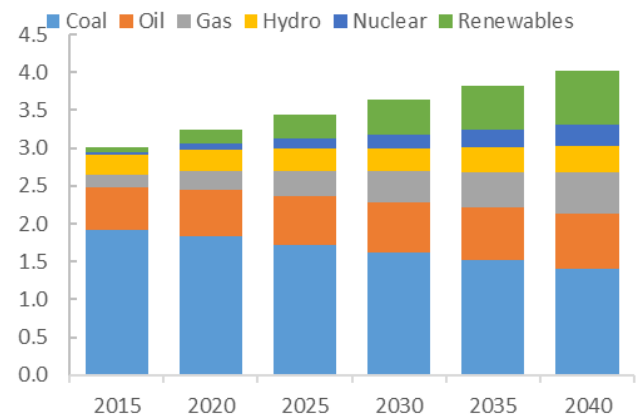


Figure 2: BP energy demand forecast, btoe

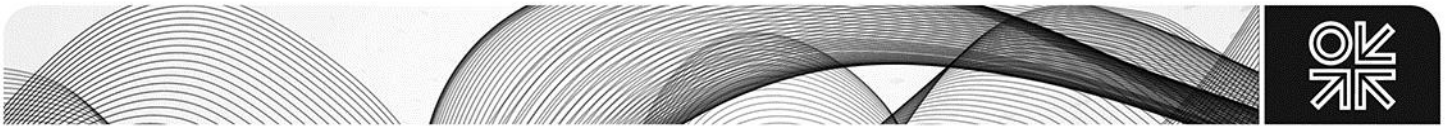


Sources: Author's calculations based on CNPC Economics and Technology Research Institute (ETRI) 2050 Outlook, 2019 edition; BP 2019 Outlook.

Growing strong

Driven by strong primary energy demand growth in China during 2018 (up 3.3 per cent year on year (y/y)), it appears likely that CNPC increased energy demand in its outlook period, with **primary energy demand peaking between 2035 and 2040 at close to 4 btoe**, (vs 3.9 btoe in the 2018 outlook). As a result, CNPC expects **primary energy demand to grow by 2.4 per cent per year on average between 2015 and 2020**, compared to 2 per cent per year in the 2018 forecast. Between 2020 and 2030, CNPC still sees primary energy demand rising by 2 per cent per year on average before slowing through to 2040 and falling (by 0.3 per cent per year) until 2050.

¹ See Michal Meidan, 'US-China: The great decoupling', *OIES Energy Insight* 53, July 2019, www.oxfordenergy.org/publications/us-china-the-great-decoupling/?v=79cba1185463.

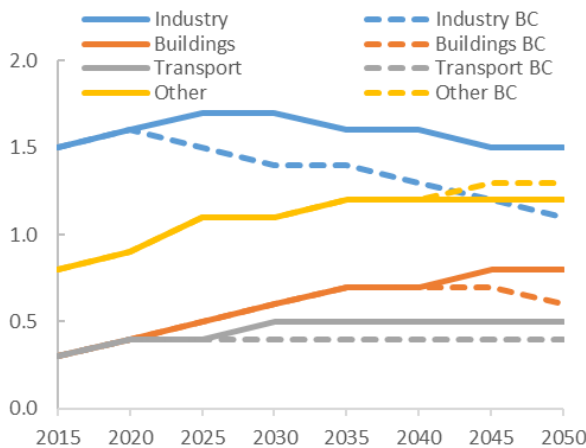


While the share of coal in the energy mix will continue to fall through to 2050, absolute demand for coal is expected to remain at its current levels until 2025 (see Figure 1), given its importance in power generation. Indeed, **coal use in power continues to rise, peaking at 4.9 trillion kWh in 2025**, even though its share of the power stack is also falling (see below, Figures 8 to 10). Demand for electricity continues to grow through to 2050, more than doubling from 2015 levels (5.5 trillion kWh) and reaching 11.2 and 12.2 trillion kWh in 2035 and 2050, respectively. As such, CNPC expects **the country's CO₂ emissions to peak between 2025 and 2030**, earlier than China's Nationally Determined Contribution pledge of emissions peaking in 2030 and sooner than the 2018 forecast. But emissions are now expected to peak **at 10 gigatonnes (Gt), higher than the 2018 forecast of 9.5 Gt**.

As CNPC has not altered the macroeconomic fundamentals underpinning its forecast, it is still assuming that industrial energy use is gradually making way for consumer-led energy demand – with industrial demand peaking in 2025. Energy consumption by the steel and construction industries are expected to start falling around 2030, with energy demand from chemicals still growing strongly. Demand from buildings continues to grow through to 2050, while transport remains the smallest energy consumer in China and sees demand peak in 2030 (see Figure 3). Electrification of end uses reaches close to 40 per cent.

In its more progressive environmental scenario, which CNPC has dubbed 'Beautiful China', an accelerated optimisation of China's economic structure (i.e. a faster move toward deindustrialisation) combined, with enhanced energy efficiency and deeper awareness of low-carbon consumption patterns, leads to large reductions in energy consumption compared to the base case (see Figure 3). This also assumes that electrification in end uses reaches close to 50 per cent in 2050 – 10 percentage points higher than in the base case scenario – but thanks to increased efficiency, overall power demand is 12.3 trillion kWh.

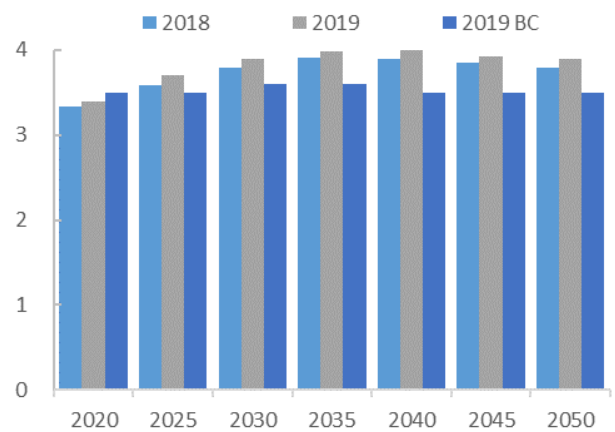
Figure 3: End-use demand by sector, btoe



Note: BC denotes demand under the 'Beautiful China' scenario.

Source: Author's calculations based on CNPC ETRI 2050 outlook, 2019 edition.

Figure 4: Primary energy demand forecasts, btoe

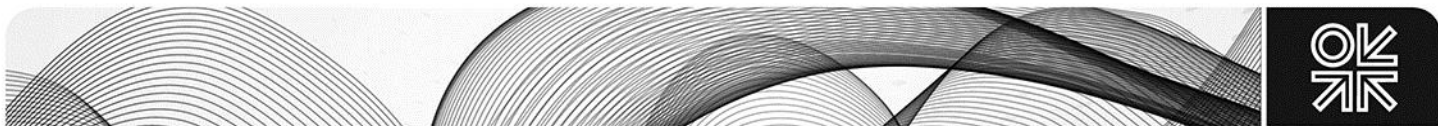


Notes: 2018 and 2019 denote forecasts made in those outlooks; 2019 BC is the 2019 'Beautiful China' scenario.

Source: Author's calculations based on CNPC ETRI 2050 outlook, 2018 and 2019 editions.

Oil demand peaks in 2030, but gasoline use declines after 2025

Oil currently accounts for 19 per cent of China's primary energy mix – roughly half the average levels in OECD countries – and it is expected to remain at these levels during 2030–2035, falling to around 15 per cent by 2050. Indeed, in its 2019 outlook CNPC expects oil demand to peak around 2030 at 705 mt (about 16.5 mb/d), up from about 600 mt (close to 14 mb/d) in its 2017 outlook, and higher than its 690 mt forecast last year. But considering that China's implied annual oil demand grew by more than 5 mb/d between 2008 and 2018, this outlook, which is on the high side, represents a

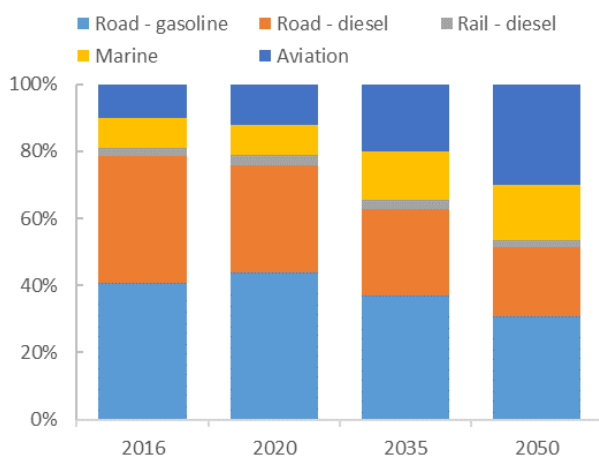


significant slowdown. This year's forecast also includes a revision of CNPC's models, allowing it to focus more on oil use in petrochemical production (although the report does not provide details on the change in methodology), while taking into consideration technological developments in the renewable and electric vehicle (EV) sectors.

By sector, transport continues to account for roughly half of total oil demand over the forecast period. Industrial use, however, in line with the structural shifts in the Chinese economy, gradually falls from around 25 per cent of total use currently to under just over 10 per cent in 2030, displaced by chemical demand, which by 2030 is expected to account for one-fifth of total oil use, double its current share. By 2050 chemicals represent one-third of total oil demand.

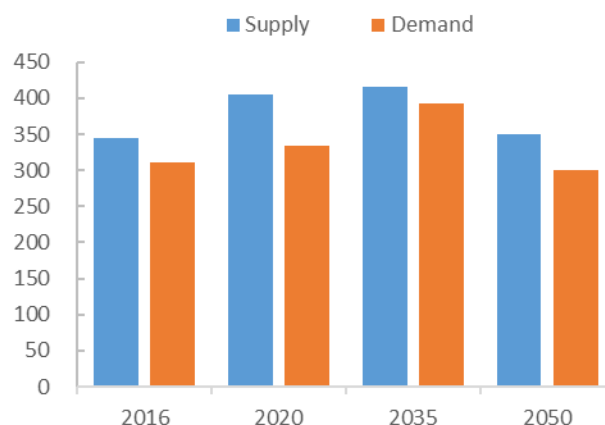
These structural shifts therefore impact product demand, with gasoline and jet fuel leading the growth, at an average rate of 2.4 per cent every year between now and 2030, and then slowing to 0.6 per cent per year on average until 2050. CNPC expects gasoline demand to catch up with diesel use by 2025 (up to 2010 China consumed almost twice as much diesel as gasoline), but gasoline consumption declines faster as of 2035 as diesel remains an important fuel in road freight, rail transport and bunkering (Figure 5) (although in marine demand, CNPC does not provide a break down between distillates and fuel oil). Demand for jet fuel continues to rise through the forecast period, as does demand for petrochemicals.

Figure 5: Transport demand



Source: Calculations based on the 2019 CNPC ETRI 2050 outlook.

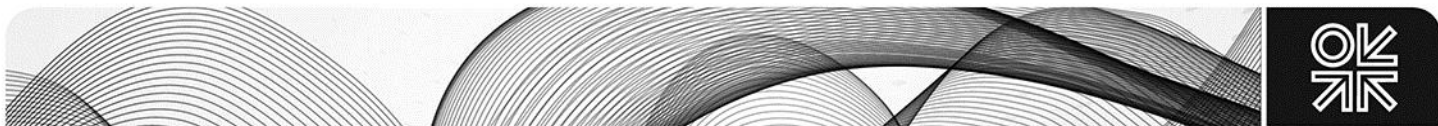
Figure 6: Oil product supply and demand, mt



Source: Calculations based on the 2019 CNPC ETRI 2050 outlook.

These changes also foretell Chinese refiners' yield shifts. CNPC expects refiners to shift yields more rapidly to petrochemicals after 2030, thereby reducing the oversupply of oil products from an estimated 60 mt in 2035 to 23 mt in the 2019 forecast. **That said, the 2020 excess is now pegged at 70 mt compared to an earlier forecast of 60 mt (see Figure 6). CNPC's forecast is not necessarily indicative of government policy, but with export quotas in 2019 already covering close to 60 mt of gasoline, diesel, and jet fuel exports, next years' quotas (barring reform of the quota system) may well increase by over 10 mt.**

However, CNPC's expectations of domestic product oversupply may be on the conservative side. It expects roughly 9–10 mt (0.18–0.20 mb/d) of new refining capacity additions every year through to 2025, but there are already 2.5 mb/d of capacity additions planned out to 2023 alone. It is not impossible that the government's consolidation efforts, especially in Shandong, will lead to refinery closures, but it seems unrealistic to assume even 1 mb/d of shutdowns (roughly one-quarter of Shandong's independent refining capacity) given the current economic context and the Shandong government's track record of protecting its local refining industry. So while product oversupply could worsen in the near term, China's crude demand should also remain supported.



The shift to light ends will also affect China's crude slate. Both its domestic production and current import patterns are distillate-biased, and even though the country's refineries are increasingly complex, they are still set to need lighter grades. Moreover, domestic crude output is expected to rise only gradually to 4 mb/d through to 2030 (from 3.8 mb/d in 2018) and gradually decline thereafter, suggesting that China's crude requirements will remain strong throughout the period, regardless of its stockpiling needs (which the report does not discuss).

What comes after the ICE age?

As China enters the era of light ends, markets have been expecting strong gasoline demand growth due to higher car ownership alongside more driving. But the central government's assertive efforts to promote new energy vehicles (NEVs, which in China include battery electric, plug-in hybrid and fuel cell vehicles), alongside the advent of bike-sharing apps and high gasoline prices, have led to soft increases in gasoline demand.² CNPC forecasts a 17 per cent increase in gasoline demand from 2016 to 2020, followed by a 7 per cent increase by 2025 and a levelling out over the subsequent five-year period as the report assumes strong improvements in energy efficiency.

CNPC also expects China's passenger vehicle fleet to expand from 270 million in 2020 to 400 million in 2035 and 500 million in 2050, or 350 vehicles per thousand people. The report assumes that sales of gasoline-powered vehicles have already peaked and will continue falling through to 2050, although they still account for over two-thirds of the fleet in 2030. In 2035 and 2050 NEVs are expected to account for 21.5 per cent and 44.2 per cent of the fleet, respectively. But NEV sales will match gasoline-powered vehicle sales only in 2040, despite reports that the government intends to ban internal combustion engine (ICE) vehicles. To be sure, in mid-July the Ministry of Industry and Information Technology (MIIT) posted a reply on its website to a proposal from the Chinese parliament, asking it to set a time frame to end sales of gasoline-powered vehicles,³ stating that it will consider allowing experimental no-go zones for conventional vehicles. But MIIT's full text implies caution, as it states that while 'supporting the development of new energy vehicle industry, our country has also placed strong emphasis on the development of energy saving vehicles'. So before setting out a time frame to phase out fossil fuels, MIIT has pledged to engage with other government agencies to assess a potential ban. In the interim, only Hainan province has announced that it would ban sales of vehicles running on fossil fuels in 2030, although a number of cities are promoting EV buses and increasingly adding informal barriers to ICE vehicles.⁴

NEVs are set to gain significant market share in China, but the questions remain how much and how quickly. In the context of falling car sales in China, in the first seven months of 2019 aggregate sales of EVs and plug-in hybrids surged 41 per cent to approach 700,000, an extremely strong growth momentum. But this is still a fraction of the 14.1 million new vehicles sold overall during the same period.⁵ Moreover, Beijing is winding down the subsidy programme for EVs and plug-in hybrids at the end of 2020 after making a major cut in the subsidies in June, which could slow sales in the near term.

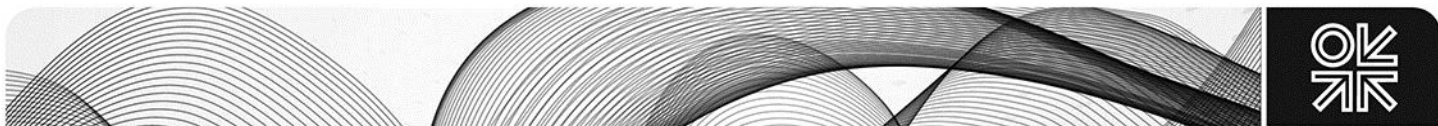
The successes and failures of the government's EV policy are likely to be scrutinized over the coming months, with changes to incentive schemes likely to be debated as the government draws up the 14th FYP. Questions will revolve around EV manufacturing and sales and charging infrastructure, but also whether the government should move to restrict e-bikes and low-speed electric vehicles (LSEVs). These have developed rapidly in China's less affluent provinces, because of their low cost and easy charging. LSEV sales even expanded, reaching close to 1.5 million units in 2018, despite government

² Anupama Sen, Michal Meidan, and Miswin Mahesh, 'Gasoline demand in transport in Non-OECD Asia', *OIES Energy Insight* No. 22, November 2017, www.oxfordenergy.org/publications/gasoline-demand-transport-non-oecd-asia/?v=79cba1185463.

³ 'China mulls ban on gasoline cars in some regions', *Reuters*, 22 August 2019, www.autonews.com/china/china-mulls-ban-gasoline-cars-some-regions.

⁴ See for example Echo Huang, 'China is leaning on ride-hailing to boost sales of electric vehicles', *Quartz*, 4 September 2019, <https://qz.com/1687137/china-counts-on-ride-hailing-to-boost-ev-sales/>.

⁵ As reported by the Chinese Association of Automobile Manufacturers, www.caam.org.cn/tjsj.



campaigns that sought to rein in their sale and use due to safety concerns.⁶ E-bikes and LSEVs rarely displace existing ICE vehicles (and therefore gasoline demand), but they displace potential gasoline use as new consumers opt for smaller and cheaper modes of transport rather than ICE vehicles or top-range and expensive EVs.

The other question that the CNPC report also flags is hydrogen vehicles. In its baseline scenario CNPC sees 2 million and 10 million hydrogen vehicles on China's roads in 2035 and 2050, respectively. But in a hydrogen vehicle breakthrough scenario (where costs fall materially as technology improves), with as many as 86 million vehicles on the road in 2050, diesel demand is roughly one-third lower than in the baseline scenario and gasoline use 15 per cent lower. Such ambitious scenarios will rely heavily on government support, which does not seem forthcoming. Currently the government is aiming for 1 million fuel cell vehicles on the roads by 2030, but despite subsidies ranging from RMB 200,000 (\$28,000) per passenger vehicle to RMB 500,000 (\$70,000) for a heavy commercial vehicle (which remain unchanged despite the withdrawal of NEV subsidies), in the first seven months of the 2019 sales of hydrogen fuel cell vehicles reached just 1,106 units (albeit a tenfold increase on 2018 levels).⁷

While the baseline is very low, production and sales could rise further this year in particular, as local-level officials are looking into offering support to fuel cell vehicles. In December 2018 China's former science and technology minister, and the founder of China's EV roadmap, advocated their development, especially in public transport.⁸ In mid-January, the southern city of Foshan, Guangdong province, announced a plan to build at least 22 hydrogen refuelling stations⁹ as part of the plan to boost the fuel cell industry. Shanghai followed suit in June 2019,¹⁰ and depending on the government's subsidy framework, efforts to support both production and purchase of fuel cell vehicles could be scaled up. For now, the government seems to have limited appetite to further support FCVs,¹¹ although it will all be up for debate ahead of the next FYP.

Limited upside for natural gas

After two years of phenomenally strong growth in gas demand in China, 2019 is emerging as a year of softening. Partly reflecting this, in its 2019 outlook CNPC has revised down its medium-term gas demand outlook, suggesting a more subdued future for gas use in industry. The company has revised down its 2025 forecast by almost 30 bcm, from 455 bcma previously to 420 bcma, although the 2035 outlook is essentially unchanged at 610 bcma (vs 620 bcma previously), and the 2050 forecast is now higher at 690 bcma (vs 650 bcma last year). While industrial demand has been revised down by as much as 50 bcm compared to the 2018 forecast, CNPC increased its estimate for gas in power, albeit by a more modest 20–30 bcm (compared to last year's outlook). Overall, CNPC's growth estimates of 130 bcm between 2018 and 2024 (see Figure 7) are also lower than those of the International Energy Agency (IEA), which has demand growth at over 160 bcm¹² with major discrepancies in the volume of industrial and residential demand growth. Still, the share of gas in the energy mix hovers at around 14 per cent during 2030–2035, rising to 17 per cent in 2050. In the power sector, gas accounts for 10 per

⁶ Gabriel Collins, 'Low-speed electric vehicles: An underappreciated threat to gasoline demand in China and global oil prices?', Rice University Baker Institute for Public Policy Issue Brief, 15 May 2019, www.bakerinstitute.org/media/files/files/7c7fe1f9/bi-brief-051519-ces-chinalsev.pdf.

⁷ 'China's installed capacity of hydrogen fuel cells soars sixfold in first seven months', *Xinhua*, 1 September 2019, www.xinhuanet.com/english/2019-09/01/c_138356098.htm.

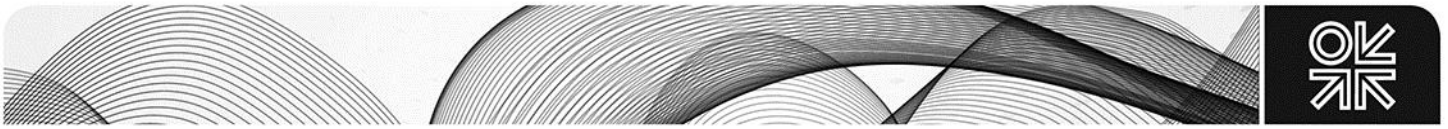
⁸ Wan Gang, 'Promote the healthy development of China's new energy vehicle industry' (Chinese), *People's Daily*, 15 December 2018, http://paper.people.com.cn/rmr/html/2018-12/15/nw.D110000renmrb_20181215_1-06.htm.

⁹ 'A ten-billion hydrogen industry settles in Foshan; initial investments reach 2.16 billion yuan' (Chinese), *Guangzhou Daily*, 22 January 2019, www.in-en.com/finance/html/energy-2239165.shtml.

¹⁰ David Kirton and Sun Liangzi, 'Shanghai scales up hydrogen-powered car development', *Caixin*, 14 June 2019, www.caixinglobal.com/2019-06-14/shanghai-scales-up-hydrogen-powered-car-development-101427127.html.

¹¹ 'Ministry of Finance: Conditions are not ripe for the large-scale promotion of hydrogen fuel cell vehicles; they cannot replace pure EVs' (Chinese), *Caixin*, 31 August 2019, www.caixin.com/2019-08-31/101457339.html?originReferer=gh_caixinwang.

¹² *Gas 2019*, International Energy Agency, www.iea.org/gas2019/.



cent in 2035 and 13 per cent in 2050, although under the 'Beautiful China' scenario it remains capped at 10 per cent through to 2050.

Figure 7: Gas demand by sector, bcm

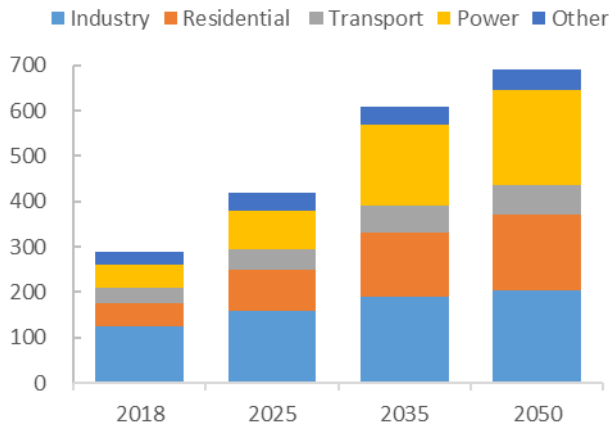
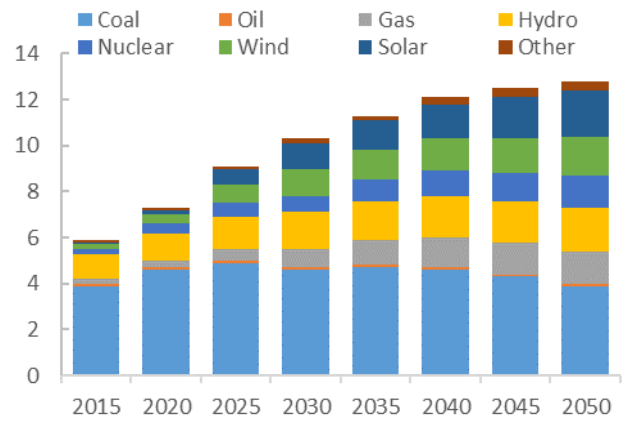


Figure 8: Power demand, trillion kWh



Source: Calculations based on the 2019 CNPC ETRI 2050 outlook (base case scenario).

CNPC's gas demand estimates are not too far from BP's 2019 outlook (641 bcm in 2040), but CNPC's production forecast falls short of BP's, at 300 bcm in 2035 and 350 bcm in 2050 compared with BP's more optimistic 367 bcm in 2040. With conventional production peaking at 150 bcm around 2030, tight gas continues to supply 30–50 billion cubic metres per annum (bcma) throughout the period (peaking at around 50 bcm in 2030 and falling back thereafter to 20–30 bcma).

Production of shale gas, according to CNPC, picks up gradually, hitting 35 bcm by 2025, or 17 per cent of total production (more than triple the 2018 volumes) and achieving around 50 bcm in 2030 before rising to close to 100 bcma by 2050. Coal-bed methane remains a minor contributor to domestic supplies through to 2030 (roughly 10 bcma) and rises to around 40 bcma at the end of the forecast period.

As a result, China's dependence on imported gas is set to rise to 50 per cent. Assuming China does not sign any pipeline deals after the Power of Siberia (which is unlikely), the country's call on liquefied natural gas (LNG) reaches 100–120 bcma in the early 2020s before doubling toward 2030. Yet the outlook for gas in China is fraught with uncertainty both in the near and medium term. In the short term, the combination of slowing economic growth and the new midstream company, which is expected to be established in the next few months, are generating caution among Chinese importers. They remain uncertain about the country's demand trajectory (due to the economic outlook) and cost structures when the new midstream company is created.

More broadly, the government's plans for price reforms and broader liberalisation, while viewed positively on the whole, are another element of uncertainty that could slow demand growth (if domestic prices rise, for example) while also spurring imports as new actors seek market share. In the longer term, gas in power could face challenges from renewables, even though it is widely assumed that it will play some role in peak shaving. Whether that role requires closer to 150 bcm or 200 bcm in 2035 is a meaningful question.

The coal conundrum

The share of coal in China's primary energy mix is expected to fall, with CNPC forecasting that renewables, oil and gas combined will overtake coal's share of primary energy consumption by 2050. But while its share of primary energy consumption is in freefall, declining from 70 per cent in 2011 to 59 per cent last year, it will still remain the single largest supply source through to 2050.

In power generation, coal is set to peak only in 2030 and even as industrial coal use declines after 2030 (see Figure 8), coal use in petrochemicals offsets some of that fall. The more progressive 'Beautiful China' scenario sees a more dramatic decline in coal use, especially in the power sector as renewable penetration rates accelerate significantly starting in 2035 (see Figures 9 and 10).

Figure 9: Power demand in 2035

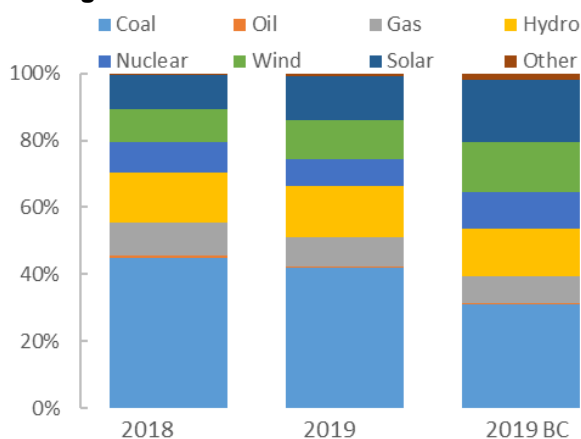
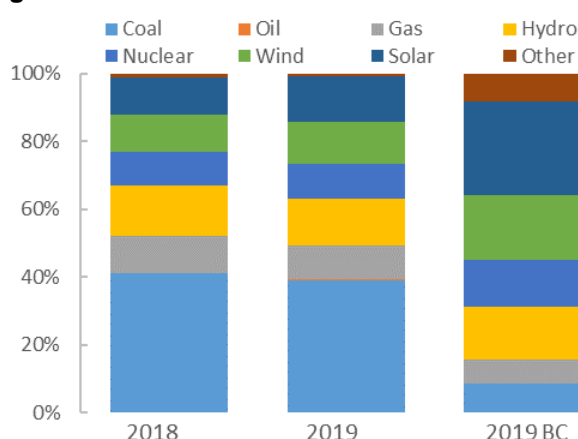


Figure 10: Power demand in 2050



Notes: 2018 and 2019 denote forecasts made in those outlooks; BC is the 2019 'Beautiful China' scenario.

Source: Calculations based on the 2019 CNPC ETRI 2050 outlook.

But whether China's power sector follows CNPC's base case or something closer to a 'Beautiful China' scenario will depend as much on the pace of innovation and cost reductions as it will on policy support. Some estimates suggest renewables have already reached grid parity in China,¹³ but there are still numerous obstacles to a strong uptake of wind and solar power. For one, renewables have been heavily dependent on subsidies, and growth in installations has slowed since the government started cutting subsidies. In 2017, for example, solar installations hit a record 53 gigawatts (GW), but slowed to 41 GW in 2018. While wind capacity is largely on track to meet its 13th FYP target of 210 GW of installed capacity (reaching 193 GW in June 2019) and solar has outstripped its 110 GW targeted capacity (with 186 GW installed in June 2019),¹⁴ growth rates are set to slow. In the first half of 2019, new solar additions reached a softer 11.4 GW as most new installations have been unsubsidized. The 14th Energy FYP is likely to set a more realistic target for wind and solar capacity, while addressing the grid integration problems that led to high curtailment rates of wind and solar power over the last FYP period.

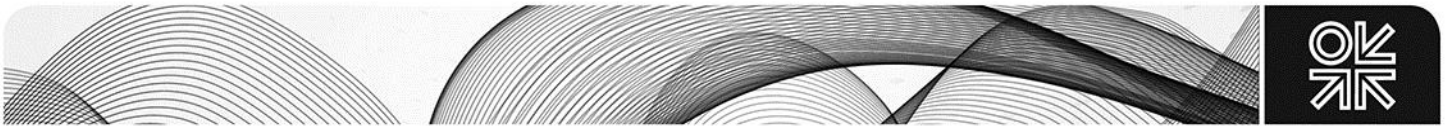
A more fundamental issue plaguing the uptake of renewables in China has been the poor coordination of wind and solar installations with grid construction. Most of the country's wind and solar potential is located in western areas such as Xinjiang, Inner Mongolia, and Gansu province, far away from the main consumers in the country's eastern regions. Roughly a quarter of wind-generated energy in these provinces was curtailed in 2018, prompting the government in March 2019 to prohibit new wind farms with no access to the national grid.¹⁵ With additional government efforts to reduce wastage, curtailment in these three areas fell by 15.2 per cent, 9.5 per cent, and 7.4 per cent, respectively, in 2019 y/y.¹⁶ The government is now aiming to reduce curtailment to just 5 per cent

¹³ Jinyue Yan, Ying Yang, Pietro Elia Campana, and Jijiang He, 'City-level analysis of subsidy-free solar photovoltaic electricity price, profits and grid parity in China', *Nature*, 12 August 2019.

¹⁴ 'China's renewable power capacity up 9.5% year-on-year in June', *Reuters*, 25 July 2019, <https://uk.reuters.com/article/us-china-renewables/chinas-renewable-power-capacity-up-9-5-year-on-year-in-june-idUKKCN1UK1MF>.

¹⁵ 'Notice regarding the results of the 2019 annual wind power investment survey' (Chinese), National Energy Administration, 4 March 2019, http://zfxqk.nea.gov.cn/auto87/201903/t20190308_3631.htm.

¹⁶ 'China is wasting less solar and wind power', *Caixin*, 2 May 2019, www.sixthtone.com/news/1003939/china-is-wasting-less-solar-and-wind-power.



nationwide and in May 2019 it began drawing up plans for a new mechanism¹⁷ to guarantee minimum levels of regional renewable energy consumption. Local energy authorities must come up with a plan for increasing their renewables consumption, which Beijing will then start assessing from the beginning of 2020, with targets then likely to be introduced in the 14th FYP.

This work will dovetail with the question of whether or not China will introduce a carbon emissions cap. Currently China has pledged to attain peak carbon emissions by 2030 at the latest, but it has been reluctant to promise an absolute cap. This could change in the next FYP, but it is likely to prove contentious. The Ministry of Ecology and Environment commissioned research projects in late April 2019 in preparation for the 14th FYP, one of which will investigate a carbon emissions cap. The study will look at how other countries set targets to limit total carbon emissions and how these targets break down at sectoral and regional levels, and will suggest an adequate approach for China,¹⁸ an objective that prominent think tanks in China also support.¹⁹

On the other side of the debate are China's power producers, who have asked the government to allow for the development of between 300 and 500 new coal power plants by 2030, suggesting that coal-power capacity should expand to 1,300 GW by 2030,²⁰ 290 GW higher than the current capacity. The China Electricity Council (CEC), the influential industry body representing China's power industry, in its review of the government's FYP, requested the acceleration of gas-fired power projects, raising the target of west-to-east electricity transmission capacity from 270 GW to 300 GW by 2020, nearly doubling targeted solar PV capacity to 200 GW, and increasing the wind power target marginally, from 210 GW to 220 GW. Still, the CEC proposes a target of non-fossil power generation of 50 per cent by 2035, roughly in line with CNPC's forecast, but a far cry from China's National Renewable Energy Center's 2°C scenario, which calls for 77 per cent of non-fossil power generation by 2035, while the IEA says 70 per cent is needed by 2030.

The debates begin

While the rest of the world discusses the rise of EVs and developments in mobility models, taking electrification as the basis for decarbonisation, China's conundrum at its core is about electrification. To be sure, changes in the country's transport policy will determine whether gasoline demand grows by 0.5 mb/d or by 1 mb/d between now and 2025 – informing decisions on refining additions, product yields, and how much product oversupply China will be able to export. Similarly, the government's decisions on how quickly to impose shifts from coal-fired boilers to natural gas will determine whether China absorbs an incremental 160 bcma of natural gas through to 2025, or whether it will be a more modest 120 bcma (roughly equivalent to Qatar's planned expansion). But for China's decision makers, the key question is how quickly to displace coal. Ahead of the 14th FYP, the government will need to weigh up the economic, political, social, and diplomatic costs of its energy revolution. Ministries and powerful state-owned companies will lobby for their interests, with this CNPC report likely to be foretelling the fossil fuel sectors' pitch.

¹⁷ 'Joint notice by the National Energy Administration and the National Development and Reform Commission regarding the guarantee mechanism renewable energy power consumption' (Chinese), 15 May 2019, www.ndrc.gov.cn/xwzx/xwfb/201905/t20190515_936199.html.

¹⁸ Tom Baxter and Yao Zhe, 'The 14th Five Year Plan: what ideas are on the table?', *China Dialogue*, 7 August 2019, www.chinadialogue.net/article/show/single/en/11434-The-14th-Five-Year-Plan-what-ideas-are-on-the-table-.

¹⁹ 'Enhancing new consensus on green development: The pathway to China's high quality development during the 14th Five Year Plan Period: Policy recommendations from the 2019 AGM of China Council for International Cooperation on Environment and Development'.

²⁰ 'An assessment of the power industry's 13th FYP at mid-point', China Electricity Council, 18 March 2019, <http://shupeidian.bjx.com.cn/html/20190318/969403.shtml>.