Overview of China's Energy Transition 2022

Chapter on Oil

BACKGROUND

Agora Energiewende

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Dear Reader,

We would like to present the next chapter of the Overview of China's Energy Transition. The purpose of this publication is to deliver facts and background information, rather than address specific policy challenges or delve into possible solutions. We present fundamental data that should be helpful to readers in gaining a better understanding of the Chinese energy system.

The current chapter introduces the basics of the Chinese oil industry, with a focus on supply, imports, consumption, market reform, and the continuing transformation of the sector. This overview will be followed by chapters dedicated to coal, electricity and carbon-dioxide emissions from fuel combustion, among other topics.

The Chinese energy system is undergoing dramatic shifts, with a top-down mandate to transform a carbon-intensive economy towards carbon peaking before 2030 and carbon neutrality before 2060. Despite rising energy security anxiety, China is expected to uphold both climate commitments, which were announced by President Xi Jinping in September 2020. As with the European Union, though a short-term setback to its clean energy transition may occur, China is nevertheless doubling down on efforts to transform its fossil fuel-driven economy towards a renewables-based flexible system.

China achieved the goal of self-provision of oil products in 1965, and oil accounted for about a fifth of the country's energy mix since 1970. Nevertheless, after Beijing lost its long-cherished status of energy self-reliance in 1993 when the country became a net oil importer again, China's dependency on oil imports kept rising and reached 72% in 2021. Oil imports have been the cornerstone of China's energy security strategy in the past few decades. Unsurprisingly, against the current backdrop of heightened geopolitical tensions, ensuring adequate oil supply has become a top government priority in China. Meanwhile, due to a largely successful electric-vehicle program, the peaking of China's oil consumption is almost in sight, even if tricky questions persist about how entirely to phase out fuel combustion of oil.

I hope you find this chapter useful for better understanding the Chinese oil industry and its future.

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Table of Contents

II | Oil

1 | Overview of the Oil Sector

Chinese oil demand has undergone unprecedented growth in the past two decades, making China an increasingly important player in the international oil markets.

At present, China is the world's second-largest oil consumer after the United States. Its oil demand has almost tripled in the past 20 years. China represents about a third of incremental global oil demand every year.

China accounts for about 5% of global oil production, ranking sixth worldwide. However, China's oil output has risen only very slightly in the past two decades: China's domestic production remained in the range of 190–200 million metric tons per annum (Mtpa). Most of the domestically produced oil in China comes from mature fields, which require capital-intensive investments to maintain output levels. As a result, the large gap between supply and demand on the domestic market is increasingly filled by imports as domestic production cannot keep pace with surging consumption.

China became a net oil importer in 1993. In 2017, as a result of both rapid gross domestic product growth that stimulated Chinese oil demand and the American shale revolution, China surpassed the United States to become the world's largest oil importer. As imports have grown, China's dependency on crude oil imports has increased to more than 70%. At the same time, the Chinese government and state-owned enterprises have taken numerous steps to diversify sources and routes of oil imports to ensure national energy security.

China is also the world's second-largest oil refiner after the United States with a growing refining capacity that could propel the country into the top position in the coming years.

China's economic slowdown, its net-zero pledge, the continuing COVID-19 pandemic, and the ongoing Russia-Ukraine War have complicated the development of the Chinese oil sector. The pandemic has not only slowed oil demand growth but also accelerated changes in the structure of consumption. The Omicron outbreaks in China in 2022 further dented oil demand as a result of widespread lockdowns and transport restrictions. Faced with rapid electrification and a shift away from fossil fuels in transport, oil demand in China has started to moderate.

The elephant in the room is oil's precise role in China's ongoing energy transformation in general and the country's oil demand trajectory in particular. Will China's oil demand peak before, around or after 2030? Questions abound about when oil consumption will peak in China and whether it will start to decline after the COVID-19 pandemic. The major driving forces would include, but not necessarily be limited to, fuel switching in the transport sector as evidenced by the growing number of electric vehicles as well as the feedstock needs of China's burgeoning chemical industry.

2 | Supply

2.1. How much oil does China produce?

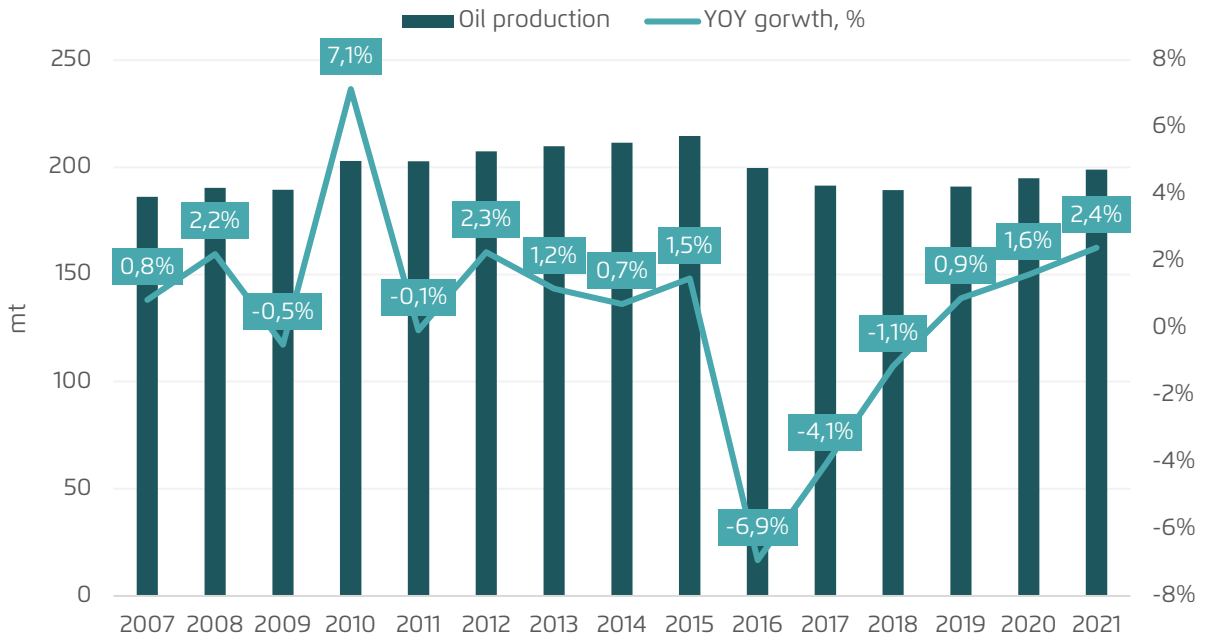
In 2021 China's domestic oil production was 199 million metric tons (Mt) and returned to the level of 2016. But the year-on-year (YOY) growth rate of 2021 was 2.4% compared with a decline of 6.9% in 2016.

Since peaking at 218 Mt in 2015, China's oil production has followed a "V-shape" trajectory with three consecutive years of decline and another three years of growth.

In general, China's annual oil production has been around 200 Mt over the past 15 years with average yearly growth of 0.5%. This is well below the growth in demand, leading to a surge in crude oil imports.

Along with being the world's sixth-biggest oil producer, China ranks second in national oil consumption.

Figure 1 | Annual oil production and oil production growth in China in 2007–2021



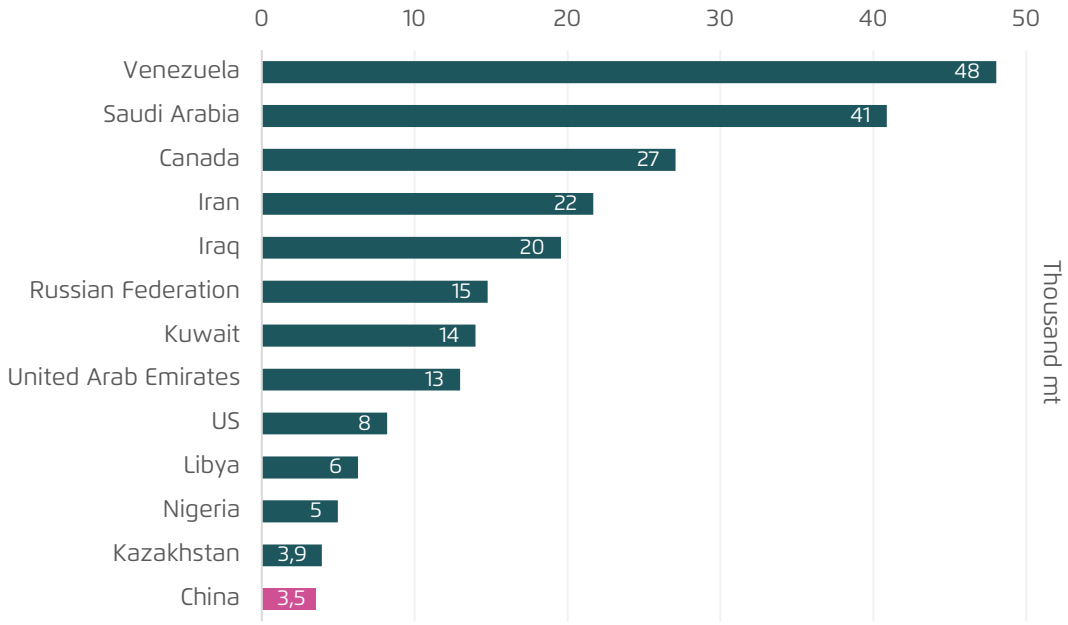
Source: National Bureau of Statistics of China (NBS)

2.2. How big are domestic oil reserves in China?

China holds only about 1% of global crude oil reserves and occupies the 13th place in the world in the amount of oil reserves.

China's proved oil reserves are estimated at 3.5 billion tons (bt).

Figure 2 | China's proven oil reserves in the international context in 2021

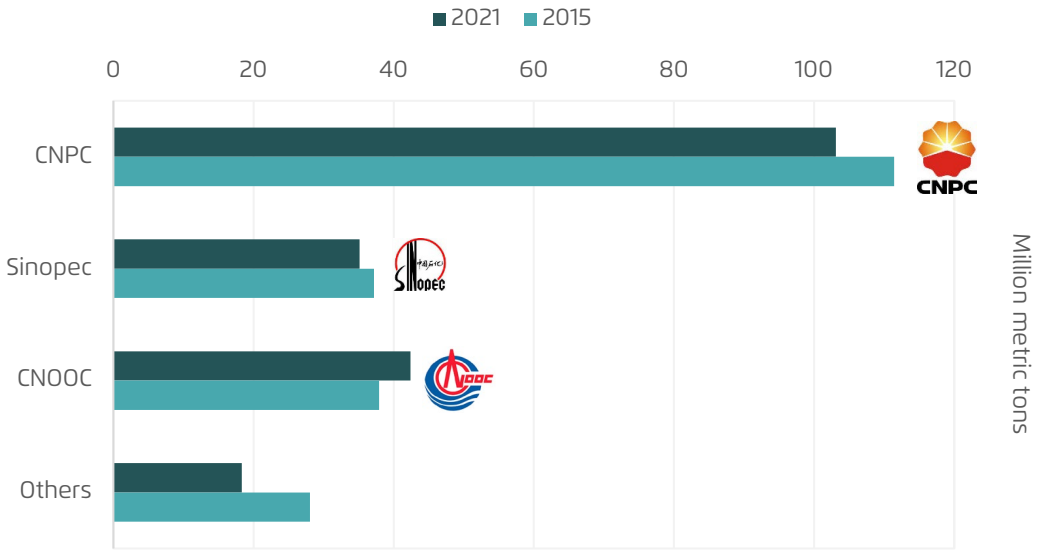


Sources: World Energy Council, BP Annual Statistical Review 2022

2.3. Which companies are the major oil producers in China?

China's crude oil production is concentrated in the hands of the 'three barrels of oil' – China National Petroleum Corporation (CNPC), China Petroleum & Chemical Corporation (Sinopec) and China National Offshore Oil Corporation (CNOOC). Together these companies account for about 86% of China's domestic crude oil production.

Figure 3 | Domestic crude oil production by companies in 2015 and 2021

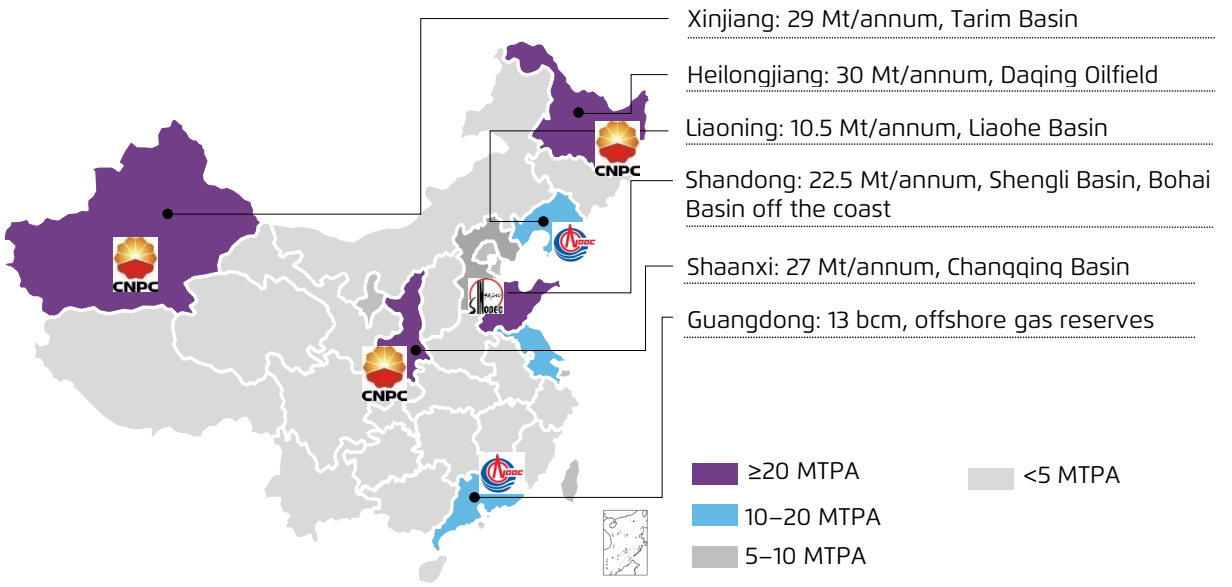


Sources: National Bureau of Statistics of China (NBS), corporate annual reports

2.4. What are the major oil-producing regions in China?

Four provinces or regions – Heilongjiang, Xinjiang, Shaanxi and Shandong accounted for about 55% of total crude oil production in China in 2021. Heilongjiang province is home to the Daqing oil field, China's first major one. Rich in both fossil-fuel and renewable-energy resources, Xinjiang autonomous region has most of its crude oil reserves in the Tarim, Junggar and Turpan-Hami basins. Shandong province has both onshore and offshore oil and gas reserves. Most national oil output comes from the Tarim basin in the west or Daqing oil fields in the northeast, far from major consumption centres in southern and eastern China.

Figure 4 | Crude oil production in China in 2021 by provinces



Source: China Energy Statistical Yearbook, 2022

3 | Imports

3.1 China's crude oil imports and import dependency

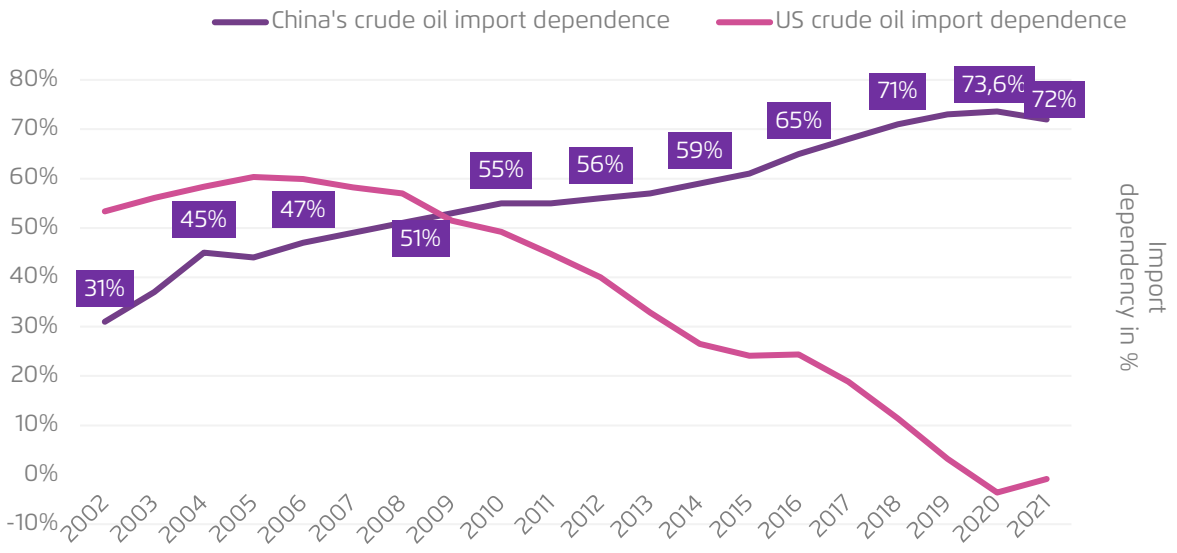
China became a net oil importer in 1993. By 2017, as a result of double-digit GDP growth, China had overtaken the United States as the largest oil importer in the world. High import levels were accompanied by growing oil import dependency. Consequently, China's import dependency grew from just 31% in 2002 to 74% in 2020 before decreasing slightly in 2021 to 72%.

China's oil import dependency rate contrasts sharply with a parallel drop in the United States, which had a 60% reliance on imported crude oil in the early 2000s and is now a net oil exporter.

Against the backdrop of stagnant domestic production in China, imports have satisfied most of the country's growing oil demand.

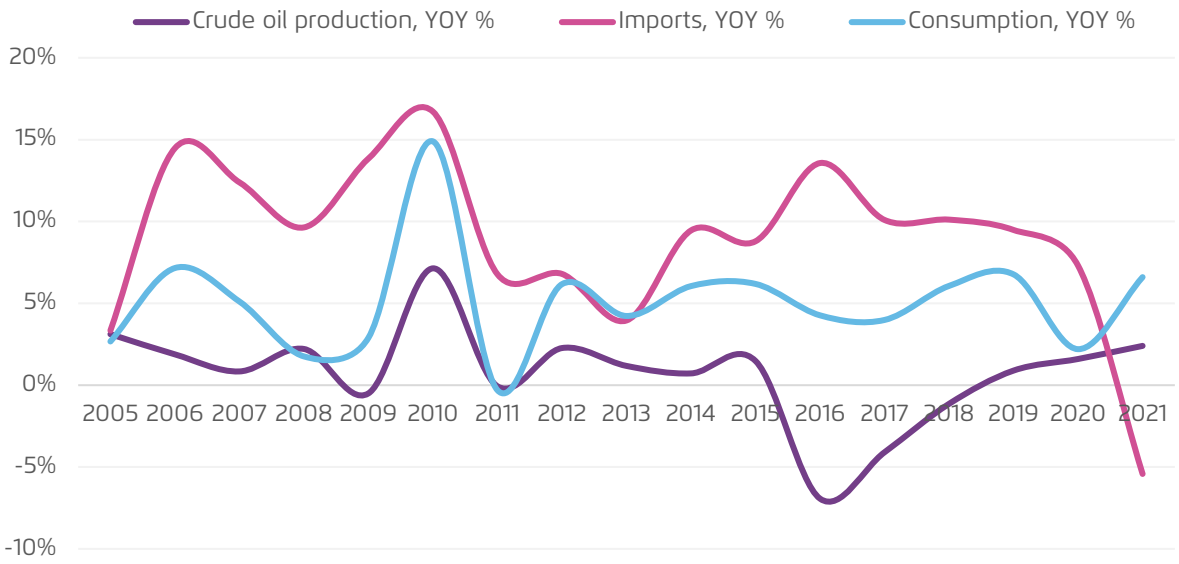
At present, China accounts for 19% of global oil imports, making Chinese demand an important factor in international oil markets.

Figure 5 | Comparison of China's and U.S. dependency rate on oil imports in 2002–2021



Sources: EIA, General Administration of Customs of China

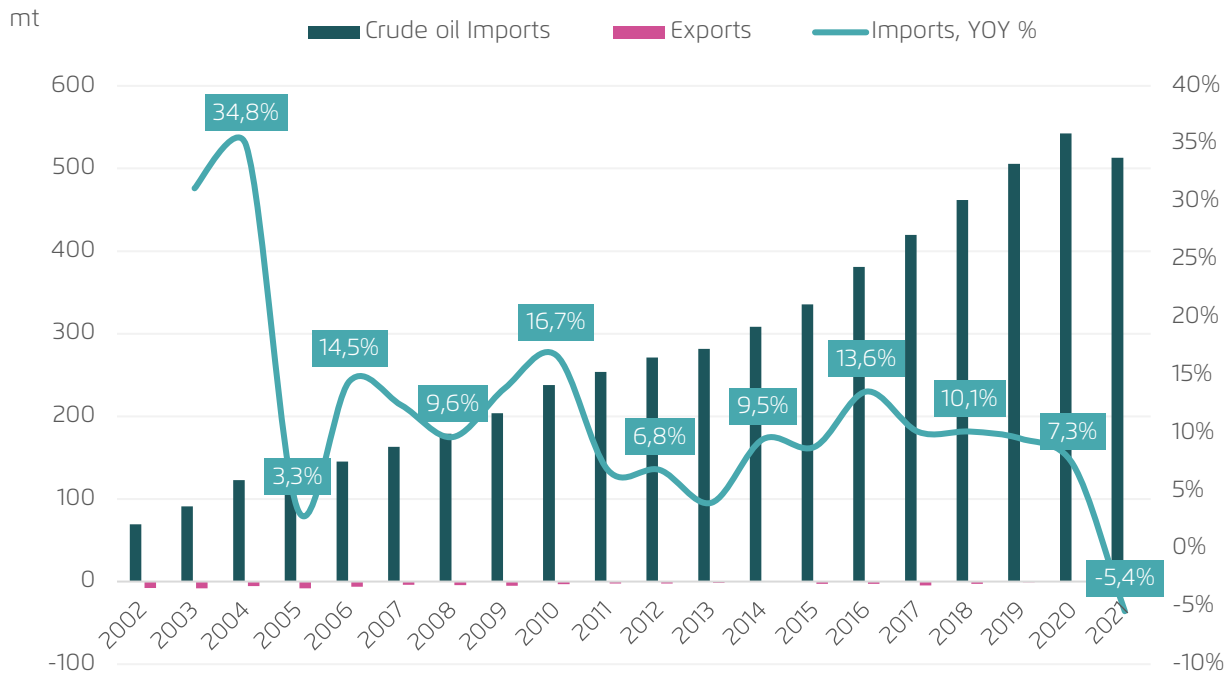
Figure 5 | Comparison of crude oil production, imports and consumption growth in China in 2012–2021



Sources: National Bureau of Statistics of China, NDRC

In 2021, China imported 513 Mt of crude oil, a 5.4% decline compared with 2020 and the first YOY drop in almost two decades. However, it was caused largely by high prices on international markets rather than by any sign of a long-term contraction of oil demand.

Figure 6 | China's pipeline crude oil imports in 2012–2021



Source: General Administration of Customs of China

In terms of energy security, China's heavy reliance on oil imports is compensated by relatively high import diversification: China imports crude oil from almost 50 countries, making foreign supplies relatively secure. OPEC countries represent major oil trading partners for China with Saudi Arabia, Iraq and Angola ranking as the top three among OPEC members. One-third of China's oil imports in 2021 came from two major suppliers: Saudi Arabia (17%) and Russia (16%), supplying ~88 Mtpa and ~80 Mtpa respectively. Other major foreign oil suppliers in 2021 included Iraq (11%), Oman (9%), Angola (8%), the United Arab Emirates (6%), Brazil (6%) and Kuwait (6%). Highly diversified geographical distribution ensures the security of oil supplies.

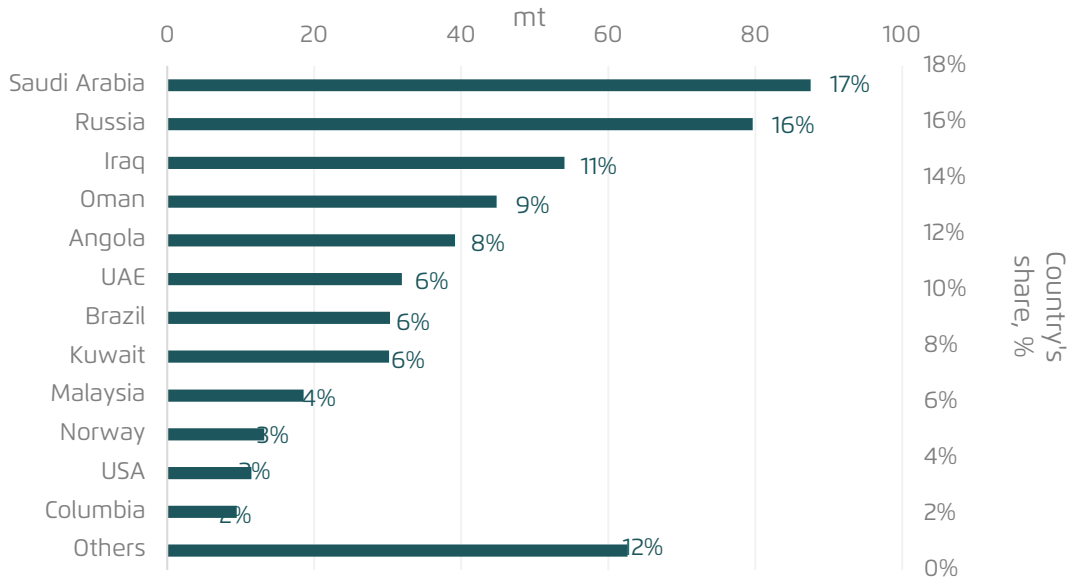
Russia supplies crude oil to China mainly via the Eastern Siberia – Pacific Ocean pipeline (ESPO) and by tankers from the Skovorodino port. In 2009, Rosneft and CNPC signed a 30-year sales and purchase contract to supply 35 Mt of crude oil per year via ESPO. The same year ESPO-1 (Taishet-Skovorodino) was commissioned, and oil supplies began. ESPO-2 was commissioned in 2012. In 2019 ESPO-1's capacity reached 80 Mtpa and ESPO-2's 50 Mtpa.

In 2011, the cross-border Skovorodino-Mohe connection was commissioned, allowing an increase in seaborne shipments of oil from the Russian Far East to China.

On February 4, 2022, CNPC and Rosneft signed an agreement to supply 10 Mtpa of oil to China via Kazakhstan for 10 years through the Atasy-Alashankou pipeline (basically extending an existing contract). The COVID-19 pandemic and the ongoing fossil-fuel crisis in 2022 led to changes in China's oil imports.

At the beginning of the pandemic, China's oil demand tumbled in the first half of 2020. However, China's economy recovered quickly, and oil consumption rebounded in the second half of 2020. Moreover, relatively low oil prices in 2020 (below 50 USD per barrel) as global demand fell allowed Chinese companies to store a portion of oil imports and replenish strategic petroleum reserves.

Figure 7 | China's crude oil imports in 2021 by country



Source: General Administration of Customs of China

All these factors explain why China's crude oil imports posted strong growth of 7.3% in 2020 despite the pandemic. The situation changed in the following year. Oil-price increases in 2021, as world demand for crude outpaced supply, were the major reason that China's imports, fell 5.4% that year.

The West's sanctions and restrictions on Russian oil exports in 2022 led to discounts on the Urals blend. As a result, Russia's supplies to China grew strongly, reaching 79.8 Mt in January-November 2022, though Saudi Arabia remained the top exporter to China, supplying 80.4 Mt over the same 11-month period.

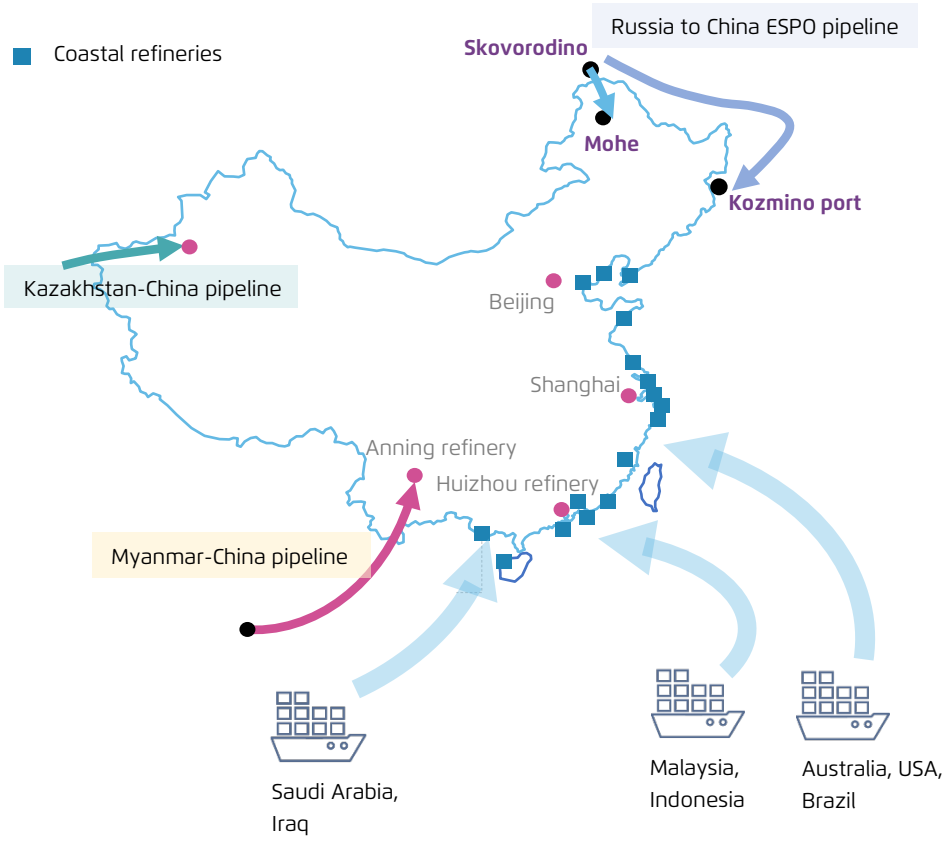
3.2 China oil imports infrastructure

In addition to the EPSO network from Russia, Chinese pipeline imports of crude oil occur via the Kazakhstan pipeline. A China-Myanmar pipeline launched in 2013 has a delivery capacity of 22 Mtpa but is largely underutilized.

Together, the three pipelines account for less than 10% of China's crude oil imports.

The majority of crude oil imported by China is transported by sea, with most of the tankers passing through the Indian Ocean and the narrow Malacca Strait. This explains the "Malacca Strait dilemma," a reference to China's anxiety about relying on such a strategic choke point for large quantities of seaborne oil deliveries.

Figure 8 | Map of overland and maritime crude supply routes to China



Source: General Administration of Customs of China

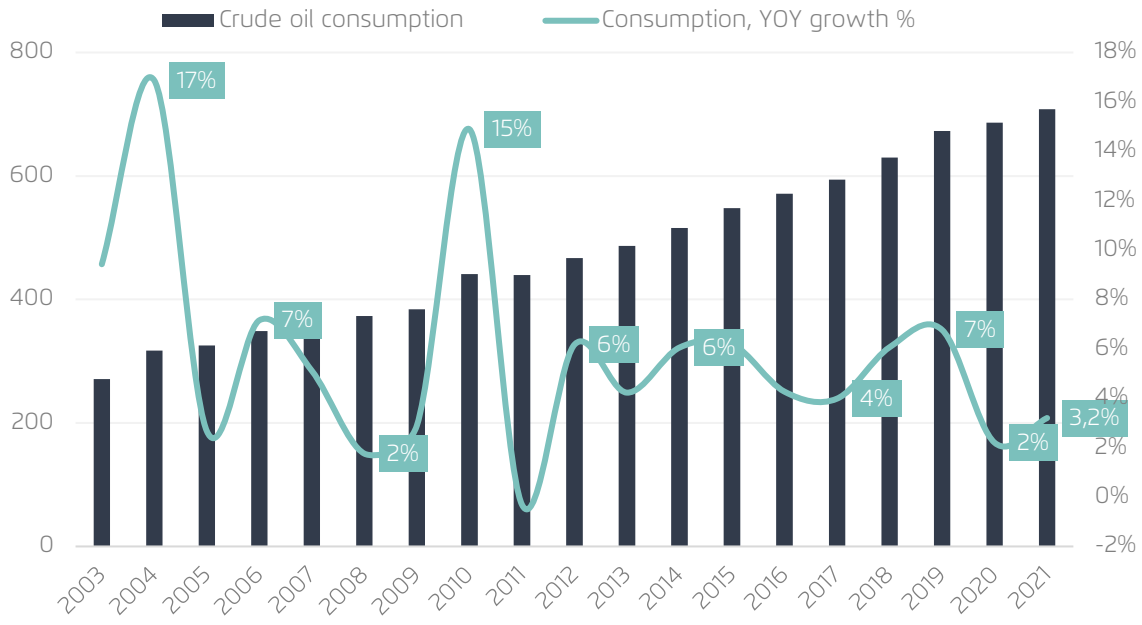
4 | Consumption

4.1 China is the 2nd-largest crude oil consumer in the world

China ranks second in the world in oil consumption, accounting for 13% of global demand in 2021. The country contributed to at least one-third of the world's incremental growth in oil consumption in the last decade.

In 2021, oil consumption in China increased 3.2% YOY to 718.5 Mt. Apart from the post-pandemic recovery in 2021, this moderate growth could be largely explained by the changes in the structure of oil demand across various industries.

Figure 9 | China's Apparent Oil Consumption, 2003–2021



Source: National Bureau of Statistics of China, NDRC, BP Annual statistical review 2022

Oil consumption is dominated by the transport industry with a share of approximately 60%; the petrochemical sector (industrial raw materials) accounts for about 15% of consumption. Oil demand has historically grown in China due to a surge in vehicle ownership and transportation needs, developing in parallel with the car market. However, oil demand has been hit recently by a booming electric-vehicles (NEVs) sector, higher fuel-efficiency standards and electrification. As a result, there is a gradual shift towards chemicals in China's oil use. Demand for petrochemicals is projected to increasingly support oil consumption beyond 2030.

4.2 Refining sector development in China

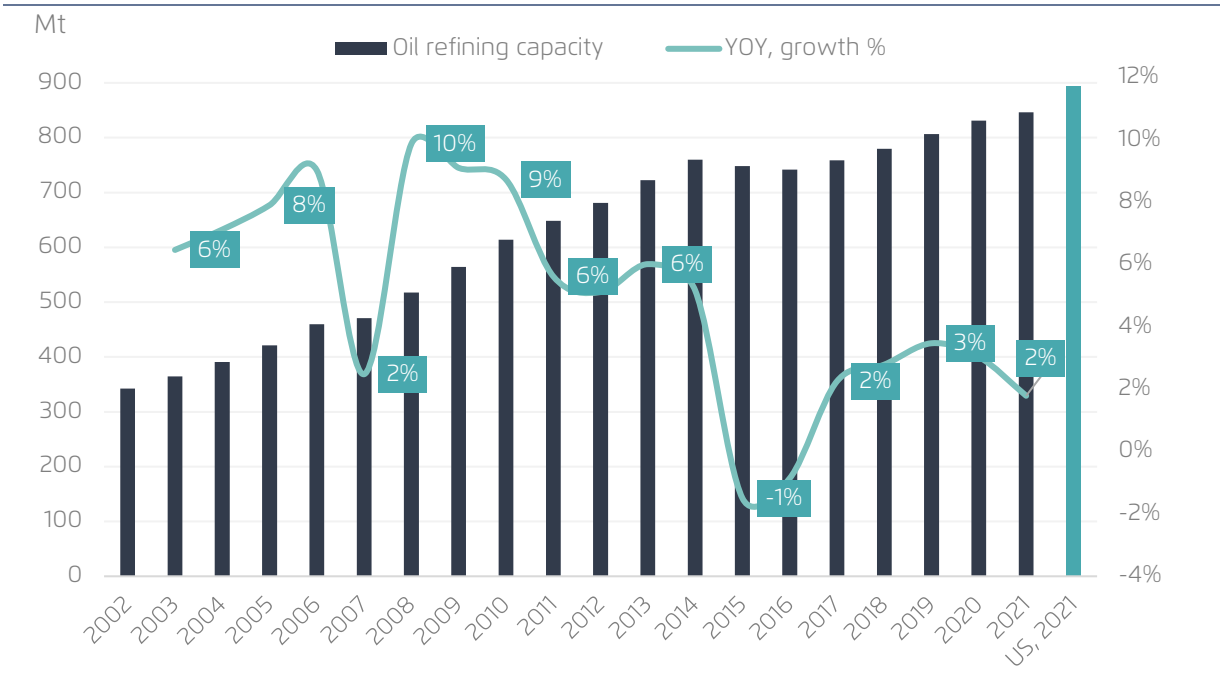
In the past two decades, China has gradually expanded its oil-refining capacity to meet domestic demand for refined petroleum products. In 2021, China accounted for more than 17% of global oil-refining capacity and has become the second largest in the world after the United States, which has a 17.6% share of global refining capacity. In 2019, China's oil-refining capacity exceeded 800 Mt. China is likely to overtake the United States in refining capacity in the near term, as American capacity is declining.

However, China has one of the world's lowest operating rates of refining capacity. That means further expansion will result in obsolete capacities.

Apart from big players, there is a large number of private refiners in China (or "teapots"), which are mainly clustered in the coastal Shandong province. In general, most of the refineries in China are located in coastal areas.

China's immense petroleum market is largely designed to serve domestic needs. Beijing strictly controls petroleum-product exports through quotas and other policy mechanisms that also apply to private companies. Consequently, the large expansion of the country's refining capacity has not resulted in a similar growth of oil-product exports.

Figure 10 | Refining oil capacity development in China, 2002–2021



Sources: BP Annual Statistical Review 2022, National Bureau of Statistics of China

Crude oil is used to produce ~80% of liquid fuels (gasoline, kerosene and diesel) in China. In the early 2000s, diesel oil was the major driver of oil-demand growth resulting from industrial expansion. In the 2010s, China's oil demand became primarily gasoline-driven due to an increase in car ownership and a slowdown in industrial activity. At the same time, it became more 'consumer-driven' and dependent on user behaviour and preferences (like a switch to NEVs), adding to volatility.

Consumption of most oil products fell in 2020 as a result of the pandemic, which led to travel restrictions and a sharp decrease in flights. The biggest contraction was in kerosene consumption (-14.6%) due to restrictions in the aviation industry. In 2021, demand for gasoline and aviation fuel both went up 5.7 % while consumption of diesel gained only 0.5%, resulting in overall moderate oil-products consumption growth of 3.2% to 341 Mt.

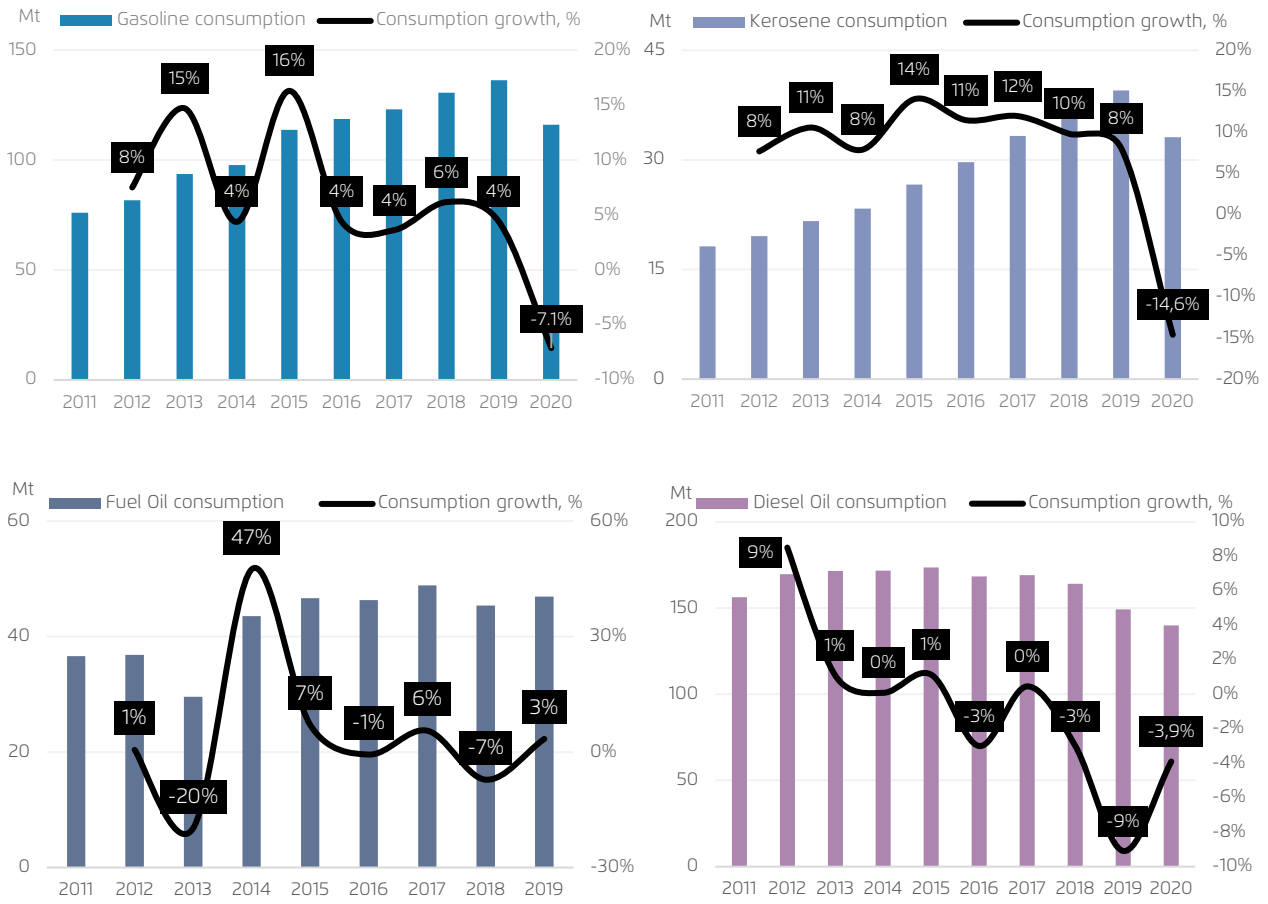
According to the CNPC Economics and Technology Research Institute (ETRI), diesel, gasoline and kerosene consumption is forecast to peak in around 2025 at about 390 Mt. Strong demand from the petrochemical sector will support oil consumption up to 2030. Afterwards, demand from transport is expected to decline while consumption in the petrochemical sector will likely expand.

The government is opening up the petroleum products industry to greater competition. In 2007, the Ministry of Commerce allowed foreign players to participate in wholesale and retail oil-product markets. Since then, their market share has increased and reached about 45% in 2020.

The government also applies various kinds of controls to keep prices for petroleum products stable, like price ceilings and floors, float ranges, etc. As a result, prices for petroleum products in China in general are cheaper than in developed countries. Retail fuel prices are assessed every 10 working days based on global crude-oil benchmarks.

In 2021, China's total apparent oil product consumption was estimated at 341 Mt with a YOY increase of 3.2%.

Figure 11 | Gasoline, kerosene, diesel oil and fuel oil consumption in 2011–2020



Source: National Bureau of Statistics of China

4.3 Will oil consumption in China continue to grow?

Demand in the transport sector remains the main driver of oil consumption in China. However, it has been growing at a slower pace due to:

- a slowdown in GDP growth in China
- fuel switching and electrification in the transport sector
- efficiency improvements and higher fuel standards
- competition from alternative fuels and natural gas-fueled vehicles

One of the biggest challenges faced by the oil market in China is the active development of electric vehicles and electrification in the transport sector. Combined with the latest government's emphasis on fuel efficiency and low-carbon policies, oil demand is expected to peak in the mid-2020s (according to various estimates) and then decline. CNPC ETRI expects China's oil consumption to keep growing for a decade on robust chemical demand, reaching a peak of about 780 Mt by 2030.

Another major Chinese player, Sinopec, projected that oil consumption will peak in 2026 at 790 Mt (16 million barrels per day).

According to the Natural Resources Defense Council (NRDC) report entitled 'Research on China's oil consumption peak and cap plan', China can 'leap over the age of oil' and - with certain policy - measures reach a peak in demand by 2025 at approximately 720 Mt.

5 | Conclusion

Since the beginning of the millennium, we have witnessed a dramatic ascendance of the Chinese oil sector as China became the second-largest consumer in the world after the United States and the biggest importer. The primary driver was increasingly strong fuel demand from the growing automotive fleet across the country. China has been responsible for almost a third of global oil demand in the past two decades. To satisfy such a consumption surge, Chinese enterprises - especially national oil companies - actively invested in crude oil production at home and abroad. However, domestic production and supply could not keep pace with demand growth and, as a result, imports soared, and the dependency rate exceeded 70% in 2018. Oil has become one of China's largest commodity imports, posing challenges not only to energy security but also to national security. This dependency is projected to grow further as domestic production stagnates.

In 2021, China produced 199 Mt of oil and imported 513 Mt. Oil consumption rebounded to 718.5 Mt the same year due to post-pandemic recovery. In the last decade, oil consumption in China has grown steadily at ~4% annually. No longer posting double-digit economic growth, oil demand is expected to moderate further.

China's refining sector has also demonstrated unprecedented growth in the past two decades with operable atmospheric crude oil distillation capacity exceeding 800 Mtpa. China is on track to overtake the United States in refining capacity in the near term. However, due to relatively low capacity utilization rates, further expansion might result in obsolete refining capacities across China.

The Chinese petroleum industry is highly concentrated with three major actors (known as the 'three barrels of oil') - CNPC, Sinopec and CNOOC.

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Therefore, China's energy transition in the oil sector will largely depend on its strategy and ability to shift away from oil- and gas-based business models. Because all three are national oil companies (NOCs), their strategic priorities and decarbonization pathways depend on the central government's policy signals and long-term goals. In light of China's newly established dual carbon goals, the companies need to accelerate their low-carbon transition and align with state objectives.

The structure of oil demand is undergoing major shifts. Transport remains the major consumer of crude oil and refined products, accounting for around 60% of demand in China. However, electrification and light-duty road transport vehicles will eventually lead to a decline in the share of oil in China's energy mix. As a result of the decarbonization of road transport, oil demand in China is projected to peak in the mid-2020s. According to the NRDC report, China can 'leap over the age of oil' and with certain policy measures reach a peak in oil consumption by 2025 at approximately 720 Mt.

Chemical demand and the development of the petrochemical industry might support oil consumption beyond 2030. According to the Sinopec research institute, oil consumption will peak at 790 Mt in 2026, while CNPC's ETRI projects a peak of 780 Mt by 2030.

Peaking oil consumption earlier would accelerate China's energy transition and ensure that the country reaches its 2030 and 2060 climate targets. Decisive policies that encourage fuel switching and the use of NEVs could accelerate the 'decline of oil', thereby also reducing the country's reliance on oil imports and easing Beijing's rising energy-security concerns in a world disrupted by multiple crises.

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About Agora Energiewende

Agora Energiewende develops scientifically sound, politically feasible ways to ensure the success of the energy transition – in Germany, Europe and the rest of the world. The organization works independently of economic and partisan interests. Its only commitment is to climate action.

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