

GREEN GIANTS? CHINA'S NATIONAL OIL COMPANIES PREPARE FOR THE ENERGY TRANSITION

**BY DR. ERICA DOWNS
SEPTEMBER 2021**

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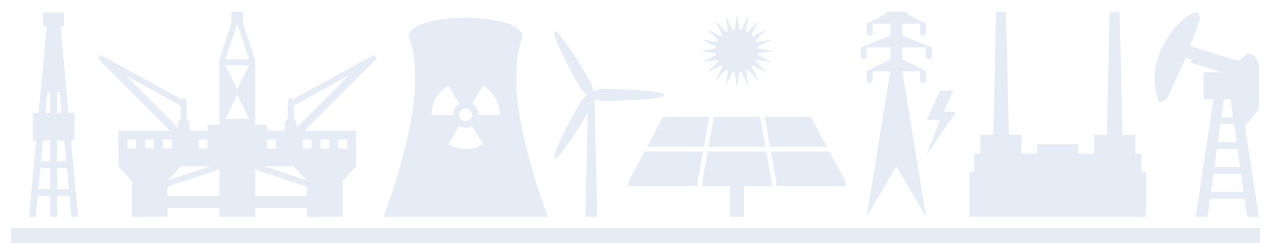
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EXECUTIVE SUMMARY

On September 22, 2020, China's leader, Xi Jinping, made a surprise announcement about China's climate ambitions during remarks to the United Nations General Assembly. He stated that China, the world's largest emitter of greenhouse gases (GHGs), aims to achieve carbon neutrality before 2060. Xi also said that China's GHG emissions would peak before 2030, a slight revision to China's pledge under the Paris Climate Agreement to peak emissions around 2030.

China's new climate targets spurred the country's three major national oil companies (NOCs)—China National Petroleum Corporation (CNPC), China Petrochemical Corporation (Sinopec Group), and China National Offshore Oil Corporation (CNOOC)—to strengthen their climate ambitions. PetroChina (the flagship subsidiary of CNPC), which had already set a goal of achieving near-zero emissions by 2050, intends to peak its carbon emissions by 2025. Sinopec Corp. (the flagship subsidiary of Sinopec Group) also aims to peak its carbon emissions by 2025 and to achieve carbon neutrality by 2050. CNOOC Ltd. (the flagship subsidiary of CNOOC) plans to reduce its GHG emissions by 16 percent between 2020 and 2025 and aims to peak its carbon emissions before 2030 and achieve carbon neutrality before 2060.

This report, part of the China Energy and Climate Program at Columbia University's Center on Global Energy Policy, provides a baseline for understanding how China's NOCs are responding to climate change. It examines the activities the three companies identified as part of their emerging energy transition strategies before Xi unveiled the carbon peaking and carbon neutrality targets, and why they didn't do more. The report then assesses the implications of China's new climate ambitions for its NOCs and lays out their preparations to date for supporting Xi's 2030 and 2060 pledges.

The main findings include the following:

- China's NOCs are balancing support for Beijing's decarbonization agenda with its energy security agenda. Ensuring oil and natural gas supplies for China, which imports more than 70 percent of its crude oil and more than 40 percent of its natural gas, is job number one for the NOCs. However, the companies must also demonstrate that they are developing credible plans to support China's carbon peaking and carbon neutrality goals.
- China's NOCs are shifting from "oil and gas" to "gas and oil" companies. Beijing's new climate targets are reinforcing a shift that was already underway in the companies' domestic production mixes from oil to natural gas. This change is driven by geology (production at China's largest and oldest oil fields is in decline) and policy (Beijing's push to increase natural gas use to improve air quality). China's new climate goals provide its NOCs with another reason to increase natural gas exploration and production. Natural gas can reduce China's GHG emissions if it substitutes for coal and methane emissions are managed.



- China's NOCs are looking beyond oil and natural gas. Although these fossil fuels will remain the NOCs' core business for at least the next decade, the companies recognize that they may have to expand the scope of their operations to adapt to a decarbonizing world. The NOCs are investing in low-carbon energy and technologies where they have comparative advantages:
 - CNOOC Ltd. is capitalizing on its decades of experience with offshore engineering to invest in China's fast-growing offshore wind industry.
 - Sinopec Group seeks to leverage its network of more than 30,000 retail stations to become a leading supplier of hydrogen fuel across China.
 - CNPC's plans are less clear, but the company signaled its intent to increase its participation in the energy transition when it merged its oil and natural gas and new energy divisions in April 2021.

While preparations specific to China's new peaking and neutrality goals are still in the early stages and China's NOCs are unlikely to reinvent themselves anytime soon, the NOCs are aware that they will need to continue to flesh out their plans for a smooth energy transition to show support for China's climate ambitions.



INTRODUCTION

China's leader Xi Jinping unexpectedly announced new climate change goals to the United Nations General Assembly on September 22, 2020.¹ He stated that China, the world's largest emitter of greenhouse gases, aims to achieve carbon neutrality before 2060. Xi also said that China's emissions would peak before 2030, a slight revision to the country's pledge under the Paris Climate Agreement to peak emissions around 2030. These two objectives are often referred to as the "30-60" targets in China.

But even before Xi announced the 30-60 goals, China's three major national oil companies (NOCs)—China National Petroleum Corporation (CNPC), China Petrochemical Corporation (Sinopec Group) and China National Offshore Oil Corporation (CNOOC)—had already begun to sketch out responses to climate change. Some of the activities in the three NOCs' emerging energy transition strategies, such as improving energy efficiency and reducing air pollution, initially had been undertaken to advance two other high priorities of China's leaders: slowing energy demand growth and improving air quality. The NOCs undertook other activities in response to pressure from foreign investors and regulators and exposure to the carbon management practices of multinational corporations. These activities include CNOOC's investment in renewable energy in the 2000s; development of an emissions trading team by CNPC's flagship subsidiary, PetroChina, in 2010; and Sinopec's efforts to improve its climate governance in the 2010s.

The three NOCs had also set greenhouse gas emission reduction targets of varying ambition on the eve of Xi's unveiling of the 30-60 goals. In August 2020, PetroChina, China's largest oil and natural gas producer, announced during its midyear earnings call that it was targeting near-zero emissions by 2050.² In 2019, Sinopec Corp. (a subsidiary of Sinopec Group) and CNOOC Ltd. (a subsidiary of CNOOC), set shorter-term goals. Sinopec Corp. is aiming to reduce its GHG emissions by 12.6 million tons of carbon dioxide (CO₂) equivalent (7.3 percent) between 2018 and 2023.³ CNOOC Ltd. set out to reduce its GHG emissions by 3.2 million tons of CO₂ equivalent between 2015 and 2020.⁴

Xi's announcement of the 30-60 targets has prompted the NOCs to announce additional carbon peaking and carbon neutrality goals. In March 2021, PetroChina and Sinopec Corp. both said they aim to peak their carbon emissions by 2025.⁵ Sinopec Corp. also disclosed that it intends to achieve carbon neutrality by 2050, making it one of a handful of central state-owned enterprises to have a midcentury emissions reduction target as of this writing.⁶

CNOOC Ltd. has set shorter- and longer-term goals to help China meet the 30-60 targets. The company plans to reduce its GHG emissions by 16 percent (1.5 million tons) between 2020 and 2025.⁷ CNOOC Ltd. also aims to peak its carbon emissions before 2030 and achieve carbon neutrality before 2060.⁸ In August 2021, the company's chairman, Wang Dongjin, told reporters, "We have set up a team to study and formulate our plans to implement carbon reduction targets for 2030 and 2060."⁹

China's NOCs have engaged in a flurry of activity to demonstrate support for the 30-60 targets.



All three companies are implementing, to various degrees, many of the same measures that leading international and national oil companies are pursuing to decarbonize their operations and provide their customers with lower-carbon alternatives. Sinopec, already China's largest hydrogen producer, seeks to shift away from producing hydrogen from fossil fuels toward producing hydrogen from renewable energy sources.¹⁰ CNOOC, which has decades of offshore engineering experience, has identified offshore wind as the renewable source of energy that is most compatible with the company's business. CNPC, which plans to increase its investment in renewables and hydrogen, is restructuring its corporate headquarters to reflect the higher priority it attaches to preparing for the energy transition.

That said, securing the oil and natural gas supply of China, the world's largest importer of oil and natural gas, remains job number one for the NOCs. China imported 73 percent of its oil and 43 percent of its natural gas in 2020.¹¹ These projections probably underpin the importance attached to oil and natural gas supply security in China's 14th Five-Year Plan for the period 2021–2025.¹² Indeed, CNPC, China's largest producer of oil and natural gas, projected in April 2021 that by 2025, China's oil import dependence will range from 70 to 75 percent and its natural gas import dependence will range from 34 to 66 percent.¹³

The elevation of responding to climate change on Xi's policy agenda means that China's NOCs almost certainly will have to balance their efforts to support the 30-60 goals not only with their energy security responsibilities but also with other obligations, such as maintaining large workforces, for at least the next decade. The three NOCs have indicated that this balancing act will initially involve increasing the role of natural gas in their production mixes, which can have energy security, employment, and some climate benefits if natural gas substitutes for coal and methane emissions are controlled. China's NOCs view natural gas as playing an important role in China's energy transition in the 2020s because renewable sources of energy alone cannot meet the country's energy demand during this period. In the meantime, the three NOCs intend to increase investments in renewables and clean energy technologies to demonstrate that they are doing their part to advance the 30-60 goals and to experiment with ways to repurpose existing assets, such as large service station networks and acreage with good solar and wind resources, to adapt to a lower-carbon future.

The energy transition activities of China's NOCs are worth paying attention to for several reasons:

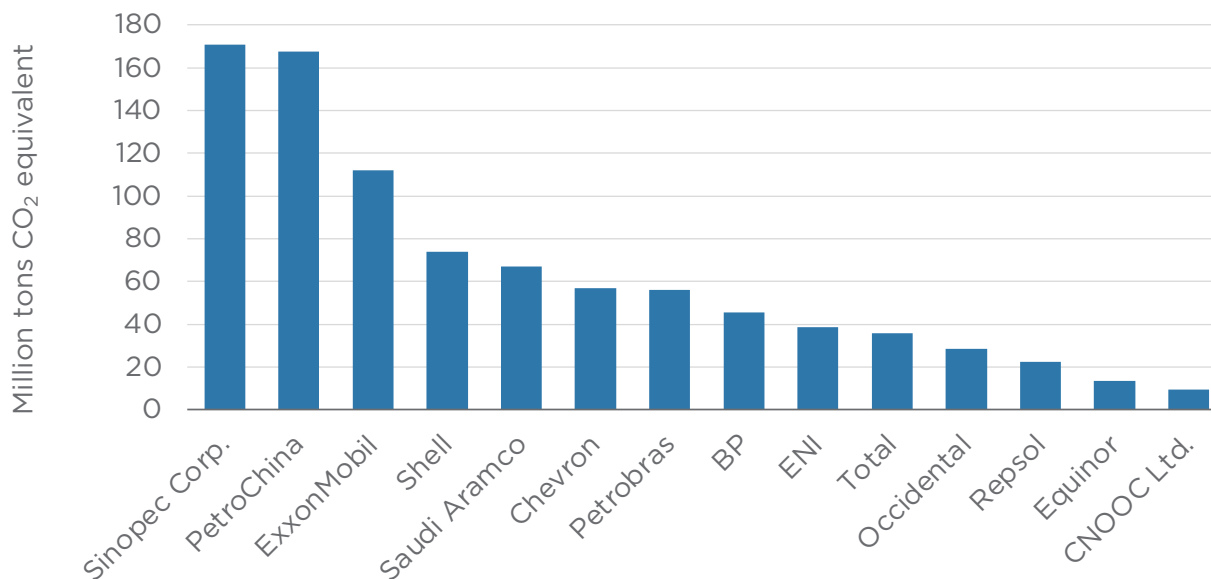
- China's NOCs can help decarbonize the global oil and natural gas industry by decarbonizing their own operations. PetroChina and Sinopec Corp. are two of the largest emitters of greenhouse gasses among publicly traded oil and gas companies (see Figure 1).
- China's NOCs have a role to play in helping China decarbonize. Indeed, Beijing has already called on all companies owned by the central government to actively support the country's carbon peaking and carbon neutrality goals.¹⁴
- A deep dive into the energy transition activities of China's NOCs provides a window into how central state-owned enterprises in one of China's high-emitting industries are responding to the 30-60 goals.



- Climate commitments affect the cost structures of oil companies. Whether and to what extent China's NOCs are making ambitious climate commitments on par with European oil companies has implications for how the companies would fare in head-to-head competition for assets.¹⁵
- The decarbonization agendas of China's NOCs will likely influence their appetites for acquiring additional exploration and production assets overseas and the development of new cross-border pipelines.
- China's NOCs are an avenue for engaging with China on climate change.

This report provides a baseline for understanding how China's NOCs are responding to climate change by offering a comprehensive analysis of what the companies are doing to prepare for the energy transition. Part one introduces China's NOCs. Part two discusses activities the three NOCs had identified as part of their climate agendas before Xi announced the 30-60 goals. Part three explains why China's NOCs engaged in these activities, while part four examines the factors that prevented them from more proactively responding to climate change prior to the announcement of the 30-60 targets. Part five discusses the implications of China's 30-60 goals for the NOCs with a focus on the 2020s.

Figure 1: Combined Scope 1 and Scope 2 emissions of select oil companies in 2020



Note: The data in this figure is from numbers provided by the companies for their GHG emissions from operated assets except for ExxonMobil, which calculates its GHG emissions on a net equity basis, and PetroChina and CNOOC Ltd., which do not indicate whether their GHG emissions are calculated on an operational control or equity share basis. The Scope 2 numbers for Equinor and Shell used in this figure were calculated by the company using the location-based method. Emissions data for Occidental Petroleum is for 2019.

Source: See appendix.



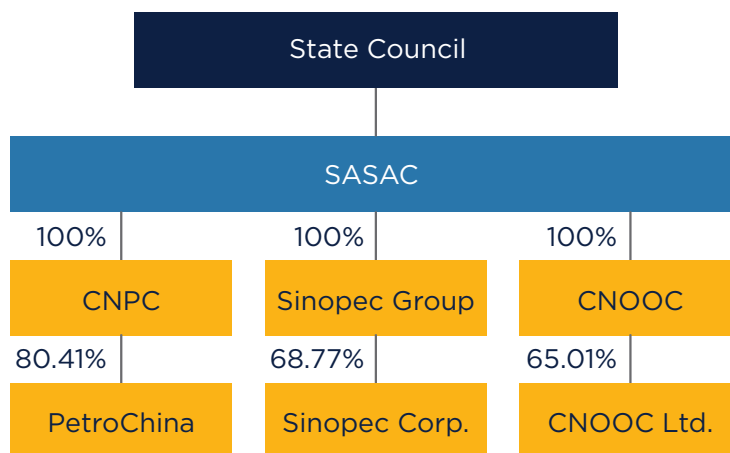
CHINA'S NATIONAL OIL COMPANIES

China's three major national oil companies, CNPC, Sinopec Group, and CNOOC, have flagship subsidiaries: PetroChina, Sinopec Corp., and CNOOC Ltd., respectively. The flagship subsidiaries own most of the upstream and downstream assets of their parent companies. Exceptions include the ownership of certain domestic upstream assets by CNPC, some overseas upstream assets by CNPC and Sinopec Group, and domestic refineries by CNOOC. The flagship subsidiaries also publish more information about their emissions profiles than their parent companies. There are several facts about Beijing's ownership and control of the three NOCs and the companies' operations that are useful to understanding their climate activities.

First, China's NOCs are owned by the Chinese government, and their top executives are appointed by the Communist Party of China, which makes the companies responsive to Beijing's policy priorities to include energy and climate goals. PetroChina, Sinopec Corp. and CNOOC Ltd. are majority owned by their respective parent companies, which are wholly owned by China's central government (see Figure 2).

The parent companies rank among the 97 central state-owned enterprises (SOEs) under the administration of the State-owned Assets Supervision and Administration Commission (SASAC), which reports directly to China's cabinet, the State Council.¹⁶

Figure 2: Ownership of China's NOCs



Note: This diagram reflects PetroChina's ownership on December 31, 2020; Sinopec Corp.'s ownership on April 15, 2021; and CNOOC Ltd.'s ownership as of March 31, 2021.

Source: See appendix.



CNPC, Sinopec Group, and CNOOC belong to the group of 50 “core” central SOEs regarded as important to China’s economic development and national security.¹⁷ The top executives of the NOCs and other “core” central SOEs generally hold vice-ministerial rank and are appointed, removed, and promoted by the Central Organization Department (COD) of the Communist Party of China (CPC).¹⁸ The COD is the human resources arm. It oversees the appointment of leadership positions throughout China, including at government ministries, SOEs, universities, think tanks, and media outlets.¹⁹ Consequently, the extent to which the heads of China’s NOCs advance the economic and political interests of the party plays a role in determining their career prospects.

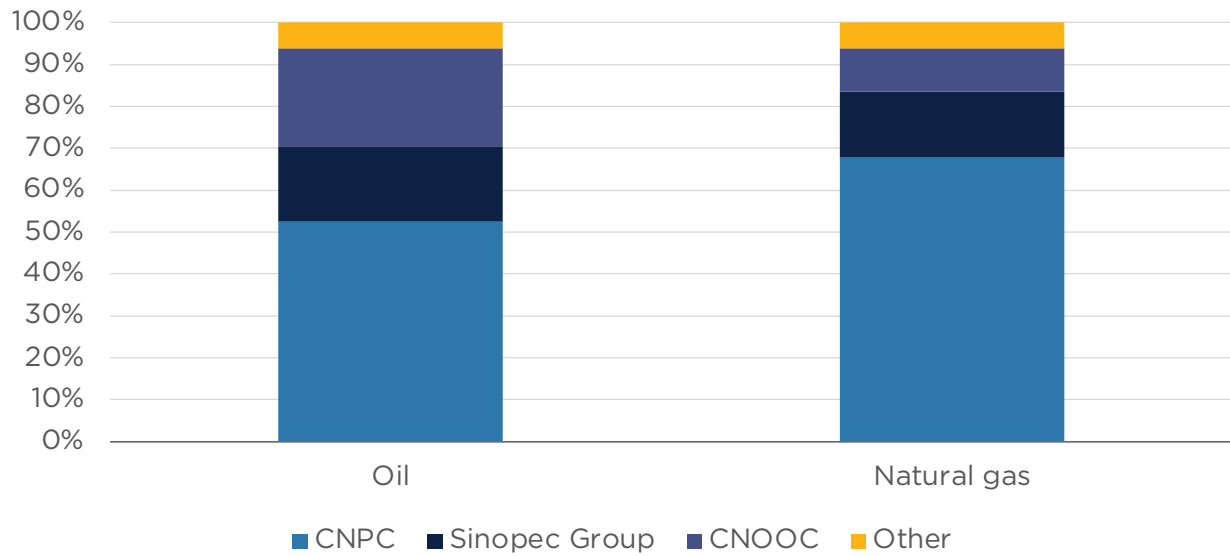
The authority of the COD to appoint top executives extends, indirectly, to PetroChina, Sinopec Corp., and CNOOC Ltd. The individuals selected as chairmen and general managers of the parent companies often serve as the chairmen of the board of their flagship subsidiaries. For example, the current chairmen of CNPC and CNOOC are also the chairmen of PetroChina and CNOOC Ltd., respectively.²⁰ Zhang Yuzhuo also concurrently served as chairman of Sinopec Group and Sinopec Corp. prior to his promotion to party secretary of the China Association of Science and Technology, an organization that serves as a bridge between the CPC and China’s science and technology community, in August 2021.²¹

Second, PetroChina, Sinopec Corp., and CNOOC Ltd. are publicly traded companies listed on stock exchanges, including those in Shanghai, Hong Kong, and New York, which provide actors other than China’s party-state with an avenue to influence the NOCs’ responses to climate change.²² The NOCs engage with their shareholder or shareholder representatives, including institutional investors, on climate change. For example, EOS at Federated Hermes has engaged with PetroChina and Sinopec Corp. to help ensure their corporate strategies are aligned with the Paris Agreement goal of limiting climate change to well below 2°C, and ideally to 1.5°C, an issue that will be discussed later in this report.²³

Third, China’s NOCs dominate the Chinese oil industry, which makes them key actors in China’s efforts to achieve carbon neutrality by 2060. CNPC, Sinopec Group, and CNOOC accounted for more than 90 percent of China’s oil production of 3.9 million barrels per day (bpd) and more than 90 percent of its natural gas production of 192.5 billion cubic meters (bcm) in 2020 (see Figure 3). In addition, the three NOCs operate about 60 percent of China’s refining capacity (see Figure 4).²⁴

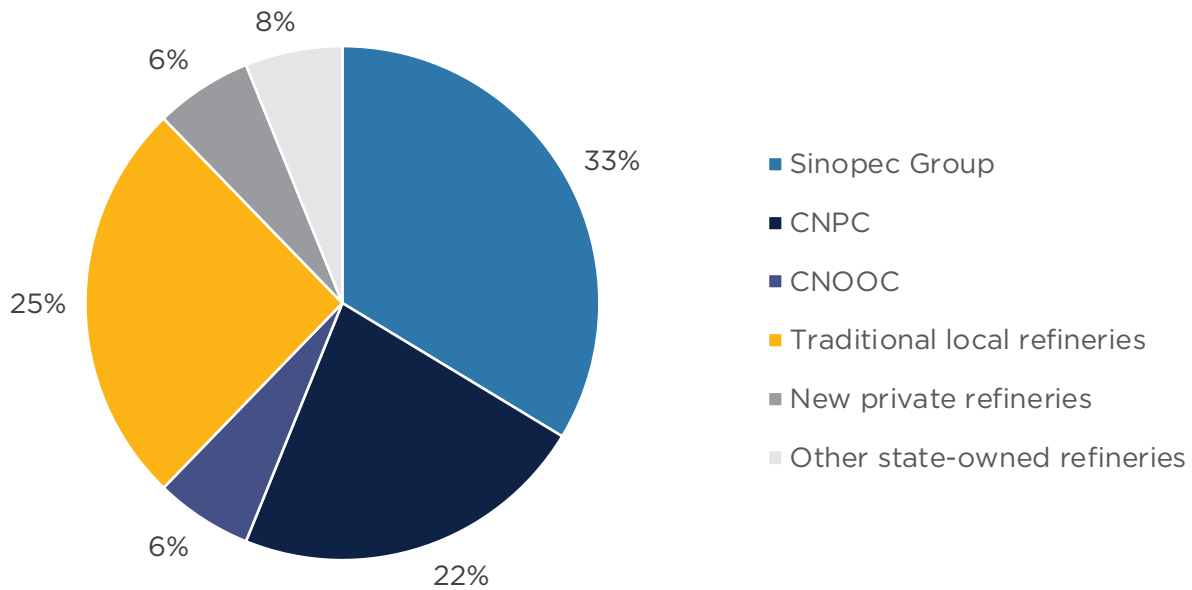


Figure 3: China's oil and natural gas production in 2020



Source: See appendix.

Figure 4: China's refining capacity in 2019

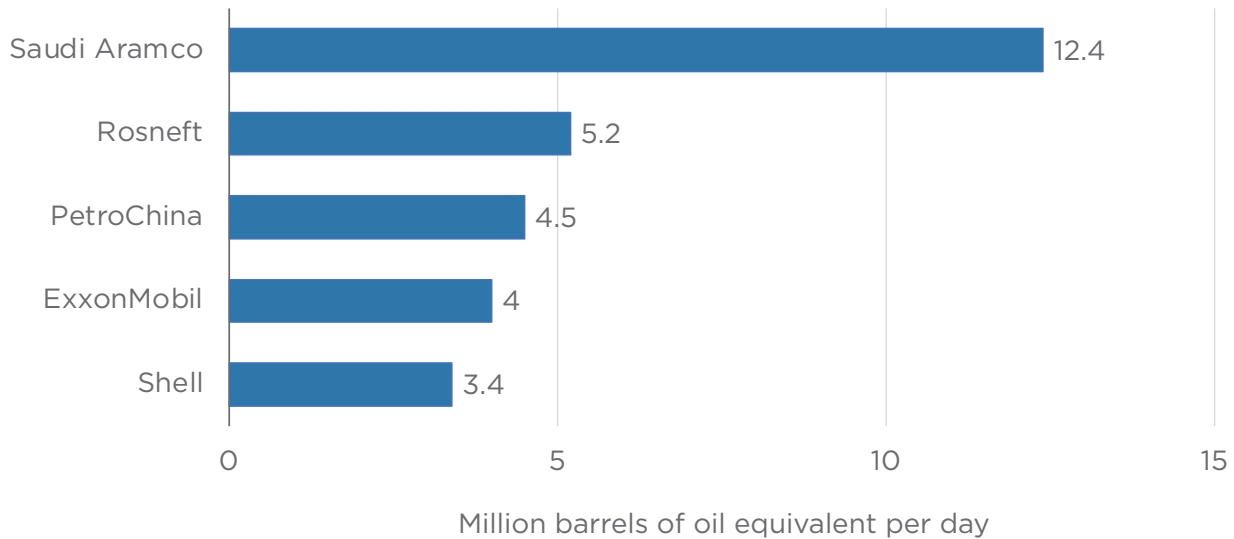


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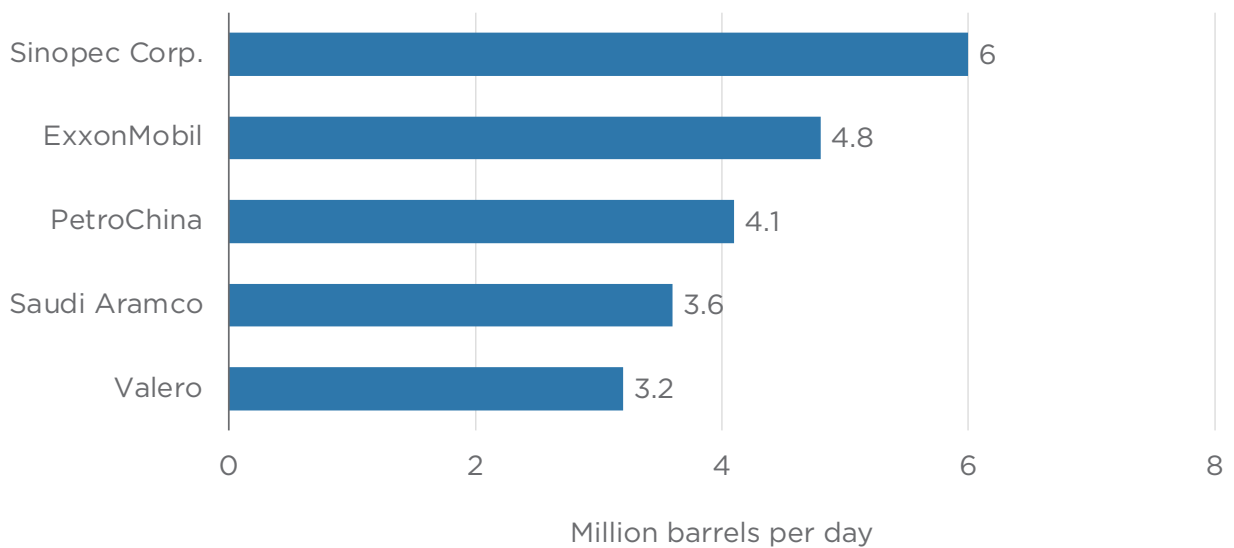
Fourth, PetroChina and Sinopec are major players in the world's oil and natural gas industry, which gives them a role to play in its decarbonization. PetroChina is the world's third-largest publicly traded oil and gas producer and its third-largest publicly traded refining company by capacity (see Figures 5 and 6). Sinopec is the world's largest refiner by capacity.

Figure 5: World's largest publicly traded oil and gas producers in 2020



Source: See appendix.

Figure 6: World's largest publicly traded refining companies by capacity in 2020



Source: See appendix.



Fifth, China's NOCs operate assets around the world, which subjects them to foreign regulatory requirements including those of Canada, the European Union, the United Kingdom and the United States. CNPC is China's largest overseas oil and natural gas producer (see Table 1). In 2020, the company produced 1.6 million bpd of oil and 29.8 bcm of natural gas abroad, including PetroChina's overseas output of 465,000 bpd of oil and 4.4 bcm of natural gas.

Table 1: Overseas oil and natural gas production of China's NOCs in 2020

Company	Oil production (bpd)	Gas production (bcm)
CNPC	1,591,715	29.75
<i>of which: PetroChina</i>	464,657	6.4
Sinopec	678,660	10.2
<i>of which: Sinopec Corp.</i>	95,315	0
CNOOC	640,019	10.5
<i>of which: CNOOC Ltd.</i>	341,560	4.4

Source: See appendix.



ENERGY TRANSITION ACTIVITIES OF CHINA'S NOCS BEFORE THE 30-60 TARGETS

China's NOCs had already begun to identify elements of their responses to climate change before Xi announced China's ambition to achieve carbon neutrality before 2060. Their energy transition activities are similar to those undertaken by two other leading national oil companies, Equinor and Saudi Aramco (more on their efforts in a text box toward the end of this section). The three NOCs' climate actions are discussed thematically below with differences between the companies highlighted.

Managing Greenhouse Gas Emissions

China's NOCs publicly report greenhouse gas (GHG) emissions. CNOOC Ltd. began reporting its Scope 1 and Scope 2 emissions in 2016, followed by Sinopec in 2017 and PetroChina in 2019 (see Table 2). PetroChina began disclosing this information later than its domestic peers in part due to the large number of assets to be metered and the large number of employees to be trained in gathering and reporting data.²⁵ Indeed, PetroChina stated in 2018 that it had been working on improving its system for GHG emission accounting and reporting and collecting data from all of its units.²⁶

Table 2: Greenhouse gas emissions of China's NOCs

		Million tons of CO ₂ equivalent				
		2016	2017	2018	2019	2020
CNOOC Ltd.	Scope 1	6.735	7.736	7.345	8.597	9.123
	Scope 2	0.36	0.093	0.135	0.186	0.222
	Scope 1+2	7.095	7.829	7.48	8.783	9.345
PetroChina	Scope 1				132.17	127.57
	Scope 2				41.91	39.87
	Scope 1+2				174.08	167.44
Sinopec Corp.	Scope 1		123.05	128.57	125.68	128.58
	Scope 2		39.61	42.95	45.01	42.36
	Scope 1+2		162.66	171.52	170.69	170.94

Source: See appendix.



Categorizing Greenhouse Gas Emissions

GHG Protocol, which provides the world's most widely accepted GHG accounting standards, categorizes a company's GHG emissions into three "scopes":²⁷

Scope 1 emissions are direct GHG emissions from sources owned or controlled by a company, such as emissions from a refinery or an oil truck.

Scope 2 emissions are indirect GHG emissions from the generation of energy purchased by a company, such as electricity bought to power its operations.

Scope 3 emissions are all other indirect emissions that result from a company's value chain, such as the combustion of diesel or gasoline by a consumer.

As noted in the introduction, PetroChina and Sinopec Corp. rank among the highest GHG emitters on a gross basis when compared to other leading publicly traded oil companies. The two companies' high GHG emissions are partly due to their large upstream and downstream operations.²⁸ In 2020, 84 percent of Sinopec Corp.'s emissions came from refining and chemicals.²⁹ (PetroChina does not provide a similar breakdown of GHG emissions by business line.) In contrast, CNOOC Ltd. ranks among the world's lowest emitters in terms of both emissions per barrel of oil equivalent produced and gross emissions, in part because it does not operate any refineries.³⁰

China's NOCs do not report scope 3 emissions, which occur during the combustion of their oil and natural gas products by end users. Scope 3 emissions account for the majority of the GHG emissions associated with the oil and natural gas industry. For example, Shell reported in 2017 that scope 3 emissions accounted for 77 percent of its total emissions.³¹

As noted in the introduction, the three NOCs had set emissions reduction targets before Xi announced the 30-60 goals. PetroChina's objective of achieving near-zero emissions by 2050 is probably the most ambitious. Meanwhile, Sinopec Corp. aims to reduce its GHG emissions by 12.6 million tons of CO₂ equivalent between 2018 and 2023. CNOOC Ltd. set out to reduce its GHG emissions by 3.2 million tons of CO₂ equivalent between 2015 and 2020.

Improving Energy Efficiency

China's NOCs identify improving energy efficiency as a component of their climate strategies. However, the data on energy conservation released by China's NOCs suggests that China's mature oil fields are complicating their efforts to improve energy efficiency; the amount of energy the companies consumed for every unit of oil equivalent produced has increased or remained relatively flat in recent years.

PetroChina and CNOOC Ltd. have published data on energy consumption per unit of oil and natural gas produced since 2015 and 2016, respectively (see Table 3). The amount of energy CNOOC Ltd. has used per each ton of oil and natural gas increased by 17 percent from 2016 to 2019. In contrast, PetroChina's energy consumption per unit of oil and natural gas produced



fell by 7 percent from 2015 to 2016 and then remained relatively flat through 2020.

Table 3: Energy efficiency data for CNOOC Ltd. And PetroChina (kilograms of standard coal consumption per ton of oil and natural gas production)

	2015	2016	2017	2018	2019	2020
CNOOC Ltd.	NA	47	49	52	55	55
PetroChina	128	119	118	122	119	118

Source: See appendix.

Sinopec Corp. has published data on its energy consumption per RMB 10,000 (\$1,500) of production value since 2017 (see Table 4). However, these numbers do not provide any insight into whether the company used energy more efficiently in 2018 than it did in 2017. Sinopec Corp. reported the same economic energy intensity in 2017 and 2018 (0.496 tons of standard coal consumed per RMB 10,000 of production value) but did not release any information about whether this was the result of the value of its products (which include oil, natural gas, refined products, and petrochemicals) increasing to the same degree that its energy use increased or the result of the value of its products decreasing to the degree that its energy use decreased.³²

Table 4: Sinopec's energy efficiency data

Indicator	Unit	2017	2018	2019	2020
Energy consumption per RMB 10,000 of production value	Tons of standard coal	0.496	0.496	0.494	0.490

Source: See appendix.

Increasing Natural Gas Production

China's NOCs describe increasing natural gas production as a key element of their decarbonization strategies. During PetroChina's midyear earnings conference call in August 2020, the company's chief financial officer, Chai Shouping, stated that natural gas will have an "irreplaceable position" in PetroChina's energy transition.³³ That same month, during CNOOC Ltd.'s midyear earnings conference call, the company's chairman, Wang Dongjin, said that CNOOC Ltd. would increase the share of natural gas in its production mix as part of its green and low-carbon development strategy.³⁴ Two years earlier, Sinopec Corp.'s spokesman, Lü Dapeng, told China's media in 2018 that the company regards the "transition to natural gas" as one of the largest components of its move toward a lower-carbon energy mix.³⁵

The importance these NOC executives attach to natural gas as a transition fuel is reflected in



their companies' production targets for 2025. All three companies plan to expand the share of natural gas in their production mixes. PetroChina and Sinopec Corp. have also set targets for increasing production of unconventional gas (see Table 5).

Table 5: Natural gas production targets of China's NOCs for 2025

Company	Natural gas production targets for 2025
CNOOC Ltd.	<ul style="list-style-type: none"> • Increase the share of natural gas in its production mix to 30% from approximately 20% in mid-2020
PetroChina	<ul style="list-style-type: none"> • Increase the share of natural gas in its domestic production mix to 55% from 45% in 2019 • Increase shale gas production to 20 bcm from 6 bcm in 2019 20% in mid-2020 • Increase tight gas production to 35 bcm from 28.6 bcm in 2019 20% in mid-2020
Sinopec Corp.	<ul style="list-style-type: none"> • Increase the share of natural gas in its production mix to 50% in 2023 from 41% in 2019 • Increase natural gas production to 46 bcm from 29.67 bcm in 2019 • Increase shale gas production to 13 bcm from 7.34 bcm in 2019

Source: See appendix.

To be sure, increased natural gas production has a role to play in reducing China's greenhouse gas emissions if methane emissions are controlled. Studies show that coal-to-gas switching in China, where coal accounted for 57 percent of China's energy consumption in 2021, can lower China's greenhouse gas emissions.³⁶ According to the International Energy Agency, coal-to-gas switching reduces CO₂ emissions by 33 percent when providing heat and 50 percent when producing electricity.³⁷

However, the climate change benefits of substituting natural gas for coal during the energy transition could be reduced or eliminated if there are leaks of methane during the production, distribution, or consumption of natural gas. This is because methane is a much more potent gas than carbon dioxide; a methane molecule is roughly 90 times more effective at trapping heat than a molecule of carbon dioxide over a 20-year period.³⁸ Specifically, the climate benefits of replacing coal with natural gas are negated if the total amount of methane leaked in the supply chain is more than a few percent of the natural gas consumed.³⁹

China's NOCs are doing many of the same things that international oil companies are doing to prevent methane emissions,⁴⁰ including emission accounting (all three companies),⁴¹ methane recovery (all three companies),⁴² avoidance of routine flaring (CNPC, PetroChina, and Sinopec Corp.)⁴³ and implementation of leak detection and repair programs (CNPC only).⁴⁴

CNPC reduced its methane intensity in 2019 by 12.3 percent below the 2017 level and, in July 2020, announced a new aim to halve its intensity by 2025.⁴⁵ The company does not disclose its methane emissions. Sinopec Corp. has set a methane reduction target but has not disclosed it.⁴⁶



Investing in Low-Carbon Energy

China's NOCs were cautiously making investments in low-carbon energy and technology before Xi set the 30-60 goals. The companies are most active in areas where they have comparative advantages. CNOOC is focusing on offshore wind, while Sinopec Group has ambitious plans for building hydrogen refueling stations. CNPC leads its domestic peers in the deployment of carbon capture, utilization, and storage (CCUS).

CNOOC: Investing in Offshore Wind

CNOOC is investing in China's fast-growing offshore wind industry because of its long history of developing and operating offshore oil and natural gas projects.⁴⁷ (CNOOC began operating in offshore China in 1982.) This track record allows the company to overcome the biggest challenge that onshore wind developers face in moving offshore: a lack of experience in offshore engineering.⁴⁸ Indeed, CNOOC pioneered the development of China's offshore wind sector in 2007 when it began operating China's first wind power plant in the Bohai Sea to supply electricity to one of its offshore oil fields.⁴⁹

CNOOC returned to the offshore wind sector in January 2019 when CNOOC Ltd. invested in an offshore wind project in Jiangsu province with a capacity of 300 megawatts (MW), which connected to the power grid in September 2020.⁵⁰ CNOOC Ltd. established CNOOC Renewable Energy Co., which is dedicated to the offshore wind business, in 2019.⁵¹ The company's CEO, Xu Keqiang, told reporters in January 2020 that CNOOC Ltd. will increase the ratio of offshore wind power in its portfolio to prepare for the energy transition. He also said that the company is focusing on projects in Guangdong, Jiangsu, and Fujian provinces and plans to spend 3-5 percent of its annual budget on offshore wind.⁵² In April 2020, CNOOC Ltd. won a development license for its second offshore wind project in Shantou, Guangdong province, which has an expected capacity of 1,000 MW.⁵³

Sinopec Group: Hydrogen Giant

Sinopec Group seeks to leverage its roles as China's largest refiner and operator of the country's largest network of retail stations to become a leading supplier of hydrogen fuel across China. The company is already China's biggest producer of hydrogen, which it uses for refining and petrochemical production.⁵⁴ Sinopec Group's hydrogen output is 3.5 million tons per year, 14 percent of the national total, but its output is mainly gray hydrogen (meaning it burns fossil fuels in its production; see the text box).⁵⁵ Sinopec Group also operates more than 30,000 retail stations nationwide.⁵⁶



Three Colors of Hydrogen

Most—if not all—of the hydrogen Sinopec Group produces is “grey hydrogen” made from fossil fuels in a process that generates CO₂ as a byproduct.⁵⁷ In order for hydrogen to help Sinopec Group decarbonize its operations and provide its customers with low- or zero-carbon fuels, the company will need to replace its grey hydrogen with blue or green hydrogen. Blue hydrogen is also made from fossil fuels but with carbon capture and storage, and green hydrogen is made from renewables. Ninety-six percent of the hydrogen produced today is made from fossil fuels.⁵⁸ Green and blue hydrogen are not yet cost competitive with grey hydrogen. According to the hydrogen strategy published by the European Union in July 2020, grey hydrogen costs \$1.80 per kilogram (kg), blue hydrogen costs \$2.40 per kg and green hydrogen costs between \$3 and \$6.55 per kilogram.⁵⁹

Sinopec Group’s expansion in China’s hydrogen sector is part of the company’s aspiration to become a world-leading clean energy and chemical corporation.⁶⁰ At an internal study session on the company’s hydrogen development strategy on July 21, 2020, the company’s then chairman, Zhang Yuzhuo, said that as technology matures and costs drop significantly, hydrogen energy is ushering in a period of strategic opportunity for rapid development. He also stated that Sinopec Group would continue to invest in hydrogen, aiming to form a “certain scale” of high-purity hydrogen production capacity during the 14th Five-Year Plan period (2021–2025).⁶¹

Sinopec Corp. had begun to build hydrogen refueling stations at its existing retail sites before Xi unveiled the 2060 carbon neutrality target. In July 2019, the company opened the first service station in China that combines hydrogen fueling and the retail sale of diesel and gasoline in the city of Foshan in Guangdong province.⁶² By the end of 2020, Sinopec Corp. had developed 27 of the roughly 100 hydrogen refueling stations in China.⁶³ Sinopec Corp. has also agreed to supply hydrogen to fuel cell vehicles in Beijing and Zhangjiakou to support the sustainability agenda of the 2022 Winter Olympics, which the two cities are cohosting.⁶⁴

PetroChina and CNOOC are also exploring hydrogen. In April 2020, PetroChina agreed to build hydrogen refueling stations in Beijing in collaboration with a subsidiary of carmaker Beijing Automotive Industry Holding Co., Ltd. and a new energy technology developer, Beijing SinoHytec Co., Ltd.⁶⁵ In July 2020, CNOOC’s subsidiary, CNOOC Energy and Technology Services, and Linde, a global leader in hydrogen technology, signed a memorandum of understanding to jointly develop China’s hydrogen energy industry.⁶⁶

CNPC: Capturing Carbon

CNPC leads China’s NOCs in the deployment of carbon capture, utilization and storage technology. In 2018, the company’s CCUS for an enhanced oil recovery (EOR) project at the Jilin oil field in northeastern China began commercial operations, making it the world’s 18th large-scale CCUS project.⁶⁷ It has a capacity of 600,000 tons per annum of CO₂.⁶⁸ (For comparison, according to the Global CCS Institute, of the 28 commercial carbon capture and storage facilities in operation globally in 2020, the smallest has a capacity of 100,000 tons



per annum and the largest has a capacity of 700,000 tons per annum.⁶⁹) CNPC injected more than 1.5 million tons of CO₂ into the Jilin oil field during the 11 years it operated the Jilin CCUS-EOR project as a demonstration project (2007–2018).⁷⁰

CNPC's leading position is due to both geography and history. In terms of geography, the location of the Jilin oil field close to a low-cost source of CO₂ has enabled it to circumvent the high capture and transportation costs that hinder the development of other CCUS-EOR projects in China.⁷¹ The CO₂ for the Jilin CCUS-EOR project is captured during the processing of natural gas extracted from the Changling field. The gas is 22.5 percent CO₂ and would otherwise be vented.⁷² The CO₂ is then transported about 50 kilometers by pipeline for injection into the Jilin oil field.⁷³

In terms of history, CNPC has decades of experience experimenting with different types of EOR, including CCUS-EOR at its famed Daqing oil field, the discovery of which in 1959 enabled China to become self-sufficient in oil in the mid-1960s and a major oil exporter within East Asia in the 1980s before the country shifted back to a net oil importer in 1993. CNPC's efforts to squeeze more and more oil out of Daqing made the field a hotbed of EOR activity, where “nearly every sort of enhanced recovery method has been tried.”⁷⁴

CNPC is also capturing carbon from hydrogen production from one of its refineries in Xinjiang for enhanced oil recovery as part of its participation in the CCUS KickStarter initiative of the Oil and Gas Climate Initiative (OGCI; more on the OGCI below).⁷⁵ The initiative aims to decarbonize five commercial hubs to facilitate large-scale commercial investment in CCUS. The other four hubs are in the Netherlands, Norway, the United Kingdom, and the United States.⁷⁶

CNPC is not the only NOC involved in CCUS for EOR. Sinopec is also developing a large-scale CCUS-EOR project. The Sinopec Qilu Petrochemical Project began construction in 2018.⁷⁷ It will capture CO₂ from chemical production for injection into the Shengli oil field, 75 kilometers away.⁷⁸ The project's capacity is listed as 0.35–0.5 million tons per year.⁷⁹ It is expected to come online in 2020–2021.⁸⁰

Joining International Climate Bodies

CNPC joined the Oil and Gas Climate Initiative in 2015.⁸¹ The OGCI is an organization established in 2014 by the CEOs of major international and national oil and natural gas companies to accelerate the industry's response to climate change through their own actions and by setting an example for other oil and natural gas companies to follow.⁸² The OGCI's members are BP, Chevron, CNPC, Eni, Equinor, ExxonMobil, Occidental, Pemex (inactive), Petrobras, Repsol, Saudi Aramco, Shell, and Total.⁸³ They accounted for more than 30 percent of the world's oil and natural gas production and almost 20 percent of the world's primary energy consumption in 2018.⁸⁴

The OGCI has set short-term methane intensity and carbon dioxide intensity reduction targets. In September 2018, the OGCI announced a target to lower by 2025 the collective average methane intensity of the aggregated upstream operations of its member companies by one-fifth (below 0.25 percent) with the aim to achieve one-third (0.20 percent) from a baseline of 0.32 percent in 2018.⁸⁵ In July 2020, the OGCI announced a target to reduce the collective average carbon dioxide emissions intensity of member companies' upstream



operations by 9–13 percent between 2017 and 2025 (from a collective baseline of 23 kilograms of carbon dioxide per barrel of oil equivalent in 2017 to between 20 and 21 kilograms of carbon dioxide per barrel of oil equivalent by 2025).⁸⁶

In addition to contributing to the OGCI's methane and carbon dioxide emissions targets, OGCI member companies agree to⁸⁷

- Support the goals of the Paris Agreement;
- Commit to the CEO's personal involvement in the OGCI Steering Committee;
- Report key data using common methodologies to measure progress in key areas;
- Support the OGCI's methane intensity target;
- Support the OGCI's CCUS aspiration;
- Make senior staff and experts available for OGCI activities;
- Share information on low carbon best practices and experience;
- Support the initiative Zero Routine Flaring by 2030; and
- Contribute \$100 million over 10 years to OGCI Climate Investments, a fund that supports the development of technologies that lower emissions (or in the case of CNPC, contribute \$100 million to an investment fund created by CNPC and OGCI Climate Investments with a focus on emissions reduction technologies in China).⁸⁸

Responses to the OGCI have been mixed. Some observers have criticized the OGCI's methane and carbon dioxide targets as unambitious because they seek to reduce the intensity of emissions (which allows for an increase in emissions overall) instead of absolute emissions and do not cover scope 3 emissions.⁸⁹ Critics also note that the \$100 million contributed to OGCI Climate Investments is just a tiny fraction of the companies' overall capital expenditure and criticize the OGCI for a lack of data transparency.⁹⁰ Other observers argue that having some greenhouse gas reduction targets is better than having none. Still others applaud the OGCI for including CEOs from national oil companies because it demonstrates that climate change is an issue on which both international and national oil companies must engage.⁹¹

Responses to Climate Change by Other Leading NOCs: Snapshots of Equinor and Saudi Aramco

Equinor, Norway's NOC, and Saudi Aramco, Saudi Arabia's NOC, illustrate the variation in the climate mitigation strategies of leading NOCs. Both companies rank among the world's lowest-emission producers. Equinor, which sees global oil demand peaking by around 2027–2028, seeks to transform itself from an oil company to an energy company by increasing investment in renewables.⁹² In contrast, Saudi Aramco maintains that oil demand will be healthy in the long term, peaking in the late 2030s,



and that the company is well positioned to meet demand because of its low-cost and low-emission crude production.⁹³

Equinor

Equinor is committed to being a leader in the energy transition, according to the company's CEO, Anders Opedal. On his first day on the job, November 2, 2020, he announced that Equinor has the ambition to achieve net-zero emissions by 2050. The company's pledge covers not only Scope 1 and Scope 2 emissions but also Scope 3 emissions.⁹⁴ Equinor has also set interim goals. For example, it intends to reduce the carbon intensity of its globally operated oil and natural gas production from 9.5 in 2019 to less than 8 kilograms of CO₂ per barrel of oil equivalent in 2025.⁹⁵ The company's upstream operated carbon intensity improved to 8.0 kilograms (kg) per barrel of oil equivalent (boe) in 2020, well below the global industry average of 17 kg per boe.⁹⁶ Equinor also aims to achieve carbon neutral global emissions by 2030.⁹⁷

Equinor seeks to meet its climate ambitions in several ways.⁹⁸ First, the company will continue to invest in renewables with the aim of increasing its production capacity to 4–6 gigawatts (GW) by 2026 and 12–16 GW by 2035. The company's initial focus is on wind power because of its experience operating offshore, which includes five decades of ocean engineering and project management expertise.⁹⁹ Second, Equinor is investing in the development of carbon capture and storage and hydrogen technologies. Third, the company will produce less oil and natural gas in the longer term even though it expects its output to increase by 3 percent per year from 2019 to 2026.

Saudi Aramco

Saudi Aramco aims to maintain its position as one of the world's lowest-cost and lowest-emission oil producers to deliver the supplies the company expects the world to need for decades.¹⁰⁰ The company extracts crude at just \$2.80 a barrel, which is reportedly less than half of Equinor's lifting cost and one-fifth that of ExxonMobil's.¹⁰¹ The carbon intensity of Saudi Aramco's oil and natural gas production in 2020 was 10.5 kilograms of CO₂ per barrel of oil equivalent.¹⁰²

Saudi Aramco attributes the relatively low-carbon intensity of its operations to the unique geology of Saudi Arabia's reserves and the company's innovation and reservoir management practices.¹⁰³

Saudi Aramco is working to find ways to reduce its carbon emissions. For example, the company is working to develop more efficient internal combustion engines and new fuel formulations.¹⁰⁴ The company is also investing in the development of blue hydrogen. According to Aramco's chief technology officer, Ahmad Al-Khowaiter, the company is "going to have a large share" of the global market for blue hydrogen, which the company does not expect to be fully developed before 2030.¹⁰⁵ In September 2020, Aramco exported the world's first shipment of ammonia made from blue hydrogen to Japan for use in power generation.¹⁰⁶



DRIVERS OF THE ENERGY TRANSITION ACTIVITIES OF CHINA'S NOCS BEFORE THE 30-60 TARGETS

Before Xi announced the 30-60 targets, China's NOCs pursued the activities on their emerging energy transition agendas for multiple reasons in addition to furthering Beijing's climate change objectives. To be sure, during the 12th Five-Year Plan period (2011-2015), the Chinese government encouraged China's NOCs to increase natural gas production to generate fewer greenhouse gas emissions and began to require China's NOCs to measure and manage greenhouse gas emissions. However, in the two decades before Xi unveiled the 30-60 targets, Beijing's campaigns to slow energy demand growth and reduce air pollution were much more powerful drivers of the NOCs' efforts to use energy more efficiently and increase natural gas production, both of which had the added benefit of slowing the growth of GHG emissions. Meanwhile, pressure from foreign investors and regulators and exposure to the carbon management practices of multinational corporations also influenced the nascent energy transition activities of China's NOCs.

Concerns about Climate Change

The Chinese government had already started to interact with China's NOCs on climate change about a decade before Xi unveiled the 30-60 targets. Beijing began to encourage China's NOCs to increase natural gas production to lessen GHG emissions before it launched its campaign against air pollution in 2013. In addition, China's government mandated that firms in certain industries, including oil and natural gas, report greenhouse gas emissions and included the NOCs in pilot emission trading schemes (ETSs).

Increasing Natural Gas Production

China's 12th and 13th Five-Year Plans for the Development of Natural Gas (for the periods 2011-2015 and 2016-2020, respectively) focus on developing the natural gas supplies and infrastructure needed to increase natural gas use and identify responding to climate change as a reason to do so. The 12th Five-Year Plan for natural gas, released on October 22, 2012, states that if China's natural gas consumption reaches 230 billion cubic meters (bcm) by 2015, an increase of about 120 bcm over 2010, then China's carbon dioxide emissions would decrease by 520 million tons per year when compared to the same increase in the consumption of coal of the equivalent calorific value.¹⁰⁷ Similarly, the 13th Five-Year Plan for natural gas, published on December 24, 2016, states that if natural gas consumption reaches 360 bcm in 2020, an increase of 167 bcm from 2015, then carbon dioxide emissions would decrease by 710 million tons per year when compared to the same increase in the consumption of coal of the equivalent calorific value.¹⁰⁸

Measuring Greenhouse Gas Emissions

Beijing began to require China's NOCs to measure and report greenhouse gas emissions during the 12th Five-Year Plan period. The plan itself, which was the first to contain a carbon



emissions intensity reduction target (a 17 percent decline from 2010 levels by 2015), called for the development of a system to calculate and verify greenhouse gas emissions.¹⁰⁹ To this end, the National Development and Reform Commission (NDRC) issued a notice in March 2014 stating that all companies that emitted 13,000 tons or more of carbon dioxide equivalent in 2010 or consumed energy equivalent to 5,000 tons of standard coal or more must report their emissions of all six major greenhouse gases.¹¹⁰ The NDRC also prepared greenhouse gas accounting and reporting guidelines for 10 industries using the GHG Protocol Corporate Standard developed by the World Resources Institute and the World Business Council for Sustainable Development.¹¹¹ Two of the 10 industries were oil and natural gas production and petrochemicals.¹¹² One purpose of the industrial protocols is to support the development of China's ETS.¹¹³

Participating in Carbon Trading Pilot Projects

The 12th Five-Year Plan also set the goal of gradually establishing an ETS.¹¹⁴ In October 2011, the NDRC released Document 2601, which mandated the establishment of carbon trading pilots in seven cities and provinces.¹¹⁵ All seven pilots called for the participation of entities in China's petrochemical industry, while the Tianjin pilot also included oil and natural gas exploration to account for emissions from oil and gas operations in Bohai Bay.¹¹⁶

An ETS is a tool for putting a price on carbon. Participating companies must hold permits for every ton of CO₂ they emit. They can purchase, receive, and trade permits. At the end of each year, participating companies need to submit permits equal to their emissions.¹¹⁷

Anecdotal information indicates that the carbon prices from the pilots, which ran through 2020, probably were not high enough to spur emissions reductions by the NOCs. For example, Sinopec Corp. paid \$3.50 per ton of CO₂ in 2019 and \$4.00 per ton in 2020.¹¹⁸ These prices are just a small fraction of the \$40–\$80 per ton by 2020 and \$50–\$80 per ton by 2030 that the High-Level Commission on Carbon Prices chaired by economists Joseph Stiglitz and Nicholas Stern in 2017 said would be needed to meet the goals of the Paris Agreement.¹¹⁹

China's National Emissions Trading Scheme

China's national ETS started operating on July 16, 2021. It initially covers about 2,200 firms in the thermal power sector. PetroChina and Sinopec Corp. have a combined 31 power subsidiaries participating. The two NOCs are among the 10 SOEs that account for a large proportion of the covered emissions. The ETS will eventually cover firms in seven additional sectors (petrochemicals, chemicals, nonferrous metals, building materials, iron and steel, pulp and paper, and aviation.)¹²⁰

Firms participating in China's ETS have been allocated permits for carbon emissions for free. Lower-polluting companies can sell permits to higher-polluting companies. Unlike other ETSs, China's does not auction permits, have a fixed cap on emissions, or promise a declining cap over time. However, such features could be incorporated if Beijing decides to tighten the scheme.¹²¹



China's ETS targets emissions per unit of economic output rather than total emissions. As a result, absolute emissions can still increase as energy production increases provided firms are reducing emissions per unit of output. The focus on emissions intensity instead of absolute emissions may reflect an effort by Beijing to balance its climate and economic growth goals.¹²²

China's carbon market is unlikely to spur covered firms to curb their emissions, especially in the near term. The price of carbon permits opened at \$7.42 per ton and reached a high of \$8.18 per ton on the first day of operations.¹²³ For comparison, carbon traded around \$59 per ton in the European Union in mid-July 2021.¹²⁴ According to the 2020 China Carbon Pricing Survey, participants in China's carbon markets in July–August 2020 expect carbon permits to trade at around \$7.71 per ton and to increase to \$10.95 per ton in 2025 and \$10.95 per ton by 2030.¹²⁵

Concerns about “Runaway” Energy Demand Growth

The genesis of one of the carbon management activities of China's NOCs, improving energy efficiency, was the rapid increase in the country's energy demand in the early 2000s. China had just accomplished the unprecedented feat of quadrupling its gross domestic product (GDP) while only doubling its energy use between 1980 and 2000. No other major developing country has experienced declining energy intensity until much later in its development process.¹²⁶ Consequently, Chinese (and foreign) energy experts expected that China's energy demand would continue to grow more slowly than its GDP through 2020.¹²⁷

Much to the surprise of Beijing (and the rest of the world), China's energy consumption grew much more quickly than its GDP from 2002 to 2005.¹²⁸ Senior Chinese government officials viewed the rapid increase in China's energy demand as unsustainable due to the stress the construction of new energy supply infrastructure was putting on China's industrial system and environment. China's leaders were sufficiently alarmed such that in November 2005, the Politburo took the unusual step of issuing a mandatory target for energy intensity, which was subsequently incorporated into the 11th Five-Year Plan.¹²⁹ According to experts in the China Energy Group at Lawrence Berkeley National Laboratory, the fact that the Politburo set the type of target that is usually determined by the government instead of the party indicates just how alarmed China's leaders were by the increase in China's energy intensity.¹³⁰

China's government established the Top 1,000 Enterprise Program and the Top 10,000 Enterprise Program to support the achievement of the energy intensity targets of the 11th Five-Year Plan (20 percent reduction by 2010) and the 12th Five-Year Plan (16 percent reduction by 2015), respectively.¹³¹

The Top 1,000 program involved 1,008 firms that accounted for 30 percent of China's energy consumption in 2005, while the Top 10,000 program involved 14,641 firms that accounted for more than 60 percent of China's energy consumption in 2010.¹³² Both programs set specific energy conservation targets for firms, including the NOCs, and made target achievement a



component of performance evaluation for SOE leaders.¹³³

The Top 1,000 Enterprise Program surpassed its energy conservation goal by 50 percent. The program called for energy savings of 100 million tons of standard coal equivalent by 2010, and the companies saved 150 million tons of standard coal equivalent.¹³⁴ As a result, the Top 1,000 Enterprise Program contributed significantly to the achievement of China's goal of reducing its energy intensity by 20 percent below the 2005 level by 2010.¹³⁵

China's NOCs helped make the Top 1,000 Enterprise Program a success by exceeding their energy savings targets for the 11th Five-Year Plan period. A comparison of the targets and results by the companies' subsidiaries reveals that the companies saved substantially more energy than expected. For example, 31 CNPC subsidiaries had combined energy saving targets of 5.3872 million tons of standard coal equivalent. The actual amount of energy saved by these companies was 8.9577 tons of standard coal equivalent.¹³⁶

The Top 10,000 Enterprises Program also delivered more energy savings than expected. It achieved the energy savings targets for the 12th Five-Year Plan period (2011–2015) ahead of schedule. According to the NDRC, the Top 10,000 Enterprises Program had saved 309 million tons of standard coal equivalent by the end of 2014 compared to the target of saving 250 million tons of standard coal equivalent by the end of 2015.¹³⁷ The total energy savings of the Top 10,000 Enterprises Program for the 12th Five-Year Plan period has not been published.

Although Beijing implemented the Top 1,000 and Top 10,000 Enterprise Programs to moderate energy consumption, the two programs also aided the central government's initial efforts to slow the growth of China's GHG emissions. The Top 1,000 Enterprise Program reduced CO₂ emissions by approximately 350 million tons from 2006 to 2010, and the Top 10,000 Enterprise Program decreased CO₂ emissions by an additional 700 million tons from 2011 to 2015.¹³⁸ The 12th Five-Year Plan's carbon intensity targets reportedly were directly derived from the plan's energy intensity targets.¹³⁹

Concerns about Air Pollution

Beijing's fight against air pollution was the primary impetus for China's NOCs to pursue another energy transition activity: the expansion of China's natural gas supplies. Severe air pollution in the winter of 2012–2013, dubbed the “airpocalypse,” made improving air quality a higher priority for China's leaders. Indeed, then Premier Li Keqiang famously announced that “we will resolutely declare war against pollution” during a speech at the opening of the National People's Congress in March 2014.¹⁴⁰ President Xi Jinping underscored the ongoing importance of winning the fight against air pollution in remarks to the Central Committee for Financial and Economic Affairs in April 2018 in which he identified pollution as one of the “three tough battles” China must win along with poverty alleviation and the prevention of financial risks.¹⁴¹

The “airpocalypse” prompted Beijing to issue a series of policy documents that identified natural gas as a key “weapon” in China's fight for cleaner air. These documents also stipulated a central role for China's NOCs. Beijing tasked the NOCs with not only undertaking expensive refinery upgrades to produce cleaner fuels but also increasing the production of natural



gas and building the infrastructure needed to deliver growing volumes of natural gas to consumers.¹⁴²

On September 13, 2013, the State Council released the “Air Pollution Control and Prevention Action Plan” (the “Action Plan”).¹⁴³ Experts have described it as China’s “toughest ever clean-air policy.”¹⁴⁴ The Action Plan stipulated ambitious targets for reducing air pollutants between 2013 and 2017, with the strictest targets set for Beijing and the surrounding region. Specifically, it mandated that the Beijing-Tianjin-Hebei region lower particular matter (PM) 2.5 levels by 25 percent and that Beijing reduce PM 2.5 levels by 33 percent from 89.5 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 60 $\mu\text{g}/\text{m}^3$.¹⁴⁵ For comparison, the World Health Organization’s recommended average annual PM 2.5 level is 10 $\mu\text{g}/\text{m}^3$.¹⁴⁶

The central government enlisted China’s NOCs to help achieve the air pollution reduction targets in the Action Plan. On September 22, 2013, Wu Xinxiong, then a vice minister of the National Development and Reform Commission and the head of the National Energy Administration, convened a meeting with executives from the three NOCs and Datang Group (one of China’s five major power generation companies) to discuss the implementation of major energy projects intended to improve air quality in Beijing. The mission statement signed by Wu and the energy executives committed the companies to completing 36 projects aimed at expanding natural gas supplies, upgrading oil products, increasing the supply of electricity to eastern China, and developing renewable energy. CNPC agreed to undertake 10 projects including the construction of natural gas pipelines, storage, and a liquified natural gas (LNG) import terminal.¹⁴⁷

In May 2014, the National Development and Reform Commission, the National Energy Administration, and the Ministry of Environmental Protection (now the Ministry of Ecology and Environment) issued a work plan to guide the energy industry’s efforts to combat air pollution. It tasked the NOCs with increasing China’s natural gas supplies through development of the major projects that the NOCs had agreed to undertake. The work plan aimed to raise the share of natural gas in China’s energy mix to more than 7 percent in 2015 and more than 9 percent 2017. It also set goals for China’s “supply capacity” (a term that refers to the sum of domestic production capacity, pipeline import capacity, and the total volume of long-term LNG contracts) at 250 bcm in 2015 and 330 bcm in 2017.¹⁴⁸

Subsequent policy documents similarly called for China’s NOCs to help improve air quality. For example, in August 2017, a group of central, provincial, and local governments issued an air pollution control action plan for the Beijing-Tianjin-Hebei region for the fall of 2017 and the winter of 2018. The plan called for Beijing, Tianjin, and 26 other cities to retire coal-fired boilers and replace them, primarily with gas-fired ones.¹⁴⁹

In July 2018, the State Council published the “Three-Year Action Plan for Winning the Battle for Blue Skies,” which covered more cities than the Action Plan issued in 2013 but did not set more difficult targets.¹⁵⁰ The “Three-Year Action Plan” called for increasing the share of natural gas in China’s energy mix to 10 percent by 2020. It also called for continuing to build the country’s natural gas production, supply, storage, and marketing system and the replacement of coal-fired boilers with natural gas units, especially in the Beijing-Tianjin-Hebei region.¹⁵¹



Improving Air Quality: An Early Driver of Fuel Cell Vehicles

Beijing's concerns about air pollution have also been a primary impetus of another activity on the energy transition agendas of China's NOCs: expanding the use of hydrogen as a transportation fuel. Indeed, hydrogen refueling could reduce air pollution through the reduction of diesel use by trucks and ships. Other long-standing drivers include slowing the growth of China's oil imports and leapfrogging global competitors in an emerging industry.¹⁵²

All three motivations date to the turn of the century when China's Ministry of Science and Technology invited Wan Gang, an engineer working for Audi in Germany—who would later become China's minister of science and technology and the father of "China's electric vehicles"—to come back to China to devise a strategy for China's automobile industry.¹⁵³ Wan returned to China in 2000 and concluded that China would not be able to catch up with American, German, and Japanese manufacturers of automobiles powered by internal combustion engines. Instead, he determined that the fortunes of China's automobile industry lay in the development of new energy vehicles, a category that includes pure plug-in electric vehicles (EVs), hybrids, and fuel cell vehicles (FCVs) powered by hydrogen.¹⁵⁴

Wan succeeded in persuading China's government to back the unproven technology of EVs.¹⁵⁵ China's government has spent more than \$58.5 billion in the development of an EV industry, according to a report published by the Center for Strategic and International Studies in November 2018.¹⁵⁶ This investment helped China become the world's largest EV market.¹⁵⁷

That said, Wan first focused on FCVs upon his return to China. As the chief scientist and overall team leader of the major electric vehicle project of the national 863 Program (China's high-tech development strategy), Wan developed three FCV prototypes in the period 2003–2005.¹⁵⁸ But China's government initially opted to support hybrid and battery EVs over FCVs, perhaps due to the difficulties of promoting fuel cell technology in the early 2000s.¹⁵⁹

Wan remained a proponent of developing FCVs to combat air pollution after he became a vice-chairman of the Chinese People's Political Consultative Conference. In remarks to a forum on hydrogen energy at Tsinghua University on June 28, 2018, he recommended FCVs for heavy-duty trucks that drive long distances and face stricter environmental protection requirements.¹⁶⁰ FCVs address both issues. They can refuel in less than four minutes and have a driving range of 300 miles, similar to vehicles with internal combustion engines.¹⁶¹ In terms of environmental protection, FCVs have zero emissions, whereas diesel-powered trucks rank among the highest contributors to GHG emissions and street-level pollution.¹⁶²



Investor Pressure

Even though PetroChina, Sinopec Corp. and CNOOC Ltd. are majority owned by central state-owned enterprises, they are still under some pressure from equity markets to demonstrate their preparedness for the energy transition because they are, or were, listed on stock exchanges in Hong Kong and New York. (All three companies are listed in Hong Kong, and PetroChina and Sinopec Corp. are listed in New York. CNOOC was listed in New York until March 2021, when the New York Stock Exchange delisted it to comply with an executive order signed by former President Donald Trump.¹⁶³) To be sure, the pressure on China's NOCs from investors does not compare to that on European oil companies. That said, Hermes Investment Management's engagement with Sinopec Corp. and PetroChina demonstrates that both NOCs are responsive to some of the climate concerns of long-term institutional investors.¹⁶⁴ Hermes is an asset manager that enables such investors to be more active owners of their assets by engaging with companies on environmental, social, and governance issues including climate change.¹⁶⁵

In 2014, Hermes Equity Ownership Services (EOS) began to voice concerns to senior executives at Sinopec about the company's lack of information on its climate change strategy and risk mitigation measures.¹⁶⁶ Over the next few years, Hermes EOS continued to encourage Sinopec Corp. to set internal targets for the disclosure of information about its carbon emissions. Hermes EOS also repeatedly found opportunities to engage with Sinopec on climate change. For example, the asset manager supported the United Nations Global Compact seminar hosted by Sinopec Corp. to discuss its initiative on GHG reduction and disclosure, encouraged Sinopec Corp. executives to attend the first climate change training workshop held by the CDP in Beijing, and provided a shareholder view of the importance of climate change and the disclosure of emissions information. In 2018, Hermes EOS ran a workshop for Sinopec Corp. on the recommendations of the Task Force on Climate-related Financial Disclosures and discussed how Sinopec could analyze its portfolio resilience to several low-carbon scenarios.

Information provided by Hermes EOS indicates that Sinopec Corp. has taken a number of steps to respond to climate change since it began to engage with the asset manager. These actions include the following:¹⁶⁷

- Establishment of board oversight of climate governance by the social responsibility management committee, which was comprised of the then chairman Zhang Yuzhuo, then independent nonexecutive director Fan Gang and independent nonexecutive director Tang Min;¹⁶⁸
- Creation of several internal task forces to assess climate change-related risks and opportunities for incorporation into the company's longer-term business strategy;
- Release of the Green Enterprise Action Plan in April 2018 with specific targets for 2023, 2035, and 2050 (note that these are qualitative targets such as leading the world in green, low-carbon development by 2050);¹⁶⁹
- Introduction of a methane-reduction program and establishment of an undisclosed methane-specific reduction target; and



- Disclosure of its absolute level of carbon emissions by business division for the first time in 2018.

Hermes has engaged with PetroChina to share best practices on climate change.¹⁷⁰ In February 2019, representatives of Hermes met with senior representatives of PetroChina, including technical experts responsible for low-carbon transition technologies, to advocate for PetroChina to improve disclosure of its climate change strategy and risk management plan.¹⁷¹ This engagement reportedly contributed to PetroChina's disclosure of a climate change strategy and a plan to contribute to the goal of limiting climate change below 2°C.¹⁷²

Foreign Regulatory Requirements

Foreign jurisdictions require China's NOCs to manage greenhouse gas emissions. The companies operate in countries where emissions are regulated and carbon pricing exists, such as Canada and the United Kingdom. Consequently, China's NOCs participate in overseas carbon markets and invest in carbon offsets in other countries as part of their compliance obligations.

CNOOC Ltd. operates the Long Lake oil sands project in the Canadian province of Alberta, which has had carbon pricing since 2007 and had a carbon tax in 2018–2019.¹⁷³ The company complies with Alberta's carbon emissions reduction regime by reducing emissions through efficiency improvements, earning carbon credits through its ownership in the Soderglen wind farm in southern Alberta, and making payments of \$30 per ton into Alberta's Climate Change and Emissions Management Fund.¹⁷⁴ In terms of efficiency improvements, CNOOC Ltd. reduced the amount of energy required to extract one barrel of bitumen at its Long Lake facility by 40 percent between 2010 and 2019, which in turn significantly lowered the carbon intensity of Long Lake's bitumen production.¹⁷⁵

Oil platforms operated in the UK's offshore by CNOOC Ltd. and Repsol Sinopec Resources UK, a joint venture between Repsol and Sinopec Group, are covered by the European Union's emissions trading system (EU ETS). The data on greenhouse gas emissions published by both companies in annual environmental statements submitted to the UK government is more granular than the data on greenhouse gas emissions made publicly available by either CNOOC Ltd. or Sinopec Group in China. CNOOC Ltd. and Repsol Sinopec Resources UK report their annual carbon dioxide emissions on an installation basis, and Repsol Sinopec Resources UK also reports such data for its methane emissions.¹⁷⁶

Meanwhile PetroChina's investment in European refineries covered by the EU ETS prompted the company to form an emissions trading team, reportedly the first one set up in a Chinese company. In July 2011, PetroChina and INEOS, a global petrochemical manufacturer, established Petroineos, a refining and trading joint venture that owns the Grangemouth refinery in Scotland and the Lavéra refinery in France.¹⁷⁷ In October 2010, while PetroChina was negotiating with INEOS, the Chinese company hired Garth Edward, who previously ran Citigroup's global business in carbon trading and Kyoto emissions trading credits, to head its new UK-based emissions trading team.¹⁷⁸ According to an unnamed source close to PetroChina interviewed for a Chinese media report, the immediate impetus for PetroChina's establishment of an emissions trading team was to ensure that the company met its EU ETS obligations at the minimum cost. The same source said that PetroChina's decision to hire



Edward was also motivated by China's plans to develop a domestic emission trading system.¹⁷⁹

International Exposure

Before Xi announced the 30-60 goals, China's NOCs had already taken some steps toward a lower-carbon future as a result of exposure to the carbon management practices of multinational corporations. These practices provided China's NOCs with benchmarks against which to compare themselves. Comments by the NOCs indicate that their initial climate mitigation activities, notably developing the capacity to measure and report their greenhouse gas emissions, reflect both an ambition to prepare for the energy transition and a desire to bolster their reputations as responsible corporate citizens.

Preparing for the Energy Transition

Fu Chengyu, a former chairman of both CNOOC and Sinopec Group, developed an interest in reducing greenhouse gas emissions as a result of his dealings with foreign companies. He told a reporter who interviewed him for a story about his environmentalism published in December 2015 that in the 1980s foreign companies already knew how much carbon one air conditioner could emit while he was still wondering whether air conditioners had carbon emissions. Fu treated this discovery as a call to action, stating, "It is thus apparent that international corporations have long been doing it, yet we did not start until the 21st century. Therefore, environmental protection should be done as early as possible. Once we know what others are doing, we should catch up the soonest we can."¹⁸⁰

CNOOC inventoried greenhouse gas emissions under Fu's watch. The company's first sustainability report, for the year 2005, states that the company implemented greenhouse gas emissions reduction projects in onshore engineering projects and offshore oil fields in order to accumulate experience for larger-scale emissions reduction projects in the future.¹⁸¹ During 2007, CNOOC determined the CO₂ emissions of each of its oil and natural gas fields.¹⁸² The company later became the first central SOE to conduct a system-wide inventory of greenhouse gases that involved gathering data from more than 100 subsidiaries in 2010 and 2011.¹⁸³

Foreign companies also informed CNOOC's broader low-carbon agenda in the 2000s. Specifically, the growing importance of combatting climate change in the global business environment influenced Fu's push, beginning in the mid-2000s, to transform CNOOC from an oil company to an energy company by investing in renewable energy. Fu said as much to a reporter for the Chinese magazine *Green Living* in January 2021: "The main reason for this was that the international business community at that time, especially the manufacturing and energy companies in developed countries, already regarded climate change and carbon emission reduction as corporate social responsibility and ethical standards."¹⁸⁴

When Fu became chairman of Sinopec Group in 2011, he made several changes to prepare the company for a lower-carbon future. First, he incorporated a green and low-carbon strategy into the company's development strategy. Second, he created an energy and environmental management department to address the issues of energy efficiency, environmental protection, and carbon dioxide emissions reduction. Third, he launched a survey of Sinopec Group's carbon emissions that lasted three years. As a result, Sinopec Group "may be the first large



Chinese company that fully understands its carbon emissions,” according to Fu in an interview with a Chinese journalist in January 2021.¹⁸⁵

CNPC's participation in the OGCI is another example of how engagement with other multinational companies has shaped the energy transition activities of China's NOCs. The OGCI helped the company develop the capacity to report greenhouse gas emissions externally, which it began to do in 2019.¹⁸⁶ In addition, as an OGCI member, CNPC is required to contribute to the targets set by OGCI member countries to reduce the carbon and methane intensity of their aggregated upstream oil and gas operations. By the end of 2019, the OGCI had reduced its absolute methane emissions by 22 percent since 2017 and its absolute carbon emissions by 7 percent since 2017.¹⁸⁷

Burnishing Reputations

China's NOCs have also been motivated to engage in energy transition activities to burnish their reputations. For example, CNOOC became the first Chinese company invited to join Combat Climate Change, a global business leaders initiative, in 2007, and Fu reportedly viewed its membership in this organization as marking CNOOC's shift from being a “multinational business entity” to being a “responsible multinational business entity.”¹⁸⁸ When CNOOC launched its greenhouse gas emissions inventory project in September 2010, the company said that one of its objectives was to “become a widely respected responsible transnational entity.”¹⁸⁹ Both of these examples are consistent with Fu's long-standing view that companies need to be responsible corporate citizens in order to survive and thrive.¹⁹⁰

CNPC and PetroChina have similarly viewed participation in the OGCI as a way to develop a positive international image. Indeed, PetroChina identifies the absence of such an image as one of the climate-related risks it faces. The English language version of the company's *2019 Environmental, Social, and Governance Report* states: “A low-carbon image is an important indication of the influence of multinational companies and a major concern of stakeholders. If the Company fails to meet its low-carbon development goals or fails to meet such goals by the expected routes and measures, its reputation and image may be adversely affected.” The report also states that PetroChina is managing this risk through active participation in the global oil and gas industry's efforts to tackle climate change.¹⁹¹ Similarly, a CNPC executive wrote in 2018 that CNPC has developed a “responsible international image” through its participation in various OGCI activities such as the formulation of the “OGCI 2040 Low Emission Roadmap,” conducting surveys on methane emissions, and the establishment of evaluation standards for carbon dioxide storage capacity.¹⁹²



WHY CHINA'S NOCS DIDN'T DO MORE BEFORE THE 30-60 PLEDGES

The response of China's NOCs to climate change has been constrained by their role in China's political economy. Specifically, addressing climate change is one of multiple objectives China's leaders expect the NOCs to advance, and not necessarily the most important one. Enhancing oil and natural gas supply security and maintaining employment almost certainly ranked higher and still do. In addition, the NOCs have periodically faced headwinds in the form of profit targets set by the central government and periods of low oil prices.

The Oil and Natural Gas Supply Security Imperative

The most important objective the NOCs pursue for China's leaders is securing oil and natural gas for domestic consumption. China was the world's largest importer of crude oil and natural gas in 2019.¹⁹³ In 2020, China depended on imports for 73 percent of its crude oil and 43 percent of its natural gas.¹⁹⁴

Xi Jinping highlighted the centrality of the NOCs to Beijing's pursuit of supply security in July 2018 when he instructed China's oil companies to ramp up domestic exploration and production of oil and natural gas to ensure the country's energy security.¹⁹⁵ Xi's directive to the NOCs came at a time when China's crude output was in its third consecutive year of decline (from 4.3 million bpd in 2015 to 3.8 million bpd in 2018).¹⁹⁶ It was also consistent with a broader push for greater self-reliance amid trade tensions with the United States.¹⁹⁷

The three NOCs responded to Xi's directive by issuing their first ever seven-year plans for intensifying the exploration and production of domestic oil and natural gas in 2019–2025.¹⁹⁸ The broad objective of these plans is to stabilize oil production and increase natural gas production.¹⁹⁹ These goals reflect the fact that the prospects for boosting domestic output are brighter for natural gas than for oil because of the maturity of China's largest oil fields. China's NOCs achieved both objectives in 2019, which saw the country's oil output grow by 0.9 percent and its natural gas production increase by 9.8 percent.²⁰⁰ (For comparison, in 2019, China's apparent oil consumption increased by 5.2 percent, and its apparent natural gas consumption grew by 9.4 percent.²⁰¹) The companies delivered again in 2020, with China's oil production increasing by 1.6 percent and its gas production growing by 9.8 percent.²⁰²

PetroChina, the country's largest producer of oil and natural gas, often highlights its responsibility to ensure stable supplies in its sustainability reports. For example, after shortfalls in pipeline gas deliveries from Turkmenistan and the aggressive implementation of "coal-to-gas" switching for heating in northeastern China during a colder than usual winter resulted in natural gas shortages in 2017, PetroChina's *2017 Sustainability Report* stated that it ensured maximum gas production, maximum unloading capacity at LNG terminals, and maximum gas storage volume to secure stable supplies.²⁰³

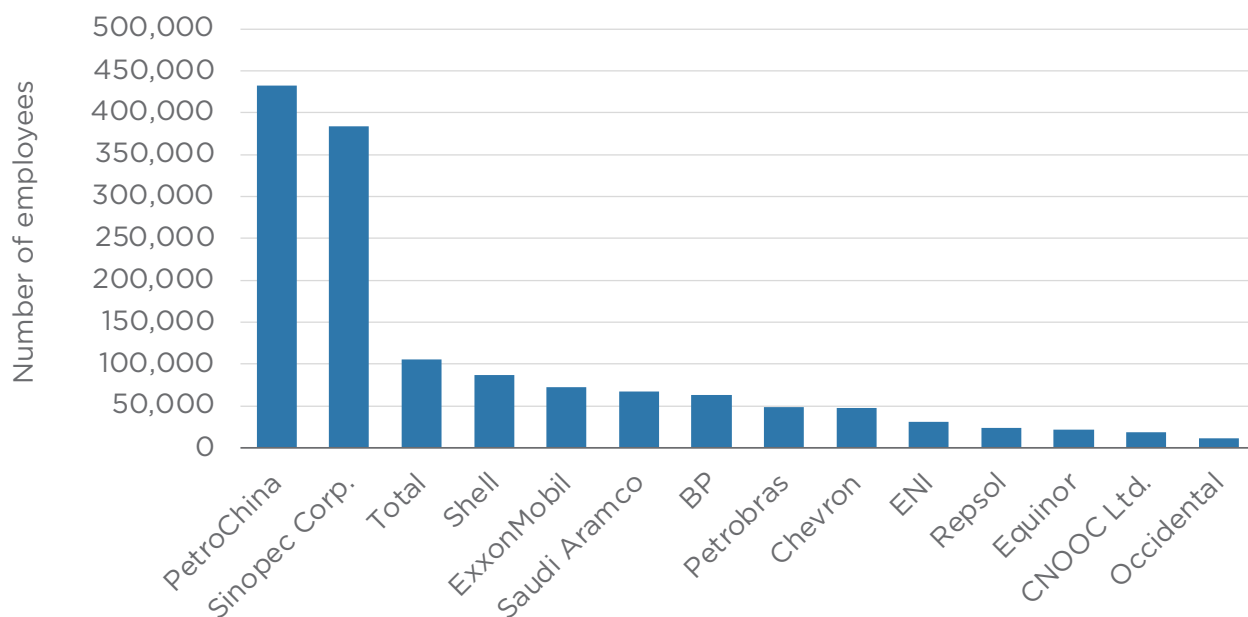


The Employment Imperative

China's NOCs, notably CNPC and Sinopec Group, have a responsibility to keep people employed. The need to maintain, and even grow, their workforces constrains the extent to which—and certainly the pace at which—the NOCs can pivot away from oil and natural gas production.²⁰⁴ To be sure, as the International Energy Agency argued in its report, *Net Zero by 2050*, the oil and natural gas industry has skills and resources that are a good fit with some of the technologies needed to reduce greenhouse gas emissions, such as CCUS, hydrogen, and offshore wind power. However, transitioning employees from exploring and producing oil and natural gas to developing low-carbon fuels and technologies undoubtedly will take some time. If such a transition occurs in China, it almost certainly will proceed gradually to avoid large-scale layoffs or unemployment.

China's NOCs, and their respective flagship subsidiaries, have enormous numbers of employees. As of December 31, 2020, PetroChina employed 432,003 people, Sinopec Corp. employed 384,065, and CNOOC Ltd. employed 18,353.²⁰⁵ For comparison, as of August 2021, CNPC employed 1,242,245 people (including PetroChina employees), Sinopec Group employed 553,833 (including Sinopec Corp. employees), and CNOOC employed 80,058 (including CNOOC Ltd. employees).²⁰⁶ These head counts are much larger than those of other leading oil companies (see Figure 7). For example, ExxonMobil employed 72,000 people and Royal Dutch Shell employed 87,000 in 2020.²⁰⁷

Figure 7: Employees of select oil companies in 2020



Source: See appendix.



The importance of China's NOCs as sources of employment is highlighted by Beijing's use of central SOEs to hire more workers in the wake of the COVID-19 pandemic to support economic recovery and social stability. In March 2020, SASAC issued a notice urging central SOEs to create more jobs, especially for recent college graduates, migrant workers, and laborers from poor areas.²⁰⁸ The NOCs responded by announcing plans to step up their hiring, especially of new graduates. One media report estimated that the three NOCs would hire about 20,000 college graduates in 2020, 90 percent more than in 2019.²⁰⁹

Similarly, an exchange between Xi Jinping and Jiang Wanchun, the Communist Party secretary of PetroChina's Daqing oil field, during the annual meeting of China's National People's Congress in March 2016, highlights the importance China's top leader attaches to the NOCs as sources of employment.²¹⁰ Jiang, then the highest-ranking official at Daqing, reported to Xi that the oil field, which is owned by PetroChina, had lost around \$800 million in the first two months of 2016 due to low oil prices. (The spot price for Brent crude averaged \$31 per barrel in January and \$32 per barrel in February, far below Daqing's production cost of \$45 per barrel.²¹¹) Xi responded by inquiring whether the workforce was stable and their salaries guaranteed despite the difficult operating conditions. Jiang replied that the jobs and salaries of "frontline" workers were safe. Xi then stated that structural adjustment cannot be made at the expense of employee interests and that the income and treatment of frontline employees must be guaranteed.

Wang Yilin, then the chairman of the board of CNPC and PetroChina, subsequently underscored Jiang's comment about the job security of oil workers. During a meeting with the Chinese media on the sidelines of the National People's Congress in March 2016, Wang made clear that letting people go in tough times isn't an option. He said that CNPC was not like international oil companies because it would not undertake large-scale layoffs to cut costs in response to low oil prices.²¹²

Financial Pressures

China's NOCs are subject to financial pressures that can impact their climate actions. These include domestic regulatory pressures such as profit targets set by SASAC. Market pressures, such as the price of crude oil, have also affected the climate mitigation activities of China's NOCs.

Profit Targets

SASAC conducts annual and triennial performance reviews of central SOE executives. The basis for the assessment is the previous period's performance. At the beginning of each year and three-year term, SOE executives and SASAC sign an annual performance agreement that details performance goals, evaluation criteria, and rewards and punishments.²¹³ The performance indicators used by SASAC include net profits and economic value added.²¹⁴

In June 2019, SASAC announced that central SOEs had agreed to boost their annual net profits by 9 percent in 2019. SASAC further stated that a subset of 20 companies, including CNPC, pledged to achieve 12 percent growth in net profits in 2019. The new net profit goals were incorporated into the central SOEs' performance agreements for 2019. SASAC hosted



a performance agreement signing ceremony on June 12, where SASAC Party Committee Secretary and Director Hao Peng requested that the SOEs do their part to help stabilize China's economy.²¹⁵

Oil Prices

The price of oil influences the climate actions of China's NOCs. Carbon capture and storage for enhanced oil recovery (CCS-EOR) is a case in point. High oil prices provide an incentive to invest in CCS-EOR while low oil prices do not. One proposed CCS-EOR project that fell victim to the crude oil collapse in the mid-2010s was Sinopec's plan to capture carbon dioxide from a power plant for injection into the company's Shengli oil field. Sinopec delayed making the final investment decision because the project economics did not meet its investment criteria. Indeed, Sinopec calculated that the internal rate of return for the project was just 5.6 percent when the price of crude oil was \$70 per barrel in November 2014, below the minimum rate of return acceptable to the company. (One Chinese analysis of this project indicated that the minimum acceptable rate of return for the project was 8 percent based on the fact that CNPC's economic evaluation parameters of construction projects [2013] requires the after-tax internal rate of return for special onshore oil field development to be at 8 percent.)



WHAT THE 30-60 TARGETS MEAN FOR CHINA'S NOCS

China's ambition to peak carbon emissions before 2030 and to achieve carbon neutrality before 2060 is putting pressure on the country's central SOEs, especially ones in high-carbon emission industries, to help the country achieve its climate targets. During December 16–18, 2020, the Central Economic Work Conference, an annual meeting at which China's leaders determine their economic priorities for the following year, convened in Beijing and identified “carrying out carbon peaking and carbon neutrality work” as one of eight key tasks for 2021.²¹⁶ One week later, at a meeting of the heads of central SOEs during December 24–25, SASAC announced that engaging in carbon peaking and carbon neutrality activities would be a key task for central SOEs in the following year.²¹⁷

During a press conference on April 16, 2021, SASAC secretary-general and spokesperson Peng Huagang reminded central SOEs of their responsibility to help China realize its climate ambitions. He called on the firms to “contribute to the power of central SOEs in achieving the carbon peaking and carbon neutrality goals.” He also said that SASAC would formulate policies to guide central SOEs in implementing “carbon peaking and carbon neutrality” requirements.²¹⁸

In the meantime, numerous central SOEs announced plans to achieve carbon peaking (see Table 6) and carbon neutrality ahead of China's 30-60 goals. On March 25, 2021, PetroChina, which had already set a near-zero emissions goal for 2050, announced that it is aiming for peak carbon emissions by 2025. Four days later, Sinopec Corp. revealed that it is targeting peak carbon emissions by 2025 and carbon neutrality by 2050, making it one of a handful of central SOEs to set a midcentury target.

Table 6: Carbon peaking targets of select central SOEs

Date announced	Company	Peaking year
December 8, 2020	State Power Investment Corporation	2023
December 20, 2020	China Energy Investment Corporation	2023
January 21, 2021	BaoWu Steel Group	2023
January 21, 2021	China Datang Group	2025
January 28, 2021	China Huadian Group	2025
March 12, 2021	China Three Gorges Corporation	2023
March 18, 2021	China Resource Power Corporation	2025
March 25, 2021	PetroChina	2025
March 29, 2021	Sinopec Corp.	2025
June 8, 2021	Chinalco	2025

Source: See appendix.



China's NOCs have also engaged in a variety of activities to demonstrate their commitment to the 30-60 goals. For example, on November 23, 2020, Sinopec Group signed a letter of intent for strategic cooperation with the NDRC's Energy Research Institute, the National Center for Climate Change Strategy and International Cooperation, and Tsinghua University's Laboratory of Low-Carbon Energy to jointly research a strategic path for Sinopec to take the lead in carbon peaking and carbon neutrality in the energy and chemical industries.²¹⁹ In January 2021, CNOOC announced the official launch of its carbon neutrality plan, established a research institution to formulate a road map for reducing carbon emissions and a carbon neutrality target, and created a new subsidiary to focus on the development of new energy technologies with offshore wind power as its primary focus.²²⁰ In April 2021, CNPC announced that it is reorganizing its headquarters to reflect the increased importance the company now attaches to renewables and low-carbon technologies, a development that is discussed in more detail below.

These expressions of support for the 30-60 goals belie the likelihood that producing oil and natural gas will probably remain the primary remit of China's NOCs at least through 2030, the year before which China intends to peak its emissions. The chairmen of the three NOCs have said as much. They have also indicated that they intend to increase the share of natural gas in their production mixes, a shift they regard as helping China to transition to a lower-carbon future. (As CNPC Chairman Dai Houliang told China Central Television in February 2021, "coal is high-carbon, oil is medium-carbon, and natural gas is low-carbon."²²¹) That said, the three NOCs, aware that they eventually may need to expand their core business area beyond hydrocarbons, will continue to explore ways to decarbonize their operations and provide consumers with lower-carbon alternatives with a focus on areas where they have comparative advantages.

Oil and Natural Gas Likely to Remain the Core Business

Oil and natural gas almost certainly will remain the core business of China's NOCs through at least 2030. China's demand for and imports of oil and natural gas are likely to increase during this period. As a result, the primary responsibility of the three NOCs is likely to continue to be ensuring China's oil and natural gas supply security.

CNPC, China's largest oil and natural gas producer, expects the country to consume and import larger volumes of oil and natural gas. In April 2021, CNPC's Economics and Technology Research Institute released the 2020 version of its *Domestic and Foreign Oil and Gas Industry Development Report*. A summary of the report's projections of China's oil balance through 2025 by a newspaper owned by CNPC states that China's oil demand will increase from 14 million bpd in 2020 to 14.6-15 million bpd in 2025, the year around which the company expects China's oil demand to peak. If China's domestic oil production continues to be around 4 million bpd (the summary does not contain a production figure), then China's oil imports will be 10.6-11 million bpd in 2025. The report also expects that between 2020 and 2025, China's natural gas demand will grow from 326 bcm to 420-500 bcm and that its natural gas imports will increase from 133.6 bcm to 170-275 bcm (see Table 7).²²²



Table 7: CNPC's projections of China's oil and natural gas balance through 2025

	2020	2021	2025
Oil (million barrels per day)			
Demand	14.0	14.2	14.6-15.0
Production	3.9	4.0	4.0
Imports	10.1	10.2	10.6-11.0
Natural gas (billion cubic meters)			
Demand	326.0	354.0	420.0-500.0
Production	193.0	204.0	235.0-250.0
Imports	134.0	150.0	170.0-275.0

Source: See appendix.

Meanwhile, in November 2020, CNPC Chairman Dai Houliang provided an additional explanation for why his company has no immediate plans to alter the status of oil and natural gas exploration and production as CNPC's primary business. In remarks at an international oil and gas conference, he stated that hydrocarbons emit less carbon dioxide than coal. Consequently, oil and natural gas will remain the core business of CNPC for some time to come.²²³

During an appearance on China Central Television's Dialogue program in April 2021, Sinopec Group's then chairman, Zhang Yuzhuo, said that his company will remain an oil and natural gas producer even as it offers lower-carbon alternatives to customers. In response to a question about whether hydrogen will be the ultimate solution for carbon neutrality, he replied, "Ultimately, for Sinopec, hydrogen may not be able to fully undertake the task because Sinopec itself is a supplier of energy and material. We are an energy and chemical company. In the field of energy, oil and gas may still be needed for a long period of time in the future. We will meet everyone's demand for oil and gas. In this process, we will accelerate the introduction of hydrogen and electricity to replace traditional petroleum products. So the scenario is going to be that, in the future, Sinopec will provide oil, gas, hydrogen, and electricity plus integrated services."²²⁴

CNOOC CEO Wang Dongjin similarly stressed the continued primacy of oil and natural gas production in his company's operations in an essay he penned for the March 18, 2021, issue of *China Energy News*. Wang states that CNOOC will "unswervingly implement the seven-year action plan for increasing domestic oil and natural gas reserves and production to demonstrate CNOOC's efforts to ensure national energy security and at the same time provide strength for the energy transition." He subsequently noted that his company will promote the clean energy transition in the longer term.²²⁵

China's leaders also foresee a continued role for oil and natural gas in China's energy mix. In November 2020, the Central Committee of the Communist Party of China released its



recommendations for the contents of the 14th Five-Year Plan (2021–2025), which include strengthening domestic oil and natural gas development and accelerating the construction of oil and natural gas storage facilities and pipelines.²²⁶ In March 2021, the National People's Congress approved the “Outline for the 14th Five-Year Plan and Long-Term Targets to 2035.” Unlike the 13th Five-Year Plan, the 14th Five-Year Plan (2021–2025) devotes a stand-alone section to energy security, which is focused on hydrocarbons. This section states that “the core demand for oil and gas should rely on self-sufficiency” (a recommendation that is absent from the 13th Five-Year Plan). It also calls for maintaining and increasing oil and natural gas production.²²⁷

Another reason that oil and natural gas are likely to remain the core business of China's NOCs is the competition in the renewable energy sector from private firms and China's state-owned power generation companies, which had established themselves as the dominant players in China's renewable energy industries before the NOCs began to pursue wind and solar projects. As Peng Peng, secretary-general of the China New Energy Investment and Finance Alliance said in an interview with Chinese media in October 2020, most areas suitable for onshore wind power have already been developed, with 80 percent of the high-quality projects in the hands of state-owned generation companies.²²⁸ Similarly, before CNOOC returned to the offshore wind market in 2019, a group of central SOEs including the China General Nuclear Power Corporation, China Three Gorges Corporation, and State Power Investment Corporation had established themselves as the leaders in the development of offshore wind power.²²⁹ Central SOEs are also moving into the solar business to help China decarbonize.²³⁰ In 2020, state-owned generation companies were the main drivers of the 178 percent year-on-year increase in solar power capacity (48.2 gigawatts of new capacity, the most since 2017) and the 60 percent year-on-year growth in wind power capacity (71.1 gigawatts of new capacity, twice the previous high).²³¹

A Shift from Oil and Gas Companies to Gas and Oil Companies

China's aim to become carbon neutral by 2060 is likely to reinforce a shift already underway in the companies' production mixes from oil to natural gas. In 2020, CNPC's production of natural gas exceeded its production of oil for the first time.²³² This shift to producing more natural gas is also occurring at Sinopec Group and CNOOC. The share of natural gas increased in each company's domestic production mix between 2016 and 2020 (see Table 8).

Table 8: The shifting domestic production mixes of China's NOCs

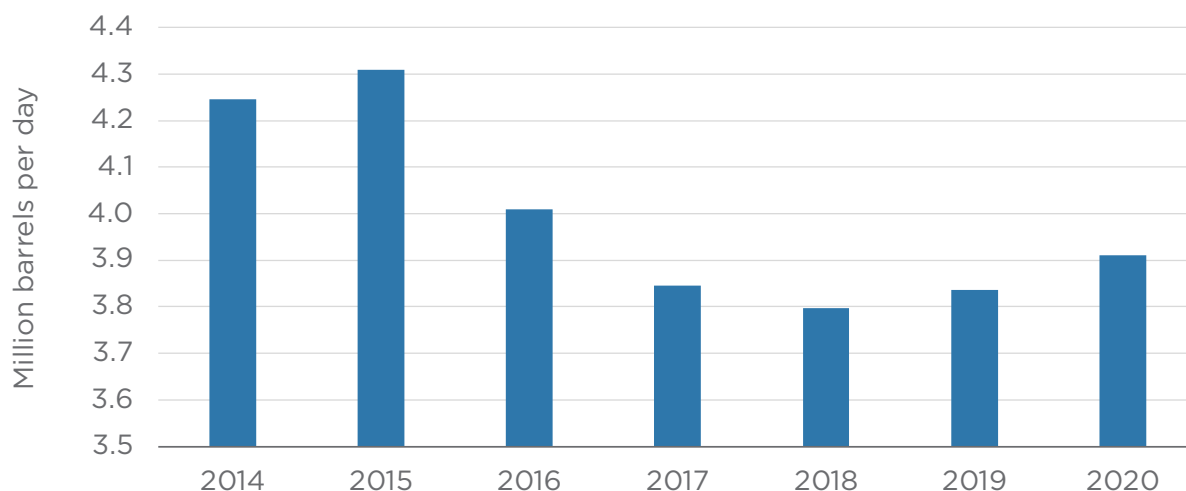
	2016		2020	
	Oil	Natural gas	Oil	Natural gas
CNPC	56%	44%	48%	52%
Sinopec Group	66%	34%	57%	43%
CNOOC	80%	20%	73%	27%

Source: See appendix.



The NOCs' transition from oil and gas companies to gas and oil companies is being driven by geology and policy. In terms of geology, production at China's oldest and largest oil fields, including Daqing and Shengli, is in decline.²³³ Finding replacement reserves has been difficult, with one NOC manager quipping that "without rice in hand, you can't make a meal."²³⁴ As a result, it has been difficult for China's NOCs to maintain—let alone substantially grow—oil production (see Figure 8).

Figure 8: China's oil production



Source: See appendix.

In terms of policy, Beijing's push to reduce air pollution underpins its commitment to expanding not only China's natural gas consumption but also its production. China's government targeted an increase in the share of natural gas in China's energy mix from 5.9 percent to 8.3-10 percent between 2015 and 2020 and an increase in China's natural gas production from 135 bcm to 207 bcm over the same period.²³⁵ (China achieved the first goal but not the second.) Ongoing efforts to improve air quality will support the expansion of China's natural gas demand and supply during the 14th Five-Year Plan period.²³⁶

China's carbon neutrality goal provides another incentive for China's NOCs to produce more natural gas. Several NOC executives have stated that this is one of the ways their companies will support the 2060 carbon neutrality goal. For example, in October 2020, CNOOC Ltd.'s chief financial officer, Xie Weizhi, told reporters that CNOOC Ltd. planned to increase the share of natural gas in its production mix from 21 percent in 2020 to 50 percent by 2035 to contribute to China's carbon neutrality target.²³⁷ In November 2020, then Sinopec Group chairman, Zhang Yuzhuo, told participants in the Bloomberg New Economy Forum that Sinopec regards natural gas as the most important energy resource to develop during the transition period.²³⁸



In April 2021, Zhang Rongwang, deputy general manager of CNOOC Gas and Power, told an industry forum that the use of natural gas should be accelerated during the 14th and 15th Five-Year Plan periods (2021-2030) to help China peak carbon emissions before 2030 and to buy more time to realize the 2060 carbon neutrality goal. According to Zhang, nonfossil energy cannot fully satisfy China's energy demand in the short-term due in part to the need for technological breakthroughs in energy storage and hydrogen. Consequently, in Zhang's view, natural gas is a realistic choice to ensure energy security and support the transformation of China's energy structure in the near future.²³⁹

CNPC has made natural gas the centerpiece of its emerging energy transition strategy, a move consistent with its status as China's largest natural gas producer. In March 2021, during PetroChina's annual results briefing, Chairman Dai Houliang stated that the company's first step toward lowering its emissions is to increase natural gas production with the aim of expanding its share of the company's production mix to 55 percent by 2025.²⁴⁰ (Natural gas accounted for 47 percent of PetroChina's production mix in 2020.²⁴¹)

Movement on Methane

China's NOCs are aware that methane emissions need to be controlled in order for natural gas to serve as a bridge to a lower-carbon future. To this end, CNPC, Sinopec Group, CNOOC, and four other Chinese oil and natural gas companies (Beijing Gas Group Co., Ltd.; China Resources Gas Group Ltd.; ENN Energy Holdings Ltd.; and China Oil and Gas Pipeline Network Corp.) established the China Oil and Gas Methane Alliance in May 2021. According to CNPC, acting as the alliance's first president, the group will serve as a platform for exchanging best practices, promoting emissions control standards, and improving the standardization and transparency of emissions data. The member companies aim to reduce the average methane intensity of their natural gas production to below 0.25 percent by 2025 from an unidentified level and reach an undefined "world-class level" by 2035.²⁴² (For comparison, the OGCI member companies aim to lower their collective upstream methane intensity to 0.20 percent by 2025, down from 0.23 percent in 2019.²⁴³)

In addition, Sinopec Corp. became China's first NOC to publicly report methane emissions. The company's *2020 Sustainability Report* states that Sinopec Corp.'s methane emissions in 2020 were 283.56 million cubic meters, with the company's oil and natural gas exploration segment accounting for 245.98 million cubic meters.²⁴⁴

Expanding beyond Oil and Natural Gas

China's NOCs are likely to contribute to the 30-60 goals by continuing to explore ways to expand their core business area beyond oil and natural gas. The NOCs' recognition that they might have to broaden the scope of their operations to adapt to a decarbonizing world is reflected in the types of companies the NOCs have said they want to become:²⁴⁵

- An integrated energy supplier (CNPC),



- An international first-class energy company with Chinese characteristics (CNOOC), and
- A world-leading clean energy and chemical company (Sinopec Group)

The NOCs' blueprints for translating these visions into reality are works in progress. Sinopec Group and CNOOC are focusing on hydrogen and offshore wind power, respectively, which build off of existing areas of expertise. Although CNPC's plans are vaguer, the company has signaled that it intends to devote more resources to supporting China's carbon peaking and carbon neutrality goals.

CNPC: Restructuring for the Energy Transition

CNPC is making structural changes that indicate the company is planning to step up its participation in the energy transition. On April 8, 2021, CNPC announced a plan to reorganize its nine business lines into four new ones, including “oil and natural gas and new energy.”²⁴⁶ (According to CNPC, “new energy” includes geothermal energy, gas hydrates, biomass, energy storage, hydrogen fuel, and uranium.²⁴⁷) An unnamed company official told an industry publication that the reorganization “is the strategic choice for CNPC to better follow the global energy transition trend.”²⁴⁸ Indeed, industry analysts interpreted the reorganization as a sign that CNPC had elevated the strategic importance of new energy to the same level as oil and natural gas.²⁴⁹ The merging of the oil and natural gas and new energy divisions is also consistent with Chairman Dai Houliang's statement in November 2020 that CNPC would promote the creation of a “‘low-carbon energy ecosystem’ in which fossil fuels and new energy are fully integrated, to enable the company to stay highly competitive during the transition.”²⁵⁰

CNPC also intends to create an investment vehicle to support its “green and low-carbon development,” according to a filing PetroChina made with the Hong Kong stock exchange on April 29, 2021. The new company, CNPC Kunlun Capital, will be a joint venture between CNPC (51 percent), PetroChina (29 percent), and CNPC Capital (20 percent), CNPC's financial services arm. The three shareholders have committed to injecting \$1.5 billion into the new investment vehicle within three years.²⁵¹

Meanwhile, PetroChina executives provided more information about PetroChina's plans to achieve near-zero emissions by 2050 during its midyear earnings call in August 2021. Chairman Dai stated that PetroChina aims for new energy, oil and natural gas to each account for one-third of the company's capital expenditure by 2035. He also spoke of continuing to exploit wind and solar resources at the company's oil fields, investing in more geothermal projects and developing “a series of technologies around CCS and CCUS.” Executive director and president Huang Yanzhong said PetroChina will look for new opportunities in hydrogen.²⁵²

CNOOC: Prioritizing Offshore Wind

CNOOC Ltd. has increased the share of its budget that it invests in low-carbon energy. On August 19, 2021, chairman Wang Dongjin said the company intends to spend 5 to 10 percent of its total annual capital expenditure on low-carbon projects in 2021–2025, up from the 5 percent announced in early 2021.²⁵³ CNOOC Ltd.'s planned capital expenditure for 2021 is RMB 90–100 billion (\$13.9–\$14.5 billion).²⁵⁴



Wang stated that CNOOC Ltd.'s low-carbon energy investments will continue to focus on offshore wind. However, the company will also invest in onshore wind and solar power. Wang also said that the company expects to have non-fossil energy generate more than half of its earnings by 2050.²⁵⁵

Sinopec Group: Betting on Hydrogen and CCUS

Since Xi announced the 30-60 targets, Sinopec Group has made it increasingly clear that the company's plans for the energy transition involve playing a larger role in the development of two industries critical to the decarbonization of China and the world: green and blue hydrogen and CCUS. The company is positioned to make contributions in both areas, given its status as China's largest refiner and hydrogen producer, the integration of its upstream and downstream operations, and the professional background of its former chairman (see the text box at the end of this section).

Hydrogen

Sinopec Group's preparations for a lower-carbon future center on hydrogen. Indeed, its former chairman, Zhang Yuzhuo, spoke frequently of transforming the company into China's leading hydrogen energy company.²⁵⁶ During Sinopec Corp.'s earnings call with investors and analysts on March 29, 2021, Zhang announced that "hydrogen is at the core of Sinopec's low carbon business transformation." During the company's midyear earnings call on August 30, 2021, Sinopec Corp.'s president, Ma Yongsheng, doubled down on the company's commitment to making hydrogen the focus of its energy transition strategy when he unveiled plans to invest \$4.6 billion in the development of China's largest supply chain for automotive hydrogen.²⁵⁷

Ma reiterated the goal previously announced in February 2021 by Sinopec Group's newspaper, *China Petrochemical News*, of opening 1,000 hydrogen refueling stations (HRSs) in China by 2025.²⁵⁸ (For comparison, there were 100 HRSs in China and 650 HRSs worldwide at the end of 2020.²⁵⁹) According to Ma, the 1,000 HRSs will have an overall service capacity of 200,000 tons per year by the end of 2025.²⁶⁰

Ma also indicated that Sinopec Corp. will stick with the plan, previously outlined by former chairman Zhang, to shift from using fossil fuels to using wind and solar to produce hydrogen.²⁶¹ Specifically, the company aims to develop green hydrogen production capacity of more than one million tons per year by 2025.²⁶² To this end, Sinopec Group has sought partnerships with foreign and domestic firms.²⁶³ The company intends to launch its first green hydrogen project with a production capacity of 10,000 tons per year in Inner Mongolia in 2022 and is planning to build another green hydrogen project with an annual production capacity of 20,000 tons per year.²⁶⁴

During the conference call, Ma reminded analysts of why Sinopec Corp. is well-positioned to become China's top hydrogen company. He said that, as a major energy company, Sinopec Corp. has "accumulated rich experience and technological advantages" in the production and use of hydrogen. Ma also said that the company's more than 30,000 service stations give it an edge in the distribution of hydrogen.²⁶⁵



CCUS

On July 5, 2021, Zhang revealed his ambition for Sinopec Group to play a much larger role in the development of China's CCUS industry with his announcement that the company had begun construction of China's largest CCUS project (1 million tons) in Shandong province and that the project is expected to go into production by the end of 2021.²⁶⁶ The project will capture CO₂ produced by the company's Qilu refinery during a hydrogen-making process and inject it into the Shengli oil field to enhance oil production. According to Sinopec Group, over the next 15 years, the project will inject 10.68 million tons of CO₂ into the oil field and increase oil production by around 2.97 million tons (about 4,000 bpd).²⁶⁷

Comments by Zhang make it clear that the Qilu-Shengli CCUS project intends to lay the groundwork for the construction of additional, large-scale CCUS projects in China by Sinopec Group and other companies by providing engineering experience and technical data.²⁶⁸ Zhang said that during the 14th Five-Year Plan period, Sinopec Group will construct additional megaton projects that will capture CO₂ from the company's refineries and petrochemical plants in Jiangsu and inject it into the company's Jiangsu and Huadong oil fields.²⁶⁹

Will Sinopec Become China's Leading Hydrogen Company?

Former Sinopec Group Chairman Zhang Yuzhuo's professional background, Sinopec's hydrogen experience and infrastructure, and the growing interest in green hydrogen domestically and internationally as a decarbonization technology have laid the groundwork for Sinopec to achieve its goal of becoming China's leading hydrogen company.

Zhang's background: Zhang is a technical expert in gasification, which is important to the development of low-carbon blue hydrogen in China.²⁷⁰ He was probably the only central SOE executive with experience making blue hydrogen from gray hydrogen. When he was president of the coal liquefaction company of Shenhua Energy, China's largest coal company, Zhang oversaw the development of China's first and only project that combines coal liquefaction with carbon capture and storage.²⁷¹ And in his position as party secretary of the Tianjin Binhai New District, Zhang encouraged the zone to develop emerging industries such as hydrogen fuel cells and new energy vehicles.²⁷²

Sinopec's advantages: Sinopec Group has experience producing, storing, transporting, and using hydrogen due to its status as China's largest refiner.²⁷³ One of the reasons Zhang stated for his confidence that Sinopec can become China's leading hydrogen company is its acceleration in building the necessary infrastructure for hydrogen,²⁷⁴ including at Sinopec Group's network of more than 30,000 service stations nationwide. Also, Sinopec is essentially its own power company and can build and buy wind and solar plants, which can be used to make green hydrogen.²⁷⁵

High-level interest: Zhang assumed the chairmanship of Sinopec Group in January 2020, during a time of increasing interest in hydrogen at home and abroad. For example,



in June 2019, Wan Gang—the former Audi executive turned minister of science and technology mentioned earlier in this paper—urged China to invest in the infrastructure for distributing hydrogen as a fuel to spur the development of China’s fuel cell industry.²⁷⁶ In March 2021, China’s 14th Five-Year Plan identified “hydrogen energy and energy storage” as one of six future industries to be developed.²⁷⁷ Additionally, China’s growing interest in hydrogen is occurring against the backdrop of a global competition to develop cost-competitive technologies to produce green hydrogen and secure export opportunities.²⁷⁸

Possible roadblocks: Sinopec may face several challenges in its quest to become China’s leading hydrogen company, including bottlenecks in core technologies such as liquid hydrogen storage, high-end materials, and equipment manufacturing; the high cost of producing green hydrogen; and insufficient policy support.²⁷⁹ There is also the risk that not all of the carbon dioxide generated from the production of blue hydrogen will be captured and stored.²⁸⁰



CONCLUSION

The 30-60 targets have created a new mandate for China's NOCs to contribute to the country's efforts to peak carbon emissions before 2030 and achieve carbon neutrality before 2060. The higher priority Xi himself attaches to decarbonization has also made it a higher priority for China's NOCs. As Li Peng, the director of strategic management at another central SOE, State Power Investment Corporation, said in May 2021, "carbon neutrality is a central responsibility of state-owned enterprises."²⁸¹

The carbon peaking and carbon neutrality goals mean China's NOCs must balance supporting the Chinese leadership's energy transition agenda with advancing its oil and natural gas supply security agenda. To be sure, in the longer term, decarbonization should enhance China's energy supply security by shrinking the role of imported fossil fuels in China's energy mix. However, in the shorter term, the NOCs are trying to thread the needle of preparing for the energy transition at a time when concerns about fossil fuel supply security are elevated in Beijing as indicated by the greater emphasis on this issue in the 14th Five-Year Plan. In short, oil and natural gas supply security almost certainly will remain job number one for the NOCs, but the companies almost certainly will have to continue to demonstrate support for the 30-60 goals too.

The leaders of the three NOCs have indicated that they initially intend to further their decarbonization and energy supply security agendas by focusing on what is arguably the greatest area of overlap: increasing natural gas production. Natural gas is regarded by China's NOCs as a "low carbon" fuel (as compared to coal and oil) that can have intermediate climate benefits if it backs out coal and methane emissions are managed. Since China's geology and Beijing's war on air pollution were already pushing the NOCs in this direction, it is not surprising that the three companies have chosen to make virtue of necessity by giving plans to grow natural gas production—and the share of natural gas in their production mixes—a prominent place in their low-carbon development plans. Moreover, increasing China's natural gas output is featured in the inaugural seven-year plans to expand China's domestic oil and natural gas reserves and production that the NOCs drafted in response to Xi's instruction in July 2018 to enhance national energy supply security.

By identifying increasing natural gas production (and increasing the share of natural gas in their production mixes) as an initial focal point of their emerging energy transition strategies, the NOCs buy themselves some time to figure out how they might be able to best position themselves to survive and thrive in a world where oil and natural gas play smaller roles in China's energy mix. It is unlikely that the companies will stop producing oil and natural gas or that oil and natural gas will cease to be a—if not the—core business. But the NOCs are aware that they almost certainly will need to continue to flesh out their responses to the energy transition. These responses likely will include additional investments in low-carbon hydrogen and CCUS, technologies needed to get China and the world to net-zero emissions.

This report yields three additional insights about the NOCs' energy transition strategies.



First, there is likely to be considerable support for energy transition activities that also advance other priorities of China's leadership. Increasing natural gas output, which also helps improve air quality and enhance energy supply security, is a case in point. The production of blue or green hydrogen is likely another example. Not only would it help reduce air pollution and bolster energy security but hydrogen is also one of six future industries listed in the 14th Five-Year Plan that Beijing wants to develop.

Second, central SOE executives can play an important role in shaping their companies' preparation for the energy transition by championing particular initiatives. It's hard to imagine that CNOOC would have invested in renewables in the 2000s without Fu Chengyu, equipped with his international experience, as the chairman. Similarly, former Sinopec Group chairman Zhang Yuzhuo's resume reads as if he had been preparing over the course of his entire career to lead Sinopec Group as the company seeks to advance China's hydrogen and CCUS technologies.

Third, external actors can shape the transition activities of China's NOCs, within limits. Indeed, some of the initial steps taken by the NOCs to explicitly prepare for a lower-carbon future resulted from exposure to and collaboration with foreign companies. CNOOC's decision to invest in renewables in the mid-2000s, PetroChina's establishment of what may have been China's first corporate carbon emissions trading team, and Sinopec Corp.'s disclosure of more information about its climate change strategy and risk mitigation measures all grew out of the companies' participation in international markets.

That said, domestic forces play a much more important role in determining the energy transition activities of China's NOCs. The 30-60 goals are a case in point. Xi's announcement of these targets has resulted in a big uptick in what China's NOCs are saying and doing about climate change.



APPENDIX: SOURCES FOR FIGURES AND TABLES

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