

Geopolitics of China's Energy Future

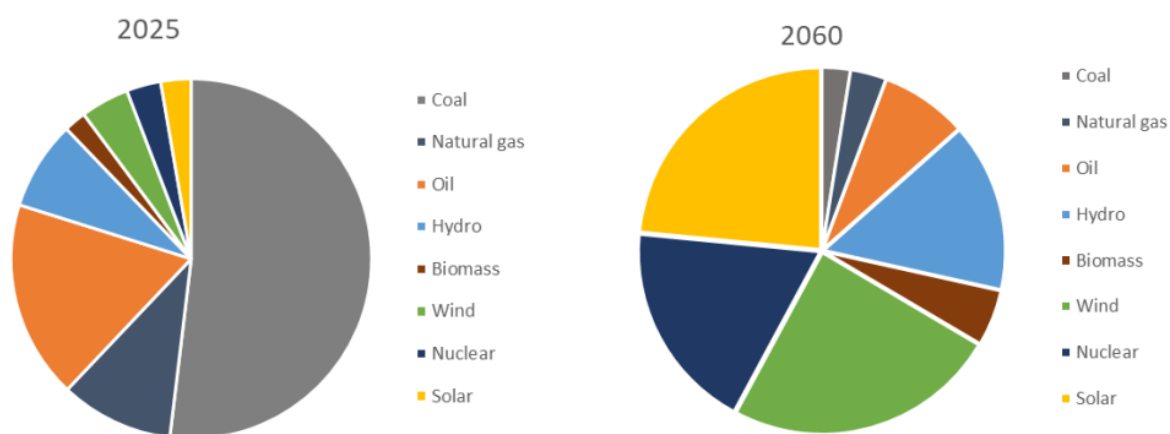
Chetan Hebbale, Rakesh Jha, Jack Payne, Chris Telley

Introduction: How Energy Fits into China's Superpower Ascendancy

China is the world's largest consumer of energy and emitter of CO₂ emissions – nearly double that of the United States^{1,2}. Amidst global pressure to decarbonize its economy, China is concurrently ascending as the world's pre-eminent industrial superpower. The Chinese Communist Party's (CCP) 14th Five Year Plan (2021-2025) makes binding directives to shrink carbon emissions while also forecasting new energy requirements for "high-quality" development and economic growth³. China made a monumental 2060 net-zero pledge that stands as an ideal vision rather than a detailed roadmap, with specifics that will take years to formalize, much less implement⁴. Along the way, China will have to reconcile its pledge with being the world's largest consumer of coal and second-biggest consumer of oil and gas.

These contradictions in China's energy strategy are explained by the imperative for China to maintain economic growth in order to sustain the CCP's legitimacy. The Party set a very optimistic GDP growth target of around 5.5% this year which they seem unlikely to meet⁵. This will continue a trend of year-on-year growth slowing. If China wants to be the world's dominant power, it needs to continue to grow. And a growing economy, one on pace to become the largest in the world by the next decade⁶, will require much more energy. Indeed, China's GDP growth remains tightly coupled with its energy consumption which puts pressure on the CCP to acquire as many sources of energy as it can.

Figure 1: Forecasts of China's energy mix, 2025, 2060



Source: Tsinghua ICCSD

Source: Michael Meiden, "Unpacking China's 2060 Carbon Neutrality Pledge," *The Oxford Institute for Energy Studies*, December 2020, <https://www.oxfordenergy.org/publications/unpacking-chinas-2060-carbon-neutrality-pledge>

The fundamental constraint for the Chinese today is that they are energy insecure. A near term forecast as indicated by Figure 1 sees the CCP continuing to get these sources from coal, oil and natural gas. China's energy portfolio today is highly dependent on both high polluting and imported energy sources – a vulnerability that has been well acknowledged by Chinese policymakers for years. This has driven many of China's flagship geostrategic projects including the Belt and Road Initiative (BRI) which aim to secure maritime trade routes and transportation infrastructure across Africa, Asia, and Europe to guarantee energy access⁷. However, a green transformation is in the cards over the next 40 years. China's overall economic diplomacy and foreign policy will increasingly include discussions of energy and can help relieve some of their constraints for relying on fossil fuels. The government has a familiar playbook of interventions that is used to shore up its actual growth metrics and perceptions of its strengths, using its economic heft for both business leverage and geopolitical gain.

Thus, this paper sets out to answer the question: how can China's energy policy help them meet their growth aspirations and achieve energy security while working towards their emission reduction targets? There are four dimensions of China's current plans for their energy mix that will be analyzed to answer this question along with their geopolitical implications: clean energy, critical minerals, oil and gas, and coal. These represent the principal levers through which China will control their energy future. After framing the current state of these energy sectors, policy recommendations are provided on how best they can leverage the clean energy, critical minerals, and fossil fuel portfolios to achieve their triple aim of energy security, economic growth, and emission reduction.

The Path to Net Zero: China's Clean Energy Roadmap

Clean energy plays a central role in both China's pledge to reach carbon neutrality by 2060 and plans to achieve domestic energy security. Today, China leads the world in deployment of clean power with more than three times as much renewable energy capacity as any other nation^{8,9}. However, this only represents about 16% of China's overall energy mix, a percentage it aims to get to 80% by 2060¹⁰.

In its 14th Five Year Plan (14FYP), China has set a number of binding "green ecology" targets to achieve between 2021-2025 to help achieve this lofty goal. These include: increasing the share of non-fossil energy to 20%, reducing energy consumption per unit of GDP (energy intensity) by 13.5%, and reducing CO₂ emissions per unit of GDP (CO₂ intensity) by 18%. The fact that China has listed the latter two as binding targets indicates a level of seriousness from the central government to commit to decarbonize its energy system over the coming years.

The primary method that China plans to achieve these targets with is through a combination of environmental conservation and construction projects for a "modern energy system" which China claims "will promote the energy revolution, build a clean, low-carbon, safe, and efficient energy system, and improve energy supply assurance capabilities"¹¹. China has laid out five construction project domains: (1) large clean energy bases, (2) coastal nuclear power, (3) power delivery channels, (4) power system regulation, (5) oil and gas storage and

transportation capacity. This section will focus on the first four domains and their geopolitical implications, while the fifth will be covered in the third section taking a closer look at China's reliance on oil and gas for energy security.

Large Clean Energy Bases: Global Sanctions and Supply Chain Constraints

China plans to build nine clean energy bases all across the country which will be composed of primarily solar power, wind power, hydropower, and nuclear. Based on Figure 2, they will be located in the upper and lower reaches of the Jinsha River, the Yalong River basin, the upper reaches of the Yellow River and the Ordos Loop, the Hexi Corridor, Xinjiang, Hebei, and Songliao. Offshore wind power bases will be off the coasts of Guangdong, Fujian, Zhejiang, Jiangsu, and Shandong, while hydropower projects will be focused on the lower end of the Yarlung Tsangpo River.

Mega clean-energy bases to watch over next 5 years

Nine  large-scale clean-energy bases illustrated in China's 14th Five-Year Plan (2021-2025)

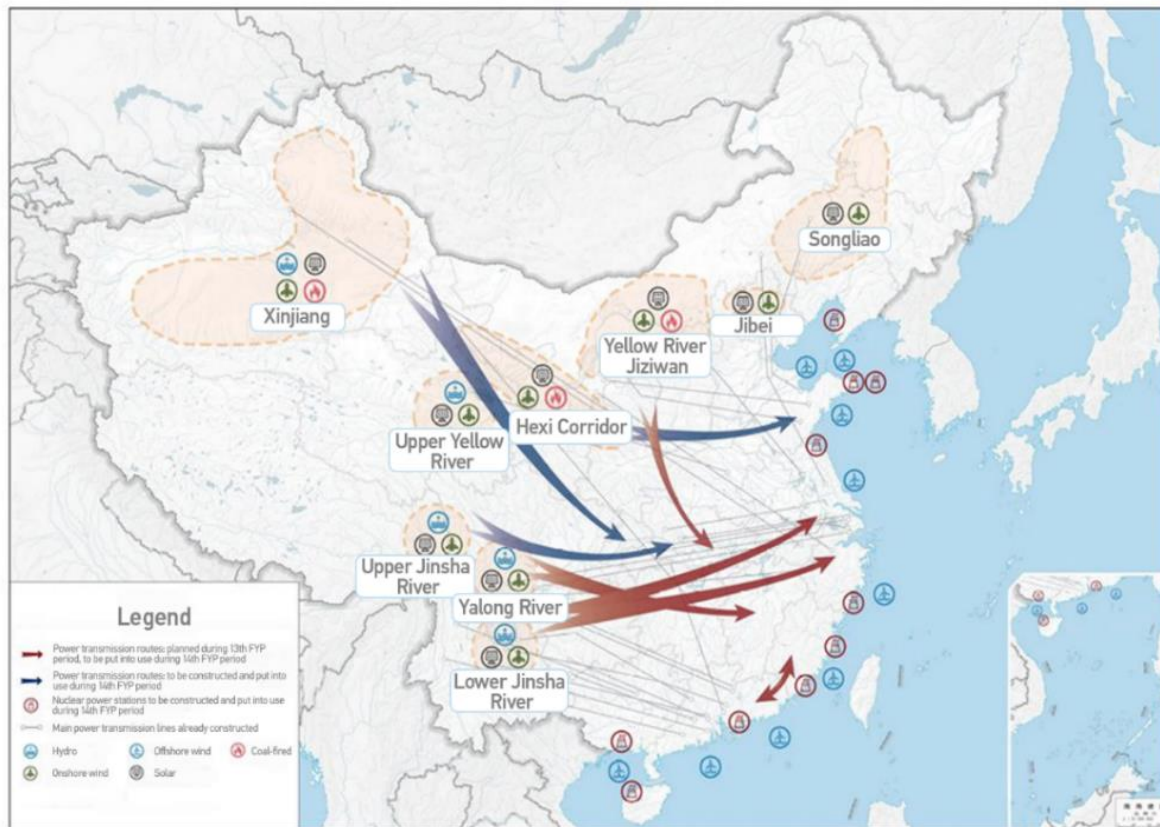


Figure 1 - China's Clean Energy Bases

CGTN

Source: Hu Yiwei and Hu Xuechen, "Graphics: Secret behind China's expansive grid infrastructure, July 4th, 2021, <https://news.cgtn.com/news/2021-07-04/Graphics-Secret-behind-China-s-expansive-grid-infrastructure-11vPCWffSSy/index.html>.

One interesting development in the 14FYP is that it first addresses wind and solar power before hydropower and then nuclear. This contrasts to the 13FYP where hydropower was addressed first, followed by wind and solar and then nuclear¹². The 14FYP also imbued a sense of urgency where they declared that China would “vigorously increase” the scale of wind power and photovoltaic power generation, compared to the 13FYP where they said they would “continue to push forward” development of these resources. The change in sequence indicates that wind and solar are taking the center stage in China's non-fossil energy development, which tracks with the progress those energy sources have made. For example, solar power overtook hydropower in the last five years making it the largest contributor to China's new power generation capacity.

The geopolitical implications of this plan are felt in the potential supply chain constraints for other nations to have access to key wind and solar power components, as well as global sanctions against forced labor further putting pressure on that supply chain. By 2030, China plans to build up to 1.2 terawatts of wind and solar capacity in these clean energy bases - enough to meet all of America's electricity needs today¹³. Doing so will require a massive investment in manufacturing and deploying the necessary components and parts for this energy infrastructure. Luckily, China is home to 8 of the 10 largest solar companies in the world¹⁴. IHS Markit found that China accounts for about 70% of the world's solar panels and an even higher percentage of solar PV cells manufactured each year¹⁵. In the same vein, China produces 56% of the components for wind turbines¹⁶. This has raised concern amongst all nations about the extent of their dependence on China for green technologies and what that means for their continued access in the event that China scales back its exports in order to service massive domestic deployment of renewables.

An additional headwind are sanctions from the U.S. that target the use of forced labor in Xinjiang to produce key components of the renewable energy supply chain, including solar panels component polysilicon¹⁷. These sanctions along with an investigation into tariff evasion has the potential to halt up to 64% of U.S. solar installations planned this year¹⁸. Sanctions can threaten to spill over into access to wind turbine components as well as one of the sanctioned entities, the Xinjiang Production and Construction Corps (XPCC)¹⁹, is also linked to China's largest wind turbine manufacturer - Xinjiang Goldwind Science & Technology Co Ltd²⁰.

Coastal Nuclear Power: Nuclear Exports and Non-Proliferation Risks

China did not build its first nuclear reactor until 1991. In contrast, the U.S. built its first nuclear reactor in 1951²¹. However, China has added the most nuclear capacity in the world in the last decade, building more than 35 reactors between 2011 and 2019, compared to one being built in the U.S. over the last nearly 30 years²². China has the third largest nuclear fleet in the world at 45 GW behind France (63 GW) and the U.S. (98 GW). In the 14FYP, China is targeting an installed nuclear capacity of 70 GW by 2025, with a plan to overtake the U.S. by 2030 with over 120-150 GW. Nuclear power plants are set to produce more than 15% of the country's electricity by 2050.

To do this, China will build an additional 29 nuclear reactor units (Hualong One and Guohe One models), conducting advanced reactor demonstrations such as modular small-scale reactors, 600,000-kilowatt commercial high-temperature gas reactors (HTGRs), and offshore floating nuclear power platforms, constructing low- and medium-level radioactive waste disposal sites, and build spent fuel reprocessing plants²³.

China will not just be developing these advanced nuclear technologies for domestic energy consumption; they will also be exporting them abroad. Nuclear power is “a nexus of clean energy, economic incentives and international prestige” for the Chinese²⁴. This has made nuclear a particular focus of its economic and industrial strategy and driven the expansion of nuclear energy exports under the Belt and Road Initiative. The BRI “virtually requires” China’s nuclear state-owned enterprises to “aggressively pursue overseas marketing opportunities” and is looking to export nuclear technology to countries “where installed energy capacity is limited, economics weak, and industrial levels low, but have good relationships with China”²⁵.

Right now, China is doubling down on its effort to become a leader in global nuclear commerce by proactively pursuing export deals in Argentina, Brazil, the Czech Republic, Kenya, Malaysia, Thailand, Turkey, South Africa, and Saudi Arabia. Thus far, however, the only host to Chinese reactors is Pakistan, where China’s first reactor export came online in 2000. The lack of success in building overseas reactors has largely been due to reactor construction costs. China’s Hualong One reactor is estimated to cost at least \$2,500 per kilowatt. By comparison, China can generate solar energy at a cost of 2.5 cents per kilowatt hour²⁶. In order to bring these costs down, China is actively working to establish an “independent and indigenous” nuclear supply chain by localizing key electrical equipment like instrumentation and control (I&C) systems, valve actuation devices and cables, combined with using foreign exchange reserves to depress export costs²⁷.

The rise of China in the global nuclear commercial landscape raises safety and proliferation concerns in light of growing interest in nuclear power generation from countries with limited economic means and governance capacity. It’s been reported that 28 BRI countries have planned to develop nuclear power²⁸ with China expecting 20 to 30 percent market share in over 40 countries within the BRI²⁹. Though China has come to accept a variety of nonproliferation principles in the recent years, the country is known for generally prioritizing commercial benefits over values in much of its economic endeavors around the world³⁰. Thus, China can expect the International Energy Atomic Agency (IAEA) to come knocking as it aims to ramp up its nuclear export industry.

Power Delivery Channels: Aspiring for Global Grid Integration

In 2015, Xi Jinping debuted a proposal at the United Nations Sustainable Development Summit to radically transform the world’s power grids - the Global Energy Interconnection (GEI). The goal of GEI was to knit together dozens of fragmented electrical grids across Eurasia into a global network, underpinned by ultra-high voltage (UHV) transmission lines to serve as the backbone for clean energy grid. Such a super-grid would enable more efficient load

balancing to transfer primarily solar and wind power to different locations where it may not be sunny or windy on a particular day. From its origins, China has described GEI as not only a “a personal project of Xi Jinping”, but also “a roadmap for combating climate change.”³¹

China is a natural choice to lead an effort of this scale - the State Grid Corporation of China (SGCC) which has been tasked with advancing this goal is the second largest company in the world after Walmart with stakes in major utilities across Asia, southern Europe and Latin America³². China became the largest consumer of electricity in the world in 2011³³ and of the 27 UHV transmission lines that exist globally, 25 are in China³⁴. China is investing \$7 trillion in new power grid construction, creating 200 million new jobs. In the 14FYP, China plans to move massive amounts of clean energy produced at these energy bases through UHV transmission lines crisscrossing the country going from Bailutan to the east coast, and the upper end of the Jinsha river. In addition, China plans to implement the Fujian-Guangdong interconnection network, Sichuan-Chongqing UHV exchange project, and research and demonstrate UHV transmission from Longdong to Shandong and from Hami to Chongqing.

The goal of building these large networks will eventually be to put them at the periphery of its neighbors, including Russia, Mongolia, South Korea, and other Southeast Asian countries. Being able to connect to those grids would grant China leverage over a large economic swath of land - highlighting the role of interconnected infrastructures to distribute political power in the modern global economy. Would other countries allow that to happen?

Inevitably SGCC's involvement in the GEI extends suspicions of a state-backed plot to gain political leverage, but ultimately the world is desperate for transmission investments. SGCC offers technical expertise and cheap capital to help strengthen grid systems to prepare for the clean energy transition. Although there are risks involved, there is no comparable volume of Western finance countering grid investments at this scale³⁵. However, there are still obstacles for China's to achieve its aims of a super grid – primarily in harmonizing regulatory standards and building political support over a vast ecosystem of stakeholders in the power trade market including national utilities, generation companies, civil society and communities affected by transmission siting. Engaging in institution building amongst these stakeholders will need to be a priority for China to construct a continental grid in the clean energy age.

Power System Regulation: Water Diplomacy with Mekong River Basin Countries

China currently stands as the largest hydropower market in the world and will stay that way until at least 2030. Going forward, over half of all new hydropower projects in Latin America, Southeast Asia and sub-Saharan African will be built, financed or partially owned by Chinese firms³⁶. Specifically, China accounts for more than half of global pumped storage hydropower in the world which makes up a core part of the 14FYP to build out energy storage.

Over the next five years, China plans to construct large-scale energy storage pumped-storage projects through hydropower stations in Fuyu, Pan'an, Tai'an Phase II, Hunyuan, Zhuanghe, Anhua, Guiyang, and Nanning. They will complement this with innovative energy

storage demonstration projects such as electrochemistry, compressed air, and flywheel projects. One of the primary implications of this will be felt among the nations downstream of the Mekong River Basin.

The Mekong is southeast Asia's longest river where China has already built eight dams and is planning to build another twenty. Unfortunately, China has a poor record in failing to consult downstream countries on its dam-building projects and also regularly releases large quantities of water from reservoirs with little advance warning, wreaking havoc downstream. An influx of additional hydropower projects, along with climate change induced water conflicts, will aggravate relations and fuel regional instability with these countries, including Cambodia, Laos, Thailand, and Vietnam.

Recommendations for China's Clean Energy Future

Recommendation #1: China should end the use of forced labor for clean tech manufacturing and instead invest in automation and advanced wind and solar technologies.

Western sanctions on the use of forced labor will constrict the supply chain going forward. If the U.S. is able to put pressure on its allies to join in the effort, it will put a significant dent in China's dominance in the clean energy export market which generates substantial revenue every year³⁷. Instead, China should end these abusive practices and invest in automation and advanced next generation technologies with higher efficiency and lower cost to make up for the loss of human labor³⁸.

For solar, China should invest in next generation "thin-film" solar panels with perovskite minerals, cadmium telluride, copper indium, or amorphous silicon – these materials have lower mineral intensity and higher efficiency. Additional innovations for solar that can reduce cost include bifacial panels, n-type or half-cut cells, multi busbars, dual-glass modules and string inverters³⁹. For wind, China can invest in bladeless turbines and airborne turbines⁴⁰ or thermoplastic blade parts⁴¹ to further reduce cost and the environmental impact. By staking a claim to these next generation technologies, China will be able to maintain its export dominance in the clean tech space.

Recommendation #2: China should cooperate with IAEA safeguards on exports of civilian nuclear technology and continue to push the envelope on next generation nuclear reactors including thorium and fusion.

As China continues its plans to export its Hualong One reactor technology to nations who are not party to the Nuclear Non-Proliferation Treaty (NPT) or the Nuclear Suppliers Group (NSG), it should plan to both cooperate in and facilitate stronger IAEA international inspections as a condition of supply for nuclear materials, equipment, and technology. Resistance to these measures will not only engender international backlash and potential sanctioning of the supply chain but will also increase the risks of potential reactor meltdowns, leaks, or covert attempts by these nations to enrich uranium to weapons grade levels.

In addition to the export market, China should build out its nuclear fleet with the aim of supporting its decarbonization goals and retiring fossil fuel generators. To this end, China is already testing out small modular reactors, HTGRs and offshore floating nuclear power. Further innovations in this area could use more investment, including thorium reactors which produce far less radioactive waste⁴², or fusion reactors which produce no radioactive waste at all as it doesn't use uranium or plutonium⁴³.

Recommendation #3: China should coalesce a power trade working group with national utilities, generation companies, and civil societies to develop rules of road for an interconnection roadmap with the goal of global grid integration that can serve the backbone for a clean energy economy.

Global energy interconnections and power trading requires a strong degree of interstate political trust, engagement by national utilities, and support from civil society for generation and transmission projects involved. At its core, the GEI's interconnection vision will combine domestic power sector reforms in countries that are not connected to China's grid with multilateral cooperation on how the power will be shared and distributed. China should take the lead in forging consensus on these issues through a power trade working group with these stakeholders that help establish rules of the road that guarantee there is no political interference in power distribution and instituting a network of politically non-aligned or equal national representation for system operators who manage load balancing.

If China takes the lead in rallying states around grid integration, it will be able to build durable institutions in cross-border power trade and more effectively be able to deploy capital towards socially responsible investments in interconnection that will enable clean energy access to millions who are in energy poor areas.

Recommendation #4: China should engage in water diplomacy with Mekong Basin nations and upgrade from a dialogue partner to a full partner in the Mekong River Commission.

As China plans to build out their pumped hydropower storage plans, they should consult with Myanmar, Thailand, Laos, Cambodia and Vietnam through the Mekong River Commission (MRC). Established in 1995, the MRC has served as a neutral consultation body between member states on the development of hydroelectric, damming and water diversion projects along the Mekong River and its many tributaries. China is currently only a "dialogue partner" of the MRC rather than a full member and thus is exempt from any consultation requirements⁴⁴.

China should upgrade to being a full member of the MRC for two primary reasons. First it will be seen as a symbolic win and China will be perceived as a responsible international partner in the region for developing advanced energy infrastructure. The second is that it will give China and opportunity to use water diplomacy to shape the multilateral dialogue in a way that is favorable to all parties⁴⁵.

Water diplomacy will entail information sharing with a focus on river basin wide development and integration across MRC nations, including tours of dams and hydroelectric stations. This kind of multi-party verification will improve trust and reduce backlash among downstream countries. Additionally, water diplomacy can include facilitating logistical and

financial assistance for downstream countries on their own dam construction, water access, and developing water sharing agreements.

On the Rocks: Vulnerabilities in China's Control of Critical Minerals in the Energy Transition

An energy system powered by clean energy technologies has different degrees of reliance on a range of minerals, which in turn have different criticality profiles based on factors such as price volatility and the stability of the supplier country.

- **Lithium, nickel, cobalt, manganese and graphite** are crucial to battery performance, longevity, and energy density.
- **Rare earth elements** are essential for permanent magnets that are vital for wind turbines and EV motors.
- **Copper and aluminum** underpin electricity networks, with copper being a cornerstone for all electricity-related technologies.

There is a high level of regional concentration for each of these categories of minerals. About 70% of the global supply of cobalt comes from the Democratic Republic of the Congo (DRC), over 80 percent of the global supply of lithium comes from Australia, Chile, and Argentina, and 60 percent of the global supply of manganese comes from South Africa, China, and Australia. Most notably, over 85 percent of the global supply of rare-earth elements comes from China⁴⁶. Chile and Peru control upwards of 50% of the copper produced whereas China and India lead are the world's largest aluminum producing nations.

Dominating the Value Chain: China's Control of Critical Mineral Processing

Where China differentiates itself is in dominating the global critical minerals (CRM) supply chain by strategically positioning itself as leader in the entire value chain of upstream, midstream and downstream processing. China's emergence as a major force along the clean energy technology value chain is partly the result of its resource wealth, which is visible in its dominance of global rare earths, where it has a near monopoly. Where it lacks in natural resources, it has made up with its long-term vision in terms of its industrial policies, state-sponsored investment in R&D, and targeted government support such as beneficial regulations, tax incentives, subsidies, financing by public banks, and import-export quotas.

In an effort to gain a strategic advantage, China has heavily invested in mining projects abroad. For example, Chinese enterprises have invested in cobalt mines and participate in cobalt smelting projects in DRC to secure stable access to cobalt resources. As a result, China accounts for 65 percent of the global cobalt refining capacity, as evidenced in Figure 3 below.

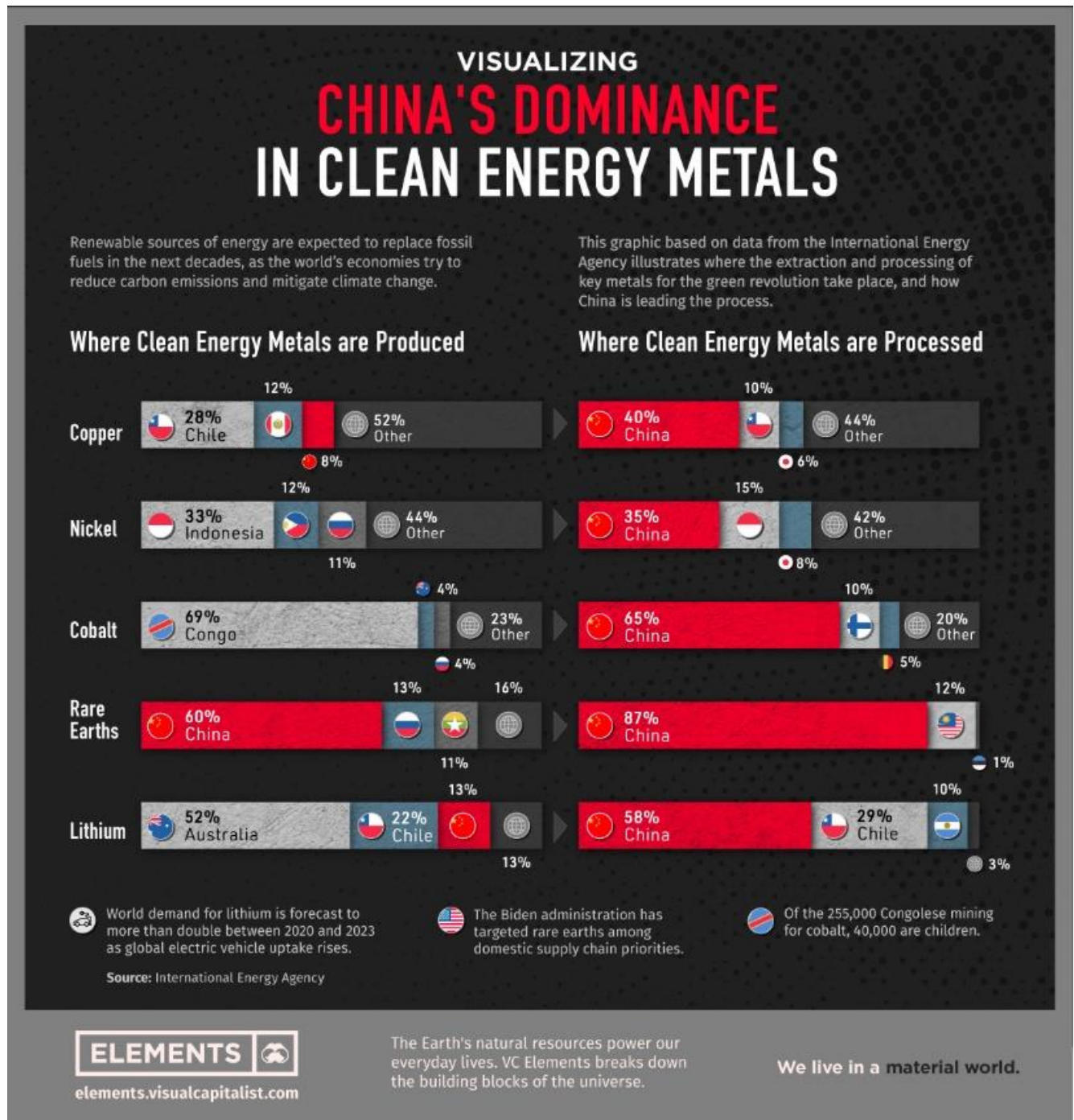


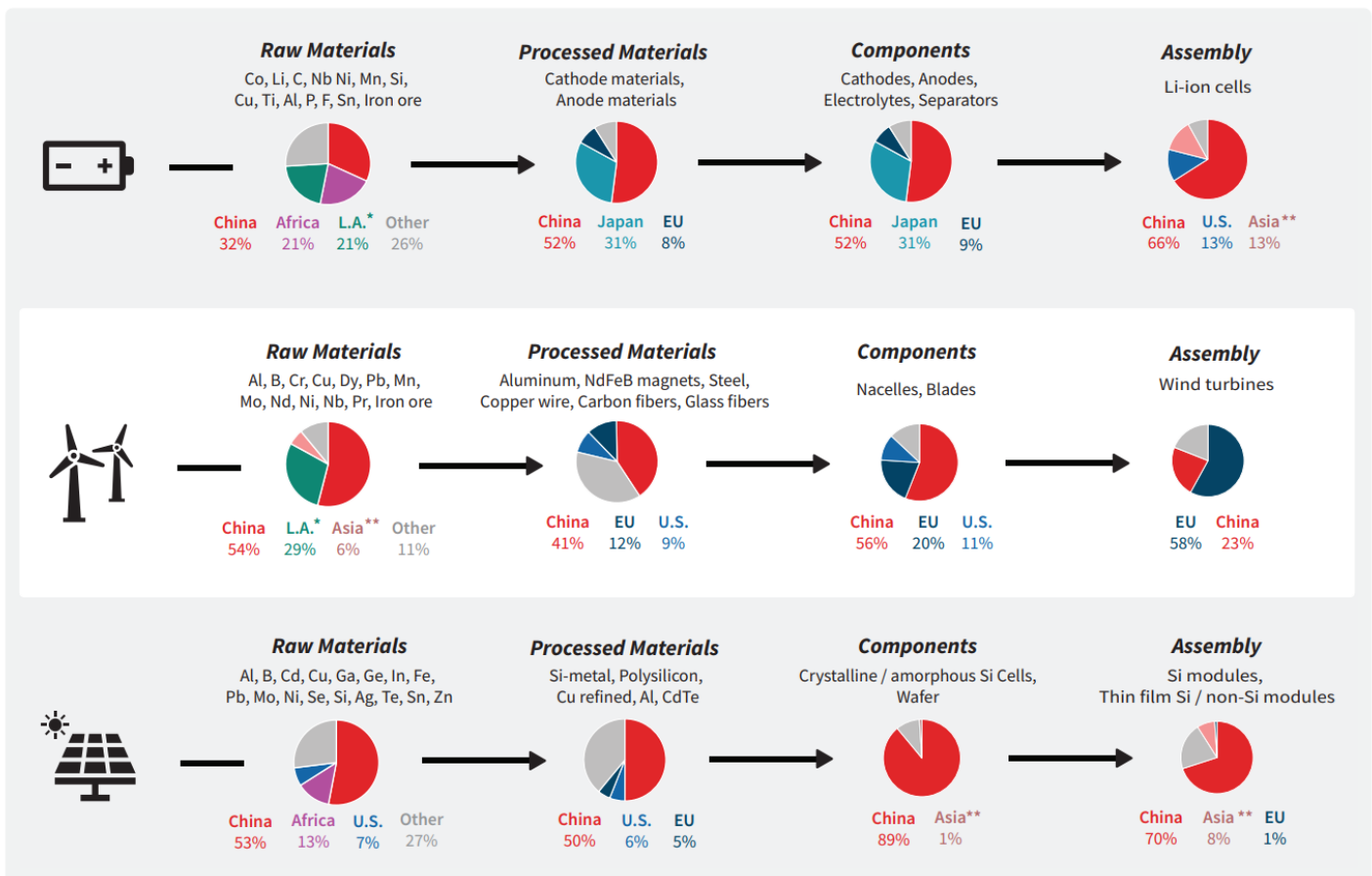
Figure 3 – China's Dominance in Critical Minerals Processing

Source: Bruno Venditti, "Visualizing China's Dominance in Clean Energy Metals," January 23rd, 2022, <https://www.visualcapitalist.com/chinas-dominance-in-clean-energy-metals/>

At a macro level, China's supply chain security gets reflected in its dominance of the two core uses of these critical minerals in the energy domain: non-carbon emitting sources of electricity and energy storage technology. Close to 89% of solar panel components come from China and about 66% of EV batteries are assembled in China. Figure 4 below schematically shows this dominance.

Clean Energy Mineral Supply Chains and Top Global Suppliers

Batteries, Wind, and Solar PV



* Latin America

** Excluding China and Japan

Source: Created by Ian Barlow based on data from European Commission, *Critical materials for strategic technologies and sectors in the EU - a foresight study, 2020* (Brussels: European Commission, 2020).

Figure 4 - China's Role in Clean Energy Supply Chains

Source: Created by Ian Barlow based on data from European Commission, "Critical materials for strategic technologies and sectors in the EU - a foresight study", 2020, <https://www.csis.org/analysis/geopolitics-critical-minerals-supply-chains>.

The Future of Critical Minerals: Exponential Demand with Supply Chain Risks

Looking to the future, supply chain security for the minerals and materials needed in clean energy technologies has become a strategic issue for China, not only because it could affect its pace of renewable deployment but also because clean energy technology has become the latest frontier for geo-economic rivalry. A case in point is the dominance of China in the rare earth minerals which it can exploit. China wants to leverage its hard-earned strength in the critical minerals supply chain through years of strategic planning.

Some scenario building is in order to get a better perspective. At a global level, the IEA estimates there will be a doubling of the demand for critical minerals by 2040, per Figure 5⁴⁷. However, in a sustainable development scenario in line with the Paris goals, there would be need for quadrupling the current production. This shows that China has to consider its own huge appetite for minerals in building geopolitical strategies around the critical minerals.

Total mineral demand for clean energy technologies by scenario, 2020 compared to 2040

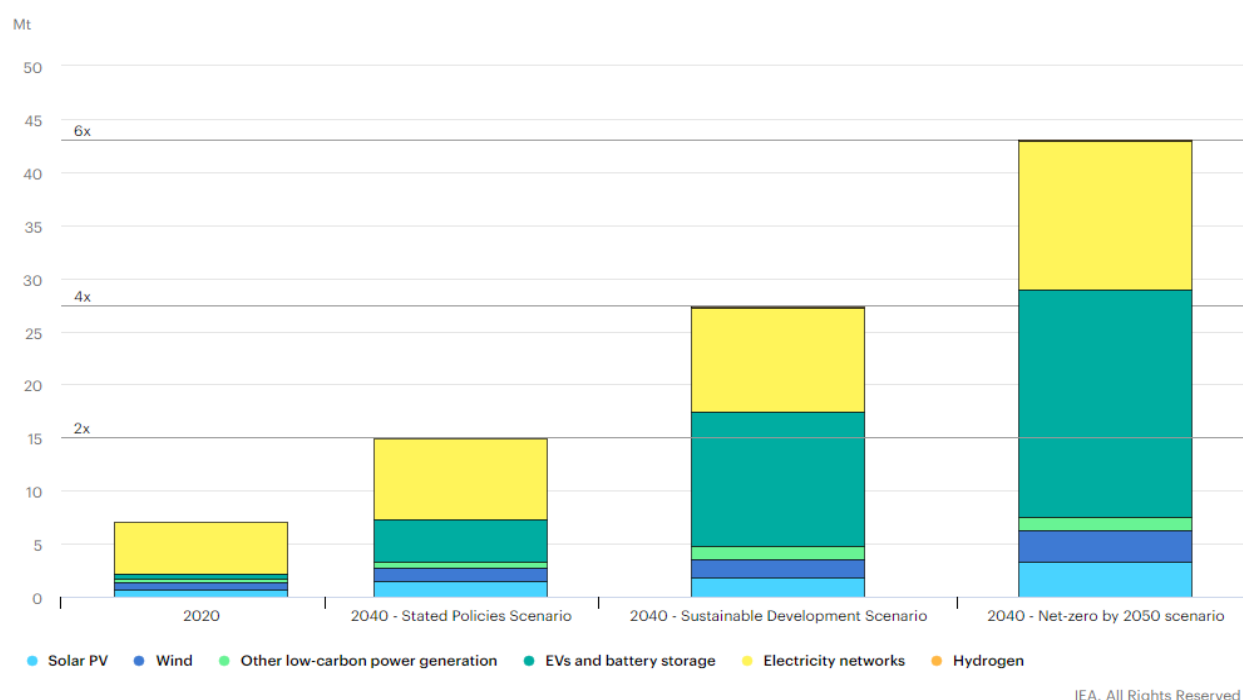


Figure 5 - Total mineral demand for clean energy technologies by scenario, 2020 compared to 2040

Source: International Energy Agency, May 6th, 2021, <https://www.iea.org/data-and-statistics/charts/total-mineral-demand-for-clean-energy-technologies-by-scenario-2020-compared-to-2040>

In 2020, President Xi Jinping announced that China would strive to achieve a carbon emissions peak by 2030 and achieve carbon neutrality by 2060⁴⁸. As the entire power system is the major contributor to national carbon emissions (41.6% in 2019)⁴⁹, it is critical to promote the energy transition by replacing conventional fossil fuel-based energy with renewable energy. However, the development of renewable energy highly relies on critical mineral resources, which may induce concerns on potential minerals shortage and corresponding environmental emissions. Since the supply chains of these minerals are vulnerable because most of these minerals are highly concentrated in a few countries, China has to be alive to the geopolitical dynamics aggravating such risks.

The rapid energy transition has enhanced the prospect of a huge increase in demand for critical minerals well above anything seen previously in most cases which can put pressures on both the availability and reliability of supply. For example, high concentration of production of cobalt in DRC and huge Chinese investments there are subject to risks that could arise from physical disruption or trade restrictions. Estimates say that in a scenario consistent with climate goals, expected supply from existing mines and projects under construction is estimated to meet only half of projected lithium and cobalt requirements and 80% of copper needs by 2030.

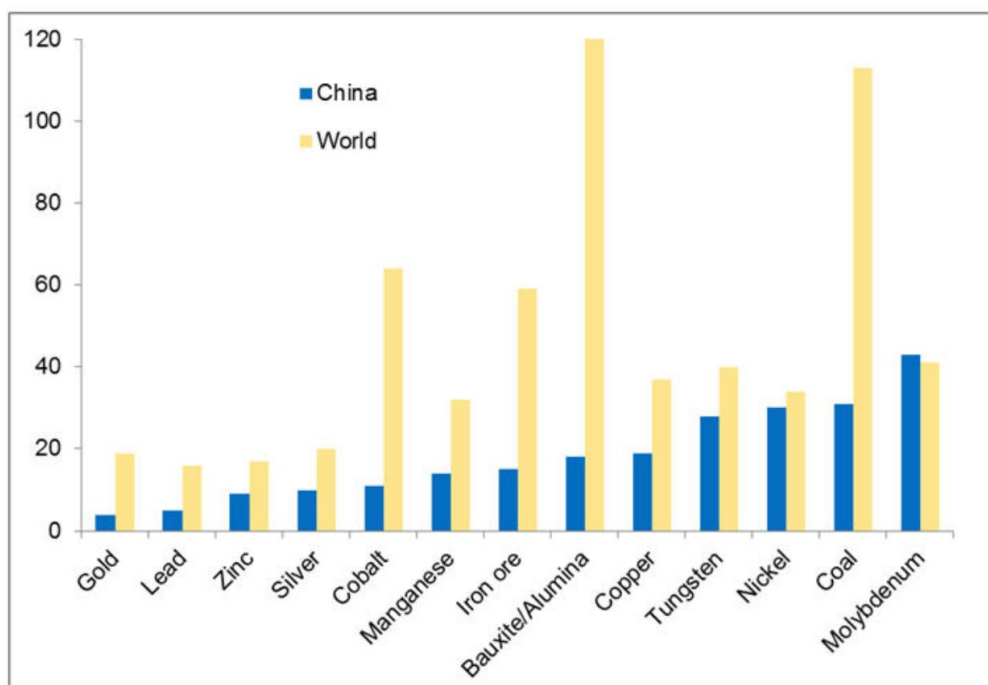
In addition, there are increased concerns with regards to environmental performance and high exposure to climate risks to some of these mining assets. To maintain its dominance China has to look at diversified sources of new supply, invest in technology innovation in the entire value chain, and step-up recycling efforts. There are four overarching vulnerabilities that China faces in the critical minerals space which are listed below along with possible solutions.

China's Vulnerabilities: An Energy and Geopolitical Perspective

First is China's huge burn rate. Burn rate or the reserves-to-production (R/P) ratio represents the ratio of proven reserves of mineral commodities to the current levels of domestic production⁵⁰. Alternatively, the burn rate is the estimate of the number of years that the site of a natural resource will continue to be productive based on current production rates⁵¹. Needless to say, a lower ratio (meaning higher burn rate) is a matter of concern. Figure 6 shows that China is in the "red zone" for future supplies of nearly all crucial minerals facing a rapid depletion of its local mineral resources.

Higher burn rate could lead to future shortages. Apart from strategic stockpiling, China has its two resources, two market policy⁵² wherein it distinguishes between domestic resources and markets from foreign ones. Thereby trying to penetrate and exploit global markets and production while keeping its resources at home fairly insulated.

R/P ratio for China in comparison to world average R/P, years



Sources: USGS, BP, country and other reports.

Figure 6 – China's Burn Rate of Critical Minerals

Source: Vladimir Basov, "China is burning through its natural resources," April 26th, 2015, <https://www.mining.com/china-burning-natural-resources/>.

Second is increased global environmental and social concerns. There is enhanced scrutiny around some of the practices around critical minerals. The use of child labor in cobalt mining in DRC is a case in point⁵³. From an environmental perspective, minerals such as copper and lithium require very high quantities of water and have high exposure to climate risks⁵⁴. China has to look at supply chain due diligence as there is a worldwide push for traceability and transparency.

Third, is declining resource quality, Extraction from bad quality ore means more costs and more energy consumption, leading to higher GHG emissions⁵⁵. This calls for innovation in extraction technologies.

Fourth is a worldwide race for innovation. There is a push for reducing material intensity in the clean technologies like EV batteries. For example, with technological innovation there is a scope for 40-50% reduction in use of silver and silicon in solar cells⁵⁶. It is also essential for China to improve the recycling rates through a circular economy⁵⁷. However, several challenges exist since recycling activities are always associated with high costs and technological and institutional barriers. China should prepare more feasible policies to facilitate the

implementation of circular economy, such as financial subsidies, capacity building efforts, research and development support, and information sharing.

From a geopolitical perspective, there is high geographic concentration of resources and China should look at future diversification of supplies. Also, it is estimated that it takes about 16 years from discovery of a mine to production⁵⁸. So unlike fossil fuels, fast ramping up of production is a challenge with minerals. In response, China's national mineral resource plan for 2016-20⁵⁹ called for establishing a range of capabilities including a warning mechanism for the rare earths wherein the industry was called to safeguard against various causes for potential disruptions and a more systematic demand supply analysis.

The export control law introduced in 2020⁶⁰ also aims to restrict exports of controlled items to protect China's interest and security. And finally with the U.S., E.U., Japan, and India finally awakening to the importance of critical minerals, the stranglehold which China has may not last for long. It is said that there are ample minerals to be found globally, it's just that China has moved fast and filled the financial gap in the past⁶¹.

Recommendations for China's Critical Minerals Future

Recommendation #1: China should intensify acquisition of critical minerals globally through the BRI.

China explicitly recognizes the link between critical minerals on the one hand and its geopolitical and climate goals on the other. China views its current strength of CRM supply chains as a geopolitical leverage. The BRI has been a big driver of its search for minerals specially in Africa. Chinese banks made up one fifth of all lending to resource rich countries like Angola, Djibouti, Ethiopia, Kenya, Congo and Zambia⁶². The BRI initiative offers a win-win partnership to some of these resources rich nations and is a reliable alternative to Western funding which they (recipient nations) perceive as norm setting. The Chinese policy is also in contrast to the Russian strategy, which is driven by military support to some of the governments in Northern and Western Africa through mercenaries, in times of conflict, in return for lucrative mining deals⁶³. However, now with the full force of Western sanctions on Russia taking effect, China can look to occupy the space which Russia will cede in these parts.

China has also increased the BRI footprint to Latin American countries like Chile, Bolivia and Brazil who are all warm to increased Chinese investment. Chinese companies are also interested at Afghanistan's untapped mineral abundance, including its estimated vast reserves of copper and lithium⁶⁴. The Taliban is blocked by Western countries in using its foreign currency reserves in international banks leaving them with hardly any other choice than to deepen and expand their political-economic ties with China. For China, it offers the perspective to expand its global dominance of the world's most important CRM supply chains and reduce its dependence on more vulnerable maritime supply routes for its CRM imports from Australia, whose increased engagement with QUAD may prove to be a strategic barrier.

Recommendation #2: China should leverage its strength in rare earths especially in light of rising E.U. dependency.

China has yet to seriously flex its strategic advantage since it cannot currently afford to alienate its top trade partners. However, there is increased competition over critical mineral supplies and all major economies are re-examining the security of their supply chains. Countries like the U.S. are looking at exploring mining globally akin to China, whereas E.U. and Japan are focused on favoring innovation to drive the reduction, reuse, and recycling of materials⁶⁵.

China is aware of these developments and in April 2020, Xi called for the need to enhance the dependence of the Western countries on China and simultaneously develop powerful retaliation and deterrence capabilities against supply chain cut offs by foreign parties. In line with this, China needs to keep the E.U. dependent on it as a strategic buffer against any future sanctions planned to be imposed by the US. Europe represents just 5% of global mining in 2020 and is the only region in the world with a declining mining industry⁶⁶. At present, China provides 98% of the EU's supply of rare earth elements, and around 62% for all its defined 30 CRMs as of 2020⁶⁷. This needs to continue.

Recommendation #3: China should invest in power projects in Africa and Latin America.

Chinese companies need to continue investing in wind and solar power projects in Africa as part of its BRI initiative⁶⁸. Of the roughly \$575 billion invested or promised under BRI for 2019, nearly half has gone to energy projects according to the World Bank⁶⁹. This way China can apply its renewables manufacturing muscle into deals that let its companies supply electricity in African and Latin American countries. They can use the energy transition to their advantage by getting a ready market for their renewable energy strength and at the same time getting access to the vast resources in some of these regions. This lock-in relationship will provide them the necessary security in the supply of critical minerals.

Recommendation #4: China should leverage its strength in critical minerals to extract better terms on other energy or trade fronts.

China should strategically exploit their CRM supply chain strength with their other energy needs. There is a global drive towards the energy transition and China can position itself strongly in negotiations given its dominance in the critical minerals space. It can act as leverage against the U.S. to roll back its protectionist policies like sanctions and tariffs in semiconductors. The U.S. is pushing its "Chiplomacy"⁷⁰ by building strategic partnerships around the globe in semiconductor value chain. China can leverage its strength in minerals in building its own strategic partnerships as China views semiconductors as a national security asset and not just some benign electronic commodity.

As part of this effort, China can push for effective international partnerships that can mitigate any supply chain risk for partner nations and also position China as a global force in line with their long-term vision. Further developing their midstream and upstream processing capacities will allow them to command the entire value chain for the foreseeable future providing them virtually permanent leverage on other trade issues.

Paying at the Pump: Oil and Gas Churns China Forward

At the end of 2021, China declined to mandate a hard energy target and has, instead, emphasized the need to secure petroleum imports.⁷¹ That means Chinese oil consumption will not peak, as predicted in the past—set for 2026—but continue to grow.⁷² Even as China locks down in the near term, in CCP's economic mandate will require more oil and gas. This sector will be the lynchpin of China's plans for energy security at the expense of its transition goals.

China has three options (1) curtail domestic demand or look to domestic expansion, (2) find and invest in new fields in emerging markets, and (3) increase imports from existing major suppliers. The most likely is the third, featuring long-term contracts with Russia, through "Teapot" refineries, and enlarged spot trading with the Gulf—a mix that will allow China to exploit emerging market opportunities while mitigating high global prices. The major problems with domestic production are currently low returns on investment and the risk of escalation in disputed zones. For emerging markets, lag time to the arrival of the product and rising political risk are the chief issues. Geopolitical action is required as demand-side policies are lagging.

Domestic Market: Lackluster Efficiency Measures and Limited Exploration Options

The CCP has already attempted to moderate the consumption of oil through efficiency and substitution. The state has implemented high fuel efficiency standards, but progress has been counteracted by increasingly popular SUVs and pick-up trucks.⁷³ New capital controls have curtailed increases in areas like rail, which would lessen some of these costs.⁷⁴ Though coal consumption peaked in 2013, oil has been rising and electric vehicles might not cap oil demand until 2034.⁷⁵ Also, large amounts of fossil fuels are consumed in places—like industry, air transport, and commercial heating—that are currently outside of the energy transition space, meaning that Chinese demand will continue while it 'goes green.'⁷⁶ As of this writing, COVID lockdowns are driving down demand for oil. However, there is no reason not to expect a repeated surge in consumption as this wave of lockdowns wanes; China still looks to increase year-on-year oil consumption for the foreseeable future.⁷⁷

China's additional oil and gas is not likely to come from internal sources. The CCP has tried to make up the shortfall domestically. In 2020, China's National Oil Companies increased their capital expenditures by 18 percent to boost domestic oil exploration and production, but little seems to have come from it.⁷⁸ China has a history of disappointing domestic petroleum exploration.⁷⁹ The primary "domestic" alternative locale that China could look at is the South China Sea, which possesses large reserves but is fraught with escalation dangers. The CCP has repeatedly tried to expand its drilling efforts there, creating tensions with neighbors like Japan and Vietnam, but has not significantly expanded.

China's National Offshore Oil Corporation (CNOOC) has been looking to expand in offshore drilling for some time. Unfortunately for the CCP, the company is having trouble finding partners, as they look to less risky areas and financing, as domestic debt markets tighten. These factors combine in projections that show production in the coastal blocks

expanding, optimistically, by only a third in the next decade.⁸⁰ China must look to foreign sources to power its growth. The CCP has managed a two-decade effort to diversify its energy import suppliers as well as transit routes.⁸¹ CCP energy diplomacy has been largely successful in securing the requisite supply chains for petroleum and the “green” technologies that will replace it, especially in Africa.⁸² The result is that China is capable of foresight and flexibility in foreign oil markets. This was demonstrated by Chinese firms snapping up oil at a bargain as the COVID-19 crisis drove prices into the basement.⁸³ That kind of fire sale is not going to help China out of today's crunch as prices are currently stratospheric. With prices so high, the choices for getting more oil will not be so much a question of diversification as one of desperation—oil and gas from any source.

Emerging Markets: Long Timelines and Instability

China's increased energy supplies are unlikely to come from emerging markets. Going down the list of potential candidates shows increasing geopolitical risks and long lead times. Venezuela is the case in point for China's portfolio risk in terms of instability and the requirement for long investment. Nigeria and Angola are classic Chinese partners but much of the current shortfall in OPEC+ comes from these two, whether due to violence or corruption, the risk here makes them less likely candidates.⁸⁴ Iraqi and Libyan oil flows are tenuously stable but face serious challenges to expansions.⁸⁵

Offshore exploration offers a hedge against some geopolitical risk. Guyana and Mozambique have offshore efforts underway, but these offer considerable risk as well as a lag between investment and arrival of the commodity. Projects in Mozambique have been plagued by instability in the country's north. Foreign companies have evacuated workers and pressured their governments to support the counterinsurgency effort whose opponents threatened greenfield LNG investments. Though French and African Union efforts have disrupted the militants, prospects for large expansions remain unclear.

There are other deposits, farther afield, which may hold more promise. In Guyana's Stabroek block, ExxonMobil has found a massive source of sweet crude which may eventually produce over a million barrels per day.⁸⁶ CNOOC has a \$5 billion stake, about 25%, in the project and took its first deliveries in early 2020.⁸⁷ Unfortunately, Guyanese production has had technical and geopolitical issues, and will take time to ramp up; even the most optimistic voices have major production starting in 2025 and more realistic projections say 2030.⁸⁸

One might expect Iranian petroleum to be significant to China's future, as that relationship has blossomed recently. Even if a nuclear deal is (re)signed, Iran's boatloads of storage will only generate a temporary surge. Until Iran receives in the realm of \$160 billion in additional investment, no significant sustainable increases will occur.⁸⁹ Emerging markets will thus offer little short-term relief for China.

Existing Markets: Working with the Gulf and Russia

The next, and best, option for China is to go with existing major producers. Though the U.S. is an increasingly dominant producer, friction with multiple administrations and Washington's desire to send fuel to Europe amidst the current crisis, make American energy a poor option. Russia has been China's biggest source of oil since 2013, with over 60% of Chinese imports from Russia coming in the form of oil and gas.⁹⁰ Saudi Arabia was in the top spot before 2013 and very recently regained this position.⁹¹ Of the two, Russia is the cheaper but more volatile and, ironically, harder to access option.

Russia has enormous proven oil reserves and the largest reserves of natural gas on Earth, at 20% of the global total.⁹² Last year, China signed a record number of LNG term contracts, up over 500%. Gas imports are already up 10 percent on those numbers, for this year. Incremental volumes, flowing through the Russia-China natural gas pipeline, continue despite the international condemnation of Moscow's war in Ukraine.⁹³ China is increasing pipeline imports of Russian gas, with further volume expansion expected as more pipeline facilities come online.⁹⁴ Given the 'special relationship' there is little need to expect something different with oil and the war.

Given the deep discount on Russian oil resulting from Western sanctions, many experts believed China would rush to take in cheap flows. With some Russian loads being discounted by up to \$35 per barrel against the Brent price, the Chinese were expected to reap a discount and some sort of bilateral political guarantees.⁹⁵ However, that has not occurred, at least for the big Chinese companies. China's oil 'majors' have largely stayed away from increasing Russian interaction. The notable, but discreet, increase in purchases of Russian oil are coming from China's independent refiners.⁹⁶

After the February invasion of Ukraine, caution abounded. In late March, Sinopec suspended talks in Russia for major investments, heeding government calls for caution over sanctions.⁹⁷ At the end of April, Shell was reported to have begun negotiations with a consortium of Chinese state-owned firms to offload its 27.5% stake in the Sakhalin-2 LNG project.⁹⁸ Just two days later, the Chinese squashed the story with CNOOC's CFO saying that no new deal was in the offing.⁹⁹ While still honoring existing contracts, China's state-owned oil companies have shied away from Russian cargoes and deals in order to avoid sanctions.¹⁰⁰

Quite notably, the sanctions concerns have not rattled China's "independent" refineries, so-called Teapots because of their small size relative to their state-owned peers. Teapots emerged in 2015 and they grew remarkably, featuring more flexible business models and higher operating rates than the national firms.¹⁰¹ Teapot refineries are showing promise as a conduit for China to take advantage of cut-rate Russian crude without risking the health of their more international firms. These agile refiners are using alternate payment channels like postdelivery settlement and cash transfers in yuan.¹⁰² Teapot firms entered the Shanghai International Energy Exchange in 2018, meaning their capital flows are more resistant to US financial controls than the larger, national bank-reliant, state-owned firms.¹⁰³ However, Teapot

refineries cannot change China's flow issues. Although Russia and China share a long border, it is not specifically well served by pipeline infrastructure to the degree China needs to build spare capacity. In the long term, more pipelines and refining infrastructure will be needed to truly exploit Russia's failing commercial links to the West. In the meantime, Russian oil may provide a stopgap for China, but it will not entirely answer the CCP's requirements.

China's dependence on imported petroleum is growing and, at least according to the U.S. Energy Information Administration (EIA), China's only credible source of its current level of imports is the Middle East.¹⁰⁴ Historically, Saudi Arabia has maintained the greatest spare capacity in the world, around 1.5 - 2 million barrels per day depending on management decisions.¹⁰⁵ Notably, this spare capacity is quite movable, especially since China owns the world's second-largest tanker fleet.¹⁰⁶ The Saudis also are joined in spare capacity, but at much lower amounts, by other Gulf producers like Iraq and the United Arab Emirates.¹⁰⁷ Saudi Arabia currently sells about 25% of its oil production to China and has hinted at allowing China to pay oil in yuan, rather than dollars.

These are positive signs for the Gulf as a potential supplier for China's expanding energy needs. Where US and European officials have failed to convince the Saudis to boost production, China may succeed. Perhaps, their answer will be to boost or discount Chinese arms transfers, which had already tripled between 2016 and 2020.¹⁰⁸ The presence of PLA forces in the region could also influence the Gulf countries but might push the CCP uncomfortably past the norms it established with counter-piracy efforts, as the opposing sides in the Persian Gulf are both partners of China's. Will China actually succeed in this effort? It remains to be seen, but it is evident that the Gulf nations are unhappy with the Americans and with the right set of incentives – say cheaper access to critical minerals for their green transition plans – they may be willing to boost supply of oil for the Chinese in current tight markets.

Whatever negotiations are required, physical conditions suggest that Russian petroleum, cut off from Western markets, and Gulf flows, with their immense spare capacity, represent the most reasonable sources for China's needs. Given some analysts' expectation of a downward trajectory for prices through the year, to perhaps \$60 USD per barrel, it is in China's interest to solidify spot buying privileges for Gulf products while also pursuing long-term contracts for Russian oil and gas, while it is cheap.¹⁰⁹

Recommendations for China's Oil and Gas Future

Recommendation #1: China will need to protect growing financial and diplomatic ties to the major producers; consider adapting security relations with the Gulf and Russia.

Regardless of their lofty clean energy goals, its economic mandates give the CCP little choice but to conditionally double down on oil and natural supplies from existing gas providers. Stymied domestic production and the infeasibility of expanding emerging market production, limit the China's options in the short term. The CCP must protect its growing financial and diplomatic ties to the major producers - the Gulf and Russia – who the most likely sources of

China's supply expansion. The CCP should consider adapting security relations with the Gulf, using its critical minerals dominance as leverage for more access to oil, and supporting geo-economic goals while edging out the West. Diplomatic support should help secure short-term contracts that do not lock in the effects of global volatility.

Recommendation #2: China should employ "Teapot" refineries to bring in discount Russian shipments while also protecting the larger National Oil Companies from sanctions risks

Teapot refineries are showing promise as a conduit for China to take advantage of cut-rate Russian crude without risking the health of their more international firms. These agile refiners are using alternate payment channels. Diplomatic support should help "private" actors to lock in long-term contracts though additional infrastructure development, for the former, and non-energy commitments for the latter, will be required.

Recommendation #3: China should engage emerging market economies like Iraq, Guyana, and Mozambique for longer-term supplies.

Without infringing on imports and while waiting for domestic results, the CCP should accelerate ties with up-and-coming producers like Iraq, Guyana, and Mozambique who have some instability and/or long lead times but proactive governments and security structures that are less subject to great power politics. If the CCP continues Deng's tradition of commercial and political flexibility, China can easily meet its national mandate for energy.

Dirty Secret: Coal Continues to Drive China's Future Energy Security

56% percent of China's overall energy mix and 68% of China's electricity generation comes from coal¹¹⁰. In 2021, China produced 5.7% more coal and imported 6.6% more coal in order to meet its largest increase in total energy consumption in a decade¹¹¹, partly induced by the COVID-19 pandemic. Additionally, recent energy shortages lowered the production capacity of energy-intensive industries such as steel, cement and aluminum, resulting in higher commodity prices¹¹². The net effect was that China was mired in an energy crisis during which it struggled to meet domestic energy consumption and thus facilitating coal's reemergence as the country's critical energy source for achieving energy security in the near term.

China's past year of struggling to reconcile its coal production with energy consumption sheds light on a greater issue of imbalance within the coal sector. Recently, three new coal mining projects in Shaanxi and Inner Mongolia were recently approved which Chinese environmentalists quickly objected to as the plans to further treat coal as a fundamental energy source in China undermines their climate goals¹¹³. As China aims to abide by its 2060 carbon neutrality pledge by imposing power tariffs for coal usage leaving power plants with no incentive to increase production knowing they will lose money for any coal turned into electricity¹¹⁴. Nevertheless, in order to prevent further energy shortages, government agencies continue to support policies to boost coal production which signals that coal may remain the dominant energy source in the years to come. Indeed, the 14FYP strongly indicates China's continued reliance on coal to meet domestic energy demand.

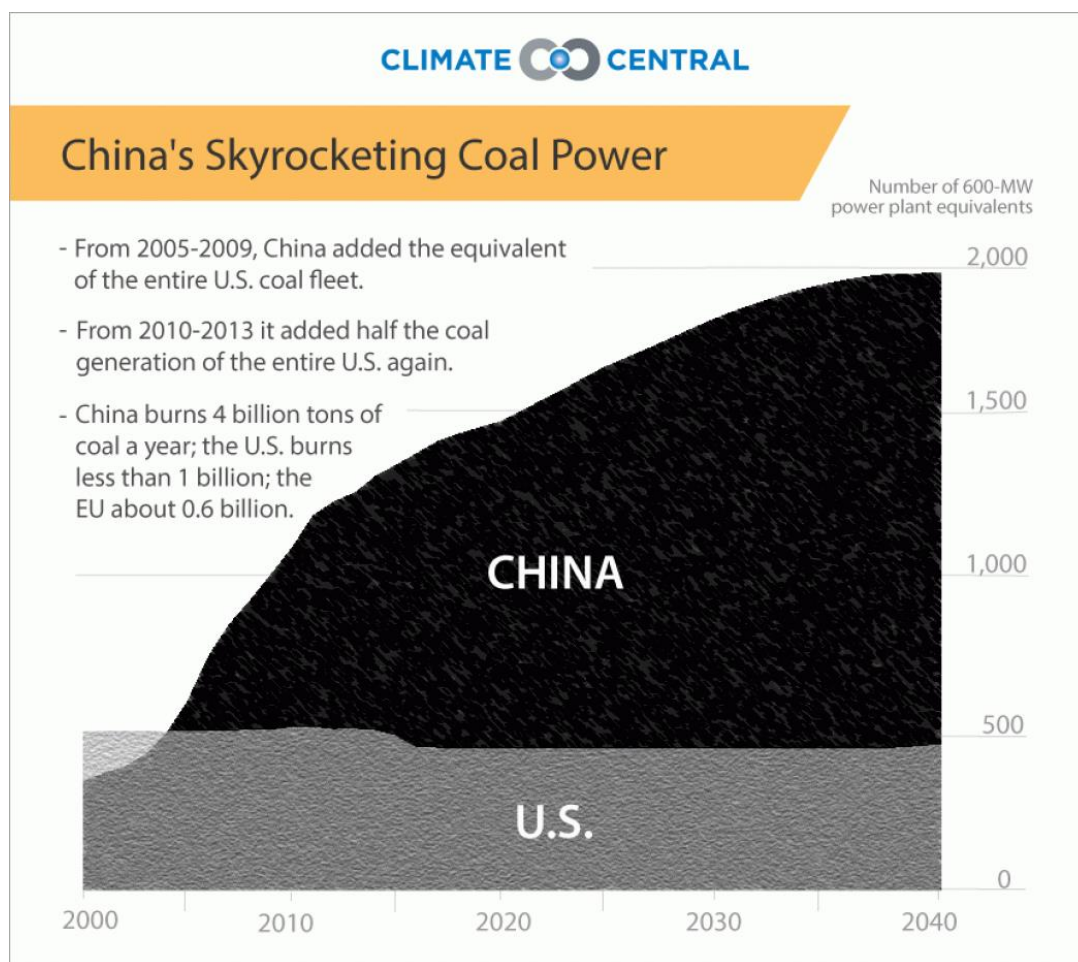


Figure 7 - China's Coal Use

Source: Climate Central, "China's Growing Coal Use Is World's Growing Problem," January 27th, 2014, <https://www.climatecentral.org/blogs/chinas-growing-coal-use-is-worlds-growing-problem-16999>.

Overall, coal highlights a critical tension between China's goals of energy security and carbon neutrality. This tension is reflected between provincial governments and the central government over coal-powered development¹¹⁵. While provincial governments want to boost coal output to raise GDP, China's central government is careful to favor policies in fear of allowing the production of coal within low-efficiency power plants to continue.

Nevertheless, Xi asserted that "coal is the dominant energy source to ensure energy security" and appears committed to participating in the energy transition - *slowly*¹¹⁶. For now, maintaining energy security through coal consumption and production is the path forward for China, particularly as they are still on track to meet key energy and climate target pledges.

Alternatives Are Heating Up: Renewables Outcompete Coal

As the world's biggest carbon-dioxide emitter, China generates 49% of the world's coal-fired electricity. They do not appear to be falling into the projected trend of a decreasing demand for coal overall¹¹⁷. However, with the rapid growth of renewables in China, it is now cheaper to build new wind or solar capacity than continue to operate 60% of existing coal plants¹¹⁸. Accordingly, China is aiming to halt the production of coal within low-efficiency coal plants and simultaneously retrofit the existing infrastructure for power storage and renewable energy production.

While it is true that the wind and solar sectors throughout China are vast, the capacity of their power generation is less than half of coal's total¹¹⁹. This is perhaps why despite the 14FYP signaling to focus on limiting its carbon intensity, it also implies that coal will figure strongly into China's energy mix. Still other types of energy production continue to add to the capacity of the electricity grid. As mentioned in the first section, 14FYP provides substantial funding targets for research and technological innovation for clean power, nuclear power plant components, and hydropower¹²⁰.

Failure to Phase Down: China's Enduring Reliance on Coal

The emphasis of the government to not restrict coal usage is indicative of the fact that energy security is its main priority. While analysts predicted China's phasing down of coal production would accelerate, it appears that China may simply be transforming how they facilitate coal production. Firstly, coal production appears to be shifting inland, closer to coal fields where it is made into synthetic natural gas, coal-based gasoline, chemicals and fertilizers¹²¹.

Moreover, China has been a net coal importer since 2009 which has greatly impacted its relations with other countries. China may slowly be transitioning away from coal for domestic power generation, but it is simultaneously facilitating a major expansion of coal power internationally by funding coal power plants in countries such as the DRC and Chile¹²². Even if coal use in China is expected to trend downwards, they are able to effectively export the coal sector through their capital and expertise and subsequently re-import the coal to meet energy demand.

The exportation of China's coal production is a strategic investment on behalf of the government to mitigate supply disruption and meet growing energy demand. It could act as a tangible step towards achieving the 2060 Carbon Neutrality Pledge provided that importing coal slows down overall coal use compared to domestic production¹²³. The net effect is that China is knowingly becoming dependent on these countries' coal exports to meet its energy demand.

If taken seriously, Xi's comments allude to a soft transition from coal to more renewable sources of energy and it necessitates the uninterrupted import of coal from abroad - an act that is easier said than done. During a diplomatic dispute between Australia and China in 2020, China banned Australian coal imports. Indonesia, another large source of coal for China, banned their coal exports in 2020 as they faced energy security concerns themselves. Both instances

caused China to boost domestic coal production to record levels in 2021 and highlight the adverse effects of depending on coal imports to meet energy security.

Recommendations for China's Coal Future

Recommendation #1: China should reduce its coal imports and overseas coal financing, requiring a reframing of its bilateral trade relations with key importers.

Abiding by the 2060 Carbon Neutrality Pledge will require China to fundamentally change its energy production and supply. Clearly, coal is currently the most prominent source of energy for China as they try to achieve energy security. However, China has been a net coal importer for more than a decade due to the fact its domestic coal consumption consistently outpaces its domestic coal production capacity. Meanwhile, 17% of current overseas coal projects are financed by China resulting in the Chinese facilitating other countries' dependency on coal abroad¹²⁴.

Due to COVID-19, Chinese energy demand reached an all-time high which required China to increase their domestic coal production to an all-time high as well. Subsequently, President Xi asserted that coal will remain a critical energy source into the future and called for coal's slow phaseout. Both coal's slow phaseout and importance to China's energy security are reflected in their 14th Five Year Plan. As such, identifying several of the more prominent coal-related goals within the plan itself will help to outline pertinent recommendations as to how China can achieve energy security by slowly phasing out coal.

As China's trade relations with countries such as Australia and Indonesia have been primarily centered on coal, the country should explore alternative trade opportunities to ensure those bilateral trade relations with important regional actors remain intact¹²⁵. Specifically, replacing coal trade with renewable energy sources or critical minerals could act as a viable next step.

Recommendation #2: China should institute a coal cap of roughly 30% of overall power generation by 2030 in order to reduce overall dependence on coal imports and help ramp up renewable energy to fill the gap.

Coal's slow phaseout has been partly permissible due to the fact that China continues to meet key energy and climate targets, such as in carbon and energy intensity per GDP¹²⁶. However, these climate targets will continuously be met as long as economic growth outpaces emissions, a trend that does not look like it will change any time soon. While the plans to improve the efficiency of coal production can help provide further energy security, details regarding reductions in coal production or consumption are absent from the 14FYP.

As a result, China should implement coal consumption caps in order to 1) show its citizens and the international community that it is committed to reducing its dependence on coal and 2) act as a more instructive mechanism in reducing their dependence on coal through concrete coal cap targets. An analysis by the IEA found that in order for China to meet its 2060

net zero pledge would require a cap of total coal-fired generation of no more than 30%, nearly halving today's contribution, by 2030¹²⁷.

Interestingly, China also plans to promote the concentration of coal production in resource rich areas to help control the efficiency and pace of coal power construction which, in line with Xi's comments, indicates that China is still focused on improving domestic coal production and storage capacity to achieve domestic energy security. In the long term, China's ability to successfully meet coal demand through domestic coal production will directly decrease its dependence on coal imports.

Recommendation #3: China should re-direct and retrofit its coal investments to heavily invest in existing infrastructure for the energy transition.

The 14FYP seeks to entirely transform China's power grid's infrastructure. This goal is dependent on China successfully promoting the flexible refitting of coal-fired power plants for the construction of pumped storage power stations and new energy technologies¹²⁸. Refitting low-efficiency coal plants for storage and new energy technologies is a key input to achieving China's net zero plans. However, at the current rate, the number of these projects is limited, and China may face consequences from the international climate community if their reluctance to reduce the number of low-efficiency coal plants continues. Therefore, as China continues to halt coal production it is critical to ensure that the existing infrastructure be re-used to increase energy storage capacity or renewable energy production.

One method to do this could be its coal transportation network. One goal of the 14FYP is to expand the coal transportation capacity of the Caofeidian Port, Zhoushan River Sea Combined Transport Service Center, the Gulf of Tonkin International Gateway Port, and Yangpu Hub Port¹²⁹. This signals that China is expanding its capacity to import coal and thus may continue to be dependent on coal imports in the near term, particularly those coming from Australia. As China's import dependency remains, it will be increasingly prone to geopolitical tensions that adversely affect the country's ability to keep up with domestic coal consumption. As China looks to wind down its imports in the future, it can ensure that any expansion to coal's transportation capacity can be refitted in the future for the transportation of alternative energy sources, such as hydrogen.

Similarly, BRI funds going towards financing overseas coal power projects, such as in the DRC or Chile, must be halted. Alternatively, the funds going towards the BRI should be reinvested in the development of domestic renewable energy sources to meet rising domestic energy demand and consumption without coal as the primary energy source. At present, Chinese companies are instead accelerating their construction of facilities to transform coal into chemicals, a process which produces an immense amount of GHG emissions and uses a considerable amount of water. The Central Environmental Inspection Team (CEIT) criticized China for failing to adequately invest in transforming low-efficiency coal power plants as they are removed from the grid¹³⁰. Therefore, while the CEIT is an implementing body, its role should be expanded, or a new leading group could be created, in order to coordinate policy planning regarding how to reuse existing coal power infrastructure for energy storage or renewable energy production in order to streamline the process.

Conclusion

The next forty years are pivotal for China. In order to meet its 2060 Net Zero pledge nothing short of a transformation of its energy sector is required. This transformation will be occurring concurrently among competing demands for economic growth and energy security as it aspires to displace the United States as the world's leading superpower. Can China have it all? This analysis lays out a potential roadmap for how they could do it.

If China has any hope of reaching net zero, it will need a massive domestic renewable expansion sufficient that it can retire fossil fuel plants without the fear of rolling blackouts and curtailing industrial capacity. At the same time, it needs to keep the rest of the world reliant on China's clean tech supply chain which will enable them to meet their targets for economic growth from the export revenues. Ensuring a successful clean energy mobilization will require China to end their use of forced labor for clean tech components, invest in next generation solar panels, wind turbines and nuclear reactors, cooperate with IAEA safeguards on exporting civilian nuclear technology, and forge consensus with its neighbors on global grid interconnection and transmission line projects as well as engage in water diplomacy with its downstream neighbors for new hydropower projects to make it win-win for the region.

While these steps will help it grow clean sources of power in its energy mix, it can use its current dominance of the critical minerals market to drive future economic growth. Doing so in the face of external competition for these resources will require China to intensify its acquisition of mineral resources in Africa, Latin America, and Afghanistan while also investing in power projects in those regions. While it retains this leverage, especially on the E.U. which gets 98% of its rare earth elements from China, it can expand its market power and extract concessions on other issues like sanctions and tariffs.

Regardless of its lofty energy transition goals, energy security is also of paramount concern for China. For this, China will need to conditionally expand consumption from its existing providers of oil and natural gas. As domestic production is slow to come online and instability risks preclude emerging market diversification, the expansion of supply is likely to come from the Gulf and Russia. Notably, so-called "Teapot" refineries are emerging as a way to exploit the market turmoil from the war in Ukraine.

Finally, a phaseout of coal, albeit slowly, is paramount. If China reinvests BRI funds into domestic renewable energy production, ensures existing low-efficiency coal power plants and transportation infrastructure can be refitted for power storage and renewable energy production, and implements coal production and consumption caps; then, China will be able to achieve energy security while slowly phasing out coal. Simply acknowledging that coal will continue to play a critical role in China's energy mix will allow for more substantive dialogue as to how the country can effectively and responsibly reduce its dependence on coal without risking energy security.

Bibliography

- Adler, Kevin, "Geopolitics on the rise in solar PV manufacturing: IHS Markit", February 8th, 2022, <https://cleanenergynews.ihsmarket.com/research-analysis/geopolitics-on-the-rise-in-solar-pv-manufacturing-ihs-market-.html>
- Aglietta, Michel, "The 14th Five-year Plan in the New Era of China's Reform: Asian Integration, Belt and Road Initiative and Safeguarding Multilateralism," CEPII, May 2021, http://www.cepii.fr/PDF_PUB/pb/2021/pb2021-36.pdf
- Angel, Rebecca, "US bans target Chinese solar panel industry over Xinjiang forced labor concerns", The Guardian, June 24th, 2021, <https://www.theguardian.com/world/2021/jun/25/us-bans-target-chinese-solar-panel-industry-over-xinjiang-forced-labor-concerns>
- Anthony H. Cordesman, "China, Asia, and the Changing Strategic Importance of the Gulf and MENA Region" CSIS, October 16, 2021: 3. <https://www.csis.org/analysis/china-asia-and-changing-strategic-importance-gulf-and-mena-region>
- Anthony DiPaola, Verity Ratcliffe and Mahmoud Habboush, "These countries have the most firepower in the oil price war," World Oil, March 24, 2020: <https://www.worldoil.com/news/2020/3/24/these-countries-have-the-most-firepower-in-the-oil-price-war>
- Bassler, Christopher and Noon, Ben, "Mind the Power Gap: The American Energy Arsenal and Chinese Insecurity", Center for Strategic and Budgetary Assessments (CSBA) , August 25th, 2021, [https://csbaonline.org/uploads/documents/CSBA8274_\(Mind_the_Power_Gap\)_FINAL_web.pdf](https://csbaonline.org/uploads/documents/CSBA8274_(Mind_the_Power_Gap)_FINAL_web.pdf)
- Bloomberg, "China Targets More Than 80% Non-Fossil Energy Use by 2060," October 24th, 2021, <https://www.bloomberg.com/news/articles/2021-10-24/china-targets-non-fossil-energy-use-to-exceed-80-by-2060>
- Burrows, Leah, "Solar energy can be cheap and reliable across China by 2060," October 18th, 2021, Harvard John A. Paulson School of Engineering and Applied Sciences, <https://www.sciencedaily.com/releases/2021/10/211018163221.htm>
- Cathrin Schaer, "Saudi Arabia and China: New best friends?," DW, March 21, 2022: <https://www.dw.com/en/saudi-arabia-and-china-new-best-friends/a-61203243>
- Cang, Alfred and Chen, Sarah, "China Needs to Hit Peak Oil Long Before It Reaches Net-Zero Emissions," Bloomberg News, February 9, 2021:

<https://www.bloomberg.com/news/features/2021-02-09/china-needs-to-hit-peak-oil-long-before-it-reaches-net-zero-emissions>

Center for Strategic and International Studies, "How Is China's Energy Footprint Changing?", March 17th, 2022, <https://chinapower.csis.org/energy-footprint/>.

Chen Aizhu, Julie Zhu and Muyu Xu, "China's Sinopec pauses Russia projects, Beijing wary of sanctions -sources," Reuters, March 28, 2022. <https://www.reuters.com/business/energy/exclusive-chinas-sinopec-pauses-russia-projects-beijing-wary-sanctions-sources-2022-03-25/> Jack, Morris Andrew, Edgecliffe-Johnson, 2022.

Chen Aizhu, Muyu Xu, "Analysis: CNOOC needs to double down on drilling and deals in carbon-cutting gas pivot" Reuters, March 11, 2021: <https://www.reuters.com/article/us-china-gas-cnooc-analysis-idUSKBN2B4036>.

China's Ministry of Natural Resources, "China Mineral Resources," Geological Publishing House Beijing, 2020, http://www.mnr.gov.cn/sj/sjfw/kc_19263/zgkczybg/202010/P020201022612392451059.pdf

Climate Diplomacy, "Dam projects and disputes in the Mekong River Basin," <https://climate-diplomacy.org/case-studies/dam-projects-and-disputes-mekong-river-basin>.

China Power CSIS, "Does China Pose a Threat to Global Rare Earth Supply Chains?", May 12th, 2021, <https://chinapower.csis.org/china-rare-earths/>

DOE Office of Nuclear Energy, "9 Notable Facts About the World's First Nuclear Power Plant - EBR-I", June 18th, 2019, <https://www.energy.gov/ne/articles/9-notable-facts-about-worlds-first-nuclear-power-plant-ebr-i>

Downie, Edmund, "China's Vision for a Global Grid," Center for Strategic and International Studies, February 13th, 2019, <https://reconasia.csis.org/global-energy-interconnection/>

Economist Briefing, "America's Domination of Oil and Gas Will not Cow China," The Economist, Sept 17th, 2020, <https://www.economist.com/briefing/2020/09/17/americas-domination-of-oil-and-gas-will-not-cow-china>

Edward Morse et al, "Global Commodities: Ukraine oil price volatility unlikely to counter supply surge ahead," CITIBANK, 22 February 2022.

Energy Iceberg, "Renewable Energy in China's 14th Five-Year Plan: Five Changes", March 24th, 2021, <https://energyiceberg.com/14th-fyp-renewable-changes/>

“Euronav and Frontline sign \$4.2bn deal to create the largest fleet of oil tankers,” Economic Times, https://economictimes.indiatimes.com//news/international/us/euronav-and-frontline-sign-4-2bn-deal-to-create-the-largest-fleet-of-oil-tankers/articleshow/90713603.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

European Parliament, “Water disputes in the Mekong basin,” April 17th, 2018, [https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/620223/EPRS_ATA\(2018\)620223_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/620223/EPRS_ATA(2018)620223_EN.pdf).

Feldmann, Nils, “Energy in China’s 14th Five Year Plan,” Next Trends Asia, 16 August 2021, <https://nexttrendsasia.org/energy-in-chinas-14th-five-year-plan/>

Feng, Ashley, and Sagatom, Sasha, “Chinese Heavy Metal: How Beijing Could Use Rare Earths to Outplay America,” August 3rd, 2018, <https://blogs.scientificamerican.com/observations/chinese-heavy-metal-how-beijing-could-use-rare-earths-to-outplay-america/>

Fromer, Jacob, and Zhou, Cissy, “As US moves to renewable energy, wind turbines from Xinjiang may get caught in political tempest,” South China Morning Post, December 30th, 2020, <https://www.scmp.com/news/china/article/3115771/us-moves-renewable-energy-wind-turbines-xinjiang-may-get-caught>

Grodski, Mike, “Automating Solar Production with Robotics and Advanced Imaging,” May 24th, 2021, https://www.novuslight.com/automating-solar-production-with-robotics-and-advanced-imaging_N11580.html.

Guo, Bingna, Hsiao, James, and Chu, Mark, “China Enacts Export Control Law Following Its Announcement of the Unreliable Entities List,” White & Case, January 15th, 2021, <https://www.whitecase.com/publications/alert/china-enacts-export-control-law-following-its-announcement-unreliable-entities>

Guo, Bingna, Hsiao, James, and Chu, Mark, “China Enacts Export Control Law Following Its Announcement of the Unreliable Entities List,” White & Case, January 15th, 2021, <https://www.whitecase.com/publications/alert/china-enacts-export-control-law-following-its-announcement-unreliable-entities>

Gupte, Eklavya, “Libyan oil output rebounds but disruption risks remain very high” S&P Global, 17 Jan 2022: <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/011722-libyan-oil-output-rebounds-but-disruption-risks-remain-very-high> ; Faleh al-Khayat and Herman Wang, “Ever ambitious Iraq faces uphill struggle to reach new oil production target” S&P Global, 21 Nov 2021: <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/112221-ever-ambitious-iraq-faces-uphill-struggle-to-reach-new-oil-production-target>

Guyana Times, "Exxon's Chinese partner CNOOC raising US\$5.1B for projects in Stabroek Block," Guyana Times, September 28, 2021: <https://guyanatimesgy.com/exxons-chinese-partner-cnooc-raising-us5-1b-for-projects-in-stabroek-block/>; Reuters Staff, "China's CNOOC to load first cargo of Guyanese oil in coming days -official," Reuters, March 19, 2020: <https://www.reuters.com/article/guyana-oil-cnooc/chinas-cnooc-to-load-first-cargo-of-guyanese-oil-in-coming-days-official-idUSL1N2BC1N9>.

He, Gang, Lin, Jiang, Sifuentes, Froylan, Liu, Xu, Abhyankar, Nikit, Phadke, Amol, "Rapid cost decrease of renewables and storage accelerates the decarbonization of China's power system," Nature Communications volume 11, Article number: 2486, <https://www.nature.com/articles/s41467-020-16184-x>

Hongquia, Liu, "Analysis: Beijing Rethinks Coal in the Aftermath of 2021's Energy Crunch," 3 March 2022, <https://www.shuangtan.me/p/analysis-beijing-rethinks-coal-in?s=r>

International Energy Agency, "Hydropower Special Market Report," June 2021, <https://www.iea.org/reports/hydropower-special-market-report>

International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", May 2021, <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>

ITER, "Advantages of Fusion," <https://www.iter.org/sci/Fusion>

Jack, Andrew Stephen Morris Andrew, and Edgecliffe-Johnson, "Companies trying to exit Russia have to 'dance with the devil,'" FT, April 30, 2022. <https://www.ft.com/content/4d66f931-563a-4fdb-9032-18cfa73a7f6>; Harry Dempsey and Sun Yu, "China's independent refiners start buying Russian oil at steep discounts," FT, 03 May 2022. <https://www.ft.com/content/4f277a24-d681-421a-9c94-29d6fd448b20>

Jaeger, Joel, Joffe, Paul and Song, Ranping "China Is Leaving the U.S. Behind on Clean Energy Investment," World Resources Institute, January 6, 2017, <https://www.wri.org/insights/china-leaving-us-behind-clean-energy-investment>.

Jefferies, Alan, "How China Plans to Win the Future of Energy," March 15th, 2022, <https://www.bloomberg.com/news/articles/2022-03-15/how-china-plans-to-win-the-future-of-renewable-energy>

Katusa, Marin, "The Thing About Thorium: Why The Better Nuclear Fuel May Not Get A Chance," February 16th, 2012, <https://www.forbes.com/sites/energysource/2012/02/16/the-thing-about-thorium-why-the-better-nuclear-fuel-may-not-get-a-chance/?sh=380e4f211d80>.

- Kelly, Hannah, "Where the U.S. Chips Fall: Fault Lines and Big Breaks in the Global Semiconductor Industry," February 17th, 2022, Georgetown Journal of International Affairs, <https://gjia.georgetown.edu/2022/02/17/where-the-u-s-chips-fall-fault-lines-and-big-breaks-in-the-global-semiconductor-industry/>
- Lawler, Alex, Payne, Julia and Bousso, Ron "Analysis: Nigeria and Angola responsible for almost half of OPEC+ oil supply gap" Reuters, May 6, 2022: <https://www.reuters.com/world/africa/nigeria-angola-responsible-almost-half-opec-oil-supply-gap-2022-05-06/>
- Lema, Rasmus, et. al. "China's investments in renewable energy in Africa: Creating co-benefits or just cashing-in?" World Development Volume 141, May 2021, 105365, <https://www.sciencedirect.com/science/article/pii/S0305750X20304939>
- Lough, John "Russia's Energy Diplomacy," Chatham House, Briefing Paper, May 2011, 4, https://www.chathamhouse.org/sites/default/files/19352_0511bp_lough.pdf
- Louwen, Atse, et. al, "A cost roadmap for silicon heterojunction solar cells," Solar Energy Materials and Solar Cells Volume 147, April 2016, Pages 295-314, <https://www.sciencedirect.com/science/article/pii/S0927024815006741>
- London, Ian, "Building a circular economy for critical materials," March 14th, 2022, Innovation News Network, <https://www.innovationnewsnetwork.com/building-a-circular-economy-for-critical-materials/18367/>
- Madhavan, Ravi, Rawski, Thomas, and Tian, Qingfeng, "10 - Capability Upgrading and Catch-Up in Civil Nuclear Power: The Case of China," June 8th, 2019, <https://www.cambridge.org/core/books/abs/policy-regulation-and-innovation-in-chinas-electricity-and-telecom-industries/capability-upgrading-and-catchup-in-civil-nuclear-power-the-case-of-china/3ADDC51E436AA6C386AB2AB9497ED818>
- McDonnell, Tim, "To score a point against China, the US is willing to kneecap its solar industry," May 11th, 2022, <https://qz.com/2164439/probe-of-chinese-solar-companies-imperils-64-percent-of-us-projects/>
- Meidan, Michal "Unpacking China's 2060 carbon neutrality pledge," The Oxford Institute for Energy Studies, December 2020, <https://www.oxfordenergy.org/publications/unpacking-chinas-2060-carbon-neutrality-pledge>
- Meidan, Michal, "The structure of China's oil industry: Past trends and future prospects," The Oxford Institute for Energy Studies, May 2016: 10-11,

<https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/05/The-structure-of-Chinas-oil-industry-past-trends-and-future-prospects-WPM-66.pdf>.

Meierding, Emily, "China's Overseas Efforts to Strengthen Energy Security," Testimony before the U.S.–China Economic and Security Review Commission, March 17, 2022, https://www.uscc.gov/sites/default/files/2022-03/Emily_Meierding_Testimony.pdf/

Meng Meng, Chen Aizhu, "Sour brew: New tax rules take steam out of China's teapot refiners," Reuters, June 15, 2018. <https://www.reuters.com/article/us-china-teapot-refinery/sour-brew-new-tax-rules-take-steam-out-of-chinas-teapot-refiners-idUSKBN1JBOKE> ; Lucy Hornby, "China's 'teapot' oil refineries pose challenge to majors," FT, April 7 2016. <https://www.ft.com/content/7fc95106-fc71-11e5-b5f5-070dca6d0a0d>

Morse, Edward et al, "Global Commodities: Ukraine oil price volatility unlikely to counter supply surge ahead," CITIBANK, 22 February 2022.

Murphy, Ben "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035", Georgetown Center for Security and Emerging Technology (CSET), May 12th, 2021, https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf.

Mooney, Chris, "It's the first new U.S. nuclear reactor in decades. And climate change has made that a very big deal," June 17th, 2016, <https://www.washingtonpost.com/news/energy-environment/wp/2016/06/17/the-u-s-is-powering-up-its-first-new-nuclear-reactor-in-decades/>

Myers, Steven Lee, "China's Pledge to Be Carbon Neutral by 2060: What It Means," September 23rd, 2020, <https://www.nytimes.com/2020/09/23/world/asia/china-climate-change.html>

Nakano, Jane, "The Geopolitics of Critical Minerals Supply Chains," Center for Strategic and International Studies (CSIS), March 2021, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/210311_Nakano_Critical_Minerals.pdf?DR03x5jlrwLnNjmPDD3SZjEKGZFEcgt

National Renewable Energy Laboratory (NREL), "NREL Explores Innovative Manufacturing Approach for Next-Generation Wind Turbine Blades," November 1st, 2021, <https://www.nrel.gov/news/program/2021/manufacturing-next-generation-wind-turbines.html>

NS Energy, "Profiling the world's top five countries in electricity consumption," February 17th, 2020, <https://www.nsenergybusiness.com/features/electricity-consuming-countries/>

- Nyabiage, Jevans China is switching its investment focus in Africa from oil to minerals, South China Morning Post, April 25th, 2021, https://www.scmp.com/news/china/diplomacy/article/3130912/china-switching-its-investment-focus-africa-oil-minerals?module=perpetual_scroll_0&pgtype=article&campaign=3130912
- Off Shore Staff, "Gas, water depths could complicate Namibian field developments," April 8, 2022: <https://www.offshore-mag.com/regional-reports/africa/article/14270822/gas-water-depths-could-complicate-namibian-field-developments>
- Ramana, M.V. and King, Amy, "A new normal? The changing future of nuclear energy in China," Learning from Fukushima, pg 115, <https://www.jstor.org/stable/j.ctt1ws7wjm.12?seq=1>.
- Rapoza, Kenneth, "How China's Solar Industry Is Set Up To Be The New Green OPEC," March 14th, 2021, <https://www.forbes.com/sites/kenrapoza/2021/03/14/how-chinas-solar-industry-is-set-up-to-be-the-new-green-opec/?sh=3bb71afb1446>
- Rapp, Nicolas and O'Keefe, Brian, "This chart shows how China will soar past the U.S. to become the world's largest economy by 2030," January 30th, 2022, <https://fortune.com/longform/global-gdp-growth-100-trillion-2022-inflation-china-worlds-largest-economy-2030/>
- Ritchie, Hannah, Roser, Max "CO2 Emissions", Our World in Data, 2020 <https://ourworldindata.org/co2missions/>.
- Sandalow, David, "China's Response To Climate Change: A Study In Contrasts And A Policy At A Crossroads," Asia Society Political Institute, July 2020, <https://asiasociety.org/policy-institute/chinas-response-climate-change-study-contrasts-and-policy-crossroads>.
- Sanderson, Henry, "Congo, child labour and your electric car," Financial Times, July 7th, 2019, <https://www.ft.com/content/c6909812-9ce4-11e9-9c06-a4640c9feebb>
- Spivak, Vita "What Does China's Energy Crisis Mean for Russia?" Carnegie Moscow Center, October 14, 2021: <https://carnegiemoscow.org/commentary/85564>
- Seeking Alpha, "Why China's Oil Consumption Will Continue to Grow" <https://seekingalpha.com/article/3966427-why-chinas-oil-consumption-will-continue-to-grow> & S&P Global Commodity Insights, "China's rationalized coal-to-gas policy crimps winter gas demand growth," <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/110719-china-rationalized-coal-to-gas-policy-crimps-winter-gas-demand-growth>

Smith, Matthew "Why Guyana's Oil Boom Can't Solve The Current Energy Crisis," OilPrice.com, March 16, 2022: <https://oilprice.com/Energy/Energy-General/Why-Guyanas-Oil-Boom-Cant-Solve-The-Current-Energy-Crisis>

Shokri, Omid, "Can Iranian oil stabilize a volatile market?," The Atlantic Council, March 3, 2022: <https://www.atlanticcouncil.org/blogs/iransource/can-iranian-oil-stabilize-a-volatile-market/>

Spivak, Vita "What Does China's Energy Crisis Mean for Russia?" Carnegie Moscow Center, October 14, 2021: <https://carnegiemoscow.org/commentary/85564>

Staff, "China's CNOOC has no concrete plans to take on Russian assets -CFO," Reuters, April 28, 2022,

Reale, Hannah, Bingham, Emma and Greenberg, Kara "Where Does China Get Its Oil?" Columbia Energy Policy, July 12, 2020: https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/Where%20Does%20China%20Get%20Its%20Oil_%20-%20The%20Wire%20China.pdf

Reuters, "Saudi Arabia is China's top crude supplier again as Russian oil falls 9%," March 20, 2022: <https://www.reuters.com/business/energy/saudi-arabia-is-chinas-top-crude-supplier-again-russian-oil-falls-9-2022-03-20/> Ariel Cohen, 2019.

Rosen, Phil "Putin ally China rejects Russian oil despite steep discounts amid Western sanctions, report says," Markets Insider, April 6, 2022. <https://markets.businessinsider.com/news/commodities/putin-ally-china-oil-deals-russia-ukraine-sanctions-sinopec-cnooc-2022-4>

Rhinehart, Charlene, "Reserves to Production Ratio," Investopedia, July 31, 2021, <https://www.investopedia.com/terms/r/reserves-to-production-ratio.asp>

Taplin, Nathaniel "China Is Approaching Its Own Peak Oil," The Wall Street Journal, Feb. 12, 2021: <https://www.wsj.com/articles/china-is-approaching-its-own-peak-oil-11613131201>

University of Geneva, "Mineral resources: Exhaustion is just a myth, say scientists." ScienceDaily. ScienceDaily, May 2nd, 2017, <https://www.sciencedaily.com/releases/2017/05/170502114002.htm>

Usman, Zainab, "What Do We Know About Chinese Lending in Africa?" Carnegie Endowment for International Peace, June 2nd, 2021, <https://carnegieendowment.org/2021/06/02/what-do-we-know-about-chinese-lending-in-africa-pub-84648>

Umbach, Frank, "Critical Raw Materials for the energy transition: Europe must start mining again," Energy Post EU, January 10th, 2022 <https://energypost.eu/critical-raw-materials-for-the-energy-transition-europe-must-start-mining-again/>

White House, "FACT SHEET: New U.S. Government Actions on Forced Labor in Xinjiang," June 24th, 2021, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/24/fact-sheet-new-u-s-government-actions-on-forced-labor-in-xinjiang/>

Xu, Yan, Kang, Junjie and Yuan, Jiahai "The Prospective of Nuclear Power in China," Sustainability, 10(6), 2086, June 19th, 2018, <https://www.mdpi.com/2071-1050/10/6/2086>

Xue, Yujie, "China's coal imports seen shrinking by almost half as carbon, energy policies hurt producers in Indonesia and Australia, South China Morning Post, April 21, 2022, <https://www.scmp.com/business/article/3174938/chinas-demand-coal-imports-drop-sharply-due-decarbonisation-energy>

Yiwei, Hu and Xuechen, Hu, "Graphics: Secret behind China's expansive grid infrastructure," July 4th, 2021, CGTN, <https://news.cgtn.com/news/2021-07-04/Graphics-Secret-behind-China-s-expansive-grid-infrastructure-11vPCWFfSSY/index.html>

Yao, Kevin and Woo, Ryan "China targets slower economic growth as headwinds gather," Reuters, March 5, 2022: <https://www.reuters.com/markets/asia/china-cuts-2022-gdp-growth-target-around-55-2022-03-05/>

Yusho Cho and Takeshi Kumon, "China is ready for its own, yuan-based oil benchmark," Asia-Nikkei, February 8, 2018. <https://asia.nikkei.com/Economy/China-is-ready-for-its-own-yuan-based-oil-benchmark>

Yu, Aiqun, "A Close Look at China's Five Year Plan for Coal," Energy Tracker Asia, 10 November 2021, <https://energytracker.asia/china-coal-plan/>

Zhou, Oceana and Mohanty, Sambit "China's economic comeback to add sparkle to oil demand," S&P, 15 January 2021: <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/011521-commodities-2021-chinas-economic-comeback-to-add-sparkle-to-oil-demand>

End Notes

- ¹ Center for Strategic and International Studies, "How Is China's Energy Footprint Changing?", March 17th, 2022, <https://chinapower.csis.org/energy-footprint/>.
- ² Ritchie, Hannah, Roser, Max "CO2 Emissions", *Our World in Data*, 2020 <https://ourworldindata.org/co2-emissions/>.
- ³ Murphy, Ben "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035", *Georgetown Center for Security and Emerging Technology (CSET)*, May 12th, 2021, https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf.
- ⁴ Meidan, Michal "Unpacking China's 2060 carbon neutrality pledge," *The Oxford Institute for Energy Studies*, December 2020, <https://www.oxfordenergy.org/publications/unpacking-chinas-2060-carbon-neutrality-pledge>
- ⁵ Yao, Kevin and Woo, Ryan "China targets slower economic growth as headwinds gather," Reuters, March 5, 2022: <https://www.reuters.com/markets/asia/china-cuts-2022-gdp-growth-target-around-55-2022-03-05/>
- ⁶ Rapp, Nicolas and O'Keefe, Brian, "This chart shows how China will soar past the U.S. to become the world's largest economy by 2030," January 30th, 2022, <https://fortune.com/longform/global-gdp-growth-100-trillion-2022-inflation-china-worlds-largest-economy-2030/>
- ⁷ Bassler, Christopher and Noon, Ben, "Mind the Power Gap: The American Energy Arsenal and Chinese Insecurity", *Center for Strategic and Budgetary Assessments (CSBA)*, August 25th, 2021, [https://csbaonline.org/uploads/documents/CSBA8274_\(Mind_the_Power_Gap\)_FINAL_web.pdf](https://csbaonline.org/uploads/documents/CSBA8274_(Mind_the_Power_Gap)_FINAL_web.pdf)
- ⁸ Sandalow, David, "China's Response To Climate Change: A Study In Contrasts And A Policy At A Crossroads," *Asia Society Political Institute*, July 2020, <https://asiasociety.org/policy-institute/chinas-response-climate-change-study-contrasts-and-policy-crossroads>.
- ⁹ Jaeger, Joel, Joffe, Paul and Song, Ranping "China Is Leaving the U.S. Behind on Clean Energy Investment," *World Resources Institute*, January 6, 2017, <https://www.wri.org/insights/china-leaving-us-behind-clean-energy-investment>.
- ¹⁰ Bloomberg, "China Targets More Than 80% Non-Fossil Energy Use by 2060," October 24th, 2021, <https://www.bloomberg.com/news/articles/2021-10-24/china-targets-non-fossil-energy-use-to-exceed-80-by-2060>
- ¹¹ Murphy, Ben "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035", *Georgetown Center for Security and Emerging Technology (CSET)*, May 12th, 2021, https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf.
- ¹² Energy Iceberg, "Renewable Energy in China's 14th Five-Year Plan: Five Changes", March 24th, 2021 <https://energyiceberg.com/14th-fyp-renewable-changes/>
- ¹³ Jefferies, Alan, "How China Plans to Win the Future of Energy," March 15th, 2022, <https://www.bloomberg.com/news/articles/2022-03-15/how-china-plans-to-win-the-future-of-renewable-energy>
- ¹⁴ Rapoza, Kenneth, "How China's Solar Industry Is Set Up To Be The New Green OPEC," March 14th, 2021, <https://www.forbes.com/sites/kenrapoza/2021/03/14/how-chinas-solar-industry-is-set-up-to-be-the-new-green-opecc/?sh=3bb71afb1446>
- ¹⁵ Adler, Kevin, "Geopolitics on the rise in solar PV manufacturing: IHS Markit", February 8th, 2022, <https://cleanenergynews.ihsmarkit.com/research-analysis/geopolitics-on-the-rise-in-solar-pv-manufacturing-ihs-markit-.html>
- ¹⁶ Nakano, Jane, "The Geopolitics of Critical Minerals Supply Chains," *Center for Strategic and International Studies (CSIS)*, March 2021, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/210311_Nakano_Critical_Minerals.pdf?DR03x5jlrwLnNjmPDD3SZkGEZFecgt
- ¹⁷ Angel, Rebecca, "US bans target Chinese solar panel industry over Xinjiang forced labor concerns", *The Guardian*, June 24th, 2021, <https://www.theguardian.com/world/2021/jun/25/us-bans-target-chinese-solar-panel-industry-over-xinjiang-forced-labor-concerns>
- ¹⁸ McDonnell, Tim, "To score a point against China, the US is willing to kneecap its solar industry," May 11th, 2022, <https://qz.com/2164439/probe-of-chinese-solar-companies-imperils-64-percent-of-us-projects/>
- ¹⁹ White House, "FACT SHEET: New U.S. Government Actions on Forced Labor in Xinjiang," June 24th, 2021, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/24/fact-sheet-new-u-s-government-actions-on-forced-labor-in-xinjiang/>
- ²⁰ Fromer, Jacob, and Zhou, Cissy, "As US moves to renewable energy, wind turbines from Xinjiang may get caught in political tempest," *South China Morning Post*, December 30th, 2020, <https://www.scmp.com/news/china/article/3115771/us-moves-renewable-energy-wind-turbines-xinjiang-may-get-caught>
- ²¹ DOE Office of Nuclear Energy, "9 Notable Facts About the World's First Nuclear Power Plant - EBR-I", June 18th, 2019, <https://www.energy.gov/ne/articles/9-notable-facts-about-worlds-first-nuclear-power-plant-ebr-i>
- ²² Mooney, Chris, "It's the first new U.S. nuclear reactor in decades. And climate change has made that a very big deal," June 17th, 2016, <https://www.washingtonpost.com/news/energy-environment/wp/2016/06/17/the-u-s-is-powering-up-its-first-new-nuclear-reactor-in-decades/>
- ²³ Murphy, Ben "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035", *Georgetown Center for Security and Emerging Technology (CSET)*, May 12th, 2021, https://cset.georgetown.edu/wp-content/uploads/t0284_14th_Five_Year_Plan_EN.pdf.
- ²⁴ Madhavan, Ravi, Rawski, Thomas, and Tian, Qingfeng, "10 - Capability Upgrading and Catch-Up in Civil Nuclear Power: The Case of China," June 8th, 2019, <https://www.cambridge.org/core/books/abs/policy-regulation-and-innovation-in-chinas-electricity-and-telecom-industries/capability-upgrading-and-catchup-in-civil-nuclear-power-the-case-of-china/3ADDC51E436AA6C386AB2AB9497ED818>
- ²⁵ Nakano, Jane, "The Changing Geopolitics of Nuclear Energy: A Look at the United States, Russia, and China," *Center for Strategic and International Studies (CSIS)*, March 2021, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/200416_Nakano_NuclearEnergy_UPDATED%20FINAL.pdf
- ²⁶ Burrows, Leah, "Solar energy can be cheap and reliable across China by 2060," October 18th, 2021, *Harvard John A. Paulson School of Engineering and Applied Sciences*, <https://www.sciencedaily.com/releases/2021/10/211018163221.htm>

- ²⁷ Nakano, Jane, "The Changing Geopolitics of Nuclear Energy: A Look at the United States, Russia, and China," *Center for Strategic and International Studies (CSIS)*, March 2021, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/200416_Nakano_NuclearEnergy_UPDATED%20FINAL.pdf
- ²⁸ Xu, Yan, Kang, Junjie and Yuan, Jiahai "The Prospective of Nuclear Power in China," *Sustainability*, 10(6), 2086, June 19th, 2018, <https://www.mdpi.com/2071-1050/10/6/2086>
- ²⁹ Ramana, M.V. and King, Amy, "A new normal? The changing future of nuclear energy in China," *Learning from Fukushima*, pg 115, <https://www.istor.org/stable/j.ctt1ws7wjm.12?seq=1>.
- ³⁰ Lough, John "Russia's Energy Diplomacy," *Chatham House, Briefing Paper*, May 2011, 4, https://www.chathamhouse.org/sites/default/files/19352_0511bp_lough.pdf
- ³¹ Cornell, Phillip, "Energy governance and China's bid for global grid integration," *Atlantic Council*, May 30th, 2019, <https://www.atlanticcouncil.org/blogs/energysource/energy-governance-and-china-s-bid-for-global-grid-integration/>
- ³² Downie, Edmund, "China's Vision for a Global Grid," *Center for Strategic and International Studies*, February 13th, 2019, <https://reconasia.csis.org/global-energy-interconnection/>
- ³³ NS Energy, "Profiling the world's top five countries in electricity consumption," February 17th, 2020, <https://www.nsenergybusiness.com/features/electricity-consuming-countries/>
- ³⁴ Jefferies, Alan, "How China Plans to Win the Future of Energy," March 15th, 2022, <https://www.bloomberg.com/news/articles/2022-03-15/how-china-plans-to-win-the-future-of-renewable-energy>
- ³⁵ Cornell, Phillip, "Energy governance and China's bid for global grid integration," *Atlantic Council*, May 30th, 2019, <https://www.atlanticcouncil.org/blogs/energysource/energy-governance-and-china-s-bid-for-global-grid-integration/>
- ³⁶ International Energy Agency, "Hydropower Special Market Report," June 2021, <https://www.iea.org/reports/hydropower-special-market-report>
- ³⁷ <https://ieefa.org/wp-content/uploads/2017/01/Chinas-Global-Renewable-Energy-Expansion-January-2017.pdf>
- ³⁸ Grodski, Mike, "Automating Solar Production with Robotics and Advanced Imaging," May 24th, 2021, https://www.novuslight.com/automating-solar-production-with-robotics-and-advanced-imaging_N11580.html.
- ³⁹ International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", May 2021, <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>
- ⁴⁰ Shah, Raj and Khan, Muqsit, "Next Generation of Wind Turbines," November 9th, 2021, <https://www.altenergymag.com/article/2021/11/next-generation-of-wind-turbines/36194>.
- ⁴¹ National Renewable Energy Laboratory (NREL), "NREL Explores Innovative Manufacturing Approach for Next-Generation Wind Turbine Blades," November 1st, 2021, <https://www.nrel.gov/news/program/2021/manufacturing-next-generation-wind-turbines.html>
- ⁴² Katusa, Marin, "The Thing About Thorium: Why The Better Nuclear Fuel May Not Get A Chance," February 16th, 2012, <https://www.forbes.com/sites/energysource/2012/02/16/the-thing-about-thorium-why-the-better-nuclear-fuel-may-not-get-a-chance/?sh=380e4f211d80>.
- ⁴³ ITER, "Advantages of Fusion," <https://www.iter.org/sci/Fusion>
- ⁴⁴ European Parliament, "Water disputes in the Mekong basin," April 17th, 2018, [https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/620223/EPRS_ATA\(2018\)620223_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2018/620223/EPRS_ATA(2018)620223_EN.pdf).
- ⁴⁵ Climate Diplomacy, "Dam projects and disputes in the Mekong River Basin," <https://climate-diplomacy.org/case-studies/dam-projects-and-disputes-mekong-river-basin>.
- ⁴⁶ China Power CSIS, "Does China Pose a Threat to Global Rare Earth Supply Chains?," May 12th, 2021, <https://chinapower.csis.org/china-rare-earths/>
- ⁴⁷ International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", May 2021, <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>
- ⁴⁸ Myers, Steven Lee, "China's Pledge to Be Carbon Neutral by 2060: What It Means," September 23rd, 2020, <https://www.nytimes.com/2020/09/23/world/asia/china-climate-change.html>
- ⁴⁹ He, Gang, Lin, Jiang, Sifuentes, Froylan, Liu, Xu, Abhyankar, Nikit, Phadke, Amol, "Rapid cost decrease of renewables and storage accelerates the decarbonization of China's power system," *Nature Communications volume 11, Article number: 2486*, <https://www.nature.com/articles/s41467-020-16184-x>
- ⁵⁰ SAI Industrial LLC, "Insights into China's Recent Investments in Mineral Resources Globally," <https://www.saiindustrial.com/insights-into-chinas-recent-investments-in-mineral-resources-globally/>
- ⁵¹ Rhinehart, Charlene, "Reserves to Production Ratio," Investopedia, July 31, 2021, <https://www.investopedia.com/terms/r/reserves-to-production-ratio.asp>
- ⁵² SAI Industrial LLC, "Insights into China's Recent Investments in Mineral Resources Globally," <https://www.saiindustrial.com/insights-into-chinas-recent-investments-in-mineral-resources-globally/>
- ⁵³ Sanderson, Henry, "Congo, child labour and your electric car," *Financial Times*, July 7th, 2019, <https://www.ft.com/content/c6909812-9ce4-11e9-9c06-a4640c9feebb>
- ⁵⁴ International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", May 2021, <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>
- ⁵⁵ International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", May 2021, <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>
- ⁵⁶ Louwen, Atse, et. al, "A cost roadmap for silicon heterojunction solar cells," *Solar Energy Materials and Solar Cells Volume 147, April 2016, Pages 295-314*, <https://www.sciencedirect.com/science/article/pii/S0927024815006741>
- ⁵⁷ London, Ian, "Building a circular economy for critical materials," March 14th, 2022, *Innovation News Network*, <https://www.innovationnewsnetwork.com/building-a-circular-economy-for-critical-materials/18367/>
- ⁵⁸ International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", May 2021, <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions>

- ⁵⁹ China's Ministry of Natural Resources, "China Mineral Resources," *Geological Publishing House Beijing*, 2020, http://www.mnr.gov.cn/sj/sjfw/kc_19263/zgkcyzbg/202010/P020201022612392451059.pdf
- ⁶⁰ Guo, Bingna, Hsiao, James, and Chu, Mark, "China Enacts Export Control Law Following Its Announcement of the Unreliable Entities List," *White & Case*, January 15th, 2021, <https://www.whitecase.com/publications/alert/china-enacts-export-control-law-following-its-announcement-unreliable-entities>
- ⁶¹ University of Geneva, "Mineral resources: Exhaustion is just a myth, say scientists." *ScienceDaily*. ScienceDaily, May 2nd, 2017, <https://www.sciencedaily.com/releases/2017/05/170502114002.htm>
- ⁶² Usman, Zainab, "What Do We Know About Chinese Lending in Africa?" *Carnegie Endowment for International Peace*, June 2nd, 2021, <https://carnegieendowment.org/2021/06/02/what-do-we-know-about-chinese-lending-in-africa-pub-84648>
- ⁶³ Feng, Ashley, and Sagatom, Sasha, "Chinese Heavy Metal: How Beijing Could Use Rare Earths to Outplay America," August 3rd, 2018, <https://blogs.scientificamerican.com/observations/chinese-heavy-metal-how-beijing-could-use-rare-earths-to-outplay-america/>
- ⁶⁴ Umbach, Frank, "Critical Raw Materials for the energy transition: Europe must start mining again," *Energy Post EU*, January 10th, 2022 <https://energypost.eu/critical-raw-materials-for-the-energy-transition-europe-must-start-mining-again/>
- ⁶⁵ Nakano, Jane, "The Geopolitics of Critical Minerals Supply Chains," *Center for Strategic and International Studies (CSIS)*, March 2021, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/210311_Nakano_Critical_Minerals.pdf?DR03x5jlrwLnNjmPDD3SZEkGEZFEcgt
- ⁶⁶ Umbach, Frank, "Critical Raw Materials for the energy transition: Europe must start mining again," *Energy Post EU*, January 10th, 2022 <https://energypost.eu/critical-raw-materials-for-the-energy-transition-europe-must-start-mining-again/>
- ⁶⁷ Umbach, Frank, "Critical Raw Materials for the energy transition: Europe must start mining again," *Energy Post EU*, January 10th, 2022 <https://energypost.eu/critical-raw-materials-for-the-energy-transition-europe-must-start-mining-again/>
- ⁶⁸ Lema, Rasmus, et. al. "China's investments in renewable energy in Africa: Creating co-benefits or just cashing-in?" *World Development Volume 141, May 2021, 105365*, <https://www.sciencedirect.com/science/article/pii/S0305750X20304939>
- ⁶⁹ Nyabiage, Jevans "China is switching its investment focus in Africa from oil to minerals," *South China Morning Post*, April 25th, 2021, https://www.scmp.com/news/china/diplomacy/article/3130912/china-switching-its-investment-focus-africa-oil-minerals?module=perpetual_scroll_0&pgtype=article&campaign=3130912
- ⁷⁰ Kelly, Hannah, "Where the U.S. Chips Fall: Fault Lines and Big Breaks in the Global Semiconductor Industry," February 17th, 2022, *Georgetown Journal of International Affairs*, <https://gjia.georgetown.edu/2022/02/17/where-the-u-s-chips-fall-fault-lines-and-big-breaks-in-the-global-semiconductor-industry/>
- ⁷¹ Bloomberg, "China Shuns Energy Use Target to Focus on Fuel Supply," March 4th, 2022, <https://www.bloomberg.com/news/articles/2022-03-05/china-avoids-2022-energy-intensity-target-amid-commodity-tumult>
- ⁷² Spivak, Vita "What Does China's Energy Crisis Mean for Russia?" *Carnegie Moscow Center*, October 14, 2021: <https://carnegiemoscow.org/commentary/85564>
- ⁷³ Meierding, Emily, "China's Overseas Efforts to Strengthen Energy Security," Testimony before the U.S.–China Economic and Security Review Commission, March 17, 2022, https://www.uscc.gov/sites/default/files/2022-03/Emily_Meierding_Testimony.pdf
- ⁷⁴ Taplin, Nathaniel "China Is Approaching Its Own Peak Oil," *The Wall Street Journal*, Feb. 12, 2021: <https://www.wsj.com/articles/china-is-approaching-its-own-peak-oil-11613131201>
- ⁷⁵ Cang, Alfred and Chen, Sarah, "China Needs to Hit Peak Oil Long Before It Reaches Net-Zero Emissions," *Bloomberg News*, February 9, 2021: <https://www.bloomberg.com/news/features/2021-02-09/china-needs-to-hit-peak-oil-long-before-it-reaches-net-zero-emissions>
- ⁷⁶ Seeking Alpha, "Why China's Oil Consumption Will Continue to Grow" <https://seekingalpha.com/article/3966427-why-chinas-oil-consumption-will-continue-to-grow> & S&P Global Commodity Insights, "China's rationalized coal-to-gas policy crimps winter gas demand growth," <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/110719-china-rationalized-coal-to-gas-policy-crimps-winter-gas-demand-growth>
- ⁷⁷ Zhou, Oceana and Mohanty, Sambit "China's economic comeback to add sparkle to oil demand," S&P, 15 January 2021: <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/011521-commodities-2021-chinas-economic-comeback-to-add-sparkle-to-oil-demand>
- ⁷⁸ Reale, Hannah, Bingham, Emma and Greenberg, Kara "Where Does China Get Its Oil?" *Columbia Energy Policy*, July 12, 2020: <https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/Where%20Does%20China%20Get%20Its%20Oil%20-%20The%20Wire%20China.pdf>
- ⁷⁹ Meidan, Michal, "The structure of China's oil industry: Past trends and future prospects," *The Oxford Institute for Energy Studies*, May 2016: 10-11, <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/05/The-structure-of-Chinas-oil-industry-past-trends-and-future-prospects-WPM-66.pdf>.
- ⁸⁰ Chen Aizhu, Muyu Xu, "Analysis: CNOOC needs to double down on drilling and deals in carbon-cutting gas pivot" *Reuters*, March 11, 2021: <https://www.reuters.com/article/us-china-gas-cnooc-analysis-idUSKBN2B4036>.
- ⁸¹ Reale, Hannah, Bingham, Emma and Greenberg, Kara "Where Does China Get Its Oil?" *Columbia Energy Policy*, July 12, 2020: <https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/Where%20Does%20China%20Get%20Its%20Oil%20-%20The%20Wire%20China.pdf>
- ⁸² Telley, 2022.
- ⁸³ Reale, Hannah, Bingham, Emma and Greenberg, Kara "Where Does China Get Its Oil?" *Columbia Energy Policy*, July 12, 2020: <https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/Where%20Does%20China%20Get%20Its%20Oil%20-%20The%20Wire%20China.pdf>
- ⁸⁴ Lawler, Alex, Payne, Julia and Bouso, Ron "Analysis: Nigeria and Angola responsible for almost half of OPEC+ oil supply gap" *Reuters*, May 6, 2022: <https://www.reuters.com/world/africa/nigeria-angola-responsible-almost-half-opec-oil-supply-gap-2022-05-06/>
- ⁸⁵ Gupte, Eklavya, "Libyan oil output rebounds but disruption risks remain very high" S&P Global, 17 Jan 2022: <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/011722-libyan-oil-output-rebounds-but-disruption-risks->

- [remain-very-high](#) ; Faleh al-Khayat and Herman Wang, "Ever ambitious Iraq faces uphill struggle to reach new oil production target" S&P Global, 21 Nov 2021: <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/112221-ever-ambitious-iraq-faces-uphill-struggle-to-reach-new-oil-production-target>
- ⁸⁶ Smith, Matthew "Why Guyana's Oil Boom Can't Solve The Current Energy Crisis," OilPrice.com, March 16, 2022: <https://oilprice.com/Energy/Energy-General/Why-Guyanas-Oil-Boom-Cant-Solve-The-Current-Energy-Crisis.html>
- ⁸⁷ Guyana Times, "Exxon's Chinese partner CNOOC raising US\$5.1B for projects in Stabroek Block," Guyana Times, September 28, 2021: <https://guyanatimesgy.com/exxons-chinese-partner-cnooc-raising-us5-1b-for-projects-in-stabroek-block/>; Reuters Staff, "China's CNOOC to load first cargo of Guyanese oil in coming days -official," Reuters, March 19, 2020: <https://www.reuters.com/article/guyana-oil-cnooc/chinas-cnooc-to-load-first-cargo-of-guyanese-oil-in-coming-days-official-idUSL1N2BC1N9>.
- ⁸⁸ Off Shore Staff, "Gas, water depths could complicate Namibian field developments," April 8, 2022: <https://www.offshore-mag.com/regional-reports/africa/article/14270822/gas-water-depths-could-complicate-namibian-field-developments>
- ⁸⁹ Shokri, Omid, "Can Iranian oil stabilize a volatile market?," The Atlantic Council, March 3, 2022: <https://www.atlanticcouncil.org/blogs/iransource/can-iranian-oil-stabilize-a-volatile-market/>
- ⁹⁰ Spivak, Vita "What Does China's Energy Crisis Mean for Russia?" Carnegie Moscow Center, October 14, 2021: <https://carnegiemoscow.org/commentary/85564>
- ⁹¹ Reuters, "Saudi Arabia is China's top crude supplier again as Russian oil falls 9%," March 20, 2022: <https://www.reuters.com/business/energy/saudi-arabia-is-chinas-top-crude-supplier-again-russian-oil-falls-9-2022-03-20/>
- ⁹² Ariel Cohen, 2019.
- ⁹³ Goliya, Kshitiz "China signed record high 22.7 mil mt of LNG term contracts in 2021: CNPC ETRI," S&P Global, 15 April 2022. <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/lng/041522-china-signed-record-high-227-mil-mt-of-lng-term-contracts-in-2021-cnpc-etri>
- ⁹⁴ Goliya, Kshitiz, "China signed record high 22.7 mil mt of LNG term contracts in 2021: CNPC ETRI," S&P Global, 15 April 2022. <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/lng/041522-china-signed-record-high-227-mil-mt-of-lng-term-contracts-in-2021-cnpc-etri>
- ⁹⁵ Jack, Andrew Stephen Morris Andrew, and Edgecliffe-Johnson, "Companies trying to exit Russia have to 'dance with the devil," FT, April 30, 2022. <https://www.ft.com/content/4d66f931-563a-4fdb-9032-18cfa73a7f6>; Harry Dempsey and Sun Yu, "China's independent refiners start buying Russian oil at steep discounts," FT, 03 May 2022. <https://www.ft.com/content/4f277a24-d681-421a-9c94-29d6fd448b20>
- ⁹⁶ Dempsey and Yu, 2022.
- ⁹⁷ Chen Aizhu, Julie Zhu and Muyu Xu, "China's Sinopec pauses Russia projects, Beijing wary of sanctions -sources," Reuters, March 28, 2022. <https://www.reuters.com/business/energy/exclusive-chinas-sinopec-pauses-russia-projects-beijing-wary-sanctions-sources-2022-03-25/>
- ⁹⁸ Jack, Morris Andrew, Edgecliffe-Johnson, 2022.
- ⁹⁹ Staff, "China's CNOOC has no concrete plans to take on Russian assets -CFO," Reuters, April 28, 2022, <https://www.reuters.com/world/china/oil-majors-would-need-moscow-approval-exit-russia-says-cnooc-cfo-2022-04-28/>
- ¹⁰⁰ Phil Rosen, "Putin ally China rejects Russian oil despite steep discounts amid Western sanctions, report says," Markets Insider, April 6, 2022. <https://markets.businessinsider.com/news/commodities/putin-ally-china-oil-deals-russia-ukraine-sanctions-sinopec-cnooc-2022-4>
- ¹⁰¹ Meng Meng, Chen Aizhu, "Sour brew: New tax rules take steam out of China's teapot refiners," Reuters, June 15, 2018. <https://www.reuters.com/article/us-china-teapot-refinery/sour-brew-new-tax-rules-take-steam-out-of-chinas-teapot-refiners-idUSKBN1JB0KE> ; Lucy Hornby, "China's 'teapot' oil refineries pose challenge to majors," FT, April 7 2016. <https://www.ft.com/content/7fc95106-fc71-11e5-b5f5-070dca6d0a0d>
- ¹⁰² Aizhu and Tan, 2022.
- ¹⁰³ Yusho Cho and Takeshi Kumon, "China is ready for its own, yuan-based oil benchmark," Asia-Nikkei, February 8, 2018. <https://asia.nikkei.com/Economy/China-is-ready-for-its-own-yuan-based-oil-benchmark>
- ¹⁰⁴ Anthony H. Cordesman, "China, Asia, and the Changing Strategic Importance of the Gulf and MENA Region" CSIS, October 16, 2021: 3. <https://www.csis.org/analysis/china-asia-and-changing-strategic-importance-gulf-and-mena-region>
- ¹⁰⁵ Energy & Financial Markets, "What Drives Crude Oil Price?," US Energy Information Agency, March 8, 2022: <https://www.eia.gov/finance/markets/crudeoil/supply-opec.php#:~:text=Saudi%20Arabia%2C%20the%20largest%20oil,on%20hand%20for%20market%20management>
- ¹⁰⁶ "Euronav and Frontline sign \$4.2bn deal to create the largest fleet of oil tankers," Economic Times, https://economictimes.indiatimes.com/news/international/us/euronav-and-frontline-sign-4-2bn-deal-to-create-the-largest-fleet-of-oil-tankers/articleshow/90713603.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
- ¹⁰⁷ Anthony DiPaola, Verity Ratcliffe and Mahmoud Habboush, "These countries have the most firepower in the oil price war," World Oil, March 24, 2020: <https://www.worldoil.com/news/2020/3/24/these-countries-have-the-most-firepower-in-the-oil-price-war>
- ¹⁰⁸ Cathrin Schaer, "Saudi Arabia and China: New best friends?," DW, March 21, 2022: <https://www.dw.com/en/saudi-arabia-and-china-new-best-friends/a-61203243>
- ¹⁰⁹ Edward Morse et al, "Global Commodities: Ukraine oil price volatility unlikely to counter supply surge ahead," CITIBANK, 22 February 2022.
- ¹¹⁰ Aglietta, Michel, "The 14th Five-year Plan in the New Era of China's Reform: Asian Integration, Belt and Road Initiative and Safeguarding Multilateralism," CEPII, May 2021, http://www.cepii.fr/PDF_PUB/pb/2021/pb2021-36.pdf
- ¹¹¹ Hongquia, Liu, "Analysis: Beijing Rethinks Coal in the Aftermath of 2021's Energy Crunch," 3 March 2022, <https://www.shuangtan.me/p/analysis-beijing-rethinks-coal-in?r>
- ¹¹² Hongquia, Liu.
- ¹¹³ Hongquia, Liu.
- ¹¹⁴ Hongquia, Liu.
- ¹¹⁵ Yu, Aiqun, "A Close Look at China's Five Year Plan for Coal," *Energy Tracker Asia*, 10 November 2021, <https://energytracker.asia/china-coal-plan/>
- ¹¹⁶ Hongquia, Liu.

-
- ¹¹⁷ Economist Briefing, "America's Domination of Oil and Gas Will not Cow China," *The Economist*, Sept 17th, 2020, <https://www.economist.com/briefing/2020/09/17/americas-domination-of-oil-and-gas-will-not-cow-china>
- ¹¹⁸ Meidan, Michael, "Unpacking China's 2060 Carbon Neutrality Pledge," *The Oxford Institute for Energy Studies*, December 2020, <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2020/12/Unpacking-Chinas-carbon-neutrality-pledge.pdf>
- ¹¹⁹ Pickford, Andrew, "China's Grand Strategy and Energy," *Perth USAsia Centre*, May 2017, <https://perthusasia.edu.au/getattachment/Our-Work/Energy-Security-Vol-3-China-s-Grand-Strategy/PUAC-Energy-Security-Program-China-May-2017.pdf.aspx?lang=en-AU>
- ¹²⁰ Feldmann, Nils, "Energy in China's 14th Five Year Plan," *Next Trends Asia*, 16 August 2021, <https://nexttrendsasia.org/energy-in-chinas-14th-five-year-plan/>
- ¹²¹ Pickford, Andrew, 12.
- ¹²² Pickford, Andrew.
- ¹²³ Meidan, Michael
- ¹²⁴ Aglietta, Michel.
- ¹²⁵ Xue, Yujie, "China's coal imports seen shrinking by almost half as carbon, energy policies hurt producers in Indonesia and Australia," *South China Morning Post*, April 21, 2022, <https://www.scmp.com/business/article/3174938/chinas-demand-coal-imports-drop-sharply-due-decarbonisation-energy>
- ¹²⁶ Hongquiao, Liu, "Q&A: What Does China's 14th Five-year plan' mean for climate change?" *Carbon Brief*, 12 March 2021, <https://www.carbonbrief.org/qa-what-does-chinas-14th-five-year-plan-mean-for-climate-change/>
- ¹²⁷ IEA, "An Energy Sector Roadmap for Carbon Neutrality in China," September 2021, <https://www.iea.org/reports/an-energy-sector-roadmap-to-carbon-neutrality-in-china>
- ¹²⁸ Meidan, Michael, "Key Issues for China's 14th Five Year Plan."
- ¹²⁹ Meidan, Michael, "Key Issues for China's 14th Five Year Plan," *The Oxford Institute For Energy Studies*, March 2021, <https://a9w7k6g9.stackpathcdn.com/wpcms/wp-content/uploads/2021/03/Key-issues-for-Chinas-14th-Five-Year-Plan.pdf>
- ¹³⁰ Meidan, Michael, "Key Issues for China's 14th Five Year Plan."