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IS CHINA STILL A DEVELOPING COUNTRY, AND WHY IT MATTERS FOR ENERGY AND CLIMATE

BY PHILIPPE BENOIT AND KEVIN JIANJUN TU

JULY 2020

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EXECUTIVE SUMMARY

China's dramatic economic growth in the 21st century has made it not only the second largest economy in the world but also a powerhouse in the global energy system. Now, as the top energy consumer and the biggest emitter of greenhouse gases, China is being closely watched and judged as its impact on energy markets and climate grows more profound. Looking forward, many issues are expected to shape the evolution of China's energy sector, not least of which is its development status.

While China's economic might makes it a superpower alongside the United States, it still faces many of the major challenges of a typical developing country, such as widespread energy poverty, including 400 million people without access to clean cooking, significant air pollution, and dependence on increasing energy use to fuel future economic growth. Its modest income per capita qualifies it as a middle-income developing country.

Evaluating China's development status is not just an academic exercise. How China views itself and its challenges and how the international community classifies it carry real-world consequences that can significantly impact how the country manages its energy needs going forward, what fuels it uses, how it interacts with energy and other partners, and the level of its contributions and commitment to climate change mitigation and adaptation efforts worldwide. Understanding the nature and implications of China's development situation can help in designing energy policies and fostering an international framework that better promote sustainable growth both within the country and globally.

This paper examines how the usual criteria employed by international organizations to determine a country's development standing have become increasingly difficult to apply to China, given the dramatic changes it has undergone over the past several decades, notably from an energy perspective. The paper finds that China combines significant characteristics of both developing and developed countries and examines the energy and environmental implications of this hybrid status. The following is a summary of the main findings:

- China is increasingly using its massive economic resources to further its energy interests internationally in both developing and developed countries through foreign assistance, overseas investments, trading relationships, and diplomatic efforts. Its development history and characteristics also give it a standing with the community of developing countries that the United States and other advanced economies lack. By fusing developing/developed country attributes with major global clout, China is unique: a *hybrid superpower*.
- Unlike advanced economies, China's energy requirements will continue to rise substantially going forward as the government seeks to sustain robust economic growth and eradicate poverty, requiring it to secure unprecedented amounts of energy. China's influence over global energy issues similarly will grow, with its energy, technological, and policy choices shaping product design, capital flows, trade, and emissions worldwide.

- China will face increasing international pressure to upgrade its climate ambitions, notwithstanding any development constraints. In addition, China's own economic achievements and future prosperity are threatened by the physical and economic damage potentially wrought by climate change. Stronger climate actions by China would promote sustainable development domestically and internationally.
- Against the current backdrop of economic and energy security anxieties (aggravated by factors such as the prolonged U.S.-China trade war and the ongoing COVID-19 pandemic), it is uncertain when the Chinese government will begin to prioritize the low-carbon transition. When it does, China's economic strength, technological sophistication, and growing influence give it the capacity to take dramatic climate actions and to lead other countries, particularly developing ones, down a low-carbon pathway.
- While China has succeeded in its transformation from a low-income country into a hybrid superpower, its prospective journey from middle-income status to that of an advanced economy may take many years if not decades to navigate, with vast uncertainties and unforeseen obstacles (as exemplified by the COVID-19 pandemic). The energy choices China makes in this long journey will shape not only its own development but also the global energy and climate landscapes.

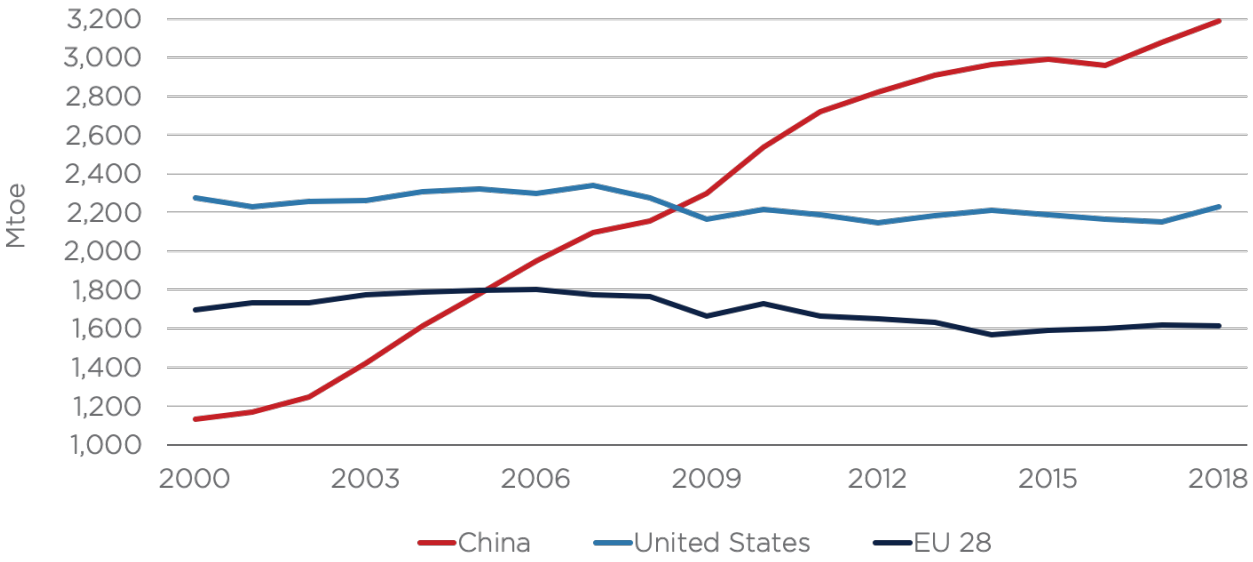
A. INTRODUCTION

China has experienced a remarkable economic expansion over the last 40 years. Since China first implemented its Open Door policy in 1978,[1] its economy has grown from less than $150 billion (current US$)[2] to over $13.6 trillion in 2018, and its gross domestic product (GDP) per capita has increased from $156 to $9,771. China's poverty rate has fallen from 66 percent in 1990 to less than 1 percent today,[3] and it has seen major improvements across a variety of human development indicators.[4] It is now the world's second largest economy.[5] Once one of the poorest developing countries, China is now viewed by many as an advanced economy, with the enormous wealth and responsibilities that this label entails. Even as the COVID-19 pandemic has slowed its economy, China has emerged as a strategic supplier of sophisticated medical devices and personal protective equipment for numerous advanced economies.

But the discourse within China offers a different story. Chinese authorities remind visiting delegations that China is still a developing country. Indeed, the country ranks a mere 86th on the Human Development Index (HDI) established by the United Nations Development Programme (UNDP), and its income per capita qualifies it as a middle-income country eligible for World Bank loans. The country is also big and diverse: while Beijing and Shanghai are modern and largely affluent, many regions in China still face the burdens of underdevelopment. Given this backdrop, China's officials argue it should remain in the developing country category used by multilateral development banks and other international organizations—and should continue to enjoy the leniency regarding international commitments that comes with that status, despite its economic might. Moreover, the COVID-19 pandemic's impacts will inevitably slow China's development.

Energy has been at the core of the country's development, with GDP and energy demand moving largely in lockstep over the last two decades. It is now the world's largest energy economy, having surpassed the United States in 2009 (figure A.1), and accounts for about 23 percent of global primary energy consumption.[6] How China uses energy to support its continued development will have a large impact on shaping the future global energy and climate landscapes. At the same time, China's development situation will in part define its options and affect its choices regarding energy use.

Figure A.1: Energy demand of China, the United States, and the European Union, 2000–2018



Source: IEA statistics database[7]

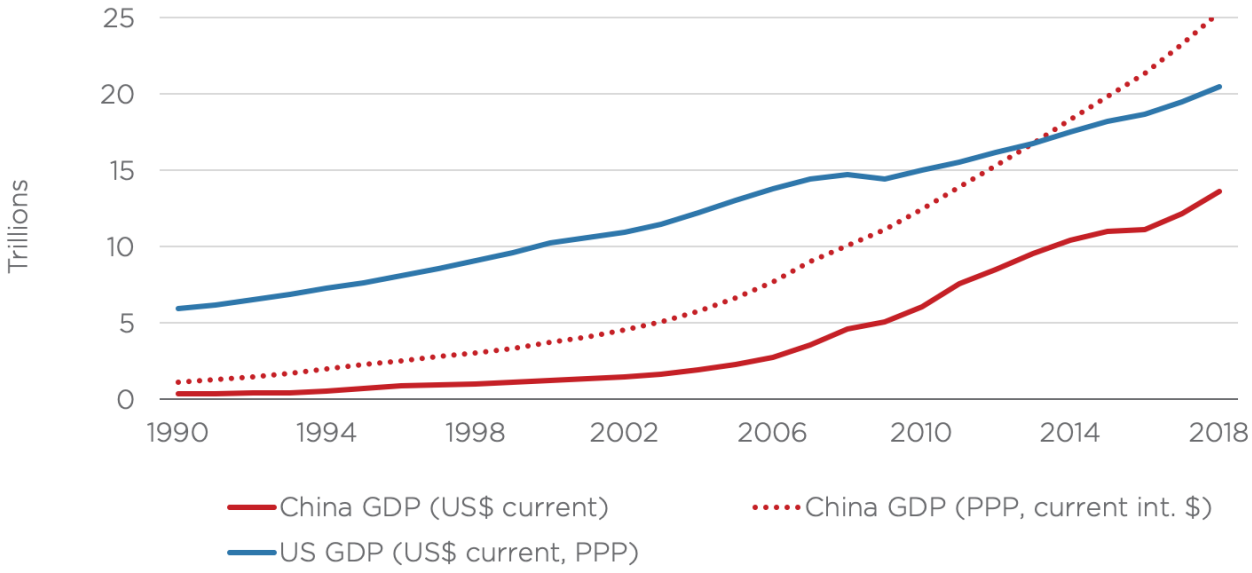
This paper analyzes China's development status through the lens of its energy sector and outlook, with particular attention given to climate change implications. Institutions, such as the United Nations, generally use economic and social indicators to evaluate a country's development status. In other contexts, governance and political criteria are considered.[8] Energy also provides important elements to evaluate the development stage of a country. The paper examines China's development position from the energy perspective, drawing on three principal dimensions: (1) the infrastructure and capacity limitations and other structural dimensions inherent in being a developing country, (2) the applicability of the developing country label and its ramifications under climate and other international frameworks, and (3) the impact of a country's development status on its state of mind and ramifications for its policy approaches and other choices.

This paper considers the factors supporting the categorization of China as an advanced economy and those that argue for its status as a developing country, with special attention to the implications of China's developing nation attributes on its energy demand and climate ambition. It finds that China's developing and developed country attributes combined with a massive economy and an energy sector unmatched in size give it a unique *hybrid superpower* status. The paper then reviews the implications of this *hybrid superpower* status on domestic and international energy and climate issues.

B. CHINA: THE ADVANCED ECONOMY ARGUMENT

Three factors point to China's developed nature: the overall size of its economy, the modernization and expansion of its energy system and related infrastructure, and its leadership role in technological advancements in energy-related areas. China's economy registered a GDP of $13.6 trillion in 2018, second only to that of the United States and far surpassing that of every other developed country.[9] In purchasing power parity (PPP) terms,[10] China's economy is the largest, having surpassed the United States in 2014 (figure B.1).

Figure B.1: China GDP relative to the United States in US$ current and PPP* terms



**Note that the U.S. economy in PPP terms is the same as in US$ equivalent terms.*
Source: World Bank DataBank[11]

China's economic might relative to other advanced economies such as Japan, Germany, or the United Kingdom (the world's third, fourth, and fifth largest economies, respectively), increases substantially when several years of economic activity are considered together. For example, while China's economy in 2018 was $9.6 trillion larger than Germany's (the world's fourth largest economy), its cumulative GDP was nearly $60 trillion larger than Germany's over the preceding decade.[12] This basic economic relationship helps explain the perspective that China should not be categorized as a developing country meriting preferential treatment.

China's centralized political and economic structure gives its government direct control over a level of financial and energy resources that no other government can match, including the United States, which relies more on private sector investment. The past decade has seen the

Chinese government put these resources to work to build out the world's largest and in many ways most advanced energy system and related infrastructure. This includes advancements in the following areas:

- China's installed operational nuclear capacity has reached nearly 50 gigawatts (GW), trailing only the United States and France. With an additional 9.3 GW of nuclear capacity under construction and much more under planning,[13] China is projected to become the world's largest nuclear power generating country by 2030.[14]
- China is building an extensive advanced ultra-high voltage transmission network, totaling more than 30,000 km.[15]
- China has invested heavily in supercritical and ultra-supercritical generation assets to replace less-efficient ones (although even these more efficient plants raise carbon emission concerns).[16] As a result of these new investments, China's coal power generation fleet has become one of the most efficient in the world, surpassing that of the United States and the European Union (EU).[17]
- China is expanding its natural gas network, constructing combined cycle natural gas power plants, liquified natural gas (LNG) regasification terminals, and import pipelines and expanding its gas distribution network to service its industry, residential (including for heat), transport, and power sectors. For example, it added 10,000 km of gas transmissions pipelines from 2015 to 2018 and increased the capacity of its LNG regasification terminals by 50 percent over that same period.[18]
- Since 2008, China has put into operation over 25,000 km of dedicated high-speed railway lines, far more than the total high-speed lines operating in the rest of the world.[19] This new electrified system is technologically comparable to the world's most advanced high-speed rail systems, such as the TGV (*Train à Grande Vitesse*) in France and the *Shinkansen* in Japan.

China has also increased funding for energy-related research, development, and deployment (RD&D), including in clean alternatives, and it is projected to soon surpass the United States as the top investor in public sector RD&D.[20] It is looking to promote technological advancements across an expanding range of energy areas. For example, its "Energy Innovation Action Plan (2016–2030)"[21] highlights 15 energy areas for innovation, including (1) unconventional, deep, and deep-sea oil and gas extraction; (2) carbon capture and storage; (3) advanced nuclear power; (4) high-efficiency solar power technologies; (5) large-scale wind power; (6) hydrogen and fuel cell technologies; (7) advanced energy storage; and (8) energy efficiency technologies.

C. CHINA: THE DEVELOPING COUNTRY ARGUMENT

Despite China's overall economic might and its modernizing energy system, it still qualifies as a developing country under the principal criteria used by development organizations. Table C.1 summarizes the typology used by the three leading development organizations: the UNDP, the World Bank, and the International Monetary Fund (IMF).

Table C.1: Definitions of developing countries[22]

State	UNDP	World Bank	IMF
Term for *developed countries*	Developed countries	High-income countries	Advanced countries
Term for *developing countries*	Developing countries	Low- and middle-income countries	Emerging and developing countries
Development threshold	75th percentile in the Human Development Index distribution	Currently (2019/20) US$12,375 per capita gross national income[23]	Not explicit
Type of threshold	Relative	Absolute	Most likely absolute
Subcategories of developing countries	(1) Low human development countries, (2) Medium human development countries, and (3) High human development countries	(1) Low-income countries and (2) Middle-income countries	1) Low-income developing countries and (2) Emerging and other developing countries

- With a per capita gross national income (GNI) in 2018 of $9,460, China is currently classified as a middle-income country under the World Bank's categorization, allowing it to borrow from the development institution. Its GNI per capita places it in the upper-middle-income subcategory,[24] higher than Mexico but lower than Malaysia, and 23 percent lower than the overall ceiling for middle-income countries. Its income per capita is also 75 percent lower than the average for Organisation for Economic Co-operation and Development (OECD) member countries.[25]
- The United Nations (through the UNDP) classifies countries using the HDI, which is a composite of life expectancy, mean and expected years of schooling, and income per capita indicators.[26] Here China is classified as a developing country, ranked 86th in the world, between Algeria and Ecuador and below other developing countries such as Brazil (79th).[27]

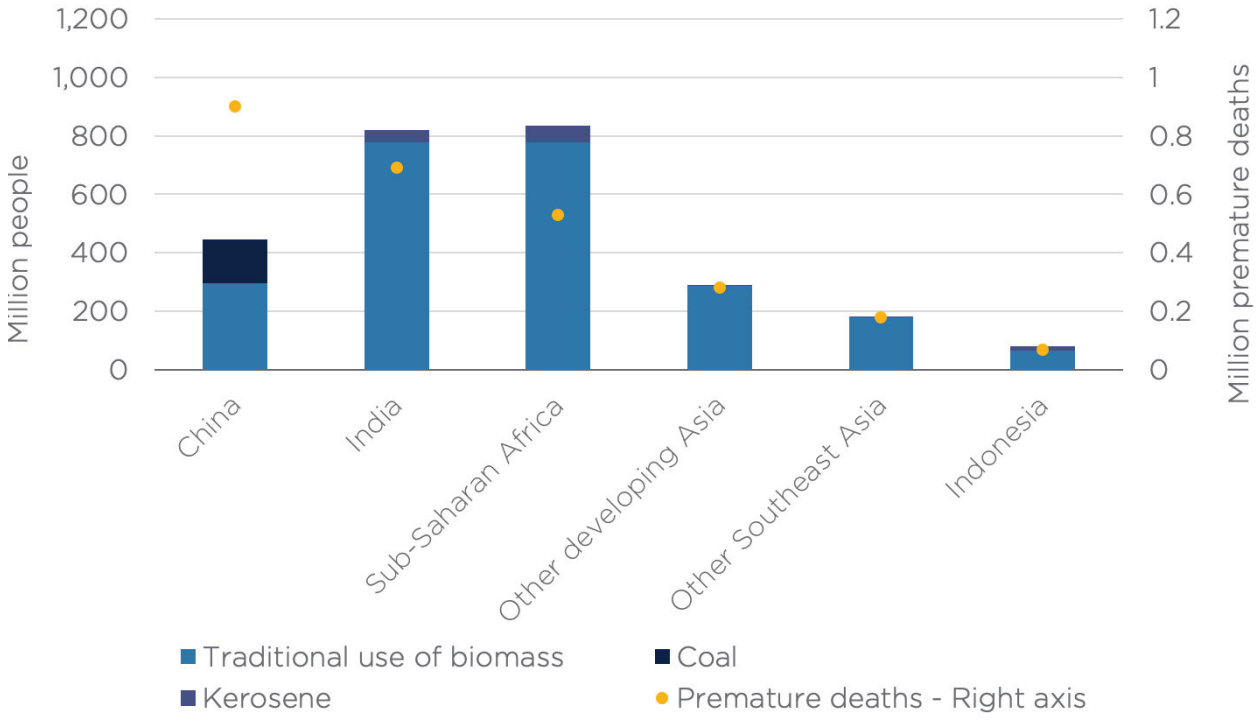
Neither the HDI nor the World Bank explicitly include in their classification systems any energy criterion, such as access to electricity or to clean cooking.[28] There are, however, several energy factors that are indicators and reflective of a country's development status, such as the extent of energy poverty and energy consumption patterns.

Widespread Forms of Energy Poverty

Indeed, despite China's impressive economic gains, large portions of its population still face energy poverty issues typical of developing countries, including lack of access to clean cooking, inadequate energy for heating homes, and low household electricity consumption.

- One of the UN's Sustainable Development Goals is universal access to clean cooking by 2030. Providing clean cooking has remained a daunting challenge for China. In 2018, there were 400 million people in China without access to clean cooking.[29] Nearly one in three of the country's population lives in a household without access to clean cooking technologies, the majority of whom rely on biomass[30] with the attendant health and other impacts, including premature death (figure C.1). This lack of access is worse than that of many developing countries, such as Indonesia, Vietnam, Egypt, Guatemala, and much of Central and South America. In fact, China's access rate to clean cooking has consistently been 25 percentage points lower than the overall rate for upper-middle-income countries.[31]

Figure C.1: Lack of access to clean cooking and premature deaths from household air pollution for China and other developing countries/regions, 2015



Source: IEA "Energy Access Outlook 2017," figure 1.5

- China's energy poverty problems also include inadequate space heating, both in the frigid northern regions of the country and in the southern ones that face cold winters. Although the coverage of urban residential central heating in northern China has been expanding quickly in recent years, the reliability and quality of the heating service has been problematic. During a cold snap in December 2018, some of China's major northern cities, including Zhengzhou and Yinchuan, struggled to maintain quality central heating services, with the majority of indoor temperature readings at an inadequate 15°C–18°C and some dropping as low as 10°C.[32] In the south, including Shanghai, the central heating plan (which was introduced in the 1950s) does not treat the vast region as one that merits central heating and other similar services. As a result, there has been inadequate installation of heating equipment, and these regions face important energy heating poverty issues during the winter season.[33]

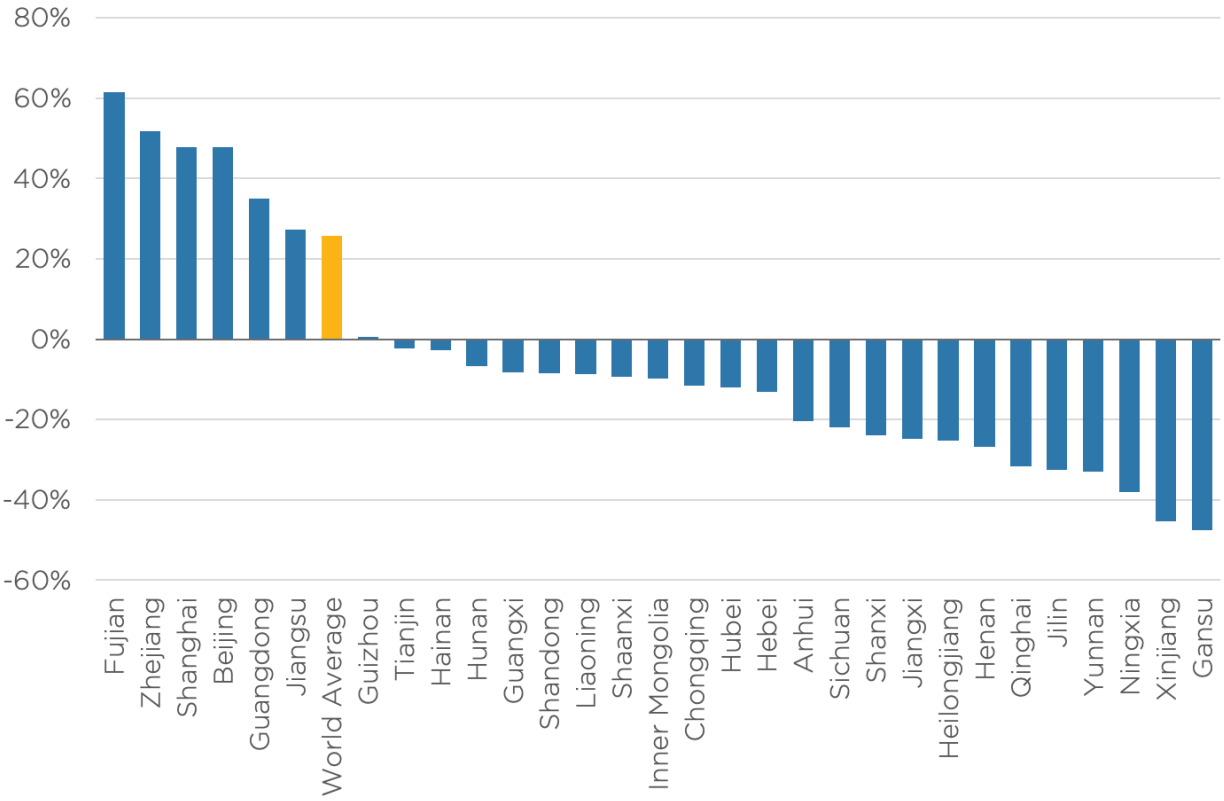
- Electricity is another area where many households face developing country conditions. Even though China's overall power generation is the highest in the world and universal electricity access was achieved in 2015, household consumption levels have remained relatively low. Residential electricity consumption per capita was only 382 kWh/capita in 2009,[34] similar to the level seen in Indonesia today.[35] China's household consumption has been rising, reaching 611 kWh/capita in 2016, which is comparable to the levels registered in developing countries such as Thailand but well short of the 2,296 kWh/capita seen in the OECD.[36]

Wealthy Cities Mask Energy Poverty in Other Regions

China's standards of living, and energy poverty, vary significantly across the country's different regions[37] and between urban and rural areas. The country's richest region, Beijing municipality, has a per capita income close to that of the advanced economy Portugal and four times higher than that of Gansu province, which has an income that resembles that of the developing country Guatemala.[38] China's high incomes are largely concentrated in the three municipalities of Beijing, Shanghai, and Tianjin, which have levels that are more than twice the country's regional average; by comparison, eight provinces have income that are 30 percent or more below the regional average.[39]

These regional differences in income are reflected in major variations in energy consumption. Residential electricity consumption per capita in more than three quarters of China's administrative regions was over 40 percent lower than in the four highest consuming regions (figure C.2). Only six of China's regions had per capita residential electricity consumption levels that exceeded the world average; most others not only fell well below the world level, they were also lower than China's own national per capita residential average.[40] The four regions with the lowest residential electricity consumption rates (and with over 100 million inhabitants) consumed 30 percent less than the average for Vietnam, which is classified as a lower-middle-income country by the World Bank.[41]

Figure C.2: Regional comparison of China's per capita residential electricity consumption to the national average, 2016

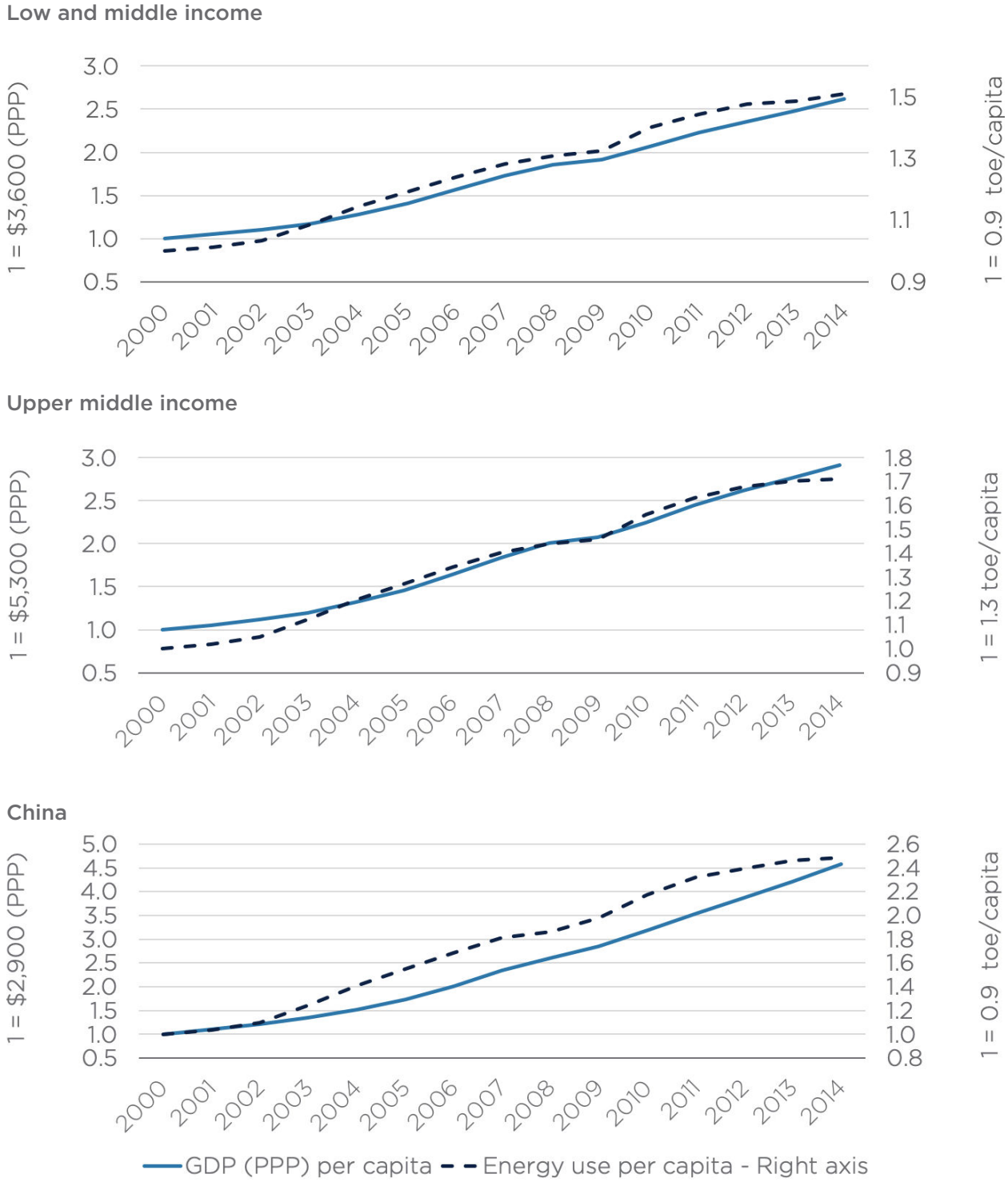


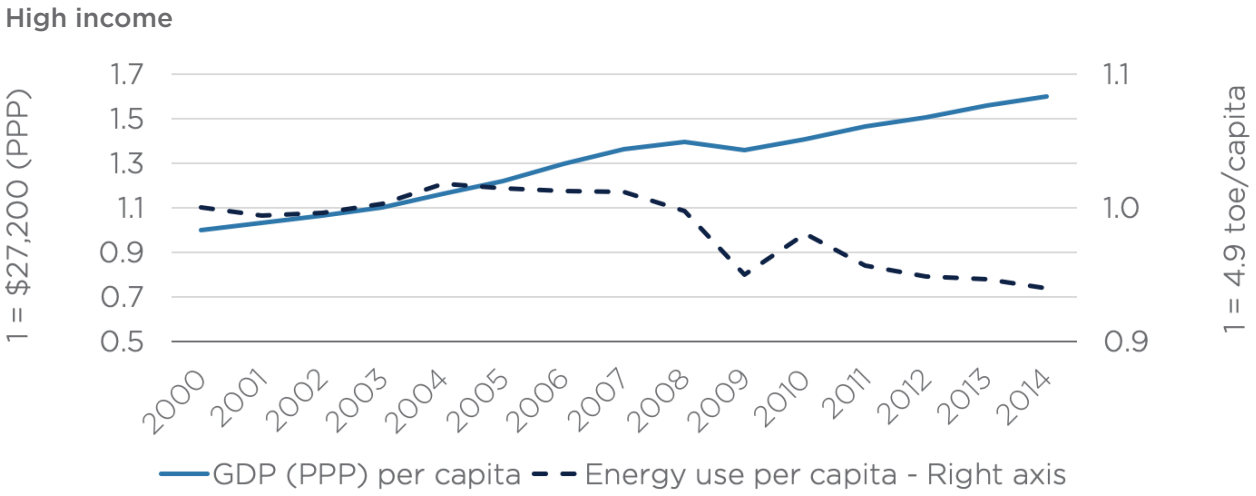
Sources: National Bureau of Statistics (2018) and China Energy Statistical Yearbook (2017).[42] The world average was drawn from the IEA and World Development Indicators.

Growth in Energy Demand

China exhibits the energy demand patterns of a typical developing country. Per capita energy consumption generally increases with per capita income in low- and middle-income countries,[43] and this has been the case for China (figure C.3). But higher-income countries have generally seen consumption fall even as income per capita continues to rise.[44] This has also been true for various individual forms of energy. For example, electricity consumption in developing countries rises as income increases, but high-income developed countries generally see either reduced or flattened consumption levels even as their incomes continue to rise.[45]

Figure C.3: Energy per capita consumption by income level (indexed to 2000 levels)



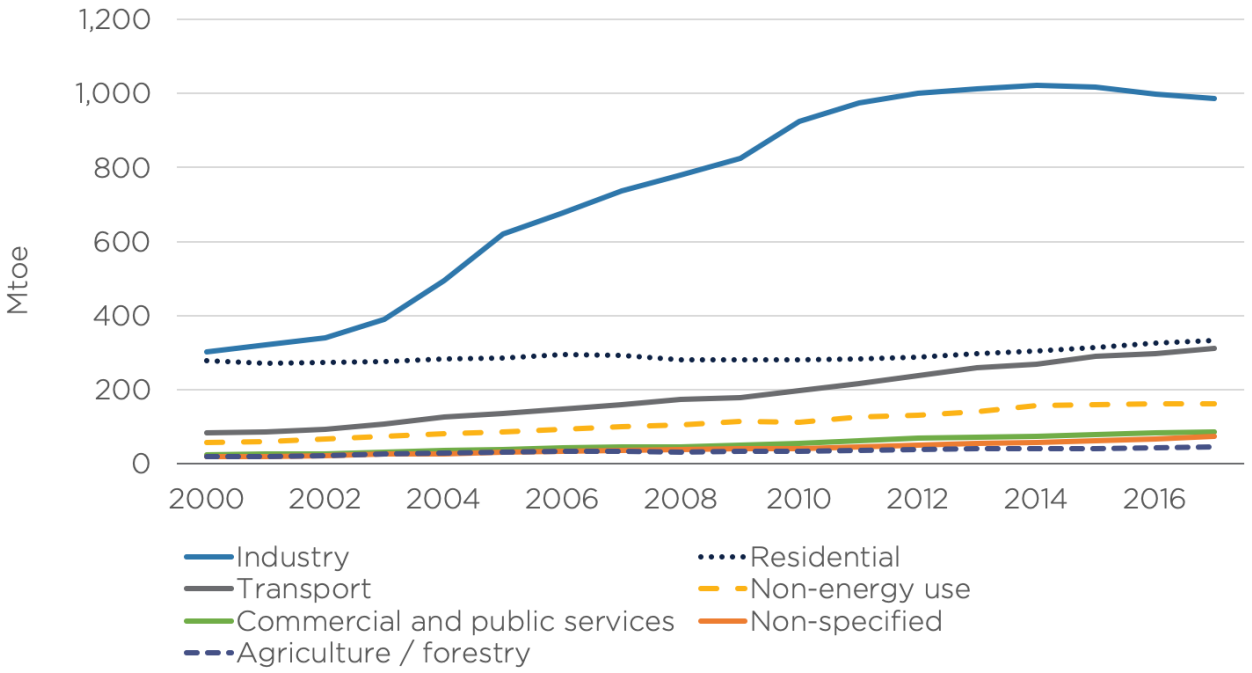


Sources: Analysis by the authors and Jeffrey Chen, of Columbia University's School of International and Public Affairs, based on data from the World Bank DataBank.

China exhibits several of the conditions that tie higher energy demand to economic growth in middle-income (and specifically wealthier upper-middle-income) countries.

- China's energy intensity per unit of GDP, like that of upper middle-income countries generally, is substantially higher than that of OECD member nations.[46] Consequently, as GDP rises, energy use can be expected to grow more in upper middle-income countries and in China specifically than in advanced economies.
- One of the key contributors to this higher intensity is that industry, which is a relatively energy-intensive sector,[47] represents one third of GDP in upper-middle-income countries as compared to only 22 percent in advanced economies.[48] In China, the industrial sector (which includes manufacturing and construction) has been particularly important, generating about 45 percent of GDP[49] and driving much of the country's increase in energy consumption from 2000 through 2012 (figure C.4).

Figure C.4: China's total final consumption by sector, 2000–2017



Source: IEA statistics database

- China's higher energy intensity of GDP also reflects its inadequate and deficient existing infrastructure base, particularly in its poorer regions, relative to advanced economies (including shortcomings in residential and commercial buildings and roads). Consequently, China, like other upper-middle-income countries, will expend a higher portion of its GDP than an advanced economy on the energy-intensive process of building out and improving this infrastructure.
- Increased consumerism is also bolstering China's energy demand. The car ownership rate virtually doubled from 80 per 1,000 thousand people in 2012 to 155 per 1,000 by 2018,[50] the type of increase that generally only occurs in the immature vehicle markets of developing countries. As a result, gasoline consumption has jumped by over 50 percent since 2012.[51] At an aggregate level, residential, transport, and other sectors tied to household consumption are contributing more to energy demand as the economy matures and industrial consumption slows (figure C.4).

This reliance on increasing energy use to fuel economic growth is also reflected in the government's growth strategy. For example, China's 13th Five-Year Plan for Energy (2016–2020) provides for an increase in energy consumption from 4.3 billion tons of coal equivalent in 2015 to no more than 5 billion in 2020, representing a nearly 3 percent increase per year even as the government also promotes greater energy efficiency.[52]

Poverty Legacy's Impact on the Energy Infrastructure

Despite China's notable economic growth, the legacy of the poverty from which it has emerged can be seen in its energy system and infrastructure. One manifestation of this poverty overhang is China's extensive reliance on coal, which developed countries have largely moved away from. Coal represented about 58 percent of China's overall energy mix in 2018, providing 64 percent of power generation. In the OECD, coal only represented 15 percent of the energy mix and 26 percent of power generation.[53] Some of this dependence can be explained by China's extensive and affordable domestic coal reserves. However, some OECD countries such as the United Kingdom also have large coal reserves that are no longer being developed at scale. Moreover, despite recent moves to cleaner fuels, China remains burdened by various outmoded and politically influential carbon-intensive industries that were created when the country rushed to develop its manufacturing capability.

China's ability to replace outmoded infrastructure has been constrained by its need to expand its systems to meet demand growth. In developed countries, flattening electricity demand[54] allows them to target their financial resources on replacing high carbon generation. In contrast, China has faced the dual challenge of replacing dirtier assets while rapidly expanding its energy system. For example, electricity generation capacity, which increased from 319 GW in 2000 to 1,870 GW in 2018,[55] is expected to double by 2040,[56] which will require massive investments in additional power plants. China's economy will face strains in replacing older higher-emission plants and other incumbent carbon-intensive energy assets while simultaneously expanding its energy infrastructure.

Widespread Energy-Induced Pollution

Pollution, especially the poor air quality largely attributable to China's energy sector, is one of the most visible manifestations of its developing country character. As China's economy expanded rapidly over the last two decades and the country transformed itself from a low-income country into an upper-middle-income one, its local pollutants also rose. As recently as 2013, seven of the top ten cities with the worst air pollution in the world were in China.[57] The link between air pollution and development is reflected in the composition of the world's 100 most polluted cities in 2019, where developing countries such as India and China dominate the list, including 48 Chinese cities and 39 Indian ones, while no high-income country has a city in the list.[58] Similarly, particulate matter emissions levels are higher in China and other developing countries than in advanced economies.[59]

China's various developing country characteristics present it with a challenge that most advanced economies have already overcome: promoting economic growth and environmental quality. These characteristics include heavy reliance on coal in the power and industry sectors, which frequently lack adequate pollution control equipment; the rapid growth of cars and trucks in densely populated urban centers; large-scale construction projects; damaging agricultural practices; and deficiencies in regulatory enforcement. China's household poverty challenges increase the problem. For example, the government's program to encourage households in Beijing and the surrounding regions to switch from coal to gas was weakened by low-income households in certain rural areas switching back to burning coal because it was more affordable.[60]

China has taken important steps to address its air quality problem through its war on pollution, which has produced some important successes. For example, the number of Chinese cities in the world's ten worst dropped from seven in 2013 to one by 2018.[61] Yet, even as China maintains its efforts to address air quality, including in the current 13th Five-Year Plan (2016–2020)[62] and a successor war on pollution program launched in 2018,[63] poor air quality remains a problem. For example, the vast majority of the population in China continues to be exposed to high levels of PM2.5.[64] The recent increase in coal consumption in response to anxieties over economic growth and energy security evidences the fragility of China's efforts to systematically and consistently tackle its significant pollution issues.

Institutional Weaknesses

China, like other developing countries, faces important institutional weaknesses that undermine its ability to effectively manage its energy sector. Two examples of these deficiencies concern statistics collection and policy implementation.

Reliable statistics are the foundation of sound energy decision-making. China has yet to meet the high-quality statistical reporting standards of a typical advanced economy, as reflected in the repeated major revisions made to its basic energy statistics. Following each of the first three National Economic Census surveys conducted in 2004, 2008, and 2013, the National Bureau of Statistics made extensive and significant revisions to the results published in the *China Energy Statistical Yearbook*.[65] For example, China's national coal production in 2000, an issue of immense importance for China's economic planning at the time, was raised by 39 percent in two rounds of statistical revisions.[66] There are concerns that China's recently concluded fourth National Economic Census may once again result in significant revisions to the previously announced statistics.

Policy implementation challenges, particularly at the local level, create uncertainties and variability in the implementation of energy-related policies and weaken the enforcement of environmental and other policies. Weak local-level policy enforcement is in part the result of China's vast geography and infrastructure constraints that limit the ability to disseminate central policy mandates. As a result, the central government often needs to delegate substantial responsibility to provincial and local authorities regarding compliance with national economic, energy, and environmental standards. Beijing does not always find local authorities who are willing followers of its national policies, in part because of divergences in the views and interests of the capital versus local governments. The result is often uneven enforcement of regulations across the country, with local officials at times interpreting and implementing central government mandates according to local or even personal preferences. Limited resources and other capacity constraints, particularly in poorer regions far from Beijing, also undermine disciplined policy enforcement (including across such varied areas as health standards and building codes). The result is that policies and regulations that are sound on paper often fail to produce the desired results on the ground. Overcoming such implementation and enforcement problems is a persistent and daunting challenge for China, just as it is for developing countries generally.

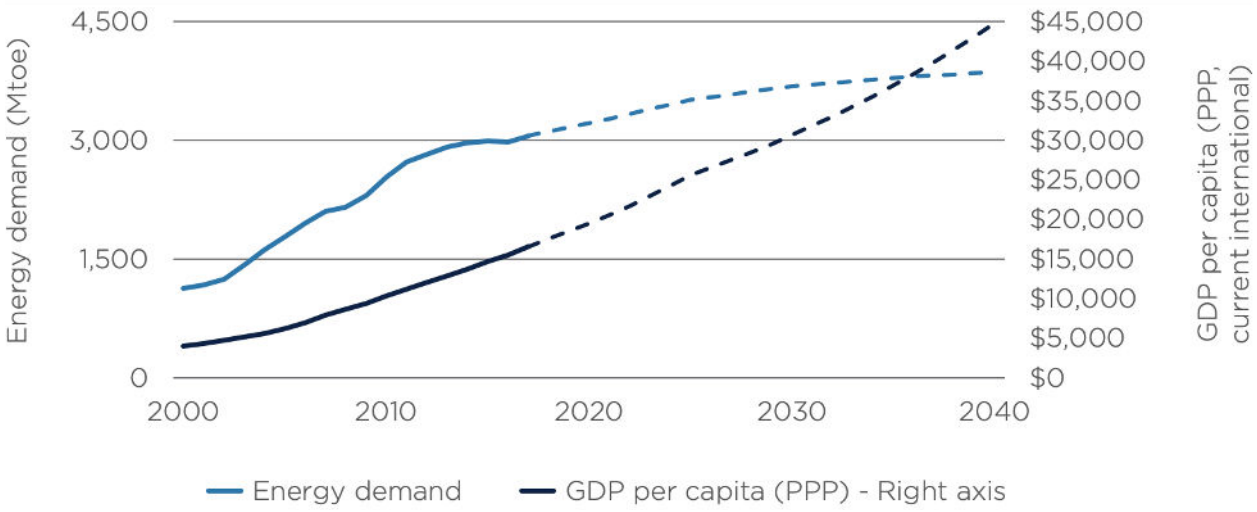
D. ENERGY-RELATED IMPLICATIONS OF CHINA'S DEVELOPING COUNTRY ATTRIBUTES

China's developing country attributes will have dramatic domestic and international impacts, including on global energy demand, government strategic choices in managing the energy sector, and greenhouse gas (GHG) emissions.

Growing Energy Demand

China's energy demand is forecast to swell to 3,684 Mtoe in 2030 (figure D.1),[67] an increase of 20 percent and the biggest projected rise for any country over this period, according to the International Energy Agency. This rise involves increases across a variety of energy forms and fuels. China is projected to increase its generating capacity by about 1,200 GW by 2030, the size of the U.S. generating fleet; this will involve major increases in gas, nuclear, solar, and wind capacity.[68] Natural gas consumption is expected to more than double over the same period. China will need to secure larger amounts of all fuels, excluding coal.[69] Increasing domestic consumerism, particularly from the expanding middle class, will drive more energy demand. From car ownership[70] to air conditioning,[71] China's increasingly affluent populations will be demanding more products and services powered by energy. While COVID-19 dramatically lowered China's energy demand in the first quarter of 2020, many analysts do not anticipate a long-term impact.[72]

Figure D.1: China's energy demand and per capita GDP, historical through 2017 and projections to 2040



Sources: WEO 2018, United Nations World Population Prospect 2017, and World Development Indicators

How this growing demand for products and services translates into increasing energy use, and what the resulting emissions profile looks like, will depend on the choices China makes. In all cases, however, China will in the short and medium terms face the major economic challenges of securing substantially larger amounts of energy (from both domestic and foreign sources) and mobilizing massive financial and technical resources to build the infrastructure such growth will require. This resource requirement will be amplified as China replaces existing high-carbon coal infrastructure with lower-carbon alternatives. Over the longer term, as China's income per capita rises above $25,000 (PPP), energy demand growth is projected to slow and then flatten (figure D.1),[73] consistent with the pattern exhibited by high-income countries. This will reduce the ongoing pressure to secure significantly larger amounts of energy, freeing up resources for other areas.

Recent Anxieties about Economic Growth and Energy Security

China is vulnerable, both economically and politically, to an economic downturn. China's modest per capita income provides little financial cushion for many households in the face of an economic downturn or energy price spikes. Moreover, the Chinese political-economic compact is built in part on poverty eradication and increased prosperity in exchange for restrained political entitlement.[74] A marked economic slowdown, including one fueled by energy disruptions, could severely undermine this arrangement and throw many households into financial crisis. Concerns about sustaining robust economic expansion are also taking place within an overall global development context that has pointed to the challenge for middle-income countries specifically to sustain robust growth rates. This is often referred to as the "middle-income trap."[75] For China's leadership, avoiding the middle-income trap has become a pressing concern as the economy showed signs of slowing growth[76] even before the U.S.-China trade war and the more recent COVID-19 pandemic.

Government apprehensions about economic growth and related concerns about energy security and affordability have arisen against the backdrop of China's rising dependency rates on oil and gas imports, which exceeded 70 percent and 45 percent in 2019, respectively.[77] The Chinese government reacted in 2018 and 2019 by pushing to increase domestic production, especially from the nation's abundant and cheap coal reserves. This has included a rise in coal chemical development, permission to build numerous greenfield coal-fired power plants, and less stringent requirements on switching from coal to gas. So while Chinese coal consumption had been dropping from a peak in 2013, the absolute level of coal use has rebounded over the last three years (even as its share in the energy mix has continued diminishing).[78] From 2017 to 2019, coal production increased by 9.4 percent, and coal imports grew by 10.5 percent.[79] This increase in coal use generated higher GHG emissions and slowed efforts to transition to a cleaner energy system. While there is increased uncertainty regarding overall coal consumption for 2020 as a result of the COVID-19 pandemic, as China looks to reignite economic activity, another surge in coal and emissions might occur if, once again, it looks to spur growth using its abundant and affordable coal. The reported approval of 11,400 MW of new coal power plants, as well as an additional 22,400 MW under planning as of May 2020 (nearly three times the total coal-fired power capacity approved in all of 2019) is a worrisome signal in this regard.[80]

GHG Emissions: A Domestic Challenge with Global Implications

China's developing country attributes affect its efforts to manage climate change in several ways, including the nature of its obligations under the international climate change framework and its ability to reduce emissions. China is the country with the highest level of GHG emissions, responsible for about 25 percent of the global total.[81] The country's reliance on increasing energy use to fuel economic growth in general and its predilection for carbon-intensive coal in particular—two factors tied to its developing country status—create major challenges in China's efforts to control and ultimately reduce emissions. China's ability to merge its development and growth objectives with significantly lower emissions will be one of the key factors affecting its success in advancing the climate agenda.

The international legal framework

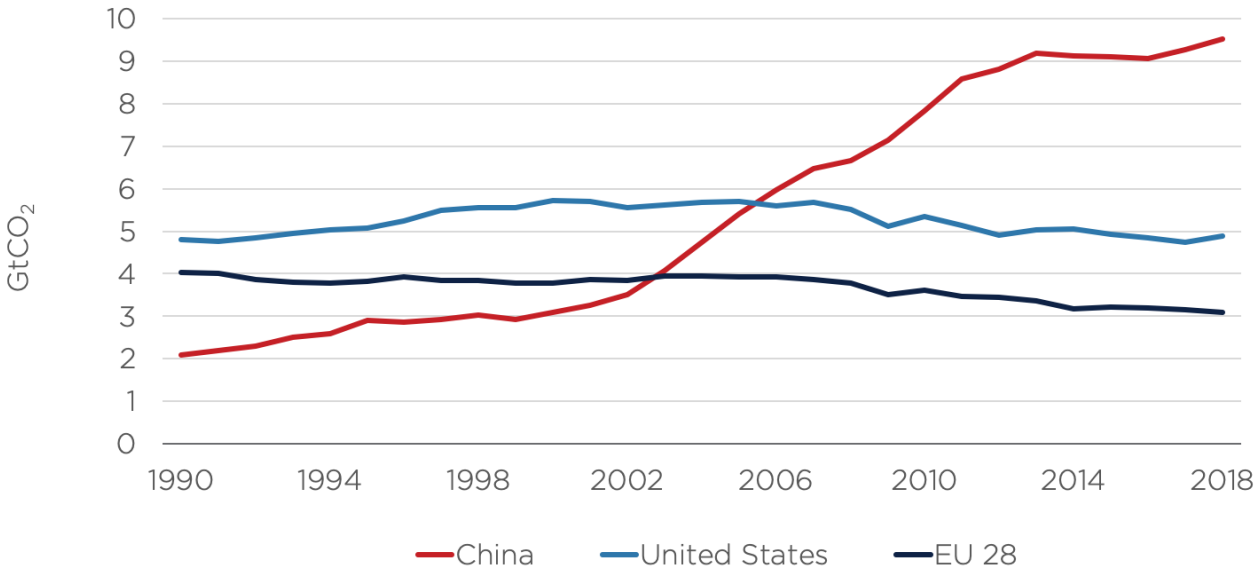
Under the terms of the United Nations Framework Convention on Climate Change (UNFCCC) adopted in 1992, developing countries have greater flexibility in addressing climate change than developed ones. When this framework was established, China was a low-income country with limited emissions and was designated as a developing country benefiting from the flexibility that the designation afforded. Similarly, the Kyoto Protocol negotiated shortly thereafter did not impose emissions reduction obligations on China as it did on developed countries.[82] Its emissions at the time were also significantly below that of the United States or the EU.

The framework has evolved since the 1990s, and developing countries are now required to make emissions reductions contributions under the terms of the Paris Agreement although they do enjoy greater flexibility. For example, the agreement provides that countries "aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties."[83] China's status as a developing country has not been formally revisited, and the framework does not provide a mechanism for countries to graduate to the developed country bloc. As a result, China continues to technically qualify as a developing country under the UNFCCC agreements.

The changing emissions landscape

However, for practical purposes, China's status under the international climate change framework has changed, driven in part by its massive emissions profile and the attendant critical role it will need to play for any successful effort to reduce global emissions. China's CO_2 emissions from the combustion of coal, oil, and gas rose from 3.1 $GtCO_2$ in 2000 to 6.0 $GtCO_2$ in 2006 when it surpassed the United States as the world's largest emitter (although the United States continues to have the biggest cumulative historical emissions and higher per capita levels as well).[84] China's energy CO_2 emissions now total over 9.5 $GtCO_2$, 28 percent of the global total and more than the United States and the EU combined (see figure D.2).[85] Over this period, China has also grown into the world's second largest economy. As a result, there has been less of a focus on China's prerogatives under the "developing country parties" label and more on the importance of China taking action to control its emissions and impact global climate change efforts. Although the COVID-19 pandemic significantly lowered China's emissions in early 2020,[86] this may prove to be a short-term phenomenon as economic activity picks up.[87]

Figure D.2: CO_2 emissions from fossil fuel combustion for China, the United States, and the European Union, 1990–2018



Sources: IEA "CO_2 Emissions from Fuel Combustion" (2018) and "WEO 2019"

China's climate undertaking

China submitted its intended nationally determined contribution (NDC) to the climate change effort a full six months prior to the COP (Conference of the Parties) 21 meetings held in Paris in late 2015, partly in recognition of its leadership position.[88] China explicitly embraces the developing country designation in its NDC[89] and sets out obligations consistent with the greater flexibility afforded such nations as it looks to a 2030 time frame to peak national carbon emissions. It also distinguishes itself from developed countries that should lead in undertaking ambitious emissions reductions under the Paris Agreement.[90] The NDC provides, among other things, for China's (1) "peaking of carbon dioxide emissions around 2030 and making best efforts to peak early," (2) lowering by 2030 of its "carbon dioxide emissions per unit of GDP by 60 percent to 65 percent from the 2005 level," and (3) increasing by 2030 "the share of non-fossil fuels in [its] primary energy consumption to around 20 percent."[91]

However, because of China's massive emissions profile, the climate goals set out in the Paris Agreement implicitly require that China peak its national emissions as soon as possible and at as low a level as possible. Moreover, the NDCs submitted by the major developed countries set an important precedent of relevance for China by providing express time-bound emissions reduction targets[92] (although the impending withdrawal of the United States from the Paris Agreement fundamentally alters the international political context facing China).

China's emissions challenge

China's growing energy demand—required to support economic growth and address its

ongoing poverty challenges—will impact its ability to manage emissions. Absent the type of short-term economic contraction caused by the COVID-19 pandemic, emissions can only drop if the rate of decarbonization is greater than the growth in energy consumption. Even though China has cut the carbon intensity of its energy mix by 5 percent since 2013 (see later figure F.1), its energy consumption increased by 10 percent and CO_2 emissions rose by 4 percent. Advanced economies show a different result: the carbon intensity of the EU's energy mix has fallen by 7 percent since 2013, while energy demand declined by 1 percent, supporting an 8 percent drop in emissions.[93]

Moreover, it is uncertain how committed the Chinese government will remain to reducing emissions in the face of anxieties about economic growth and energy security,[94] particularly in the short-to-medium term as the country faces the costs of the COVID-19 pandemic. This is problematic from an emissions perspective given China's heavy reliance on coal to power economic activity. The preceding points also touch upon a more subtle and difficult aspect to apprehend, but it is one with important implications. How does China's view of itself affect its actions, particularly regarding energy and emissions? Part of the answer is the repeated assertion by the Chinese government that it is a developing country. Another is its strong prioritization of growth and poverty eradication, even in the face of environmental damage. Ultimately, China's ability to merge its development and growth objectives with emissions reductions will be one of the key factors affecting its "best efforts to peak earlier," as well as the overall level of that peaking. In this regard, the Chinese government must incorporate into its calculation the destructive potential of climate change.

Major vulnerabilities to climate change

China's energy system—like those across the planet[95]—is vulnerable to climate change in a variety of ways, including through the destructive risks for infrastructure, the negative impacts on electricity generation, and the demand swings caused by extreme weather. This is recognized by Chinese policy makers and analysts, who have undertaken various studies on this topic.[96] However, even though China's exposure to the damage and destruction of climate change reflects the realities of all nations, it is amplified given the particular vulnerabilities that flow from its developing country attributes and the specifics of its geography.

China's still modest income levels make climate change adaptation more difficult than for wealthier advanced economies. On a per capita basis, China has fewer resources to spend on managing climate (notwithstanding its large aggregate assets). This shortcoming is exacerbated by its ongoing need to fight poverty: battling the negative impacts of climate change will divert critical resources from efforts to lift more of its population out of poverty and maintain the living standards of those who have moved up. Moreover, China's geography makes it extremely vulnerable to climate change, especially as 550 million people live in coastal provinces susceptible to sea level rise.[97] While some in the United States believe that its wealth and other assets will allow it to weather the negative impacts of climate change, China is not and will not be wealthy enough in time to withstand the negative economic impacts of climate change when they occur. To the contrary, climate change threatens to severely undermine China's ongoing efforts (and even some of its acquired successes) to raise standards of living and eradicate poverty in a sustainable manner.

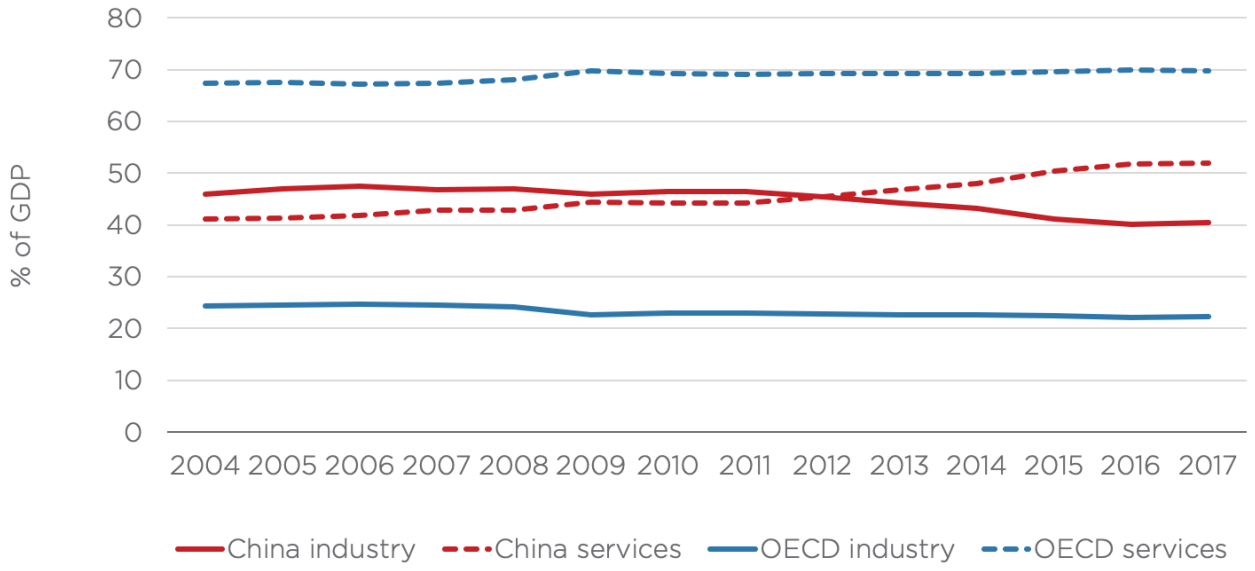
E. CHINA, THE HYBRID SUPERPOWER

Given its mixed developing and developed nation attributes, China constitutes a hybrid country from a development perspective. However, its massive economic and energy resources separate it from other countries that have had both attributes, creating a unique hybrid superpower that will have major distinctive impacts on the global energy system.

An Advancing Economy with Ongoing Poverty

China's government has been modernizing its economy along the lines of an advanced economy by promoting the services sector and lowering the energy intensity of GDP.[98] Although China's economic growth was historically powered by industry, the share of services surpassed industry as the largest contributor to GDP in 2012, but it still remains far below that of OECD countries (see figure E.1). China has successfully reduced the energy intensity of its economy and aims to further lower the figure.[99] This will require a more marked shift toward the services sector and further energy efficiency improvements.

Figure E.1: Service and industry sectors' share of GDP in China and OECD countries, 2004–2017



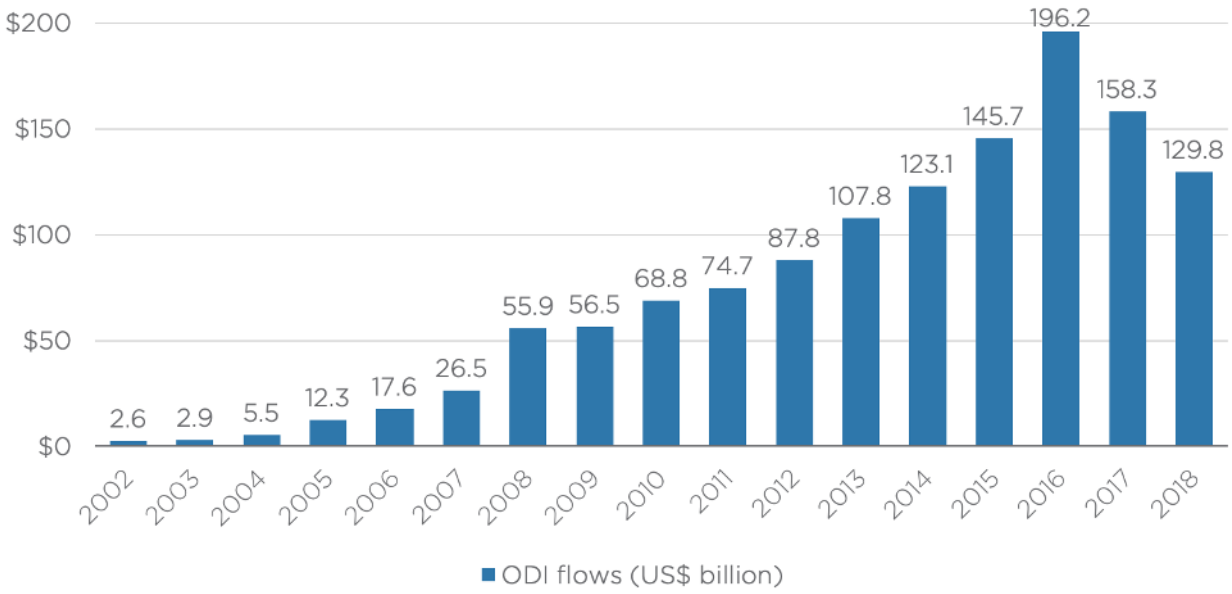
Sources: World Bank DataBank

Over the last 20 years, China has seen a dramatic growth in its middle and upper classes, bringing sweeping economic change and social transformation. China's middle class has expanded from fewer than 20 million people in 2000 to about 400 million in 2018.[100] China's upper-income class has also grown, with projections that the number of millionaires will

grow from nearly 4.5 million now to over 6.8 million by 2024.[101] Its retail market currently exceeds $5 trillion (larger than the entire Japanese or German economy) and is projected to surpass the U.S. as the world's largest retail sales market by 2021.[102] Middle-class expenditures are projected to more than double between 2020 and 2030.[103] This growing class is also activating social forces that impact the energy sector, such as the effort to curb air pollution.

Empowered by its massive economic resources, China has also become a leader in overseas investments and a major provider of foreign development finance for energy. China's overseas investments have risen significantly in absolute size and global ranking. Its outward direct investments totaled nearly $130 billion in 2018, second only to the U.S. and up from a ranking of 26th in 2002 (figure E.2). China has pledged more than $1 trillion in foreign financial support under its Belt and Road Initiative (BRI),[104] with energy currently accounting for roughly 44 percent of BRI construction.[105] China sponsors the recently created Asian Infrastructure Investment Bank, a new multilateral development bank headquartered in Beijing that funds energy and other projects abroad. The establishment of the China International Development Cooperation Agency in 2018 marked another milestone. China's overseas economic activity is being supported by an expansion in its diplomatic outreach: China now has the highest number of global diplomatic posts.[106]

Figure E.2: China's outward direct investments (US$ billions), 2002–2018



Source: EY[107]

China's robust growth rates will soon move it out of the World Bank's middle-income country classification. Based on the income per capita growth rates of the last several years, China should qualify as a high-income country before 2025,[108] a major accomplishment for a country that was a low-income country only 25 years earlier. Similarly, given its overall economic size

and general advancements, China will likely no longer qualify as a developing country against other criteria, although it is more difficult to project when it will no longer formally qualify as a developing country under the HDI, which requires improvements in life expectancy and education that are more difficult to forecast.

Yet, despite its numerous economic advancements, China will continue to face many energy poverty issues. Nearly 250 million people are expected to still lack access to clean cooking in 2030.[109] Progress in the area of pollution has been uneven, and poor air quality will remain a problem.[110] Beijing and Shanghai have seen improvements, especially as polluting industries are relocated, but real development requires adequate minimum standards across all of the country. Institutional weaknesses will continue to hamper the vast country into the next decade, particularly in its numerous decentralized and remote locations. Similarly, while graduating from middle-income status is likely (notwithstanding the negative impacts of the U.S.-China trade war or the COVID-19 pandemic), a long path remains to achieve the high-income levels that characterize advanced economies (see later discussion in box F.1).

A Category of Its Own: Hybrid Superpower

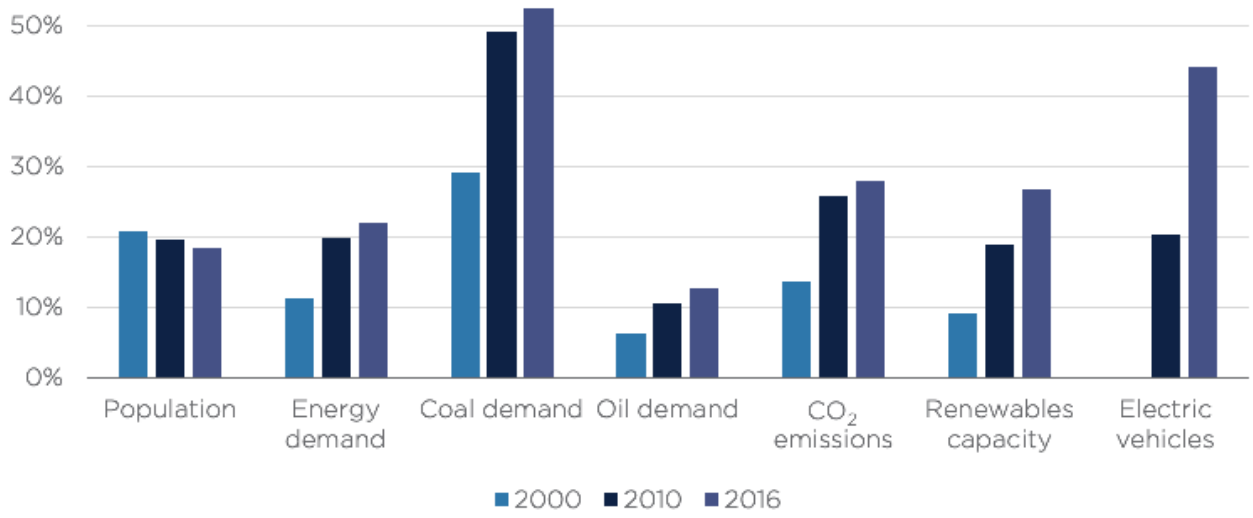
China simultaneously possesses major attributes of both a developing and a developed country. Therefore, it is perhaps best described as a hybrid economy, a term that captures China's dual nature better than trying to decide whether it should be placed within the traditional developing or developed country category. China is not unique in combining significant attributes of a developed and developing country. South Korea, Saudi Arabia, and Russia are examples of other countries that also combined both types of attributes at certain stages in their development.

China, however, differs from every other hybrid country because of its massive economic weight. China's GDP is bigger than the world's third, fourth, and fifth largest economies combined (namely Japan, Germany, and the United Kingdom). The only other country in the last 100 years that has achieved (and continues to achieve) this feat is the U.S., the preeminent developed country and superpower.[111] China's economic might enables it to project its vision and preferences internationally, influencing developing countries as well as advanced economies.[112] China's hybrid status gives it a standing and influence within the developing country community that is not enjoyed by the United States or any other advanced economy. It often acts in concert with the G77, the leading group of developing countries. China is thus able to exert substantial influence over many of the world's countries, including through a powerful combination of large-scale overseas investments, strategic commercial arrangements with trading partners, growing foreign assistance, and expanding diplomatic resources. It has become a superpower, an economic and energy behemoth with an ever-growing global influence that in various domains approaches and even exceeds that of the world's other superpower, the U.S. But China is different from the U.S. because it also simultaneously combines the attributes of a developing country with those of a developed one. It presents an unprecedented situation for global affairs since the advent of the developing/developed classification that took root with the establishment in the 1940s of the World Bank: it is the world's only *hybrid superpower*.

Driving World Energy

As noted earlier, China is the biggest energy consumer in the world, accounting for about 23 percent of global primary energy consumption. China is also the world's largest energy producer, responsible for 17 percent of total global production.[113] China became the world's energy leader as a result of a near two-decade expansion that began in the early 2000s (figure E.3). China is today a central actor across a variety of energy issues, including as the world's biggest coal and electricity producer; the largest importer of all fossil fuels;[114] and the biggest market for many clean energy technologies, such as wind and solar power generation and electric vehicles.

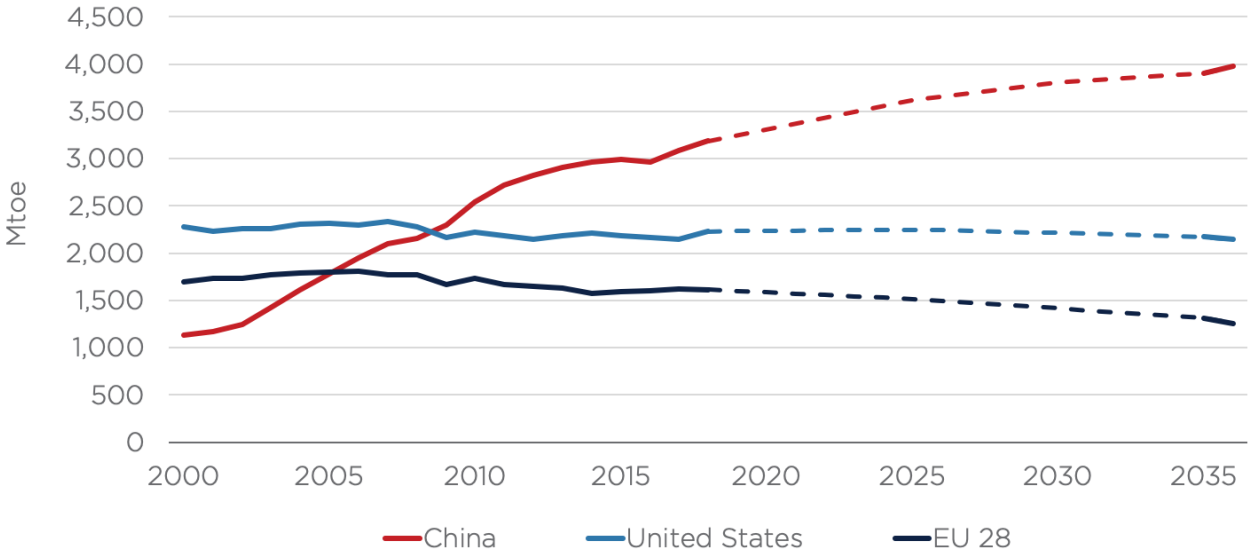
Figure E.3: China's share of selected global energy indicators



Source: "WEO 2017," figure 12.2

Looking forward, China's primacy in energy is expected to increase over the next decade, driven in part by an energy demand that is projected to rise more than in any other country.[115] China will become even more influential in global energy trade as its import requirements increase. Its oil imports are projected to grow from 8.9 million barrels per day in 2017 to 13.3 in 2040, a level that is 75 percent larger than what the entire EU is projected to import that year.[116] Similarly, China is expected to surpass Japan as the largest LNG importer by 2023,[117] and its LNG imports are projected to exceed that of Europe by 2040.[118] On coal, China's import requirements are projected to decrease, but it will remain the world's largest producer for decades to come.[119] By 2035, China's overall energy consumption is expected to exceed the United States and the EU combined (see figure E.4). Combining the growing massive energy needs of a large developing country with the financial wherewithal of an immense economy gives China a massive and increasing influence on global energy matters. In the energy domain, China is a superpower.

Figure E.4: Energy demand for China, the United States, and the European Union, 2000–2017 and projections to 2035



Source: IEA data center and "WEO 2019"

Risks and Resilience for a Hybrid Superpower

The COVID-19 pandemic and the resulting adverse impacts on economic activity will slow China's efforts to overcome its developing-country-related challenges. Even as economic activity has started to rebound in the second quarter of 2020, it is too early to quantify the total economic damage engendered by COVID-19.[120] The next 18 months should provide greater clarity regarding the extent of economic damage and slowdown in growth that China will suffer as a result of the pandemic. However, even a crisis as dramatic as the COVID-19 pandemic is not expected to fundamentally alter China's trajectory in consolidating and advancing its transformation from a developing country into a hybrid superpower and beyond.

F. ENERGY-RELATED IMPACTS OF A HYBRID SUPERPOWER

China's position as a hybrid superpower will affect the domestic and international energy landscapes, including energy markets worldwide, domestic energy choices, and the energy investments and strategies of other developing countries. China will be playing in the energy landscape not as a poor country seeking resources but as a superpower looking to exercise its influence and impose its preferences. Its interest in ensuring the security of its energy imports and overall energy security will affect its deployment of commercial, financial, diplomatic, and military assets. What happens with China's energy demand will ripple through the energy world and across the global landscape generally.

Driver of Product Choices and Design Preferences Worldwide

China's massive and rising energy use and economic weight will increasingly shape the energy markets of both developing and developed countries in a variety of ways. Several examples follow.

1. Electric vehicles and fuel economy standards. China, already the world's largest car market,[121] is projected to be the main driver of electric vehicle demand, accounting for 54 percent of global electric vehicle sales in 2025.[122] Chinese vehicle fuel economy standards and other requirements and consumer preferences will impact the global car manufacturing industry and will help to shape global mobility trends.

2. Consumer product design. Given the size of China's domestic consumer market, companies around the world can be expected to increasingly tailor their goods and services to meet the preferences of Chinese consumers. From phones to televisions to movies and other energy-consuming goods and services, Chinese preferences will make their way into the design of products for its domestic market, which in turn will affect what these products look like in other parts of the world. For example, China's energy efficiency requirements and consumer preferences will have product design and energy demand impacts that stretch beyond its shores. So too will China's use of mobile payment and other e-services. The degree of penetration of these systems across China will affect domestic energy demand patterns and will influence the availability of associated technologies in both developing and developed countries.

3. Technology exports. China is increasingly becoming a source of technological innovation, as has been illustrated by its major contribution to the lowering of the cost of solar panels worldwide. It is similarly making important strides in improving the cost efficiency of wind turbines and promoting other low-carbon technologies. At the same time, it is also becoming a leader in high-efficiency coal plant construction. The export of these energy technologies will shape global markets and will affect emissions abroad.

4. International tourism. China is now the largest source of international tourism,[123] which involves a wide range of energy use. From jet fuel for airplane travel to gasoline for bus transportation and passenger vehicle rentals, to electricity and heating for hotels, to

other forms of energy consumption, tourism requires energy. Chinese preferences on destinations, forms of travel, and recreation will thus affect energy demand.

5. The destination for energy commodities. As China's energy imports increase so will its influence on energy trade and suppliers. This will affect its relations with traditional energy suppliers, such as Russia and Saudi Arabia, as well as the United States (notably with respect to its long-term LNG exports).

Foreign Energy Engagements

China will influence the energy investments in many developing countries through its financing for power plants and other energy production and delivery systems, as well as energy-related infrastructure such as ports, roads, and industrial facilities that constitute a large portion of the BRI and overseas investment programs. Its extensive foreign assistance program is raising anxieties in the capitals of many economies, notably Washington. China's overall strategy in foreign affairs, including its foreign financial support, overseas investments, and diplomatic actions, has often been oriented to securing energy resources from other regions such as the Middle East and Africa. Its increasing weight and proactivity as a hybrid superpower will shape the global energy landscape in the years to come.

An Alternative Development Model

China's economic advancements have been achieved through the route of a centrally planned economic approach and reliance on state-owned enterprises[124] coupled with market-oriented reform. This contrasts to the private-sector-oriented development approach generally advocated by the World Bank and other development organizations. The ability of China's model to raise 400 million people out of extreme poverty since 2002, to achieve universal access to electricity, and to sustain robust levels of economic growth over four decades provides an important precedent for the developing country bloc.

China's heavy reliance on industry to drive its development will likely influence other countries, with attendant energy impacts because industry is energy intensive relative to other sectors. India's decision to adopt a "Make in India"[125] strategy emphasizing manufacturing rather than services is similar to the Chinese model. Choosing this approach will likely result in higher energy consumption in India than a services-oriented development strategy.[126] Developing countries may also look to emulate China's use of state-owned enterprises even though this runs counter to the traditional recommendations from the World Bank and similar development institutions. This choice would affect the corporate and governance structure of the energy sector, with potential knock-on impacts on market conditions and climate policies.[127] China is also encouraging its state-owned enterprises to be more active abroad, including under the BRI where they have contracted about half of the projects representing more than 70 percent of total project value.[128] The emergence of China as a hybrid superpower will likely result in developing countries more willingly partnering with state-owned companies and not just the private sector promoted by development agencies. Finally, how China's model fares against the backdrop of the COVID-19 pandemic may also affect its appeal for other developing countries.

China's Changing Status at the World Bank, World Trade Organization, and Elsewhere

Several elements that are driving China's status as a superpower are creating pressure in various international contexts to remove the benefits it has enjoyed under the developing country label. The U.S. administration under President Trump has been very vocal in seeking to remove China from the list of developing countries under the WTO[129] and to limit its access to World Bank preferential financing.[130] The World Bank has already begun to reduce its planned lending program to China by potentially as much as 45 percent, with the current United States administration seeking even deeper cuts,[131] and there will inevitably be controversy surrounding China's eligibility under the dedicated COVID-19 lending program recently established by the bank. Not surprisingly, as China's economy continues to grow and its per capita income rises (after absorbing the impact of the COVID-19 pandemic), its access to favorable treatment under these two international organizations and other similar ones (e.g., the Asian Development Bank) will likely diminish over time. More countries may also resist giving China the preferential treatment offered to developing countries in future multilateral agreements. This shift in the treatment of China will likely be reinforced by its own efforts to exercise the economic and political influence of a superpower.

Environmental Concerns of China's Expanding Affluent Class

China's growing middle and upper classes are increasingly influencing policies that affect their standards of living and quality of life, specifically on the environment and, by extension, energy issues. This can be seen in the area of air pollution, where growing public clamor has helped to drive stronger government action on air quality,[132] albeit with mixed outcomes.[133] Another potential pressure point in the future is climate change. The growing awareness of the physical and economic threats to China posed by climate change, including its potential effects on the populous coastal provinces, may prompt stronger calls from the country's affluent classes for tougher government action to reduce GHG emissions so as to protect the gains in their livelihoods.

Which Way Forward on Climate Change?

There are growing expectations internationally for China to act on climate. Indeed, China's "differentiated responsibilities" are increasingly converging with those of developed countries as its economy has grown. China is now clearly viewed by the rest of the world as a case apart given the size of its emissions and the enormous financial resources that separate it from other developing countries. The international community will look for a more ambitious climate commitment from China than just "peaking around 2030," including a clearer sense of a reasonably bounded absolute value of this peak. China will likely face greater pressure to shoulder more international responsibility and leadership in other climate issues, including providing climate finance to poorer developing countries and supporting technology innovation and transfers. Meanwhile, as noted earlier, domestic pressure to address the threat of climate change may also increase from its growing affluent population that is concerned about protecting their standard of living and future prosperity. While the COVID-19 pandemic will affect China's climate position in the near term (e.g., by reducing emissions in the short

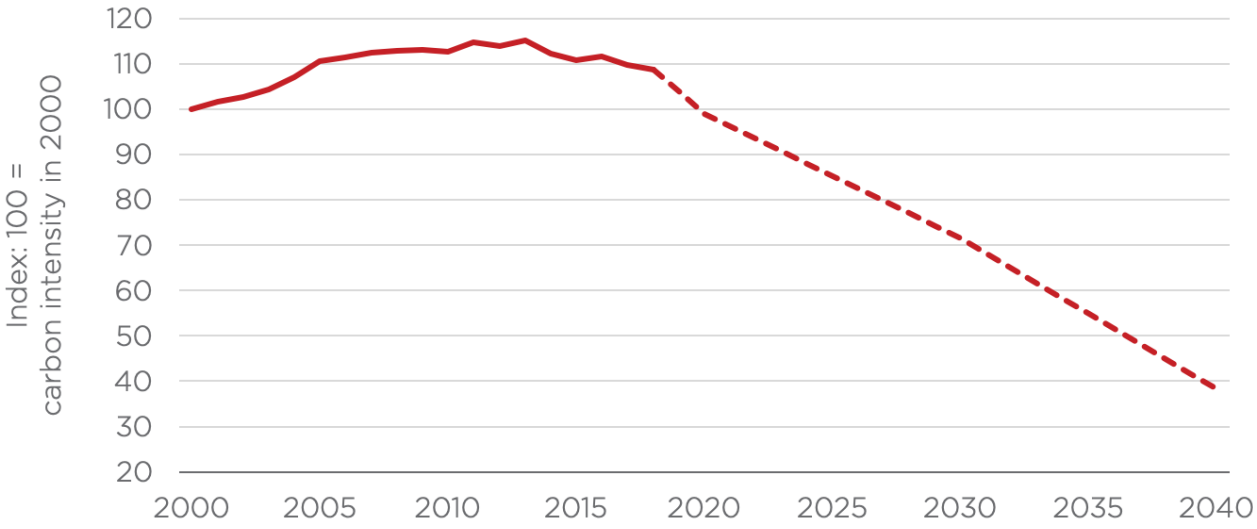
run but also leading to intensified domestic efforts to ramp-up economic activity, including a potential uptick in coal use and related emissions), it will not likely fundamentally alter the longer-term direction of government policies on climate change.

As a hybrid superpower, China has the capacity to overperform in its own decarbonization efforts and to lead other countries down a successful low-carbon pathway.

- China's economic power, its leadership in deploying renewables, its command approach to industry, and its growing success in promoting and deploying technological innovations are just some of the elements that give it the possibility to generate and deliver low-carbon breakthroughs. The government's control over major industries (more than half of its energy emissions are from state-owned enterprises)[134] gives it the ability to push aggressively for them to shift toward lower carbon-intensive manufacturing activities or into services that have a lower energy intensity. The government's ambitious and aggressive efforts to improve air quality in the Beijing-Tianjin-Hebei region, including shutting numerous factories or requiring them to shift from coal to natural gas, reflect this power.[135]

- Delinking energy use from GDP growth by increasing the weight of the service sector will be one of the critical components in China's efforts to address its emissions. However, given the development drivers that will raise China's energy consumption, any ambitious emissions reduction strategy will require significant decarbonizing of the energy mix. Even though China has succeeded in lowering the carbon intensity of its energy mix over the last decade, a much larger decline will be needed to align with a 2oC pathway (figure F.1), let alone the more ambitious goals of the Paris Agreement of "well below 2oC" or 1.5oC. This will require stronger action than the government has been willing to undertake to date, including dramatically shifting from coal to lower-carbon alternatives (notably renewables); deploying carbon capture, utilization, and storage technologies extensively in power and industry (on both coal and gas); aggressively promoting electric vehicles and other low-carbon end uses; and encouraging large-scale technological advancements—many of which China will need to develop.

Figure F.1: Carbon intensity of China's energy mix, historical through 2018 and targeted under IEA's 2°C climate scenario (intensity indexed to 2000)



Source: The authors' calculations are based on the IEA database and the 450 Scenario in the "WEO 2016."

- As a superpower with development challenges, China can seek to lead other developing countries by example in implementing a pathway that merges poverty eradication and economic growth with low-carbon alternatives. It can also promote a low-carbon development approach in developing countries through a combination of foreign assistance, its choice of investments overseas, and technology transfers. This would also involve greening its BRI program, which saw over 40 percent of funding for the power sector in 2018 allocated to coal projects.[136] However, there is also the risk that China might (explicitly or implicitly) encourage other countries to follow a high-carbon pathway, especially as its own development was built on a heavy reliance on coal (albeit at a time when there was less awareness regarding climate change concerns), and the BRI has included a large percentage of high-carbon projects.[137] Developing countries will be watching to see if China can successfully merge economic growth and poverty eradication with emissions reductions and how it chooses to deploy its financial resources abroad.

The dynamic between China and advanced economies will also influence its climate actions at home and internationally. The retreat of the United States on climate action has lowered the pressure on China, as well as on other countries, to advance the climate change agenda. The longer this remains the approach of the United States, the longer it will take for international pressure to coalesce around the need for China to upgrade its climate ambitions. Yet China must also be prepared for a new United States administration committed to addressing emissions and the resurgence of international pressure on China to act. China, however, does not need to be in a reactive mode in its interactions with the United States and other

advanced economies when it comes to the international climate change agenda. Adopting and implementing an ambitious carbon reduction program (one that includes, for example, stricter domestic emissions targets coupled with increased international climate finance and technology transfers) will increase the pressure on richer countries to act. The extent to which China asserts leadership, particularly with developing countries—including through the COP negotiations, at the UN generally, with the Asian Infrastructure Investment Bank it sponsored, or through its bilateral BRI— on the international climate change agenda will not only affect its international standing, but also influence the positioning of advanced economies on this topic, especially those concerned about China's growing diplomatic and commercial weight.

The Mentality of a Hybrid Superpower and Beyond

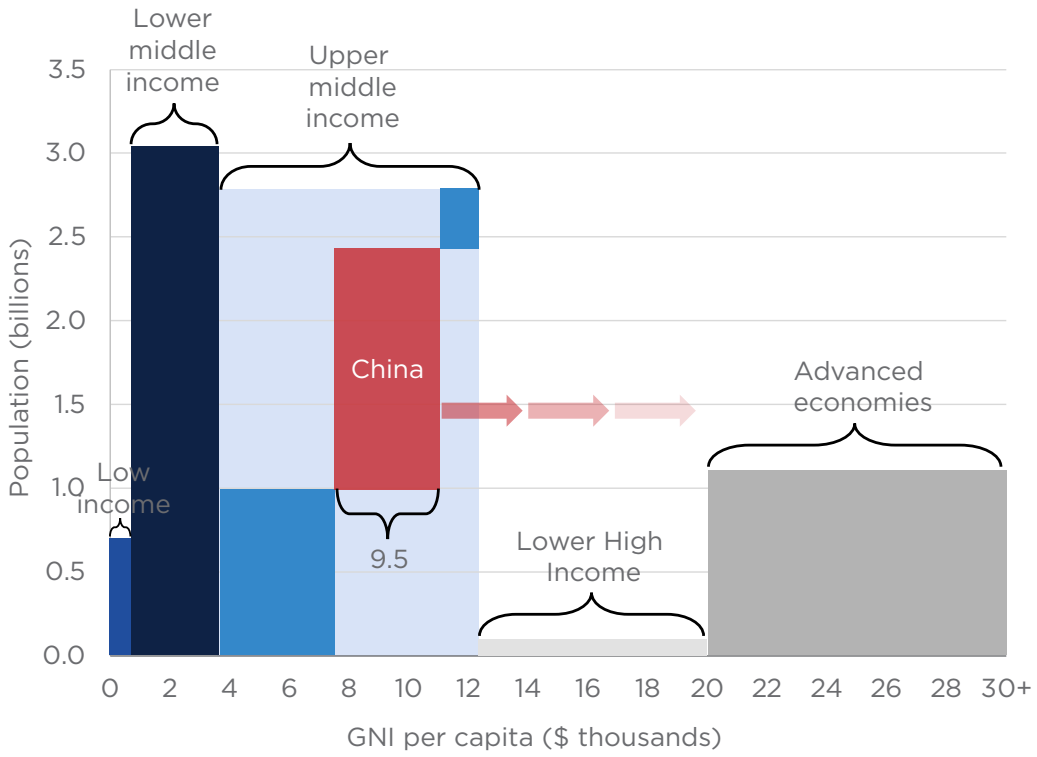
While Chinese government officials often emphasize their country's status as a developing country, China is increasingly behaving as a superpower, generating diverse reactions abroad and altering its own view of its role and position in the world. The government and domestic elites are increasingly positioning China as a country that not only controls its own destiny (rather than being subjected to foreign forces) but also asserts its influence abroad.[138] Moreover, China's current hybrid position is viewed by the country's leadership as transitional. The government's long-term objective, as articulated by President Xi Jinping, is to move the nation well beyond the status of a hybrid economy to that of an advanced one with the affluence, quality infrastructure, high standards of living, and global influence that these advancements can provide.[139]

The shift in China's state of mind away from a developing country and toward a superpower will likely accelerate going forward, driven by two dynamics. The first is the growing economic power discussed throughout this paper. The second stems from the fact that the current Chinese political leadership, most of whom are 60 years or older, came of age in a low-income China and only experienced upper-middle-income status later in life. By comparison, people in the younger generation, especially those within the urban elite, have spent much of their adult lives in a booming middle-income country with many advanced economy attributes and with the growing international aspirations and entitlements of an economic superpower. The intergenerational changes that are taking place in China between parents and children is remarkable—and potentially unsettling at times. As China's leadership integrates an increasingly higher percentage of these younger people, its policies and practices can be expected to undergo profound change. It is difficult to project what will be the mentality of the future generations of decision-makers as they consolidate and embrace China's growing capacities and influence, particularly in foreign affairs where the country's historical reticence to exert influence abroad is encountering a rising nationalism. At the same time, attaining the status of an advanced economy remains uncertain in practice, particularly for a country as populous as China (box F.1).

Box F.1. From middle income to advanced economy: A path less traveled

Despite China's impending graduation from middle- into high-income country status, there is a long journey from its current $9,500 per capita income to the $20,000 and higher levels that characterize advanced economies. Few nations have been able to reach and then successfully cross the valley between middle-income countries and advanced economies—an economic segment which accounts for less than 2 percent of the global population (figure F.2)—and no country has done so with a population even approaching China's.[140]

Figure F.2: The "valley" between the income per capita of China and advanced economies



Source: Benoit, Chen, and Tu based on World Bank DataBank. The authors have divided the "high-income" category into "lower-high-income" countries and advanced economies.

While China can build off its strong record of economic and other development achievements, the path to achieving the income levels of an advanced economy will be long and uncharted. Even assuming China can sustain the robust average annual income per capita growth rate of 6 percent (previously forecasted by the IMF for 2020), it will take 15 years to achieve that of Portugal, one of the poorer advanced

economies. The COVID-19 pandemic illustrates the type of uncertainties that can slow China's advancement. There are also geopolitical and other risks, both foreign and domestic, that can impede China's future economic growth, as illustrated by the prolonged U.S.-China trade war and the conflicts in the Hong Kong Special Administrative Region. Even though China will shortly graduate from middle-income status, achieving the wealth of an advanced economy remains an ambitious but uncertain target, especially considering the sheer size of the country's population.

CONCLUSION

China's development success has created a hybrid superpower that is altering the global energy and climate landscapes, among others. China's advancement has also brought uncertainties about both its own path forward and the future international order. Even as China strives to retain its developing country label, it is facing increasing pressure from the international community to shoulder more responsibility, particularly on global sustainability and development issues.

Energy will play a central role in China's future development. The government's choices in meeting its energy needs will have important domestic impacts and will also reverberate internationally, particularly on climate change. China's options regarding its future energy path will in part be constrained by the developing country attributes inherent in its hybrid status, particularly its reliance on greater energy use to support economic growth as well as its ongoing need to address its energy poverty, pollution, and other development challenges. Yet, as the first hybrid superpower of the 21st century, China also has the potential to overperform, notably on climate change where it can carve out a low-carbon development path for itself and support developing countries to follow a similar course.

China has already achieved an unprecedented success in transforming a low-income country into a hybrid superpower. Looking forward, can it do what no other country has ever done by raising a massive population from the modest GDP per capita levels of a middle-income country to the prosperity of an advanced economy? Its efforts in this regard will shape the global energy and climate landscapes. A better understanding by both Chinese and international stakeholders about the nature and implications of China's unique hybrid superpower status can help in designing energy policies and fostering an international framework that better promote sustainable growth, domestically and globally.

NOTES

1. The Open Door policy was implemented under the leadership of Deng Xiaoping, who was widely regarded as the paramount leader of the country while he served as the chairman of the Central Military Commission through 1989 and even thereafter until he retired from the political scene in 1992.

2. All economic data is sourced from World Bank DataBank, available at https://data.worldbank.org/. For purposes of this paper, the basic reference for economic measurements is current US$. This provides a sense of the relative global weight of different economies (although it does also incorporate local currency fluctuations relative to the U.S. dollar).

3. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/SI.POV.DDAY?locations=CN.

4. For example, China's life expectancy rose from 69 years in 1990 to 76 in 2017. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=CN-OE.

5. The United States' GDP was nearly $7 trillion higher in 2018, at $20.5 trillion (current US$). World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN-US.

6. BP, BP *Statistical Review of World Energy 2019*, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf.

7. International Energy Agency (IEA) statistics database, accessed November 11, 2019, https://www.iea.org/statistics/.

8. The Organisation for Economic Co-operation and Development uses governance criteria as part of its accession criteria. OECD, "Framework for the Consideration of Prospective Members," June 7–8, 2017, http://www.oecd.org/mcm/documents/C-MIN-2017-13-EN.pdf.

9. For example, it is more than twice the size of Japan's GDP, the world's third largest economy.

10. PPP takes into account differences in the cost of living in China relative to the U.S. Because food and other items are less expensive to purchase in China than the United States, its GDP in PPP terms is higher than in current US$ ones.

11. Data available at https://data.worldbank.org/.

12. The authors' calculations are based on World Bank DataBank GDP, current US$ figures for China and Germany. World Bank DataBank, accessed January 20, 2020, https://data.

worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN-DE.

13. "List of Nuclear Power Projects That Are Operational, Under Construction, and Under Planning in China中国投运、在建、筹备中核电项目梳理," accessed June 11, 2020, https://www.sohu.com/a/304424239_436794 and IAEA, "Power Reactor Information System," accessed June 11, 2020, https://pris.iaea.org/PRIS/.

14. IEA, *World Energy Outlook 2019*, November 2019, https://www.iea.org/reports/world-energy-outlook-2019.

15. Peter Fairley, "China's Ambitious Plan to Build the World's Biggest Supergrid," *IEEE Spectrum*, February 21, 2019, accessed July 21, 2020, https://spectrum.ieee.org/energy/the-smarter-grid/chinas-ambitious-plan-to-build-the-worlds-biggest-supergrid.

16. As of 2018, China had 255 GW of supercritical and 218 GW of ultra-supercritical coal power plants in operation, representing about half of China's operational coal-fired power generation capacity. For greenfield coal-fired power plants announced at that point for construction, supercritical and ultra-supercritical plants accounted for 25 percent and 68 percent of capacity, respectively. "Global Coal Plant Tracker," accessed July 18, 2019, https://endcoal.org/global-coal-plant-tracker/summary-statistics/.

17. *Power Magazine*, "Who Has the World's Most Efficient Coal Power Plant Fleet?," March 31, 2017, accessed January 24, 2020, https://www.powermag.com/who-has-the-worlds-most-efficient-coal-power-plant-fleet/. In 2018, China's coal power plants had attained an overall efficiency of 40 percent (IEA, "Coal 2019: Analysis and Forecast to 2024," December 17, 2019, 17, https://www.oecd-ilibrary.org/energy/coal-2019_c775e820-en).

18. National Energy Administration 国家能源局石油天然气司 et al., *China Natural Gas Development Report 2019* 中国天然气发展报告 (2019), Beijing: Petroleum Industry Press, 2019.

19. Martha Lawrence et al., "China's High-Speed Rail Development," World Bank, June 6, 2019, http://documents.worldbank.org/curated/en/933411559841476316/Chinas-High-Speed-Rail-Development.

20. IEA, *Energy Technology Perspectives 2015*, May 2015, 341, https://www.iea.org/reports/energy-technology-perspectives-2015. This does not include expenditures on research and development by the private sector, which play a larger role in the United States' economy than in China's.

21. National Development and Reform Commission 国家发展改革委 and the National Energy Administration 国家能源局, "Energy Technology Innovation Plan of Action 2016–2030 能源技术革命创新行动计划 (2016–2030年)," April 18, 2016, http://www.sic.cas.cn/zt/zscq/zlzs/zcwj/201704/P020170418529908067670.pdf.

22. L. Nielsen, "Classifications of Countries Based on Their Level of Development: How Is It Done and How It Could Be Done," IMF Working Paper, February 2011, https://www.imf.org/external/pubs/ft/wp/2011/wp1131.pdf.

23. The World Bank classifies countries into low, middle, and high income on the basis of GNI per capita (current US$). GNI differs slightly from GDP as it includes, for example, "net receipts of primary income [compensation of employees and property income] from abroad" (World Development Indicators, accessed June 6, 2020, https://databank.worldbank.org/reports.aspx?source=2&type=metadata&series=NY.GNP.ATLS.CD). The classifications being used by the World Bank in its current 2020 fiscal year are (1) $1,025 and below for low income; (2) from $1,026 to $12,375 for middle-income countries, which in turn is divided into lower middle income and upper middle income, beginning at $3,996; and (3) $12,376 and above for high income (World Bank, "World Bank Country and Lending Groups, Country Classification," accessed January 20, 2020, https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups).

24. World Bank, "World Bank Country and Lending Groups, Country Classification," accessed January 20, 2020, https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

25. The OECD level for 2018 was $40,007. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=OE-CN&view=chart.

26. UNDP, *Human Development Indices and Indicators, 2018 Statistical Update*, 1, accessed April 30, 2020, http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf.

27. UNDP, "Human Development Indices and Indicators, 2018 Statistical Update," 23.

28. Several energy indicators are now being tracked by the UNDP in connection with the Sustainable Development Goals and the Multidimensional Poverty Index. For example, the Multidimensional Poverty Index includes three energy-related factors: (1) lack of access to electricity, (2) lack of access to clean cooking technologies, and (3) lack of ownership of staples such as a radio, a computer, a motorbike, a refrigerator, and other assets that involve energy consumption of modern fuels such as electricity and gasoline. See Sabine Alkire and Maria Emma Santos, "OPHI Working Paper No. 38, Acute Multidimensional Poverty: A New Index for Developing Countries," July 2010, accessed November 2, 2019, https://www.ophi.org.uk/wp-content/uploads/OPHI-wp38_with_note.pdf and UNDP, "What Are the Differences with the 2014 Specifications Introduced by UNDP," accessed April 30, 2020, http://hdr.undp.org/en/content/2018-statistical-update-presents-multidimensional-poverty-index-based-jointly-revised. Under the multidimensional poverty analysis, only 0.4 percent of China's population is categorized as "in severe multidimensional poverty" (reflecting in part China's success in achieving universal electricity access), but 17 percent are viewed as vulnerable to this form of poverty (UNDP, *Human Development Indices and Indicators, 2018 Statistical Update*, 42, accessed April 30, 2020, http://hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf).

29. IEA, "SDG7: Data and Projections," November 2019, accessed April 4, 2020, https://www.iea.org/reports/sdg7-data-and-projections/access-to-clean-cooking.

30. The IEA estimates that the total population relying on biomass equaled 242 million in 2018. IEA, "Access to Clean Cooking," accessed April 4, 2020, https://www.iea.org/sdg/cooking/.

31. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/EG.CFT.ACCS.ZS?locations=CN-XT.

32. "Space Heating Temperature in Many Parts of Northern China Does Not Meet Standards, with Natural Gas Shortage as the Primary Underlying Factor北方多地供暖温度不达标, 天然气供应不足是主因," accessed June 11, 2020, http://www.sohu.com/a/281831454_803358.

33. Huang Lanlan, "Without Central Heating, Winter in Shanghai Can Be Unbearable," December 14, 2017, accessed July 8, 2019, http://www.globaltimes.cn/content/1080279.shtml.

34. National Bureau of Statistics of China, accessed July 8, 2019, http://data.stats.gov.cn/english.

35. Indonesia's per capita residential electricity consumption in 2016 was 382 kWh/capita. IEA, *World Energy Statistics 2018* (Paris: IEA, 2018).

36. Thailand's per capita residential electricity consumption in 2016 was 637 kWh/capita. IEA, *World Energy Statistics 2018*.

37. China is divided into 31 geographic regions for administrative purposes that consist of 22 provinces, 4 municipalities (including Beijing and Shanghai), and 5 autonomous regions.

38. In 2018, Beijing's per capita GDP was 140,761 yuan ($21,275), Portugal's was $23,145, Gansu province's was 31,270 yuan ($4,726), and Guatemala's was $4,549. NBS Database, accessed June 6, 2020, http://www.stats.gov.cn/english/Statisticaldata/AnnualData/ and World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=PT-GT.

39. NBS Database, accessed June 6, 2020, http://www.stats.gov.cn/english/Statisticaldata/AnnualData/.

40. China's residential per capita electricity consumption was 611 kWh/capita in 2016. IEA, *World Energy Statistics 2018*.

41. Vietnam's average residential consumption in 2016 was 595 kWh/capita (IEA, *World Energy Statistics 2018*). In Gansu, per capita residential electricity consumption was a mere 320 kWh/capita, and it was only 333 kWh/capita in Xinjiang and 378 kWh/capita in Ningxia (available from the NBS database, http://www.stats.gov.cn/english/Statisticaldata/AnnualData/).

42. The sourced National Bureau of Statistics data does not include comparable energy balance information for Tibet.

43. The causal relationship between energy demand and incomes is complex. Energy use for manufacturing can fuel increasing incomes, and more affluent households consume more energy. A fuller analysis can be found in the IEA's *World Energy Outlook 2018*, November 2018, https://www.iea.org/reports/world-energy-outlook-2018.

44. There are some visible exceptions to this. For example, Saudi Arabia, a high-income country whose GDP per capita reached $15,385 in 2006, saw its total primary energy demand per capita increase by 18 percent over the next decade even as its GDP per capita rose to nearly $20,000—although it has more recently dropped from its peak in 2015 (energy data from IEA statistics and economic data from World Bank DataBank).

45. IEA, *World Energy Outlook 2018*, November 2018, https://www.iea.org/reports/world-energy-outlook-2018. As the IEA explained: "Income levels in developing economies look far from the point where electricity demand growth might flatten out" ("WEO 2018," 329).

46. The most recent World Bank data is for 2014 (accessed January 24, 2020) and is calculated on the basis of GDP expressed in "constant 2011 PPP" terms. China's intensity was 0.18 toe/$1,000 (constant 2011 PPP), upper-middle-income countries had 0.15, middle-income countries 0.14, and OECD member countries 0.11. The difference between China and the OECD is more marked when calculated on a current US$ rather than a PPP basis. World Bank DataBank, accessed January 24, 2020, https://data.worldbank.org/indicator/EG.USE.COMM.GD.PP.KD?locations=OE-XP-XT-CN.

47. Industry in China has been and remains many times more energy intensive than other sectors. For example, under the data and classifications of the National Bureau of Statistics, the 2017 energy intensity for "industry" was 106 tce/million Yuan in 2017 (as compared to over 250 tce/million Yuan in 2000), which "agriculture," "construction" and "wholesale, retail, hotel and restaurants" were 15 tce/million Yuan or below. Department of Energy Statistics of NBS 国家统计局能源统计司, *China Statistical Yearbook 2018* 中国能源统计年鉴2018 (Beijing: China Statistics Press, 2019).

48. In 2017, for example, industry represented 33 percent of GDP for upper-middle-income countries and only 22 percent for OECD members. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/NV.IND.TOTL.ZS?locations=XT-OE.

49. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/indicator/NV.IND.TOTL.ZS?locations=CN.

50. Valentin Krüsmann, "Mobility in 21st Century China: Snapshots, Dynamics, & Future Perspectives," Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2019, http://www.sustainabletransport.org/wp-content/uploads/2019/07/GIZ_Mobility_China_Germany-1.pdf.

51. IEA statistics, "Oil Final Consumption by Product," accessed December 21, 2019, https://www.iea.org/data-and-statistics?country=WORLD&fuel=Oil&indicator=Oil%20final%20consumption%20by%20product.

52. "13th Five Year Plan on Energy," accessed April 30, 2020, http://www.nea.gov.cn/135989417_14846217874961n.pdf.

53. BP, *BP Statistical Review of World Energy 2019*, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf; IEA, "IEA Electricity Information 2019," September 2019,

https://www.iea.org/reports/electricity-information-2019; and China Electricity Council, "Data/Statistics," accessed June 6, 2020, http://english.cec.org.cn/No.110.index.htm.

54. For example, total electricity final consumption in the OECD was 10,331 TWh in 2010 and 10,352 TWh in 2017. IEA statistics, accessed February 16, 2020, https://www.iea.org/data-and-statistics?country=OECDTOT&fuel=Energy%20consumption&indicator=Electricity%20consumption.

55. China Electricity Council, "Data/Statistics," accessed June 6, 2020, http://english.cec.org.cn/No.110.index.htm and "WEO 2019."

56. "WEO 2018."

57. The seven cities were Taiyuan, Beijing, Urumqi, Lanzhou, Chongqing, Jinan, and Shijiazhuang. "7 of the World's 10 Most Polluted Cities Are in China, with Shijiazhuang Ranking as No.9 全球10大空气污染城市7个在中国 石家庄排第9," accessed June 11, 2020, http://hebei.sina.com.cn/news/m/2013-01-15/151228825.html.

58. IQAir, "World's Most Polluted Cities 2019 (PM2.5)," accessed June 11, 2020, https://www.iqair.com/world-most-polluted-cities.

59. World Bank, "PM2.5 Pollution, Population Exposed to Levels Exceeding WHO Interim Target-1 Value (% of Total)," accessed June 5, 2020, https://databank.worldbank.org/WHO-Interim-Target-1/id/8030eb3e.

60. This is the case, for example, for 36 percent of the residents in villages within the administrative boundary of Baoding city, which is covered by this government-subsidized campaign. "Progress of Air Pollution Control Slower Than Expectation, Prompting the Ministry of Ecology and Environment to Deliver Verbal Warning to Baoding and 5 Other Municipal Governments 大气污染治理工作滞后 生态环境部约谈保定等6市政府, " accessed July 8, 2019, http://cnews.chinadaily.com.cn/a/201906/14/WS5d030b3fa3108375f8f2a8da.html.

61. Olivia Ronsane, "The World's 20 Most Polluted Cities in 2018," EcoWatch, March 6, 2019, accessed August 27, 2019, https://www.ecowatch.com/worlds-most-polluted-cities-2630812632.html.

62. "13th Five Year Plan on Energy," Objective 23, Box 2.

63. Feng Hao, "China Releases 2020 Action Plan for Air Pollution," June 6, 2018, China Dialogue, accessed December 31, 2019, https://www.chinadialogue.net/article/show/single/en/10711-China-releases-2-2-action-plan-for-air-pollution.

64. In 2017, 81.2 percent of China's population was exposed to PM2.5 levels exceeding the WHO's Target-1 value, with even higher percentages exposed under the more stringent WHO standards. "PM2.5 Pollution, Population Exposed to Levels Exceeding WHO Interim Target-1 Value (% of Total)."

65. Huimin Li, Xiaofan Zhao, Tong Wu, and Ye Qi, "The Consistency of China's Energy Statistics and Its Implications for Climate Policy." *Journal of Cleaner Production* 199 (2018): 27–35,

https://doi.org/10.1016/j.jclepro.2018.07.094.

66. The figure for 2000 rose from 0.998 billion tons (metric) of coal equivalent in the preliminary *China Energy Statistical Yearbook* (2000–2002) published in 2004 to a value of 1.299 billion tons (metric) in the 2006 edition, and then to a value of 1.384 billion tons (metric) in the 2010 edition. Mark Thurber and Richard Morse, *The Global Coal Market: Supplying the Major Fuel for Emerging Economies* (Cambridge: Cambridge University Press), 610–611, https://doi.org/10.1017/CBO9781316136058.014.

67. These figures and graphics are based on "WEO 2018." The projection for China's demand in 2030 was recently revised upward by the IEA to 3,805 Mtoe. "WEO 2019."

68. "WEO 2018."

69. IEA, *World Energy Outlook 2017*, November 2017, 511.

70. There are numerous studies on this topic. Statista, for example, projects that the number of passenger vehicles sold in China will nearly double from 15 million in 2015 to 27.6 million in 2025. Statista, "Forecasted Sales Volume of Cars in China from 2018 to 2024," accessed December 21, 2019, https://www.statista.com/statistics/224573/forecast-for-the-number-of-passenger-cars-sold-in-china/.

71. IEA, *The Future of Cooling*, May 2018, https://www.iea.org/reports/the-future-of-cooling.

72. U.S. Energy Information Administration, "Today in Energy: EIA Revises Global Liquid Fuels Demand Growth Down Because of the Coronavirus," February 18, 2020, accessed April 10, 2020, https://www.eia.gov/todayinenergy/detail.php?id=42855.

73. As China's GDP per capita rises, the growth in China's energy demand slows, from 633 Mtoe in the 2017–2030 period to only 174 Mtoe over the 2030–2040 period. "WEO 2018."

74. Richard Haass, "Why the Coronavirus Should Change the Way We Think about China," *Washington Post*, February 11, 2020, https://www.washingtonpost.com/opinions/2020/02/11/how-coronavirus-could-change-china/.

75. Linda Glawe and Helmut Wagner, "China Caught in the 'Middle-Income Trap'?," *VoxChina*, November 22, 2017, accessed November 7, 2019, http://voxchina.org/show-3-55.html.

76. "New Normal in Economic Development," *China Daily*, October 5, 2017, accessed December 30, 2019, https://www.chinadaily.com.cn/china/19thcpcnationalcongress/2017-10/05/content_32869258.htm.

77. "What Should Be the Future of Modern Coal Chemical Development in the Era of Low Oil Prices (Hot Topic and Spotlight) 低油价之下, 现代煤化工路在何方 (热点聚焦)," *China Energy News*, accessed June 11, 2020, http://paper.people.com.cn/zgnyb/html/2020-05/25/content_1988916.htm.

78. Feng Hao and Tom Baxter, "China's Coal Consumption on the Rise," *China Dialogue*, March 1, 2019, accessed January 20, 2020, https://www.chinadialogue.net/article/show/single/

en/11107-China-s-coal-consumption-on-the-rise.

79. NBS, Statistical Communiqué of the People's Republic of China, various years, accessed June 11, 2020, http://www.stats.gov.cn/english/StatisticalCommuniqu/ and CCTD China coal online database, accessed June 11, 2020, http://www.cctdcoal.com/list-167-1.html.

80. "Addition of Greenfield Coal-Fired Power Capacity Has Exceeded That for All of 2019, Experts Call for Caution前五月新增煤电超去年全年, 专家呼吁警惕," accessed June 11, 2020, https://tech.sina.com.cn/roll/2020-06-11/doc-iirczymk6391706.shtml.

81. In 2018, China's GHG emissions totaled about 13.5 gigatons (metric) of carbon dioxide equivalent, including about 11 gigatons of CO_2, of which 9.5 $GtCO_2$ were from the combustion of coal, oil, and gas. David Sandalow, *Guide to Chinese Climate Policy 2019*, Columbia University Center on Global Energy Policy, accessed April 20, 2020, https://energypolicy.columbia.edu/research/report/guide-chinese-climate-policy and Climate Watch, Historical GHG Emissions: Global Historical Emissions, accessed April 20, 2020, https://www.climatewatchdata.org/ghg-emissions.

82. For example, China in 1997 was considered a developing country, with an overall economy that was first reaching $1 trillion and a GDP per capita that had yet to reach $900. China was not listed as an Annex 1 country, and there was little debate around this point at the time. In fact, as was noted at the time of the Kyoto Protocol negotiation, China's overall emissions were in the process of decreasing, from 3.47 $GtCO_2$ in 1997 to 3.35 $GTCO_2$ in 1998. World Bank DataBank, accessed June 6, 2020, https://data.worldbank.org/country/china.

83. UNFCCC, "Paris Climate Agreement," November 2015, accessed April 20, 2020, https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf.

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