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China's new growth story: linking the 14th Five-Year Plan with the 2060 carbon neutrality pledge

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ABSTRACT

China has announced its commitment to achieving carbon neutrality by 2060, and for this challenging goal to be reached within just four decades, there is a real urgency of shaping the low-carbon agenda in its 14th Five-Year Plan and to ratchet up ambition on climate policy in the near term to peak emissions early. This paper argues that China will have to change the way of development by take a sustainable pathway to growth. And this new approach does not mean sacrificing economic growth; quite the opposite, it can boost growth by providing great opportunities in terms of jobs, efficiency, demand, and many other aspects, while reducing carbon emissions and enabling great benefits with regards to pollution, ecological restoration, biodiversity and well-beings. The COVID-19 pandemic has provided a window of opportunity for China and other countries to cooperate to link the post-pandemic economic recovery with the fight against climate change.

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1. Introduction

The world currently faces the twin crises of COVID-19 and climate change. The COVID-19 pandemic has caused severe damage to the world economy, disrupting lives, societies and politics. Yet despite the magnitude of the crisis, which is truly global, the risks posed by unmanaged climate change are likely to be greater and longer-lasting than those posed by the pandemic. The threats must be dealt with simultaneously, but with recognition that we cannot go back to the old economic growth model and repeat the mistakes that followed the financial crisis of 2008–2010 – of overinvesting in traditional high-carbon infrastructure.

We are facing a rapidly changing world. The US–China strategic relationship and the shape of the global economy after COVID-19 have contributed to an external environment that is less favourable to China than it was before. And, as a result of the COVID-19 crisis, the world will likely continue to see a phase of deglobalisation, a trend that began in the middle of the last decade. China's share of trade in goods to GDP decreased over the past decade, but is still over 30%. However, due to the global economic depression and the deterioration of the global trade environment, exports are facing increasing

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uncertainties and difficulties. The 14th Five-Year Plan (2021–2025) needs to take into account these external challenges, in relation to external demand and geopolitical tensions, and put forward a new model of growth that shapes future development, contributing to China's own prosperity and a better world.

In September 2020 President Xi Jinping announced at the United Nations General Assembly that China will aim for carbon neutrality by 2060. This significant pledge shows China's long-term ambitions and priorities, and that the Chinese government has linked low-carbon development and carbon-neutral transition with the country's sustainable development strategy and long-term prosperity.

In November 2020, the Chinese Communist Party (CCP) Central Committee released its proposals for formulating the 14th Five-Year Plan for National Economic and Social Development and the Long-Range Objectives through 2035, putting forward a wide range of goals for the next 15 years, including emphases on innovation-driven development and construction of ecological civilisation (The State Council, People's Republic of China 2020). The overarching goal of 'a Beautiful China' shifts the definition of national wealth to a new standard that focuses not only on quantity but also on quality and many other features of growth. The two mountain theory ('green mountains are gold mountains') promoted by President Xi Jinping requires a significant increase in natural capital, among the different types of capital discussed in Stern, Xie, and Zenghelis (2020). The desire for greening China is determined by its people's pursuit of better living standards, and would mean a new form of growth and a comprehensive transformation of economic structure.

Sustainable growth is the only feasible path forward, and it is one of the few areas where a broad consensus might be reached globally. As China leads the world out of the COVID-19 crisis, it has a great opportunity to build a new vision for the country's own development and its relationship with the world. As one of the first major G20 countries to have made the transition from rescue to recovery, China can show the world that the crisis offers an opportunity for building back better, as recovery measures can also boost growth by accelerating the transition to the inevitable low-carbon economy. Failing to take this opportunity would give us a deeply dangerous world. China is at centre stage.

The remainder of this paper is organised as follows. [Section 2](#) discusses China's new growth story and how the low-carbon transition can act as a new driver of growth. In [Section 3](#) we argue that China should peak its carbon emissions during the 14th Five-Year Plan and bend the emissions curve quickly, in order to achieve the 2060 carbon neutrality goal. [Section 4](#) outlines the core policies and strategies needed in the 14th Five-Year Plan to shape the low-carbon agenda in the near to medium term.

2. China's new growth story under the net-zero commitment

The approach to development of the 19th and 20th century secured real economic success in the industrial era in terms of conventionally measured per capita output and income. China, in particular, has seen rapid growth over the past four decades by embracing a model of transformation from an agrarian economy into a modern economy, in the process of industrialisation and urbanisation. This approach to, or model of growth, has however been driven by a narrow focus on physical capital accumulation, material welfare without taking into account the full social costs of production.

China's old approaches to development are coming to an end, and attempts by the country at high-carbon growth in the medium to long term are no longer a feasible option (Hepburn et al. 2020; Stern, Xie, and Zenghelis 2020). Past growth has been driven by heavy investments in physical infrastructure, with a focus on manufacturing, high-carbon infrastructure and fossil-fuel energy. Against the background of mounting threats to natural, human and social capital – which are reflected in pressures on the environment, social strains, including inequality, changing technologies and the need for new skills, and the demographic challenges of an ageing population – new forms of growth must take account of a broader definition of prosperity, to avoid pursuing economic growth at the long-term cost to environment, human health, and social equality.

This new growth model should be sustainable, and different from the old approach in at least three major areas: First, a shift in focus from manufacturing output as a source of material wealth to a multidimensional conception of human well-being. Second, a shift from production as a function of the accumulation of human capital and the conversion of natural into physical capital, to protecting natural and social capital and recognising them as both inputs and outputs, through increased circularisation of production processes. Third, use of new technologies to produce existing goods and services sustainably (i.e. carbon-neutrally), and adapt to changes in consumer behaviour.

Low-carbon transition can act as a new driver of growth

Sustainable growth, with the low-carbon transition at its core, is not only good for the environment and climate, but also can offer new drivers of growth and rural revitalisation, and lasting improvements to wellbeing. Sustainable growth does not mean expensive ways of doing things: in fact, quite the opposite – it can push down the cost in two ways. On the one hand, it helps shift the production possibility boundary, or in economic terms the production possibility frontier (PPF), outwards (in terms of the movement of the PPF curve itself), through discovery and innovations. In other words, advancement in new, low-carbon technologies could increase a country's ability to produce more goods based on the same inputs. On the other hand, it can push the economy towards lower costs through the increasing returns to scale and through improved efficiency that achieves a certain level of output with fewer material inputs. As argued by Busch, Foxon, and Taylor (2018) and many others, investment in renewable energy capacity generates increasing returns to scale while investment in fossil fuels can only generate decreasing returns. These effects can mutually support and reinforce each other.

The new growth story, which will be innovation-driven and requires investment to achieve, will make China more competitive and much cleaner. Government commitment, providing a clear sense of direction, can foster innovation and investment for sustainable growth, and help manage the transition as efficiently and fairly as possible. The returns on investment will be strong, unlocking economic, social and environmental benefits.

Low-carbon transition can facilitate economic upgrading

China's economic expansion in the past has relied heavily on input factors of labour, capital and resources including energy, land, water and minerals. With the continuous increase of energy consumption, problems arise, such as environmental pollution and

energy resource insecurity, which have gradually become the main bottlenecks restricting further development of the nation's economy, alongside the increasingly stringent constraints on global greenhouse gas emissions. The low-carbon transition is both a challenge and an opportunity, as it is to some extent consistent with the needs for new forms of growth, structural transformation and economic upgrading in China. Thus, well-managed low-carbon development strategies can contribute to climate change mitigation and serve as catalysts for upgrading China's economy.

Investment in sustainable growth and low-carbon innovations would help promote the structural transformation of industries towards higher skills and technologies. China is already a leader in technologies of the emerging green economy (e.g. batteries, solar PV cells, and electric vehicles). If structured well, this new growth pathway can give rise to accelerated technology innovations, building the foundation for long-term economic prosperity and competitiveness.

There are great opportunities for China to lead and benefit from the low-carbon transition and establish China's competitive leadership in the world economy. Investment in the low-carbon transition would lower the cost of clean technology and thus lead to a positive 'spillover' effect in other countries (Pollitt 2020). Some new clean technologies, such as hydrogen electrolysis, offer potentially substantial export opportunities for China.¹ The race is on in this sector, as other countries – especially in Europe and particularly Germany – have also realised the scale of the opportunity (Hepburn et al. 2021). Germany is also a renewable energy world leader and its transition from fossil fuels to clean energy has had some clear economic benefits (Blazejczak et al. 2014).

Low-carbon transition offers better job opportunities

China's energy transition will create millions of jobs in the renewable energy sector. A recent study by Varro and Fengquan (2020) suggests that the job-creation rate of renewable industries is between 1.5 and three times that of traditional energy industries. According to the International Renewable Energy Agency (IRENA) (2020), globally there were 11.5 million people employed in the renewable energy sector in 2019, with the solar photovoltaic (PV), bioenergy, hydropower and wind power industries being the biggest employers. Almost 40% of global renewable energy jobs are located in China, which was estimated to amount to more than 4 million in 2020. In contrast, the coal mining industry in China is in sharp decline, with more coal workers expected to be laid off due to China's changing economic structure and the development of renewable industries (Feng 2017). The number of coal workers dramatically reduced from 4.5 million in 2015 to around 2.7 million in 2020 (CEIC 2020).

The UK is an example of a country where the low-carbon transition is leading to better job opportunities. The UK's experience in significant carbon reduction has been made through a broad portfolio that encompasses massive investment in many kinds of net-zero-aligned technologies (Woolard 2020). Unsworth et al. (2020, Table 2) summarise evidence from a range of studies that look at the job creation benefit of net-zero-aligned investments, suggesting these investments in sectors such as renewable energy, electric vehicles, hydrogen and energy efficiency improvement can each create tens of thousands of high wage jobs in the UK. Aimed at promoting a green recovery and a green industrial revolution, the Ten Point plan announced by Prime Minister Boris Johnson in

November 2020 is expected to generate 250,000 highly-skilled green jobs in the UK by 2030 (HM Government 2020). The plan could both help transform and upgrade the UK's economy and create better job opportunities, while also strengthening the UK's role as a global leader in tackling climate change. Innovation and investment in people will be critical, for example, through education and training, to ensure the availability of different skills.

Low-carbon transition supports the economy through ensuring energy security

Many studies have suggested a strong positive correlation between economic growth and energy demand (Sorrell 2015), highlighting the challenges associated with reducing energy demand to tackle climate change due to the potential negative impact on economic growth. But as energy demand continues to rise, while it is pressing to reduce consumption of fossil fuels and cut carbon emissions, energy security is becoming an increasingly important issue in China.

Failing to ensure energy security comes with significant economic consequences, including energy price shocks, physical availability of energy as a crucial input factor in production, and effects in the demand side of the economy.

Against this background, the low-carbon transition implies the need for a very great expansion of low-carbon power from renewables, to reduce dependency on fossil fuels and thus improve national energy security, which is one of the top priorities for China (Hepburn et al. 2021). Due to the geographical distribution of fossil fuels globally, the energy supply security of importing countries is often associated with geopolitical challenges and conflicts. Renewables, including solar power and wind, can reduce the uncertainty and dependence on other countries, thus are much safer than fossil fuels from the perspectives of national energy supply security, human health and climate change. The role of renewables in improving energy security is increasingly recognised. Unlike most fossil fuels, in particular oil and natural gas, renewables do not have risks associated with political instability of energy producing countries. The promotion of renewable energy can improve the diversity of the overall electricity generation portfolio and thus support energy supply security. As an important part of China's energy resource endowment, renewables have become cost-efficient options of energy delivery.

Other economic benefits

Economic benefits in the low-carbon transition also manifest in many other ways. For example, renewables are scalable in areas where there is currently little electricity, and the economic effects of securing access to electricity can be far-reaching. Reducing the use of coal would also save huge economic and societal costs, mostly associated with climate change and public health damage. In China outdoor air pollution leads to about 1.2 million premature deaths a year, while indoor pollution causes 600,000 deaths, due to the fact that one-third of Chinese households use solid fuels, including coal, for heating and cooking (Parry et al. 2016).

The new growth model is of value not just to China, but to the rest of the world. China is already at the forefront of the development of new low-carbon technologies and it has a great deal to gain by being in the vanguard of the new global growth story. If China can

achieve the modernisation of ‘harmony between humans and nature’ through embracing a new, low-carbon development model, its experience will be vital to the realisation of a globally sustainable future.

Concerns of possible negative economic impacts of a low-carbon transition are ill-founded

The devastating effects of climate change cause direct damage, including more frequent wildfires, floods, droughts and heat waves, with mounting evidence suggesting enormous risks from exceeding tipping points in the climate system (Lenton et al. 2019). A growing body of research shows the economic benefits of the low-carbon transition. In general, lower carbon emissions can be achieved by either reducing the energy intensity of economic output or driving down the carbon intensity of energy.

Reducing the energy intensity of economic output, also known as the decoupling of energy use and economic growth, can reshape an economy through causing the contraction of some industries (e. g. coal mining, steel and cement), transforming some (e.g. transport), and providing significant opportunities for others (clean-energy and energy-efficiency industries), which will offer the jobs of the future (Fankhauser and Jotzo 2018). The new opportunities greatly exceed the job losses, creating far more secure, highly-skilled jobs. The dislocation of jobs can and should be well managed to minimise the socioeconomic consequences of the transition, through strong and continuing investment in those people and places affected. This is particularly crucial for some sectors such as coal. Experience can be learnt from Germany, where about 600,000 jobs were affected by the phase-out of coal starting in the 1960s (Oei et al. 2020). In order to tackle the economic and social impact to support the energy transition, the Federal Government introduced the Commission on Growth, Structural Change and Employment (GSCE) to bring together all stakeholders (including representatives from coal industry, environmental NGOs, the affected regions and selected scientists) to build coal phase-out strategies that are economically feasible and socially acceptable (Brauers et al. 2018).

Misleading results can be obtained from macroeconomic modelling that focuses narrowly on short-term costs associated with the strong effects of a low-carbon transition on high energy-intensity industries or large structural adjustment costs due to the redeployment of labour force and investment. Current economic analyses of climate change fail to incorporate many of the largest risks, including the effects from crossing climate thresholds or ‘tipping points’. These impacts would also undermine economic growth and development, exacerbate poverty and destabilise communities (Stern 2006).

Driving down the carbon intensity of energy means shifting from fossil-fuel-based energy to renewable energy. Some worry about the relatively higher costs of renewables compared with fossil fuels, and the negative impact of this on economic growth. However, renewables are now cheaper than fossil fuels for electricity generation in many regions of the world (Eckhouse 2020). Furthermore, grid management (including the application of digital technologies) is improving rapidly, paving the way for a cleaner and safer power sector. Meanwhile, the conventional production functions in economic theory could fail to capture resources and environment restraints and natural capital

depletion (Nieto et al. 2020), and they could also fail to capture rapid technological change. The perceived costs of climate action are often overstated, failing to capture increasing returns to scale and dynamics of learning.

As a result, if models disregard the irreversibility in natural systems and assume that they can be eroded but restored, they could lead to unreliable conclusions. For example, the use of fossil fuels causes significant damage to environmental resources including water, air and forests, and the environmental damage consequently brings about enormous costs to society, including economically through reduced productivity and through other types of costs related to wellbeing and quality of life (Larsen 2004). We argued in our previous studies for this series that China's new growth story must take account for the depletion of natural capital, and this means growth and development can be steered in directions that make a material difference in terms of future prosperity (Stern, Xie, and Zenghelis 2020; Stern and Xie 2020).

The building of coal-fired plants in China must be halted due to the economic and environmental costs

The most crucial strategy for the new growth story is to stop building new coal-fired power plants – they cause significant damage to the environment and are very expensive. Bloomberg NEF, for example, suggests that solar farms and onshore wind are now the cheapest sources of new electricity for at least two-thirds of the world's population (Reback 2019).

As coal faces cleaner rivals and the prospect of more regulation, banks and investors are turning away from it, raising coal's cost of capital. The United States example shows that even though the Trump Administration favoured the coal industry with deregulation and political support, still it has declined. The main reasons are first that coal faces competition from cheap natural gas produced in the US by fracking; second, tax credits and subsidies have prompted renewables to scale up, which has, in turn, helped drive down their costs; and third, potential investors recognise that society and politics are moving strongly against coal and that the costs of renewables and storage are falling fast.

In China, electricity demand is still growing fast, with electricity consumption reaching 8,312.8 TWh in 2021, a 10.3% year on year increase. That was largely due to the strong economic recovery in 2021 and led to power supply shortage in the second half of the year. Some argue that China needs more coal as renewables alone cannot meet the gap between energy supply and increasing energy demand. However, adding more coal capacity is short-sighted, as energy demand may cool down after the strong increase in 2021 (according to estimate by IEA, China's electricity demand growth will slow to an annual average of 4.5% over 2022–2024²), and the dependence on coal and other fossil fuels will put the national energy supply security at risk, in addition to other consequences economically and environmentally. It is crucial that China immediately stops building more conventional coal-fired power plants and quickly identifies and shuts down existing old and inefficient ones. The more China invests in coal generation today, the greater the risk that these assets will be stranded in the future, which would be a massive waste of national wealth. A recent study by Edwards et al. (2022) examined the stranded asset risks from existing and planned coal-fired power plants and estimated that under a 1.5°C policy, progress made in 2021 towards no new coal can potentially avoid a \$520 billion increase in stranded assets globally.

Recognising this, China released the Energy Supply and Consumption Revolution Strategy (2016–2030) in 2017, officially setting out the national targets for building a ‘clean, low-carbon, safe and efficient’ energy system.

It is no doubt that China would need to shift away radically from coal in power generation in order to meet its 2060 carbon-neutrality goal. A recent study by the Institute of Energy, Environment and Economy (3E)³ at Tsinghua University envisages a plan for how this goal might be achieved, suggesting China should significantly increase its share of non-fossil-fuel energy in total energy demand to 84% and phase out coal-fired power plants completely by 2060, with electricity constituting 80% of the country’s total energy consumption (Bloomberg News 2020). A similar path is set out by the Institute for Climate Change and Sustainable Development (ICCS), a separate institute at Tsinghua University, which argues that coal should account for no more than 5% in electricity generation by 2050 (He 2020). This calls into question dozens of power plants currently under construction or planned, which will either lock in decades of polluting and high emissions or have to become stranded assets – this is too costly both economically and environmentally.

3. Peaking emissions early and the 2060 carbon neutrality target

China has been seeking a new form of high-quality development for some years now, and the extremely important pledge by President Xi Jinping to reach carbon neutrality by 2060 will be a significant boost in that direction. It also provides a clear signal to other countries that the COVID-19 pandemic should not prevent more ambitious action to tackle climate change.

Many countries are now recognising that the transition to a net-zero economy will help deliver economic development and growth that is more robust, sustainable and resilient; they are also recognising and being influenced by China’s commitments and model. As the world’s largest emitter of greenhouse gases, China’s pledge should help to increase momentum ahead of COP26, the 26th session of the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC), which is currently scheduled to take place in November 2021 in the UK.

A recent report by Climate Action Tracker (CAT) indicates that the Paris Agreement’s climate goals are ‘within reach’: global warming could be 2.1°C, based on new climate promises from China and other nations, and the carbon reduction plans in the US under President Biden (CAT 2020). However, long-term pledges need to be matched by short-term plans to cut emissions; and the Paris Agreement target is to limit warming to ‘well-below 2°C’ and ideally to 1.5°C. Strengthened climate plans are immediately needed to align short-term actions with the long-term vision.

China should reach its peak in carbon emissions during the 14th Five-Year Plan and Bend the emissions curve quickly

While President Xi’s announcement that China will seek to reach net-zero emissions by 2060 is hugely welcome, China would face a great challenge in achieving this target if its carbon emissions do not peak well ahead of 2030 to put the nation onto a net-zero pathway.

Many studies have found it is not only essential but also feasible for China to peak its carbon emissions much earlier. Yu et al. (2018) argued that by adopting an economic-carbon emission-employment optimisation model, China could peak its energy-related carbon dioxide emissions between 2022 and 2025, while still maintaining an annual average GDP growth of 6.1% to 6.4%. By examining historical carbon emissions from 50 Chinese cities, Wang et al. (2019) projected China's carbon emissions to peak between 2021 and 2025, well ahead of the current target of 2030. Xu, Schwarz, and Yang (2020) also suggested that the peak could occur as early as 2025, under a low-carbon energy structure scenario.

The timing of the peaking in emissions is of great significance. There is no time to waste if China is to enable such a dramatic transformation to take place within four decades. The earlier that China peaks its carbon emissions, the lower the peak value is, and the more favourable it will be to realising the 2060 carbon neutrality target. As China is still in the development stage of industrialisation and urbanisation, with a relatively high economic growth rate, its national energy consumption is likely to maintain the trend of growth in a certain period of time. Therefore, China must strengthen the policy orientation for a low-carbon development to curb the increase in carbon dioxide emissions associated with economic growth and increased energy consumption.

China's first nationally determined contribution (NDC), submitted to the UNFCCC in 2015, committed to peaking its carbon emissions around 2030. A more ambitious NDC is needed to update its commitments on carbon emissions in the short to medium term.

The path to peak carbon emissions and the remaining carbon budget will have a considerable impact on the asset prices of fossil fuels and related industries in China, and directly affect the speed to achieve carbon neutrality. Under the constraint of a given carbon budget for the next few decades, different transformation pathways and mitigation strategies yield starkly different results. Victoria et al. (2020) suggest that it is much more cost-effective to choose an 'early and steady' mitigation path that takes more stringent measures to reduce carbon emissions in the first decade and continue the trend for the following decades than to go for a 'late and rapid' path that sets an initial insufficient target for the first decade which then requires a sharp carbon reduction later.

The peaking of carbon emissions must not be followed by a long plateau – a sharp reduction in emissions is required. Green and Stern (2015) suggested that a new development model based on 'better quality' growth⁴ can boost China's economic growth while driving down its carbon emissions. That would mean China should change the way it grows its economy, with a dynamic process of major structural transformation and economic upgrading lying at its heart. China's 14th Five-Year Plan and the post-pandemic recovery present an important opportunity to accelerate this transformation to a low-carbon, more advanced economy.

Linking the 2060 carbon neutrality goal with China's 14th Five-Year Plan and the long-range objectives through 2035

Following the announcement of the carbon neutrality goal, the transition to a low-carbon economy will not automatically accelerate, nor will net-zero emissions of major industries easily be achieved, unless substantial and ambitious reform measures are put in place. The new growth model and sustainable development that is implied by the 2060 carbon

neutrality goal will also need to be rooted in existing social-economic goals and policies that have been articulated by China. The upcoming 14th Five-Year Plan is crucial in spearheading such efforts.

The 14th Five-Year Plan is of particular significance as the plan period of 2021–2025 will mark the first five years of China's new journey to 'basically' realise a modern socialist country (the overarching Long-Range Goal to 2035), on the path to the second centenary goal of achieving 'a great modern socialist country' (by 2049). The 14th Five-Year Plan covers one-eighth of the four decades leading up to the 2060 deadline for achieving carbon neutrality, and presents the opportunity to make a strong start on this path. If China can reach a carbon peak by the end of the 14th Five-Year Plan (i.e. by 2025), and then bend the emissions curve downwards quickly, after a plateau in emissions that is as short as possible, it would significantly increase the likelihood of reaching its neutrality target by 2060, and of the world achieving the climate targets under the Paris Agreement.

The CCP Central Committee has released proposals, as part of formulating the 14th Five-Year Plan and the Long-Range Objectives through the year 2035, that outline China's major economic and social development goals for the next 15 years. These goals and the 2060 climate targets are mutually supporting. China's vision for 'eco-civilisation' or 'a beautiful China', and its broad development goals for 2035 embody an innovative, sustainable and low-carbon approach to the country's development, and provide additional guidelines for strategies to achieve carbon neutrality by 2060. Simultaneously, the 2060 climate targets can reshape the economy for a sustainable future and lay the foundation for China's long-term, high-quality development, helping China deliver its articulated objectives and goals.

4. Shaping the low-carbon agenda in the 14th Five-Year Plan

The next phases of discussion and planning in China will largely focus on the policies and strategies needed to connect China's current situation through the Long-Term Goals for 2035, and to continue this transition to 2060. Clearly, these are goals to be supported. The challenge is delivery.

Energy policy is a key mechanism for delivering the carbon neutrality commitment and a cap on total energy consumption needs to be set in the 14th Five-Year Plan

Energy use plays a key role in carbon emissions reduction. Eighty per cent of China's total greenhouse gas emissions come from energy-related activities, in particular the burning of fossil fuels (Elzen et al. 2016). Therefore, strengthened national energy policy is crucial to delivering the carbon neutrality commitment.

Qi et al. (2020) assess the speed of reduction in energy-related carbon emissions and the time of their peak, based on different scenarios from the national energy targets for 2030. Their results suggest that under the current energy policy scenario – with the share of non-fossil fuels in primary energy consumption targeted at 20% by 2030, based on China's previous NDC submitted to the Paris Agreement in 2015 – carbon emissions would not likely peak until as late as 2042–52, making the commitment of carbon neutrality by 2060 almost impossible.

In December 2020, President Xi Jinping announced further commitments for 2030 at the Climate Ambition Summit, including to raise the share of non-fossil fuels in primary energy consumption to 25% (Reuters 2020). However, this strengthened target on the share of non-fossil fuels is insufficient for ensuring the country can peak its emissions earlier than committed in the previous NDC – to peak before 2030. The absolute amount of fossil energy consumption could still increase if the total energy consumption grows faster than the speed of energy transition. Under this strengthened target, China's carbon emissions could peak as early as 2024, provided China caps its total energy consumption to no more than 5.5 gigatonnes of coal equivalent (Gtce) in 2030. The peak could occur in 2033, falling short of the commitment to peak before 2030, if the cap on total energy consumption is lifted to 6.0 Gtce (Qi et al. 2020). This calls for stricter targets on both the non-fossil fuel share and total energy consumption to be adopted in the 14th Five-Year Plan.

In addition, alongside the carbon intensity target, which reflects the reduction in carbon emissions per unit of GDP, there is a need to establish a new target for total carbon emissions in China. The setting of an absolute carbon emissions cap in the 14th Five-Year Plan would be more straightforward for the carbon neutrality effort and provide a clear signal on earlier peaking.

Hepburn et al. (2021) discussed strategies for accelerating the energy transition in China, in particular to move away from coal, promote renewable energy development, deepen power sector reform and encourage the transition to new energy vehicles. Transparent and comprehensive policies are needed for the people and places affected by these strategies, to ensure a just transition. This should include compensation and medical support, in particular for poorer people; occupational retraining and life-long learning programmes to help affected workers build a future; social protection measures; and support on local skills and investment in the major provinces of coal production including Inner Mongolia, Shanxi and Shaanxi, to adjust their economic structure and seek new points of economic growth.

For the 14th Five-Year Plan, one of the most critical tasks is to strictly control the expansion of coal-fired power capacity and the potential rebound in coal consumption. The 'coal-to-gas' transition strategy in China implies that consumption of natural gas will likely continue to grow.⁵ For carbon emissions to peak, the increase in carbon emissions caused by the growing gas consumption must be offset by decreasing the carbon emissions from coal use. Therefore, the 14th Five-Year Plan must have a strict target for coal consumption.

The new technological revolution, with big data, internet of things and artificial intelligence as its core, has reshaped the global competitive landscape and brought opportunities to China's energy transformation. After rapid development over the past four decades, China has made significant technological progress in the energy field, and has been leading the world in many aspects including renewable energy production, the ultra-high voltage (UHV) grid and energy storage technologies. China should increase policy support for the development of these new energy technologies, including some next-generation technologies such as hydrogen, and accelerate the transition to a more secure and cleaner energy future. The innovation-driven energy transition will not only lead the way to carbon neutrality but also open up great opportunities and new sources of economic growth. As we have said above, China should not build any new coal-fired plants and indeed the country does not need to.

Cities and local government are at the heart of China's low-carbon agenda

In China, carbon reduction is largely a top-down process, based on central government guidance, but national carbon reduction targets need to be implemented by government at all levels, and by companies. Reaching carbon neutrality involves a series of radical changes and coordinated actions in all economic processes including production, consumption and trade, and consensus is needed across these areas.

The role of local government is crucial. In China, about 85% of carbon emissions are caused by urban energy use (Shan et al. 2019). Rapid urbanisation means that the total urban population will continue to increase significantly, and in the next three to four decades will account for 75–80% of China's total population (Gu, Guan, and Liu 2017), which could lead to significantly rising urban energy consumption. Therefore, it is vital that local governments play a central role in energy conservation and emissions reduction. Without the active participation and effective governance of local governments, it would be impossible for China to achieve its climate goals at the national level and its carbon neutrality commitments to the world. In February 2021, President Xi Jinping called for the formulation of an action plan for peaking carbon emissions before 2030 at the 18th meeting of the Central Committee for deepening overall reform.⁶ Responding to the central government, more and more local governments have put forward clear targets to peak carbon emissions in their own special plans.⁷ In the meanwhile, the central government should place special attention on the fair and reasonable allocation of energy and carbon intensity reduction targets. To relieve the regional inequality and promote more balanced development during the low-carbon transition, more responsibilities should be allocated to developed provinces (the eastern region), while helping undeveloped provinces (central and western regions) where China's fossil energy resources are largely concentrated to transform their resource advantage into economic advantage.

In many aspects including infrastructure projects and resource utilisation, regional governments should fully cooperate and work with each other to build effective incentive mechanisms for promoting the adoption of green technologies and putting into practice a green economic growth model. Environment should not simply be about constraints; it should be about fostering the right kind of investment everywhere and across all parts of government and the economy. And with investment and innovation at centre stage, financial policy and regulation should play a critical role in providing government and markets with a sense of direction and clarity. Appropriate environmental interventions means not just command and control measures, but also setting prices and allowing individuals and firms to respond.

Urbanisation has been one of the main driving factors in China's phenomenal rapid economic growth over the past few decades; however, the old drivers of urbanisation are losing momentum (Stern and Qi 2020). The problems associated with the traditional industrialisation-driven model of urbanisation at the price of intensive energy consumption, heavy pollution and high emissions put long-term growth and prosperity at risk. A new paradigm of urban development is urgently needed, moving away from the massive investment in high-carbon sectors to meet demand for buildings, steel and coal, which has been driven by the expansion of industrialisation and has caused inefficient urban sprawl. Now urbanisation needs to be 'high quality', enabled by strategic sustainable investments in cities.

Green finance, market-based measures and modes of administrative management to promote sustainable urban development and the low-carbon transition

Due to its huge population, China will likely play a particularly important role in pushing the new paradigm of urban development forward globally. Already China has been taking a leading role in boosting green finance⁸ (Yao 2018), and these developments will also be conducive to promoting urbanisation in a sustainable way in the new era. There are certainly more areas for China to explore to achieve a new type of urbanisation, driven by cleaner energy, more efficient use of resources, and innovation in technology, finance and policy. None of these can be achieved without implementation by local governments and an effective balance between traditional finance and green finance. Delivery also depends on cooperation between local and central government to mobilise more investment into the green economy and post-COVID-19 high-quality growth through policy guidance and incentive mechanisms. The low-carbon transition presents huge new investment opportunities. To support a 1.5°C transition pathway in China, new investment of CNY 138 trillion (over 2.5% of annual GDP) will be needed in the energy system between 2020 and 2050 (He 2020).

China's environmental and energy transition policies have been largely characterised by administrative measures. If long-term effectiveness is to be realised in the future, alternative market-based policies with lower social costs will have a bigger role to play. In the 14th Five-Year Plan, one crucial task is to efficiently allocate carbon emission responsibilities and incentives to local governments and enterprises in a wide range of high-emission sectors.

For local governments at all levels, their responsibility is to measure and evaluate the effectiveness of strategy, policy and planning, with the regulatory system in place. Besides administrative supervision, which may be more effective in the near term, market-based incentive mechanisms are needed to motivate local governments in terms of regulating environmental protection and carbon reduction. China's environmental protection tax (EPT), introduced in 2018, is a good example (Jia 2018). It levies a tax on polluting businesses to encourage environmentally friendly production and increases the fiscal income of local governments. Further emphasis should be placed on taxation policies of this kind, and the fiscal sharing system between central and local government should be improved to match administrative responsibilities.

Enterprises should also be aware of their environmental and ecological responsibilities, and reduce their carbon emissions to not exceed allocated emissions quotas. In the meantime, market-based mechanisms are a crucial part of measures for promoting energy conservation and emissions reduction at the micro level, in particular the development of a carbon market in which enterprises with lower carbon emissions can be rewarded by selling the right to emit to other entities that struggle to meet their carbon emissions requirements.

On 5 January 2021, China's Ministry of Ecology and Environment (MEE) issued pilot rules for the long-awaited carbon emissions trading scheme (ETS),⁹ laying carbon reduction responsibilities directly with enterprises for the first time through the allocation of emission quotas. The carbon market initially covers only the power sector, which accounts for around 30% of China's emissions (Slater, Shu, and De Boer 2021), but in the future it

will integrate more sectors such as steel, cement, aluminium and chemicals, as indicated by the MEE. The launch of the carbon market can enable a carbon price that provides an economic signal to market players, to hold emitters responsible for their activities and also to guide more investment in natural capital.

A critical time to plan the post-COVID high-quality growth and the role of natural capital

The COVID-19 pandemic has provided a window of opportunity to act through 2021. In this critical time, the formulation of the 14th Five-Year Plan must be focused on promoting the high-quality growth agenda for the time after COVID-19 and on shifting towards a green growth approach for ensuring more efficient and sustainable development. An important policy framework for sustainable development, a green growth strategy is defined by the OECD (2011) as an approach to foster economic development while managing the provision and use of natural assets and services to ensure their functioning.

In the short term, green recovery through mobilising investment in a number of green industries can stimulate strong economic growth and create far more secure, high-quality jobs (UNEP 2011), both directly and indirectly (Bowen and Kuralbayeva 2015). Investment in traditional high-carbon sectors is to be avoided, for its costs in terms of natural capital depletion, harming the foundations of long-term economic growth and wellbeing.

In the long run, green investment and consumption can cultivate new growth points, which can establish China's new competitive advantages globally and enhance the resilience and sustainability of its economic development. The Energy Transitions Commission (ETC) has summarised some key priorities to ensure a green recovery in China (ETC 2020), suggesting four pillars of economic stimulus including investment in zero-carbon electrification, investment in new technology-based forms of infrastructure, green urbanisation, and promoting green consumption. Our previous paper (Hepburn et al. 2021) also discussed key strategies and action areas for China's 14th Five-Year Plan after COVID-19, with particular focuses on energy transition, new urbanisation and investment in different types of capital. Energy Foundation China has identified key elements of strategy across the economic sectors, for achieving a sustainable post-pandemic economic recovery and meeting China's long-term economic and climate goals (Energy Foundation China 2020).

To turn these strategies into action, overall planning at the macro level is needed. For ensuring green growth globally, planning should be aimed at supporting and directing investment into a wide range of green economy industries, and should be effectively integrated with multilateral mechanisms. Ambition for building a better world is only possible with cooperation between countries, which would result in win-win outcomes. Moreover, such high-level planning should be market-oriented, allowing the market to play its full role in guiding the allocation of resources, technology and R&D investment. This process should also cover comprehensive planning and management of not only physical infrastructure but also natural, human and social capital, to achieve sustainable and inclusive economic and social development.

The role of natural capital in economic recovery must be strengthened. The management of natural resources such as land and water can help upgrade and transform traditional industries, and the transition of an economy from labour-intensive to technology-intensive would naturally mean more efficient use of natural resources. These are mutually reinforcing.

China has placed 'ecological civilisation' at the core of its modernisation process. The concept of green development, reflected by the two mountain theory ('green mountains are gold mountains'), defines the nature, characteristics and direction of China's future development. As China moves from a middle-income towards a high-income country, the proportion of natural capital in its national wealth will increase. This is in line with the concept of 'ecological civilisation' or green development, and will also open up new areas of investment and consumption, with great potential to form new growth drivers and to truly integrate economic development with environmental protection.

The concept of natural capital covers the stock of natural assets including soil, air and water, and the ecosystem services they provide, as well as the stability and security of the global system, such as biodiversity and climate change on a global scale (see Stern, Xie, and Zenghelis 2020). Investment in natural capital can affect a wide range of industries in a positive way, including links to the infrastructure, manufacturing, transport and building sectors, as well as to land use, farmland, forests, natural ecosystems and even the service sector. Therefore, investment in natural capital has a high potential to boost the development of a wide range of industries and create a substantial number of jobs, particularly related to the low-carbon energy transition.

To address the poor management of natural capital and make the investment in natural capital a new driving force for growth, the 14th Five-Year Plan needs to deal with the externality of natural capital. This requires the establishment of a new accounting system for the national economy that takes into account the negative externalities caused by pollution and carbon emissions, to reflect the real costs of economic development. This is essential (e.g. see Liu 2020) and while there is not yet a widely accepted green accounting method, some progress has been made: China started the 'Natural Capital Accounting and Valuation of Ecosystem Services' project in 2017, which states its aim as establishing 'natural resource balance sheets' (UN SEEA n.d.).

Global multilateralism and the role of China

Global challenges including the public health crisis caused by COVID-19, climate change, energy security and food security are growing more intense and increasingly urgent. No one country can stand alone. Now is a critical moment for all countries to draw lessons from history and steer the world towards stronger cooperation. New institutions are needed, built in the post-World War II spirit, to ensure a more resilient world for the long term, rather than a backward step to the fragmented development that happened after World War I.

China should work with other countries in exploring new multilateral mechanisms and models of international governance, through international organisations such as the United Nations, World Health Organisation, G20 and World Trade Organisation. These international organisations have played a very positive role in the global economy over

the past few decades. Looking ahead, some adjustment and reforms are likely to be required to adapt to the changing world economy (Heldt and Mahrenbach 2020), but rather than meaning that their role should be weakened, international organisations need to play an even *stronger* role in addressing common global challenges, including climate change.

It is vital that China takes a lead in multilateral mechanisms and the exploration of international governance in many aspects, and in particular finance through international organisations such as the Asian Infrastructure Investment Bank, World Bank and Asian Development Bank in mobilising investment towards clean energy industries, including wind, solar PV, hydrogen and nuclear. China's 14th Five-Year Plan should put forward more ambitious quantified targets in aspects of energy and climate, to support its strengthened commitments and deliver a clear message that China will work closely with other countries in ratcheting up actions to combat climate change, promoting clean technologies and innovation, pursuing sustainable development and establishing more common goals and mutually beneficial cooperation.

There is a great opportunity for China and other countries in the world to cooperate to tightly link the post-pandemic economic recovery with the fight against climate change. Countries need to take collective action on stimulus policies and on raising public awareness by investing more in green industries. If China, the EU, UK and US significantly increase investment and policy support for green industries, world demand will rise and thus push the development of new technologies further. Joint action and strategic planning will not only help the world deal with the challenges coming from climate change, but will also be of great benefit to individual countries.

The 15th meeting of the Conference of the Parties (COP15) to the Convention on Biological Diversity (CBD), originally scheduled to take place in Kunming in October 2020, has now been postponed to October 2021, and the COP26 UN climate change conference is set to be hosted in Glasgow in November 2021. These are very important talks that carry the international expectation of proposing new pathways and multilateral cooperation for achieving biodiversity targets and climate change commitments. The need for advancing the resilience agenda has never been greater, even with a growing focus on responding to the COVID-19 pandemic.

China and the EU should work closely to support the UK in making COP26 a success, including completing the negotiations on the implementation rules for the Paris Agreement, and China must take a leading role in the CBD COP15 to facilitate a new biodiversity framework, goals and action for the coming decades. China and the EU should also work to support low-and-middle-income countries in achieving a low-carbon transition and sustainable growth, through their overseas investment decisions. These countries have been deeply affected by the COVID-19 pandemic, and are more vulnerable to climate change impacts than developed countries (Habig 2020; Bhattacharya et al. 2020).

Climate change is also one of the few areas on which China and the US may now find common ground. The new US climate envoy John Kerry has insisted that climate cooperation between China and the US is a 'standalone issue', similar to public health, which should be isolated from more contentious issues such as trade and finance (Basu 2021). This could be an opportunity for the US and China together to link the current COVID crisis with the long-term climate threats and turn it into an opportunity for promoting global green growth and low-carbon transition. Funding

Notes

1. China is the largest producer of hydrogen in the world, producing over 20 million tons of hydrogen each year (China Hydrogen Alliance 2019). However, currently 95% of its hydrogen production comes from fossil fuels (Chi and Yu 2018), with extensive research and development undergoing around hydrogen electrolysis.
2. <https://www.iea.org/reports/electricity-market-report-january-2022>.
3. The Institute works closely with China's Ministry of Ecology and Environment (MEE) on projecting the nation's long-term energy and climate goals.
4. For a definition and features of the new model see page 3 in Green and Stern (2015).
5. However, there is a strong voice in China to leapfrog gas, avoiding increasing the amount of investment in gas-related infrastructure assets, under the name of clean energy. See for example: https://bao.hvacr.cn/201803_2075838.html.
6. http://www.xinhuanet.com/english/2021-02/20/c_139753184.htm.
7. http://www.xinhuanet.com/fortune/2021-01/19/c_1126997272.htm.
8. Green finance refers to financial activities aiming at promoting better environmental outcomes. See, for example, Fleming (2020).
9. http://www.mee.gov.cn/xxgk2018/xxgk/xxgk02/202101/t20210105_816131.html.

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