

CHINA'S LOW CARBON FUTURE OFFERS GLOBAL OPPORTUNITIES



CHINA'S LOW CARBON FUTURE OFFERS GLOBAL OPPORTUNITIES

*A briefing by **chinadialogue**, in association with the Energy and Climate Intelligence Unit and Low Carbon Innovation in China: Prospects, Politics and Practice.*

*Authors: **Sam Geall** and **Lulu Ning Hui**, with additional contributions from Isabel Hilton, Richard Black, Monica Wang, Yu Jie, Adrian Ely, David Tyfield and Frauke Urban.*

Contents

Executive Summary	4
China's changing position in global negotiations	6
China's low-carbon priorities and the 'new normal'	10
Planning the transition	17
Transforming the energy system	20
Low carbon innovation in a changing China	24
Putting a price on carbon	26
Opportunities for the world	31
Conclusion	33
About <i>chinadialogue</i>	34
About Low Carbon Innovation in China	35
About the Energy and Climate Intelligence Unit	36

Executive Summary

Over the last few years, China has adopted an increasingly ambitious and committed approach to climate change and low-carbon development.

The country has become the world's biggest investor in renewable energy, and has rapidly restrained and apparently reversed its previous growth in coal consumption.

The drivers include concern about environmental impacts including air pollution and climate change, and China's movement to a geopolitical role in which commitments to poorer countries and responsible global citizenship assume more central importance.

More fundamentally, the costs of renewable energy have plummeted in the last few years, driven in large part by competition between Chinese manufacturers. As a result, China is poised to become the dominant supplier of products for the global low-carbon economy of the near future, with all the economic rewards that will bring. Importantly, China's embrace of a low-carbon development model may create incentives for other countries to move in a similar direction.

Questions remain, however: what is the progress of China's efforts to decarbonise its economy? How can low-carbon innovation in China affect decarbonisation pathways elsewhere? What is driving the shift? Why has China's position at the talks changed – and what might be coming down the line?

The implications of these questions for the rest of the world will be profound. This report tries to explain the context, and capture the dynamism and scale of China's changing energy, environment and climate change landscape.

China and climate: a timeline

11th 5-Year Plan

12th 5-Year Plan

1-12 Dec 1997

The Kyoto Protocol was adopted, which for the first time set quantified greenhouse gas reduction commitments for developed countries between 2008 and 2012.

2006-2010

China's 11th Five Year Plan considers energy intensity reductions and curbing major pollutants for the first time.

3-15 Dec 2007

The Bali Action Plan started negotiations with a view to the adoption of a new international agreement in 2009, to follow on from the Kyoto Protocol in 2012.

2011-2015

China's 12th Five Year Plan includes carbon intensity reduction targets for the first time.

11 Jun 2012

China establishes national climate think-tank, National Centre for Climate Change Strategy.

12 Dec 2014

China-US Joint Announcement on Climate Change. China announces its emissions will peak in 2030.

25 Sep 2015

China-US Joint Announcement on Climate Change reveals China will set up a national carbon market in 2017 and establish of a South-South cooperation fund with an initial pledge of US\$2 billion.

3-14 Jun 1992

Creation of the United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit in Rio de Janeiro, Brazil. China is a signatory.

Jun 2007

China launches its national plan on climate change, the first of any developing country.

29 Oct 2011

China's State Council launched 7 emissions trading scheme pilots.

30 Nov-11 Dec 2015
COP21 Paris

30 Jun 2015

China submits its UN climate pledge (INDC), which commits the country to reduce its carbon intensity by 60-65% on 2005 levels by 2030.

28 Feb 2005

China's Renewable Energy Law enters into force (a further amendment released in 2009).

7-18 Dec 2009

COP15 in Copenhagen, Denmark, approved a shared target to limit global warming to 2°C, but the main deliverable, the "Copenhagen Accord" was not legally binding. China commits to 40-45% carbon intensity reduction target by 2020, on a 2005 baseline.

12 Sep 2013

China's State Council issues Air Pollution Prevention and Control Action Plan.

China's changing position in global negotiations

China's participation in international climate talks started in 1992, when the country became a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) at the Earth Summit in Rio de Janeiro, Brazil (see timeline above). At that time, China's per-capita GDP was US\$419, while its annual total energy consumption stood at 1.09 billion tonnes of coal equivalent. In 1997, China became a signatory to the Kyoto Protocol.

However, its participation in international climate processes became more significant in the following decade. As China's economy grew, it began to include efforts to conserve energy and reduce pollution in its central planning. In 2004, China announced its Medium and Long-Term Plan to 2020 would include energy intensity reduction targets for the first time. The following year, the country's Renewable Energy Law entered into force. The 11th Five Year Plan, from 2006 to 2010, was the first to contain binding national targets on energy intensity and reduction of major pollutants. In 2007, China formed its national lead office on climate change and issued the first national climate change plan of any developing country.

Despite these efforts, China became the world's largest emitter of greenhouse gases in 2007 and since then its emissions have continued to rise. China's total emissions currently far outstrip those of the United States, the second largest emitter, and the European Union (its per capita emissions are almost at the level of the EU). By 2014, China's per-capita GDP had risen to \$7,485 and its total energy consumption to 3.75 billion tonnes of coal equivalent.

With the US failure to ratify Kyoto and China's inclusion among developing nations – who have no obligation to curb their emissions under the treaty – much of the work towards a post-Kyoto framework focused on how it might include the world's two largest emitters. However, at the Copenhagen

climate summit in 2009, China was widely depicted as being one of the “laggards” that blocked a global treaty to control carbon emissions.

Just six years on, its approach to the ongoing UN climate negotiations is very different. At the time of Copenhagen, China, like virtually every other country, outlined its plans for controlling its own emissions. It followed the norm for developing countries of a pledge to reduce “emissions intensity” – the amount of greenhouse gas emitted per unit of GDP. Its target of a 40-45% cut by 2020 placed it among the more ambitious nations in the developing world. Six years on, emissions intensity has been reduced by 33%, and China is broadly on course to meet its 2020 target.

Since 2011, China has hosted its own Pavilion at UN climate conferences and also made its negotiators more transparent during the talks, including meeting with NGOs and journalists more regularly¹. The following year, China launched its national climate-change think-tank the National Center for Climate Change Strategy and International Cooperation (NCSC) under the National Development and Reform Commission, China’s top economic planner.

In 2012, China also first offered to support South-South cooperation on climate, with \$10 million in funding. By 2015 this has risen to a total of \$5.1 billion to help developing countries tackle climate change and development problems, in two large pledges from President Xi Jinping – one announced during his visit to the United States in September and another at the UN General Assembly, focused on the post-2015 Development Agenda. This is a major development, as the assumption within the UN climate convention process has been that only developed nations would put such funding forward.

Since then, China has engaged in a series of important bilateral meetings, including with the United Kingdom, South Korea, India, Brazil, France and the EU. However, the most significant have been two joint announcements from China and the United States. Not only are these nations the biggest two

1. <https://www.chinadialogue.net/article/show/single/en/3966--China-will-be-transparent->

greenhouse gas emitters by far, accounting for around half of the global total, but mistrust between the two was also a significant factor behind the failure in Copenhagen, with relations on climate change remaining frosty in the few years afterwards.

In the first of these bilateral announcements², in November 2014, President Xi pledged that China would peak its carbon emissions by 2030, with efforts to peak earlier. It will also increase the share of non-fossil fuels in primary energy consumption to 20% by 2030.

In June 2015, China officially submitted this plan to the UN climate convention (UNFCCC)³, becoming the first emerging economy to unveil its Intended Nationally Determined Contribution (INDC). In doing so it clarified that this also entails an improvement of 60-65% in emissions intensity by 2030 (on a 2005 baseline).

The second bilateral announcement⁴ took place in September 2015. The official statement from Presidents Xi and Obama noted that they share a “personal commitment to a successful climate agreement in Paris” – scene of the 2015 UNFCCC summit, at which governments are likely to conclude a new global climate change agreement. The Presidents also outlined a number of unilateral and bilateral work streams, including China’s plan to ensure half of its new urban buildings are “green” by 2020 and to introduce new fuel efficiency standards for heavy goods vehicles by 2019.

In late November, Xie Zhenhua, China’s lead negotiator and special representative on climate change, said the country hoped that the Paris conference could be a “landmark” one, at which delegates would reach an “ambitious, strong and legally binding” agreement.

2. <https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change>

3. <http://newsroom.unfccc.int/unfccc-newsroom/china-submits-its-climate-action-plan-ahead-of-2015-paris-agreement/>

4. <https://www.whitehouse.gov/the-press-office/2015/09/25/us-china-joint-presidential-statement-climate-change>

Taken together, these statements and pledges indicate that China's position at the talks, and relations between the world's two "emissions superpowers", have moved on hugely in the last six years since Copenhagen.

International diplomacy has helped to advance China's stance towards international negotiations. But far more important is the growing awareness that climate impacts and air pollution pose major threats to development, and the rapidly evolving market for low-carbon goods and services.

In short, China's new approach rests on the fact that its leaders see combatting climate change as being in the national interest. And underpinning that perception is not only a vision of how China might position itself in future, but also a real transformation already underway in China's economy.

China's low-carbon priorities and the 'new normal'

To understand China's plans to "green" its economy, it is important to identify the multiple challenges the country faces, and the priorities of its government. After three decades of wasteful and highly polluting growth, China now aims to develop a new growth model that addresses both economic and environmental pressures.

The assumption that environmental protection entails an economic sacrifice has largely been discarded in China. Rather, the government increasingly considers low-carbon sectors as the drivers of future growth. As the state-owned *China Daily* puts it⁵: "Unlike the Western countries which only began to address environmental problems after they became rich and transferred their highly polluting manufacturing to developing countries, China has to blaze a new trail in order to achieve sustainable development."

In late 2014, President Xi first introduced the term "new normal"⁶ to describe China's transition to slower, more sustainable and efficient economic growth that avoids the "middle-income trap", where a country attains a certain income but will get stuck at the level. Environmental concerns are also seen as improving energy security, for example by reducing gas import bills.

In 2014, China's GDP growth was officially 7.4%, in line with the government's target of 7.5% for the year. In 2015, growth is expected to be 7.1%, and 6.9%⁷ by 2017. This is a much slower pace than the annual average of 10% attained in the past three decades. But it is still a medium-to-

5. http://www.chinadaily.com.cn/opinion/2015-03/26/content_19912323.htm

6. http://news.xinhuanet.com/english/china/2014-11/09/c_133776839.htm

7. https://www.worldbank.org/content/dam/Worldbank/document/EAP/China/ceu_06_15_en.pdf

high growth rate, and meeting it presents multiple challenges – for example, reconciling rapidly growing energy demand with the desire to curb imports and limit air pollution and climate change.

The leadership aims to make this growth low-carbon. *China 2050 High Renewable Energy Penetration Scenario and Roadmap*⁸, a report from the high-level energy think tank the Energy Research Institute, predicts “a true revolution of energy production and consumption”⁹; and President Xi has also called, in a major 2014 speech, for a “revolution in energy production and consumption”. According to the *Scenario and Roadmap*, by 2050, renewables will account for over 60% of China’s total energy consumption¹⁰ and more than 85% of its total electricity consumption. These targets are comparable with all but the most ambitious European countries. It also concluded that fossil fuel use and hence carbon emissions could peak by 2025.

The Energy Research Institute works under the National Development and Reform Commission (NDRC) and the study was jointly produced with a number of core energy research centres close to China’s top decision makers. By far the most ambitious projection of China’s renewable energy future, it is a clear sign of the potential scale of China’s green transformation.

Environmental issues are also becoming more and more visible in the public sphere, due mainly to the significant challenges posed by fossil fuel burning – notably, air pollution. Environmental protection became the most discussed topic on the internet in China in 2014, with three times more comments than the second ranking topic, anti-corruption, according to China Youth Daily’s online public-opinion monitoring centre.

8. <http://www.efchina.org/Reports-en/china-2050-high-renewable-energy-penetration-scenario-and-roadmap-study-en>

9. http://news.xinhuanet.com/english/china/2014-06/13/c_133405882.htm

10. <http://www.efchina.org/Attachments/Report/report-20150420/China-2050-High-Renewable-Energy-Penetration-Scenario-and-Roadmap-Study-Executive-Summary.pdf>

In response to popular pressure to tackle China's air pollution crisis, Premier Li Keqiang announced in March 2014 that the government had declared "war on pollution". China's increasingly dynamic media increasingly make the connection between environmental issues and climate change, and public awareness of climate change is high.

February 2015 saw the release of *Under the Dome*, an online documentary detailing China's severe air pollution. Financed and presented by Chai Jing, a prominent former state television reporter from China Central Television (CCTV), it attracted more than 200 million views within three days and generated a nationwide discussion. Though the authorities later censored it, the film earned official endorsements and made a strong link between air pollution and coal and oil consumption.

TENG FEI ON CHINA'S DECARBONISATION PATHWAY

Teng Fei is one of China's leading experts on climate change and a professor at the Institute of Energy, Environment, and Economy at Tsinghua University in Beijing. He is also a lead author of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. *chinadialogue* interviewed him in November.

chinadialogue (CD): *The UNFCCC and UNEP have recently published reports on Intended National Determined Contributions (INDCs) submitted by 146 different nations, assessing the gap between those targets and what is necessary to limit average temperature rises to 2C. Where do you think there is scope for more ambition? What global cooperation is needed to make it possible?*

Teng Fei (TF): Both the UNFCCC and UNEP reports stated the same basic fact: the INDCs are inadequate if the 2C limit is not to be breached.

Our research has found that different interpretations of the “fairness principle” mean each country comes to different conclusions on how the work should be divided. Currently each nation’s programme is as far as possible in its own interests. And that’s why we have that gap. Each country is using the idea of fairness that best suits it – but add it all together and you don’t do enough to avoid breaching the 2C limit.

So we still need talks and coordination at the international level, to reduce these gaps and bring about a better consensus on the fairness principle.

The current bottom-up system of submitting climate plans means each nation chooses its own definitions of fairness. So I think the only course of action is for everyone to look at their own emission reduction plans, development needs and key development targets, to find the motivation and potential for bigger cuts.

For example air pollution is currently a big problem for China. An early resolution to that problem would also help increase China’s emission cuts. It’s the same for other countries. For example energy security issues in Japan, India as well has its own important domestic development targets.

Also there’s the potential for breakthroughs in cooperation on low-carbon technology. For example reducing the cost of crucial technologies so developing nations can make use of them. That would also result in more potential for emissions cuts.

Risk management is also very important and needs more work. Estimates that we can stick to the 2C limit range from 50% to two-thirds, but climate change policy decisions may need to consider a worst case outcome. What is the worst case humanity can cope with? Can we accept a 3% or 4% chance of a 4C or 5C temperature

increase? Humanity needs to manage the small but possible risk of catastrophic outcomes.

CD: *How do you think China should decarbonise?*

TF: There are three aspects to this: The first is increasing energy efficiency, such as using better technology and structural changes to bring about sustained annual improvements in energy efficiency growth per GDP of 4%.

The second is to decarbonise the power sector by increasing the share of renewables and nuclear energy in the power mix, and using carbon capture and storage in fossil-fuel power generation to reduce the intensity of emissions. Achieving those targets will ensure that by 2050, CO₂ emissions per unit of electricity will be 90% lower than in 2010.

The third is to increase electrification, particularly in industry, transportation, and buildings. We should replace industrial coal-fired furnaces with electric ones, increase the use of electric vehicles, and use electricity more for heating and hot water.

The second and third methods are closely linked. First we need low-carbon power generation, then we have to increase electrification in order to reduce direct emissions (from heavy industry).

These three things are all essential to deep decarbonisation – none can be missed out. For the coming decades China will continue to see high levels of economic growth – we estimate annual GDP growth will drop from 7% now to about 5% in 2030 and then 2.5%-3% in 2050. GDP growth does drive emissions growth, which means we need to increase energy efficiency and improve the energy structure if China is to see emissions peak around 2030. After 2030, as GDP growth slows and

energy efficiency and structure improves, there will be an absolute fall in emissions. That's a rough idea of what will happen.

CD: *Are falling coal prices an opportunity for low-carbon development, or a threat?*

TF: Falling prices of fossil fuels alone are not helpful for low-carbon development. If those prices stay low in the long-term the larger price differential with non-fossil sources of energy will mean either development of non-fossil energy will be hampered, or the government will have to take on the financial costs of subsidising development.

But crisis brings opportunity to make some important changes. If fossil fuel prices remain low, the government can change pricing mechanisms.

Last year our research in partnership with the Natural Resources Defense Council found that coal has external costs of 260 yuan per tonne – approximately 50% of what coal costs today. But currently only 50 yuan of external costs are factored into the coal price – one fifth of total externalities. Falling prices give government the opportunity to change pricing mechanisms to better reflect social and environmental costs.

CD: *What do China's climate targets mean for business?*

TF: There are very clear signals. The 2C goal means that 80% of China's identified fossil fuel reserves must remain in the ground. So for the fossil fuel industry, continued investment in coal and coal power will result in stranded assets and unavoidable writedowns.

Meanwhile, to achieve an emissions peak in 2030, investment in non-fossil sources of energy will increase to twice 2010 levels by 2020, and to three times 2010 levels by 2030. The International Energy Agency's

2014 World Energy Investment Outlook estimated that the 2C limit will require investment in low-carbon power generation and energy efficiency to increase three-fold and eight-fold on 2013 levels by 2035. That's a very clear policy signal for investors.

Also the green and low-carbon sector will become a new point of economic and employment growth. That indicates companies and investors should invest more in green and low-carbon fields.

Although the signals are clear, we still need appropriate policies to send concrete price and market signals if we are to achieve climate targets. For example carbon markets and pricing, environmental taxes, and so on.

CD: *What impact will the 13th Five Year Plan have on China's achieving its emissions targets?*

TF: Overall the plan stresses the role of the markets, for example using energy rights and carbon markets.

What's going to be interesting is how the government uses markets to achieve policy goals, rather than continuing to hand down targets to be met.

And the relationship between government and the markets still needs to be clarified. For example in carbon markets – can the government step back and reduce intervention, providing only necessary services, rather than doing everything from policy design to allocating emissions quotas, from deal-making to third-party verification? Micromanaging by government would not help the market play a guiding role.

Planning the transition

China's Five-Year Plans (FYPs) are its most important policy documents, providing centralised and integrated frameworks for the country's economic development. Since 2006, climate and energy policies have been central elements of the plans. The 11th FYP (2006-2010)¹¹ first articulated a target for “a resource-conserving and environment-friendly society”, while the 12th FYP (2011-2015)¹² listed “sustainable growth” as a national priority.

During the period of the 11th FYP, China closed down outdated and inefficient plants in power and heavy industry. Together with other measures, this reduced energy consumption per unit of GDP by almost 20% between 2005 and 2010, saving more than 1.46 billion tonnes of CO₂ emissions¹³.

The 12th FYP went beyond energy efficiency improvements and incorporated specific climate-change targets into central planning. It includes a further 16% reduction in energy consumption per unit of GDP and a 17% reduction in carbon emissions per unit of GDP – targets that have almost been met. It prescribed an increase in the share that clean forms of energy (non-fossil fuel sources) have in the overall mix, to 11.4% by 2015, 15% by 2020 and 20% by 2030. In 2014, non-fossil fuels made up more than 25% of the country's electricity generation.

The 13th FYP is likely to show similar ambition and underpin a deepening energy transition. The process of drafting the plan started in April 2014 and the first details were revealed in October 2015 at the Chinese Communist Party's annual plenum. The next five year plan, said the plenum report, will

11. http://www.gov.cn/ztl/2006-03/16/content_228841.htm

12. http://www.gov.cn/2011h/content_1825838_2.htm

13. <http://www.unep.org/newscentre/default.aspx?DocumentID=2723&ArticleID=9584>

“highlight innovation, coordination, the environment, opening up and sharing” in order to fulfill its economic goals, which include the doubling of the country’s GDP and per-capita income of residents of cities and rural areas by 2020 on a 2010 baseline. China’s National People’s Congress is expected to endorse the final version in March 2016. The 13th FYP will be the first to start under President Xi’s leadership.

Climate change is likely to be a core aspect of the plan. In 2014, Xu Lin, director of the National Development and Reform Commission (NDRC) Development Planning Department, promised that energy efficiency and environmental protection would be central to the 13th FYP. His department is China’s top economic planning unit; it is responsible for drafting the 13th FYP, and introduced China’s first national climate change plan in 2007. China is also expected to introduce a climate change law in the next year, and future actions on low-carbon development are also likely to include new pollution controls.

Throughout his administration, President Xi has called for “significant breakthroughs” in 10 specific areas, including what he calls “ecological civilisation”¹⁴. This phrase has been fleshed out in concrete policy initiatives aimed at changing the priorities and performance of China’s local officials away from solely achieving economic growth, towards a “lifelong accountability system” that includes environmental performance in political evaluation. Premier Li Keqiang has clarified¹⁵ that an important part of ecological civilisation is the development of a green, low-carbon and recycling economy¹⁶.

Ma Jun, chief economist of the People's Bank of China's Research Bureau, told state media that the service sector and green industry will become the two major drivers of China's growth under the 13th Five Year Plan. Other key formulations from the plan, as promoted in government documents,

14. http://www.chinadaily.com.cn/opinion/2015-03/26/content_19912323.htm

15. http://www.chinadaily.com.cn/china/2015-06/13/content_20989851.htm

16. <http://steps-centre.org/publication/innovation-for-sustainability-in-a-changing-china-exploring-narratives-and-pathways/>

include: the need to “implement the most stringent environmental protection system”, including to combat air, water and soil pollution; the establishment of a resource-saving economy; building a “highly efficient, modern energy system”, including by promoting demonstration projects for zero emissions projects; and, significantly, the need to play an active role in global climate-change negotiations and the post-2015 sustainable development agenda.

Transforming the energy system

The rapid growth of renewable energy in China began in 2005, with the introduction of the first Renewable Energy Law¹⁷ (amended in 2009). It set out core regulations mandating grid connection, determining electricity pricing, cost allocation and preferential funding. Today, China is the world's leading market for clean energy finance, attracting US\$54.2 billion (around £35.4 billion) of investment in renewables in 2013, rising to \$89.5 billion (around £58.4 billion) in 2014. In that year, China invested nearly 73% more in renewables than the United States, the world's second largest market¹⁸.

Wind and solar power in particular have seen rapid expansion, as a result of a favourable policy and market environment. In 2005, China's wind power capacity stood at 0.126 gigawatts (GW), but reached 96GW¹⁹ by the end of 2014. Growth in installed solar capacity was even more remarkable, from 0.009GW in 2010 to 28GW²⁰ at the end of 2014.

China has the world's largest installed capacity of wind and hydroelectric power. In 2013, China installed more solar photovoltaic (PV) capacity than the whole of Europe; it is also the world's largest producer of wind turbines and solar panels, lowering the cost of both technologies significantly in recent years.

By 2020, China plans to install 200GW of wind energy capacity. It also plans 100GW of solar PV capacity by 2020 – almost as much as Japan and

17. <http://english.mofcom.gov.cn/article/policyrelease/questions/201312/20131200432160.shtml>

18. <http://about.bnef.com/press-releases/rebound-clean-energy-investment-2014-beats-expectations/>

19. http://www.nea.gov.cn/2015-02/12/c_133989991.htm

20. http://www.nea.gov.cn/2015-03/09/c_134049519.htm

Germany between them expect to have installed by 2030. Recent analysis suggests this target will rise to 150GW²¹.

Such rapid growth comes with considerable challenges, and insufficient grid infrastructure has tended to hamper the connection of clean power sources. To meet this challenge and get renewable energy on the grid, Ultra-High-Voltage (UHV) electricity transmission is being built across China. The State Grid Corporation has already invested 500 billion yuan (almost £52 billion, or \$79 billion) to extend the UHV grid and plans to invest a further 420 billion yuan (more than £43 billion, or \$65 billion) in 2015²². By 2020, UHV and other intra-regional transmission capacity will reach 400GW, enough to connect all planned coal, hydro, nuclear and wind power to areas with high demand.

Furthermore, China's National Energy Administration has recently announced it will invest 2 trillion yuan (around £207 billion, or \$313 billion) in the power distribution network²³ over the period 2015 to 2020.

In the meantime, a renewable energy quota system²⁴ is being introduced in China's electricity sector as part of recent power sector reforms, under which each province will be responsible for ensuring that a certain proportion (currently set between 2 and 10%) of electricity demand will be met from wind, solar and biomass.

Other power sector reform plans include introducing more market-driven competition in the electricity sector and redesigning the pricing system. Analysts point to the likelihood of green electricity tariff schemes in the new pricing system.

21. <http://cleantechnica.com/2015/09/29/china-may-lift-2020-solar-target-to-150gw/>

22. <http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/>

23. <http://finance.sina.com.cn/chanjing/cyxw/20150908/012923179847.shtml>

24. <http://guangfu.bjx.com.cn/news/20150330/603267.shtml>

China has also resumed its nuclear expansion after a year's pause for a safety review occasioned by the Fukushima disaster in 2011. As of June 2015, China had 27 operating nuclear power reactors (accounting for 2.4% of the total electricity production in China in 2014) with a further 24 reactors under construction. By 2020, nuclear power is due to provide 58GW of capacity, and some 150GW by 2030²⁵.

Despite the fast growth in renewables, the main energy source in China (accounting for around 75% of electricity production) is still coal. The country is the world's largest coal producer, consumer and importer. Coal is responsible for most of China's greenhouse gas emissions, as well as severe air and water pollution.

However, even here there are signs of change. Despite a recent revision to energy statistics, which indicated that coal consumption last year was higher than previously thought²⁶, coal is in structural decline: in 2014, demand fell for the first time in over a decade –by 2.9% compared with the previous year – even as the economy continued to grow. In the first seven months of 2015, China's coal production fell by 5%²⁷. Not only is the country importing less coal (imports were down 31% in the first seven months in 2015 on the same period last year), but the government has also constrained coal production domestically (halting new mining in eastern China).

In 2013, China introduced its first initiatives to cap the use of coal, aiming to restrict its share in the national energy mix to 65% by 2017²⁸. Based on this and other factors, including China's UN commitment to cut the carbon intensity of its economy by 60-65% by 2030 from 2005 levels, analysts

25. <http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/>

26. http://switchboard.nrdc.org/blogs/bfinamore/seven_things_you_should_know_a.html

27. http://www.stats.gov.cn/tjsj/zxfb/201509/t20150913_1243820.html

28. <http://www.carbontracker.org/report/the-great-coal-cap-chinas-energy-policies-and-the-financial-implications-for-thermal-coal/>

suggest China's greenhouse gas emissions may peak by 2025, five years ahead of the date it has pledged to the UN.

China has also introduced ambitious energy efficiency policies, such as the Top 10,000 Energy-Consuming Enterprises programme under the 12th FYP. It covers around 17,000 major firms – accounting for around two-thirds of total energy consumption – and aims to save energy equivalent to 250 million tonnes of coal over the course of the plan.

At the same time, China is catching up fast in innovation, in all sectors including low-carbon energy. From 2008 to 2012 its research and development (R&D) spending doubled, with the government investing 1.98% of GDP (compared with a mere 0.6% in 1996). The average for the EU, by comparison, was 1.96%²⁹. According to a 2014 OECD report, China will by 2019 be the world's top R&D spender.

The *New York Times* observed five years ago³⁰: “Calling renewable energy a strategic industry, China is trying hard to make sure that its companies dominate globally”; and in terms of supplying the essential infrastructure for a world decarbonising quickly, China's companies in areas such as wind turbines and solar panels are well-placed to be mass-market providers. Already, among the world's top 10 wind turbine manufactures, four are from China³¹; China is also the largest producer of solar PV modules³², accounting for more than 60% of annual production in 2012 and 2013.

29. http://www.nature.com/polopoly_fs/1.14476!/menu/main/topColumns/topLeftColumn/pdf/505144a.pdf

30. http://www.nytimes.com/2009/07/14/business/energy-environment/14energy.html?_r=0

31. <http://www.evwind.es/2014/03/27/top-10-wind-turbines-suppliers/44405>

32. <http://press.ihs.com/press-release/technology/chinese-suppliers-continued-lead-solar-pv-module-market-2014-ihs-says>

Low carbon innovation in a changing China

Beyond high-technology and centralised approaches, the dynamism of the transition in China can be found at the local level. Research by a group of academics in China and the UK, supported by the ESRC, suggests that there are significant and often overlooked aspects of China's low-carbon transition in lower-tech and bottom-up approaches to innovation.

In the often-neglected case of solar water heaters, China has the world's largest installed capacity. Far fewer barriers to adoption exist than solar PV, as this 'disruptive' technology is more compatible with existing social practices and is more actively and widely adopted³³. Despite China's dominant position in solar PV, systemic barriers to the installation of solar PV modules at the household level remain, many of which are social rather than technological, including issues around property rights and rights of access to roof-spaces for installation.

Similarly, electric cars and electric bicycles have received radically different treatment in China. The former has been the focus of ambitious industrial policy, while the latter has received effectively no government support, and is officially banned in many localities. Electric bicycles are, however, effectively ubiquitous in Chinese cities, numbering some 180 million on recent estimates, while electric cars are struggling to achieve sales beyond programmes of government procurement³⁴.

33. Urban, F. and Geall, S. (2014) Pathways Towards Renewable Energy in China: Prospects, Politics and Practices. STEPS Centre Working Paper 70, Brighton: STEPS

34. Tyfield, D. (2014) Putting the Power in 'Socio-Technical Regimes' – E-Mobility Transition in China as Political Process, *Mobilities* 9(4): 479-492

In food production and retail too, 'lower-tech' but overlooked alternatives to intensive, high-input systems – the dominant focus of state support for low-carbon innovation in Chinese agriculture -- exist in China, including low external input and organic community-supported agriculture (CSA) farms around first-tier cities. New digital networks connecting farmers and consumers that have encouraged seed saving and traditional forms of seed exchange³⁵.

Chinese policy tends to target the global competitiveness of the largest and most technologically advanced state-owned enterprises. Yet a systemic transition will be required in how China eats, moves, and heats and powers its homes. The potential exists for the state to deploy its significant resources to give support to accelerate innovation in existing bottom-up, and often 'low-tech', innovation successes in China – the results of which could be transformative, including for decarbonisation pathways in other developing countries.

35. Ely, A., Geall, S. and Song, Y. (2014) Pathways Towards Sustainable Maize Production and Consumption in China: Prospects, Politics and Practices, STEPS Working Paper 72, Brighton: STEPS

Putting a price on carbon

During his state visit to the United States in September 2015, President Xi Jinping announced that a national cap-and-trade programme for greenhouse gas emissions would be introduced in 2017. It marks the culmination of a concept first unveiled in the 12th FYP in 2010. Under the Emission Trading System (ETS), the government will set limits for greenhouse gas emissions and allow businesses to trade permits. (A similar mechanism, the EU ETS, has been in operation in Europe since 2005).

Starting with Shenzhen in 2013, China has launched a total of seven ETS pilots in five municipalities (Beijing, Shanghai, Shenzhen, Tianjin and Chongqing) and two provinces (Hubei and Guangdong), representing a variety of economic, social and geographic contexts, and covering a total population of 199 million.

These pilot schemes cover 30% of China's annual GDP and 20% of its carbon emissions. China therefore already houses the world's second largest carbon market after the EU ETS, and the national scheme will be the world's biggest when it starts in 2017. After some fluctuations, the carbon price in middle 2015 ranges from 9 yuan (around 93 pence) per tonne (in Shanghai) to 42 yuan (around £4.32 , or \$6.58) per tonne (in Beijing); an average price expectation for the national ETS in 2017 is 39 yuan (around £4.01, or \$6.11) per tonne.

According to the Washington DC-based China Environment Forum, more than 38 million tonnes of carbon dioxide had been traded in the secondary carbon markets of the seven pilot regions³⁶ by July 2015.

36. <http://thediplomat.com/2015/09/what-you-need-to-know-about-chinas-cap-and-trade-announcement/>

In addition, several cities (including Hangzhou and Qingdao) and provinces (Zhejiang, Gansu and Anhui) have begun to plan their own emissions trading systems, and pilots for low-carbon provinces and cities have been underway since 2010 in which local governments would introduce and explore multiple carbon control measures.

INTERVIEW: HE JIANKUN ON ENSURING WIN-WINS

Professor He Jiankun has been an expert on China's delegation at international climate change negotiations since the Poznan meeting in 2008. He is currently deputy chair of China's National Expert Committee on Climate Change.

***chinadialogue (CD):** The Paris climate change talks start soon. What do you hope to see?*

He Jiankun (HJ): All nations are trying to bring about progress now, and China's efforts are obvious. We have established a consensus by issuing joint statements on climate change with the United States, the EU, India, Brazil and France. China's role here is unique, as it has made joint statements with the major economies of both the developed and developing world. That consensus provides the basis for a successful outcome in Paris – the language from the joint statements may well provide the text for an agreement in Paris.

There are also disagreements between developed and developing nations, particularly on financial and technical support. In all joint statements, China has emphasised the principles of fairness, of “common but differentiated responsibilities”, and respective capabilities. And although these principles are generally accepted, each country has its own differing interpretations of what they mean.

International climate change policy needs to achieve two things. First, future international mechanisms must promote sustainable development for every country. Only when sustainable development and responding to climate change are combined will countries themselves want to take action. It is unrealistic to set emissions targets and ignore national development needs. This is particularly the case for developing nations which need to grow, to reduce poverty, to improve the lives of their citizens.

Additionally, international cooperation must ensure everyone benefits – it would be unsustainable for some nations to benefit while others lose out. Developed nations must accept their due responsibilities: in particular, providing support for climate-change adaptation in the poorest nations. Developed nations have a historical responsibility to provide financial and technical support to the developing world – a process which will provide them with a new opportunity for economic growth. If international climate-change mechanisms are to succeed they must use cooperation to provide everyone with opportunities for development.

Responding to climate change means humanity must manage climate risk, protect the Earth's ecology, and achieve sustainable development. I think progress is being made currently, and I am very optimistic.

CD: *What changes have there been in China's negotiating stance since Copenhagen?*

HJ: China's stance has been consistent: One, move the negotiating process forward; two, express the difference between developed and developing nations – on fairness, common but differentiated responsibilities, and respective capabilities.

At Copenhagen both the United States and EU were putting pressure on China. They were pressuring other countries to accept over-

ambitious targets, and that's not a realistic approach. In Paris, we are talking about a more bottom-up system, with nations themselves deciding what contributions to make, with the international community then reviewing those plans regularly and encouraging improvements, in order to achieve our climate goals.

As the international situation has developed, in particular after the Copenhagen talks, everyone is more concerned about finding and expanding the consensus, and sees responding to climate change and low-carbon transitions as a route to development. So there's a new trend towards cooperation and that means changes in the aims and methods of negotiation. That's beneficial both for resolving the climate crisis and for national development – and it's not about putting pressure on from above.

But China's positive attitude towards dealing with climate change has not changed. In 2012, China proposed building an “ecological civilisation”, which made a faster economic transition ever more important. Adjusting the energy mix and doing more to save energy both reduce emissions and help build that ecological civilisation.

***CD:** From long-term 2030 goals to the upcoming 13th Five Year Plan, what can you tell us about China's route to low-carbon development?*

HJ: In the long-term, China will take a low-carbon development pathway, which means using technology to conserve energy, developing non-fossil sources of fuel, and improving the energy mix. It also means we have to change how we grow. Developed nations took a high-carbon path, based on fossil fuels. But a developing nation like China cannot do that.

There are new issues and challenges China is facing under the “new normal” now, such as how to use innovation to drive low-carbon

development. We need to escape the middle-income trap and ensure sustainable social and economic growth, but do this in a green and low-carbon way. What policy methods will realise this? In the past we focused on researching why we should do this. Now the question is how? How to start? This is particularly important for China just now.

China submitted its INDC earlier this year, with the goal of CO₂ emissions peaking around 2030. This is an ambitious emission reduction target, which should be used to guide domestic economic growth and transition, with innovation driving that process. We need a win-win situation, both responding to climate change and promoting economic growth.

The 13th FYP aims, given the economy's "new normal" of slower growth, to encourage a change in the mode of economic growth and strengthen the building of an ecological civilisation. This is at one with the aim of responding to climate change. I think the 13th FYP will help us implement our climate change strategy.

Opportunities for the world

At an unprecedented and unanticipated pace, China is emerging as the dominant player in the world's low-carbon economy. There are many potential opportunities for countries whose political and business leaders are aligned and alert.

Some aspects of low-carbon development are technology- and capital-intensive -- and here China still needs foreign technology and investment. Other domains are knowledge-intensive or present opportunities for sharing policy learning or demand-led successes. As an example, China's ETS pilots have received technical assistance from several European countries. Experience in national and European carbon trading schemes have immense value both for Chinese policymakers and the companies involved.

Other opportunities may be found in pollution prevention and control. Over the next five years, China plans to invest 1.7 trillion yuan (around £175 billion, or \$266 billion) in environmental protection, aiming to reduce air pollution by 25% by 2017³⁷. Foreign expertise in “clean-tech” industries including, for example, waste management and green-building techniques, could be of value in China's growing low-carbon market.

Shortly before the British Chancellor of the Exchequer George Osborne visited China this year, the official newspaper *China Daily* published an article³⁸ opening with the statement that “China's move to a low carbon future will provide opportunities for companies in the United Kingdom.” It noted that China's energy transformation “... will require energy efficient

37. <http://www.reuters.com/article/2013/07/25/us-china-pollution-idUSBRE96O01Z20130725>

38. http://usa.chinadaily.com.cn/business/2015-08/25/content_21697979.htm

technology, products and solutions - and that is where the UK comes into the equation... the UK has developed a thriving "clean-tech" industry, which can help China solve its pollution problems and trigger a period of sustainable growth.

“Many industries that the Chinese government has placed a great emphasis on include renewable energy, green building techniques, manufacturing, and water and waste management. UK companies have excelled in these sectors. “Such an article in an officially sanctioned publication is, effectively, an invitation to bid, and presents opportunities for other advanced economies. Rather than viewing China’s progress in narrow terms – as a clean energy “race”, for example – it is time to view the transition underway as a potentially transformative force.

Conclusion

China is moving towards a low-carbon future with unexpected speed and remarkable breadth of vision. Its manufacturing companies already lead the world in market volume for products such as wind turbines and solar panels. Increasingly, those products will both provide power for China itself and for the rest of the world. At the same time, it is putting tougher constraints on coal-burning than any analysts deemed possible five years ago, driven by the spectre of air pollution and climate change impacts.

These national trends complement a much-changed approach to international climate change negotiations. On climate change and clean energy, the notion of China as a reluctant laggard is definitively out of date. It is keen to do business in the low-carbon marketplace and to secure a diplomatic solution to climate change within the UN system.

About *chinadialogue*

You can follow news, special reports and discussion on China's environmental crisis, water, energy and food security, as well as China's impact on climate change, global environmental and resource security on www.chinadialogue.net, a unique bilingual website where we publish information, opinion and analysis in Chinese and English. Since its launch in 2006, *chinadialogue* has established a reputation for its independence, reliability and even-handedness in its reporting and has attracted over 1.5 million unique visitors.

chinadialogue is a not for profit organisation that promotes communication across barriers of language and culture to inform, to educate, and to build constructive debate on the common challenges of climate change and the global environmental crisis. We believe that good policy and decision-making depends on the sharing of high-quality, accurate information and on well-informed, inclusive discussion.

About Low Carbon Innovation in China

This project, led from Lancaster University, is an international collaboration between researchers in the UK and at leading institutions in China to investigate different models of innovation and their role in low carbon transitions. Running from late 2013 to 2016, the project has compared government-led, high-tech 'indigenous innovation' approaches with emergent, lower-tech approaches in the areas of agriculture, energy and mobility.

The project's aim is explore the extent, nature and social implications of low-carbon transitions in China, a key concern for the whole world. There is a burgeoning literature on low-carbon innovation in China, including from think-tanks, global governance institutions and INGOs. But these reports tend to downplay the social nature of technical change, and thus questions of political change and power.

Research for this project aims to fill this gap in knowledge by offering in-depth academic analysis of several key areas of low-carbon innovation that acknowledges these key issues. It seeks to inform policymakers and stakeholders on opportunities for prospective low-carbon transitions, and optimising their global impact, as well as advancing knowledge of contemporary low-carbon innovation in China and beyond.

There is a clear project focus on impact, communications and engagement, strengthened through collaboration with the STEPS Centre ICE Unit and chinadialogue.net. The project is funded by the Economic and Social Research Council (ESRC) and is an affiliate project of the STEPS Centre.

About the Energy and Climate Intelligence Unit

The Energy and Climate Intelligence Unit is a non-profit organisation that supports informed debate on energy and climate change issues in the UK.

Climate change presents important challenges and opportunities to Britons in the decades ahead, while the choices we make on energy have implications for society, the economy and the climate system. ECIU believes that debates on these issues should be underpinned by evidence, and involve the full range of stakeholders.

ECIU supports journalists and other communicators with accurate and accessible briefings on key issues, and works with individuals and organisations that have interesting stories to tell, helping them connect to the national conversation.

Its Advisory Board reflects the breadth of society's interest in energy and climate issues. It includes climate scientists, energy policy experts and economists, as well as a range of other stakeholders including MPs and Peers. All of its funding comes from philanthropic foundations.