CHINA'S TRANSITION TO SUSTAINABLE AND RENEWABLE ENERGY

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Executive Summary

1. Green development in China has a multidimensional aspect which addresses issues in respect of sustainable development and ecological civilisation. China's green development sectors include chiefly three major industries, namely energy-saving and new energy, environmental protection and resource recycling.

2. China has announced the *Plan for the Green Development of Industrial Sectors in the 14th Five-Year Plan (FYP) period (2021-2025), Plan for Energy Saving and Emission Cutting Work* and *Plan for Modern Energy System* to push ahead with the country's pursuit of low-carbon growth in recent years.

3. China aims to lower its carbon intensity by 18% and attain a 13.5% reduction in energy intensity by 2025, cutting major pollutants such as chemical oxygen demand and nitrogen oxide by at least 8% and 10%.

4. The two plans promote high-end manufacturing, energy consumption with low carbon emissions, recycling of resources, reduction of industrial pollution, green consumption and digitalisation of manufacturing process. More specifically, renewable energy, electric vehicles, and treatment of waste and pollution are expected to receive strong policy support in the following few years.

5. At the United Nations climate summit of COP26, China formalised its commitment to raise the share of non-fossil fuels in its primary energy consumption to 25% by 2030, higher than the previous pledge of 20%.

6. Non-fossil fuels including hydro, nuclear, wind and solar power with fast growth in both production and consumption play an important role in alleviating China's energy shortage and achieving green development targets.

7. China is a leader in global renewable power generation and related equipment manufacturing; its share in global wind turbine production and solar panel manufacturing registers 45% and 72%, respectively.

8. After the 2008 global financial crisis, the gravity of solar PV production shifted from the United States, to consecutively Japan, Europe and Asia, especially China, which quadrupled its polysilicon solar panel manufacturing capacity between 2009 and 2011.

9. China has been promoting production and sales of new energy vehicles (NEVs), mainly electric vehicles (EVs), to reduce urban air pollution, greenhouse gas emissions and dependence on oil imports since the end of the 2000s. It is now the largest manufacturer and buyer of EVs worldwide and is making efforts to hit 20% market penetration for NEVs by 2025.

10. China is also promoting the research and development of hydrogen fuel technology; it has shown keen interest in deploying hydrogen fuel cell technologies in its manufacturing process as evidenced by their inclusion in the 13th Five-Year Plan (FYP) and ‘Made in China 2025’ since the mid-2010s.

11. The 13th FYP highlighted many pilot projects related to environmental protection including resource recycling, pollution management and zero-waste cities while the 14th FYP emphasised carbon emission control related to climate change.

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CHEN Gang & KONG Tuan Yuen*

Development of New Energy and Environmental Sectors

1.1 In China, green development is a vaguely defined concept that has a multidimensional aspect that addresses issues associated with the notions of sustainable development and ecological civilisation.[1] According to top Chinese planners, green development sectors include at least three major industries, namely energy-saving and new energy, environmental protection and resource recycling.[2] China's focus is on the rapidly growing new energy industry due to its relevance to China's carbon neutral pledge proposed by Xi Jinping in 2020; waste and pollution treatment continues to be an important environmental industry in China.

1.2 As early as in 2010, China's National Development and Reform Commission (NDRC) drafted the first development plan for the energy-saving and environmental protection industries.[3] China's plans to boost the environment industry as a strategic pillar industry serve the dual goal of cleaning up and finding new growth point for its economy.

1.3 According to the Ministry of Industry and Information Technology, the output of China's energy-saving and environmental protection industries reached RMB7.5 trillion by the end of 2020. In December 2021 and January 2022, China respectively released a *Plan for the Green Development of Industrial Sectors in the 14th Five-*

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1 The ruling Chinese Communist Party included the notion of "ecological civilisation" in its political report for the first time at its 17th Party Congress in 2007.

2 Chen Gang, "China's Ambitious Low Carbon Plans Making Progress", *EAI Background Brief*, No. 560, September 2010.

3 Ibid.

Year Plan (FYP) period (2021-2025)[4], *Plan for Energy Saving and Emission Cutting Work* and *Plan for Modern Energy System* (Appendix 1) to push ahead with the country's pursuit of low-carbon growth.

1.4 China aims to lower its carbon intensity (carbon dioxide [CO_2] emissions per unit of value-added output) by 18% and attain a 13.5% reduction in energy intensity (energy consumption per unit of value-added output) by 2025, as well as reduce major pollutants like COD (chemical oxygen demand) and nitrogen oxide (NOx) by at least 8% and 10%, respectively. The intensity of major pollutant emissions in key industrial sectors, which include sulphur dioxide (SO_2) and COD, will be reduced by 10%. A green manufacturing system for key sectors and regions will be basically established by 2025, with the market value for green and eco-friendly industries reaching RMB11 trillion (about US$1.73 trillion).

1.5 The two plans highlight the transformation of the industrial structure towards high-end manufacturing, energy consumption with low carbon emissions, recycling of resources, reduction of industrial pollution, green consumption and digitalisation of manufacturing process. Among these sectors, renewable energy development, electric vehicles, hydrogen energy and treatment of waste and pollution are expected to receive strong policy support in the following years.

A Rise in Renewable Energy Sectors

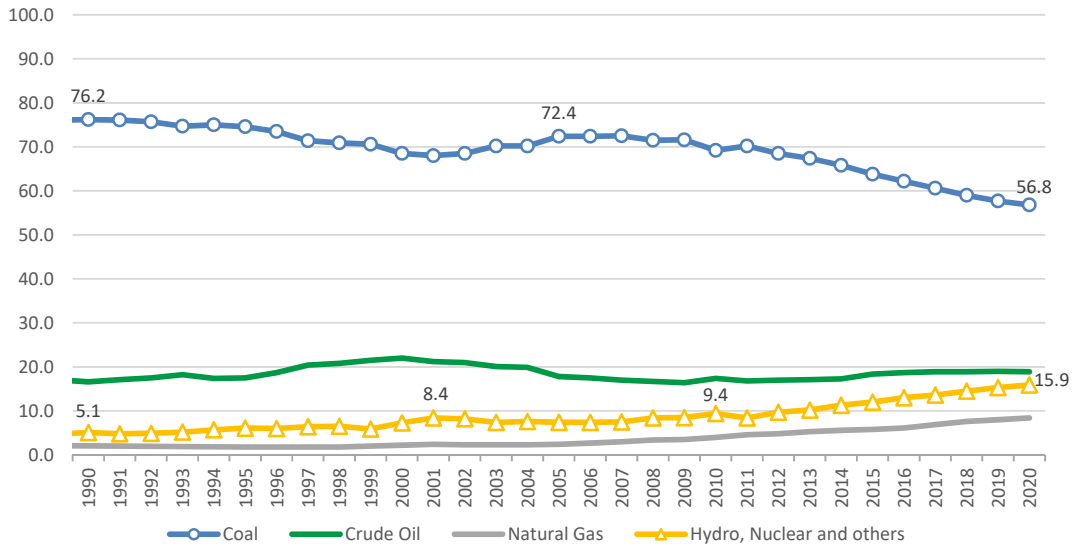
2.1 At the United Nations climate summit (the 26th of Conference of the Parties, COP26) in Glasgow, China formalised its commitment to raise the share of non-fossil fuels in its primary energy consumption to 25% by 2030, higher than the previous pledge of 20%. The Chinese central government's renewable energy ambition has been motivated by not only its concerns over energy shortage, but also mitigation imperatives in climate change and smog pollution.

[4] "Full text of China's Green Development of Its Industrial Sectors during the 14th FYP Period (2021-2025)", (Shisiwu gongyelusefazhan guihua quanwen), https://www.h2o-china.com/news/330325.html, accessed 8 January 2022.

2.2 To promote the production of low-carbon alternatives, the Chinese government has been adopting supportive policies with variation in targeted growth scopes in mid- and long-term plans. In the long run, these policies are set to profoundly change the existing structure of the electricity generation market and the country's energy mix overwhelmed by coal burning.

2.3 Non-fossil fuels including hydro, nuclear, wind and solar power witnessed a fast growth in both production and consumption in more than two decades, playing an important role in alleviating China's energy shortage and achieving green development targets. From 1990 to 2020, the proportion of the aforementioned non-fossil fuels in China's total energy consumption rose from 5.1% to 15.9% while the proportion of coal consumption dropped from 76.2% to 56.8% (Figure 1). A paradigm shift has apparently been taking place every decade since. The proportion of non-fossil fuels remained roughly at 5% from 1990 to 2000 before increasing to around 8% since 2001 and maintaining at the same level until 2011. In the last decade, it surged from 9% to 16%.

FIGURE 1 CHINA'S ENERGY CONSUMPTION (1990-2020)

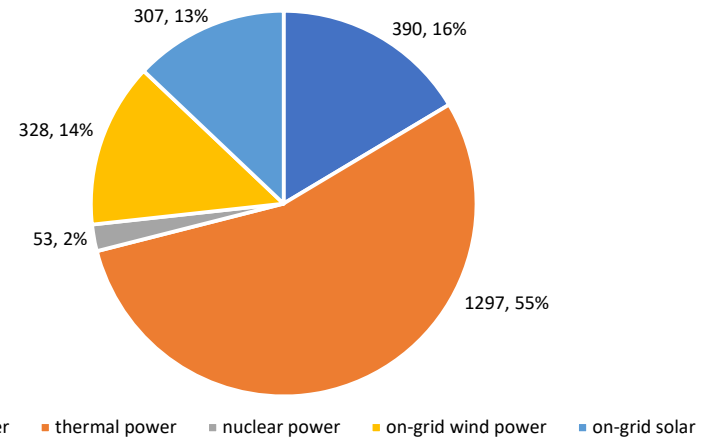


Source: CEIC Data.

2.4 Meanwhile, the shares of wind and solar in total installed capacity have witnessed substantial increase, mainly at the cost of thermal power and hydropower. At the end of 2012, China's installed capacity of on-grid wind power reached 60.8 gigawatts (GW) or only 5% of total, while solar power was merely 3.3 GW, or 0.3%

of total.[5] Five years thereafter, at the end of 2017, China's on-grid wind power capacity reached 163.7 GW, or 9% of total, and solar power surged 130.3 GW, about 8% of total installed capacity.[6] By end 2021, China's on-grid wind power capacity reached 328 GW, making up 14% of total and solar at 307 GW, or about 13% of total (Figure 2).[7]

FIGURE 2 EXISTING INSTALLED CAPACITY OF VARIOUS ELECTRICITY SECTORS IN CHINA, 2021 (in GW and %)



Source: National Energy Administration of China (2022).

2.5 China has gradually taken the lead in developing renewable energy and related manufacturing business. It is a leader in global renewable power generation and related equipment manufacturing, with its share in global wind turbine production and solar panel manufacturing registering 45% and 72%, respectively.[8] From 2010 to 2020, China's installed wind capacity increased nine times, from 31 GW to 280 GW, while from 2015 to 2020, solar expanded six times, from 42 GW to 250 GW.[9]

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[5] China Electricity Council, "Statistical Brief on China's Electricity Industry in 2012" (2012nian woguo dianli gongye gaikuang), 2013, http://www.cec.org.cn/yaowenkuaidi/2013-02-22/97555.html, accessed 10 April 2020.

[6] China Electricity Council (2018), "China's Installed Power Capacity Increases 7.6 Per cent in 2017" (2017 quanguo fadian zhuangji rongliang zengzhang 7.6%), 2018, http://www.cec.org.cn/nengyuanyudianlitongji/hangyetongji/dianlixingyeshuju/2018-03-02/178238.html, accessed 10 April 2020.

[7] http://www.nea.gov.cn/2022-01/26/c_1310441589.htm, accessed 4 March 2022.

[8] "China Can Benefit from a More Ambitious 2030 Solar and Wind Target", China Dialogue, https://chinadialogue.net/en/energy/china-can-benefit-from-a-more-ambitious-2030-solar-and-wind-target/#, accessed 4 January 2021.

[9] Ibid.

2.6 The costs for solar and wind have dropped markedly since 2010 and the downward trend is expected to continue in the near future (Table 1). Compared with the levelised cost of electricity from renewable energy in 2010, the cost of Solar Photovoltaics (PV), Concentrated Solar Power, both Onshore and Offshore Wind have reduced by at least more than half in 2020 while Bioenergy and Geothermal have gradually increased.

TABLE 1 LEVELISED COST OF ELECTRICITY FROM RENEWABLE ENERGY

	Levelised Cost of Electricity from Renewable Energy (2020 US$/kWh)		
	2010	2020	% Change
Bioenergy	0.076	0.076	0%
Geothermal	0.049	0.071	45%
Hydropower	0.038	0.057	18%
Solar Photovoltaics	0.381	0.057	-85%
Concentrated Solar Power	0.340	0.108	-68%
Onshore Wind	0.089	0.039	-56%
Offshore Wind	0.162	0.084	-48%

Source: *Renewable Power Generation Costs in 2020*, International Renewable Energy Agency.

2.7 With these trends, it is likely that China will continue replacing coal-fired power plants with renewable energy projects on a large scale. The Belt and Road Initiative (BRI) encourages Chinese enterprises to install renewable energy facilities in the developing world. China is expected to spend more lavishly on the research and development (R&D) of clean energy and other green technologies in the future. The country's carbon neutrality plan is estimated to require some US$15 trillion in investment over the coming 30 years.

2.8 China's wind turbine industry, a new growth point that is immune to global economic downturn, has witnessed galloping expansion since 2008. As the world's largest wind turbine manufacturing base, China takes up seven spots among the world's top 10 wind turbine manufacturers. The growth of China's wind turbine manufacturers can be attributed to the country's strong growth in wind power capacity.

2.9 Chinese manufacturers that made the list include Goldwind (2nd), Envision (4th), Mingyang (6th), Shanghai Electric (7th), Windey (8th), CRRC (9th) and Sany

(10th).[10] The costs of operating and maintaining wind farms dropped significantly due to increased competition among contractors and improved turbine performance. The domestic manufacturing boom has justified the government's approach to promote inland wind-generated power, which became gradually cost-competitive vis-à-vis conventional power and requiring lesser subsidies on a per kilowatt-hour basis.

2.10 Due to the inconvenient location of most hinterland wind and solar power plants, China is making a big bet on offshore wind power projects that are at the doorsteps of its coastal industrial bases. The 12th five-year special plan for wind power technology development formulated by the Ministry of Science and Technology included the R&D of key technologies of high power wind turbines, such as '10 megawatt (MW) wind turbine overall design technology', '3–5 MW permanent magnet direct drive (PMDD) wind turbine industrialisation technology' and '7 MW-class wind turbine development and industrialisation technology'.[11]

2.11 China is now capable of designing and manufacturing large-scale offshore wind turbines, and has completed the hoisting and trial operation for 6 MW offshore wind turbines. Nevertheless, as compared to onshore wind power, the development of offshore wind power is still facing difficulties in building power transmission, harnessing offshore harsh natural environments, and fulfilling multi-sectoral coordination and management.

2.12 In the production of solar equipment, China is the dominant player; about 80% of the world's solar manufacturing supply chain runs through China.[12] Some 97% of the world's silicon wafers are produced in China.[13] China exports wafers that are

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[10] https://www.evwind.es/2021/03/13/china-takes-up-7-spots-among-the-worlds-top-10-wind-turbine-manufacturers-for-wind-power/79787, accessed 8 January 2022.

[11] Wu, J, Wang, Z and Wang, G, "The Key Technologies and Development of Offshore Wind Farm in China", *Renewable and Sustainable Energy Reviews*, No. 34, 2014, pp. 454-455.

[12] https://www.marketplace.org/2021/07/07/china-dominates-solar-energy-industry-can-us-catch-up/, accessed 8 January 2022.

[13] The supply chain for solar panels starts with the refining of high-purity polycrystalline silicon (polysilicon). Polysilicon is melted to produce monocrystalline silicon ingots, which are sliced into thin silicon wafers. Silicon wafers are processed to make the solar cells that are interconnected and sandwiched between glass and plastic sheets to make crystalline silicon modules. https://www.energy.gov/sites/default/files/2022-02/Solar%20Energy%20Supply%20Chain%20Report%20-%20Final.pdf, accessed 4 March 2022.

used to make solar cells. About 75% of the silicon solar cells incorporated into modules installed in the United States are made by Chinese subsidiaries in Vietnam, Malaysia and Thailand.[14]

2.13 After the global financial crisis of 2008, the gravity of solar PV production shifted from the United States, to Japan, and later to Europe and to Asia, especially China, which quadrupled its polysilicon solar panel manufacturing capacity between 2009 and 2011. China's swelling production capacity has brought down the international price of solar panels by more than 80%.

2.14 On the other hand, to alleviate this overcapacity problem, the Chinese government has redirected energy subsidies in favour of PV power generation in order to form a sizeable domestic renewable power market to absorb oversupply in the event of overseas boycott as witnessed in recent years. The government subsidy for hardware, installation and soft cost has been instrumental to China producing the second cheapest installed cost of solar photovoltaics, just nearly one third of Russia's and Japan's, and half of the United States.[15] In the 14th FYP period, China could increase annual installations of solar power generation capacity to as much as 85 GW,[15] about double the country's current rate and more than two-thirds of all global solar capacity (115 GW) installed in 2019.

Largest Manufacturer and Buyer of New Energy Vehicles

3.1 New energy vehicles (NEVs) in China include battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), hydrogen fuel cell electric vehicles (FCEVs) and other vehicles driven by non-traditional fuels. China has been promoting the production and sales of NEVs, with electric vehicles (EVs) constituting the majority, to reduce urban air pollution, greenhouse gas emissions and dependence on oil imports.

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[14] Ibid.

[15] https://www.powermag.com/solar-takes-lead-role-in-latest-china-five-year-plan/, accessed 21 January 2022.

3.2 As buying an EV cost more than buying a conventional internal combustion engine (ICE) vehicle, in 2009 the government began to provide subsidies generously for EV purchases. Since the price differences and number of buyers were both large, paying for the subsidies became a financial burden for the government. China's policymakers have thus planned to gradually phase out the subsidies and instead imposed a mandate on car manufacturers to sell a certain percentage of battery-powered vehicles for each year.

3.3 China will cut subsidies on NEVs by 30% in 2022 and withdraw them altogether at the end of the year, according to the Finance Ministry.[16] The producers of EV need to earn a stipulated number of points based on its range, energy efficiency and performance. The requirements are getting tougher over time for EVs to make up 40% of all car sales by 2030.[17]

3.4 China is the largest manufacturer and buyer of EVs worldwide. It is now a major EV exporter in the world, registering sales of over 1.36 million vehicles shipped overseas in the first three quarters of 2021, a year-on-year increase of around 120%.[18] China has become a major producer of US Tesla models for global markets and exported over 100,000 vehicles during the period. Leading Chinese EV manufacturers include BYD, SAIC Motor Corp, Nio and Xpeng, all of which have entered the European markets.

3.5 Meanwhile, the Chinese market is also growing fast, making China the major growth factor for plug-in EVs globally. Sales of EV and plug-in hybrid vehicles in China more than doubled to 2.99 million units in 2021, accounting for 15% of total passenger car sales.[19]

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16 "Renewable Power Generation Costs in 2020", International Renewable Energy Agency.

17 https://news.mit.edu/2021/chinas-transition-electric-vehicles-0429, accessed 11 January 2022.

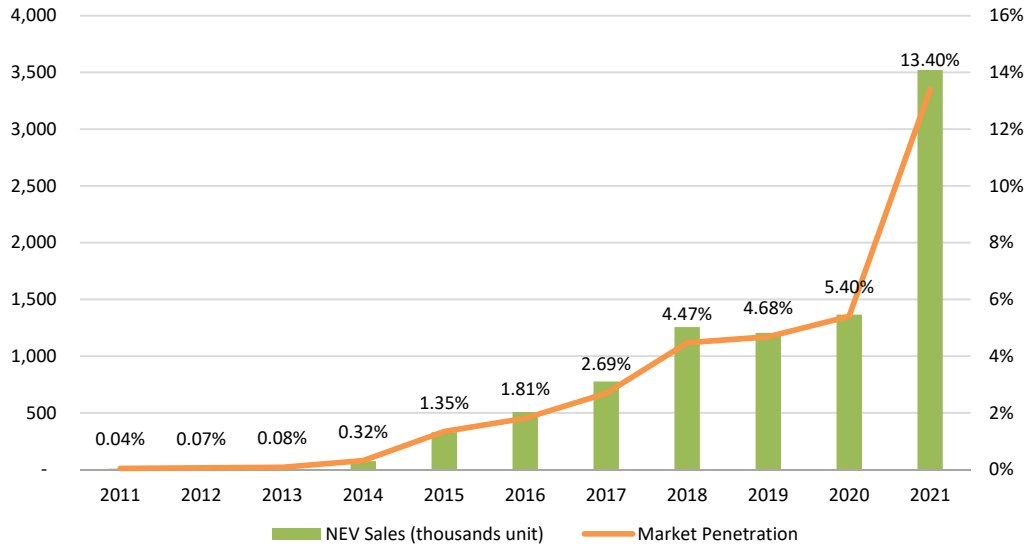
18 https://www.chinadaily.com.cn/a/202110/26/WS61775cd4a310cdd39bc714ae.html#, accessed 17 January 2022.

19 https://texasnewstoday.com/electric-vehicles-drive-growth-in-car-sales-in-china/601359/, accessed 11 January 2022.

3.6 In October 2020, the State Council released *China's New Energy Vehicle Industrial Development Plan for 2021 to 2035*,[20] which set a target for NEVs to make up 20% of auto sales by 2025. The target, however, is lower than the 25% goal mentioned in a policy proposal published by China's Ministry of Industry and Information Technology in 2019. The Plan aimed to form a globally competitive auto industry with advanced NEV technologies and good brand reputation, build up convenient charging service networks with battery electric vehicles as the mainstream in sales, and improve national energy security and air quality, mitigate climate change, and stimulate economic growth in the automobile, energy, transportation, and information and communications industries.

3.7 The sales volume of China's new energy vehicle has hit over one million units per year since 2018 and 3.5 million units in 2021. The market penetration of China's NEVs has tremendously increased from 5% in 2020 to 13% in 2021 (Figure 3); however, more efforts are needed to hit the target of China's *New Energy Vehicle Industrial Development Plan.*

FIGURE 3 SALES OF CHINA'S NEW ENERGY VEHICLES



Source: Compiled from China Association of Automobile Manufacturers, http://caam.org.cn/tjsj, accessed 10 March 2022.

[20] http://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm, accessed 20 January 2022.

Deploying Hydrogen Fuel Cell Technologies in the Manufacturing Process

4.1 The Chinese government pays intensive attention to the R&D of hydrogen fuel technology, a nascent sector, as a means of transporting, carrying and storing clean energy. China has shown its ambition in deploying hydrogen fuel cell technologies in its manufacturing process, which was included in the 13th Five-Year Plan (FYP) and 'Made in China 2025' initiative issued by the State Council in 2015.

4.2 According to China's guideline on strategic emerging sectors in the 13th FYP, the country planned to promote R&D of fuel cells, step up the building of hydrogen stations and achieve the mass production of FCEVs by 2020.[21] The 'Fuel Cell Technology Roadmap' included in the 13th FYP called for over 1,000 hydrogen refuelling stations to be in operation by 2030, with at least 50% of all hydrogen production coming from renewable resources.

4.3 In addition, the Roadmap set a target of having over one million FCEVs in service by 2030.[22] To overcome the gaps in the country's fuel cell infrastructure, China began to invest heavily in hydrogen fuel cell technology in 2018. The application of hydrogen fuel technology could in the long run make better use of China's enormous yet inefficient renewable energy capacity.

4.4 Hydrogen technology can provide effective solutions to the intermittency problems associated with power generation from renewable energy sources like wind and solar. There are two typical ways to using hydrogen to store energy, both of which involve electrolysis to convert excess electricity into oxygen and hydrogen. The hydrogen is then stored and can either be converted back to electricity, or used directly, for example by pumping it into the natural gas infrastructure or directly using it in FCEVs.[23]

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[21] *China Daily*, "Project Launched to Develop Hydrogen Fuel Cells in E China", 30 August 2018, http://www.chinadaily.com.cn/a/201808/30/WS5b873f25a310add14f3888b1.html, accessed 6 March 2020.

[22] Jackson, C, "Chinese Fuel Cell Industry Developments", Fuel Cell and Hydrogen Energy Association, http://www.fchea.org/in-transition/2019/2/4/chinese-fuel-cell-industry-developments, accessed 9 December 2020.

[23] A Medium Corporation, "China Homes in on Hydrogen", 2018. https://medium.com/@cH2ange/china- homes-in-on-hydrogen-977b37ddcca9, accessed 19 March 2020.

4.5 In the 14th FYP, China has confirmed its support for developing hydrogen and energy storage sectors as part of the "new strategic industries". Notably, provincial governments like Beijing, Shanghai, Shandong, Hebei and Jilin are pushing hard for the hydrogen agenda as various regional development plans for 2021-2025 suggest.[24]

4.6 According to the Beijing municipality's FYP, the city will build 37 hydrogen refuelling stations and have some 3,000 hydrogen fuel cell vehicles on the road by 2023. The total number of such cars in the city is expected to exceed 10,000 by 2025.[25] Shuttle buses running on hydrogen fuel cell were also used during the Beijing Winter Olympics to transport visitors and staff.

4.7 According to the Hydrogen Industrial Technology Innovation Alliance of China, by 2050, China's demand for hydrogen gas may reach approximately 60 million tonnes. Hydrogen energy will account for over 10% of China's energy system and the output value of relevant industrial chains will reach RMB12 trillion annually.

The Transformation to Zero-waste and Low Carbon

5.1 The traditional environmental protection industry excludes low-carbon sectors related to climate change and only covers such resource recycling and pollution management sectors as sewage, cement and garbage treatment, desulphurisation and denitration, and clean production. It comprises goods and services, which are clearly supplied for an environmental purpose, that have a significant impact on reducing polluting emissions and are easily identifiable statistically. In practice, this covers environmental protection services and clean products used specifically for environmental purposes.

5.2 China has been promoting pilot projects that aim to transform urban areas into "zero-waste cities", which can minimise solid waste generation and maximise waste recycling in urban areas. In the "zero-waste city" project in Shenzhen, Guangdong

[24] https://energyiceberg.com/hydrogen-14th-fyp-provincial-strategy/, accessed 20 January 2022.

[25] http://www.china.org.cn/business/2021-08/17/content_77698504.htm, accessed 20 January 2022.

province, the refuse disposal plant can handle more than 500 tonnes of household garbage daily and reduce carbon emissions by about 300 tonnes per day. The electricity generated by garbage incineration can sustain 400 households for a month, thus truly turning "waste" into electricity.[26]

5.3 According to the Plan for the Green Development of Industrial Sectors in the 14th FYP period (2021-2025), recycling of scrap steel, scrap paper and scrap non-ferrous metal will reach a respective 320 million tonnes, 60 million tonnes and 20 million tonnes by 2025, among which recycled copper, aluminium and lead will reach 4 million, 11.5 million and 2.9 million tonnes respectively. A total of 50 recycling bases of industrial resources will be built in the country.

5.4 On water recycling and pollution control, the major task includes the increase of capacity in urban sewage treatment, reduction of major water pollutants like COD and provision of clean drinking water, both in cities and rural areas. According to the 14th FYP, China will increase its daily sewage treatment capacity by 20 million cubic metres and by 2025, the collection rate of urban residential sewage will reach 70%.[27] About 95% of sewage in all counties and more than 90% of urban sludge are to be treated by 2025.

5.5 Since China started the marketisation of its sewage and water treatment sectors in 2001, foreign and private investments in these sectors have been growing very rapidly; however, state-owned entities continue to dominate the market. Despite the government's emphasis on municipal sewage treatment, the fastest growing demand for wastewater treatment now comes from industrial production in pulp and paper mills, paint factories and food processing plants.

5.6 In the area of wastewater treatment, China needs biological denitrification and phosphorus removal technology, membrane separation and manufacturing technologies and equipment, manufacturing technology of anaerobic biological

[26] https://news.cgtn.com/news/2021-12-30/China-sees-signifcant-progress-in-building-zero-waste-cities--16pJTEqDODu/index.html, accessed 12 January 2022.

[27] https://www.ndrc.gov.cn/xxgk/zcfb/ghwb/202106/P020210615582348125286.pdf, accessed 12 January 2022.

reactors, and high-concentration organic wastewater treatment technology and equipment.

5.7 Between 1990 and 2020, the amount of garbage being disposed annually in China had soared from 67.67 million tonnes to around 235 million tonnes.[28] As the country wages war on the mounting trash, many Chinese cities have implemented compulsory waste sorting in the past few years. Since 1 July 2019, over 24 million permanent residents in Shanghai could no longer dump their rubbish into the nearest dustbin they could find. Instead, they were required to sort garbage into four separate bins labelled "recyclable garbage", "hazardous garbage", "wet garbage" and "dry garbage" at a designated time and place as a new set of regulations on household garbage sorting and recycling came into force.

5.8 This practice is now adopted by more and more cities across the country. According to China's Ministry of Housing and Urban-Rural Development, the garbage sorting systems shall be established in all 300 cities at the prefecture-level and above across the country by 2025.[29] Despite the push for this system, China's urban residential garbage recycling and reuse rate is still as low as 50%, and about half of Chinese cities still do not have garbage incineration facilities.[30]

5.9 According to China's 14th FYP on Urban Trash Sorting and Disposal, urban residential garbage recycling and reuse rate should reach about 60% by 2025 and urban residential garbage sorting and transportation capacity to attain 700,000 tonnes per day, 65% of which is to be disposed through incineration (daily incineration capacity to reach 800,000 tonnes).[31] In particular, the volume of disposed living waste through incineration had increased 30 times from less than 5 million tonnes in 2003 to 146 million tonnes in 2020 (Figure 4).

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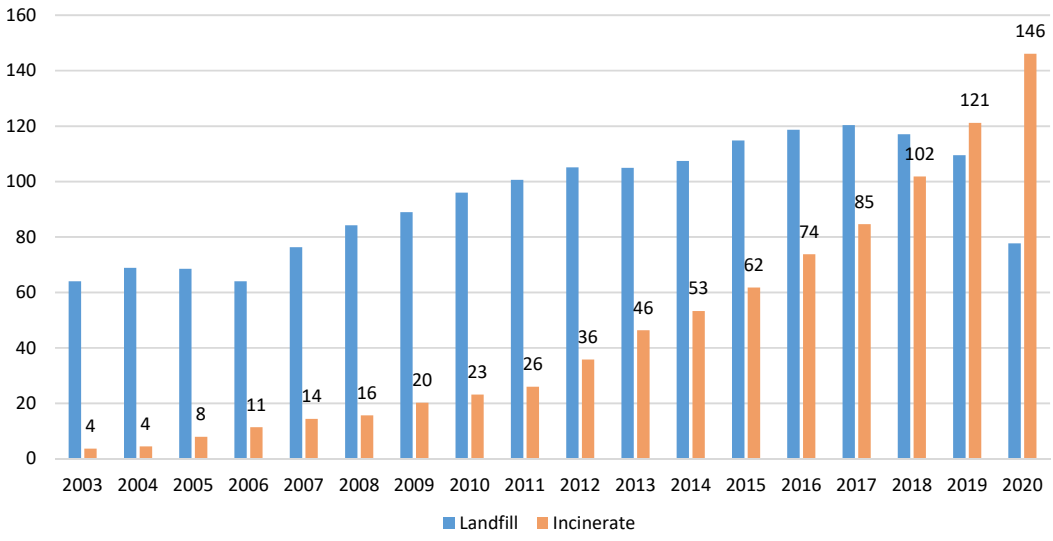
[28] https://www.statista.com/statistics/279117/amount-of-disposed-garbage-in-china/, accessed 12 January 2022.

[29] https://news.cgtn.com/news/2019-12-12/Explainer-China-wastes-no-time-in-waste-sorting-MmLjlsvvP2/index.html, accessed 13 January 2022.

[30] China's 14th FYP on Urban Trash Sorting and Disposal, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202105/P020210513624038179527.pdf, accessed 13 January 2022.

[31] Ibid.

FIGURE 4 VOLUME OF DISPOSED LIVING WASTE (million tonnes)



Source: CEIC data.

5.10 Most importantly, the incineration has surpassed landfills to become the major treatment for disposed living waste since 2019; waste treatment by landfills has continuously dropped from 120 million tonnes to less than 80 million tonnes, an indication that China has successfully implemented the sustainable treatment of disposed living waste.

5.11 China also aims to reduce NOx emissions, one of the major industrial pollution emissions, by 10% between 2021 and 2025. The Ministry of Environmental Protection has required thermal power units of key areas to be installed with denitration devices since 2009. About 90% of thermal power plants have completed low-emissions transformation, and the government is now focusing on such low-emissions transformation of steel and cement.

5.12 Besides NOx, China's air pollution control also targets SO_2, PM 2.5 and increasingly CO_2 and other greenhouse gases. China's SO_2 emissions peaked in 2005 before experiencing an 80% decline by end 2019, while emissions of PM 2.5 particles and NOx were reduced by 50% and 20-30% from the peak respectively.[32] China is the world's largest carbon emitter, accounting for about 28% of global emissions. However, since President Xi Jinping came to power, due to the urgency

[32] http://www.people.com.cn/n1/2020/1023/c32306-31903462.html, accessed 13 January 2022.

of the global climate crisis and China's domestic pollution situation, the country has begun to consider aggressive mitigation commitments and sought cooperation with the United States and other countries.

5.13 At the 2015 Paris climate summit, China pledged to peak its carbon emissions by 2030, and at the United Nations general assembly in September 2020, Xi Jinping pledged to drive down the country's carbon emissions to virtually zero by 2060. Executive Vice Premier Han Zheng, also a Politburo Standing Committee member, was named the head of a small leading group on carbon peak and carbon neutrality, or "Dual Carbon" mission.

5.14 Carbon emission control indexes have become new gauges for local officials' work performances as local governments have been criticised in recent years for blindly approving energy-intensive and high-pollution projects. China's 14th FYP set an 18% reduction target for CO_2 intensity (the amount of carbon dioxide emitted per unit of GDP) and a 13.5% reduction target for energy intensity (energy consumption per unit of GDP) from 2021 to 2025. The 14th FYP is guiding sector-specific and regional plans to reduce carbon emissions at both national and local levels.

5.15 For example, China Baowu, the world's largest steel company, announced its aim to peak CO_2 emission before 2023 and Sinopec, the world's largest oil refiner, has set a target for carbon emissions to peak by 2025.[33] The low-carbon imperative will have a significant impact on almost every part of the supply chain, particularly those that are still dependent on coal-fired power and other forms of fossil fuels. Local factories engaging in mining, steel, petrochemicals and chemicals, transportation, cement and textiles are feeling the pressure from the "Dual Carbon" targets, which could have long-term impacts on local economies, employment, tax revenue and social stability.

[33] https://www.greenbiz.com/article/chinas-5-year-plan-and-its-impact-sustainable-business, accessed 13 January 2022.

APPENDIX 1 MAJOR GREEN DEVELOPMENT POLICIES FOR SECTORS IN CHINA

	Ministry	Title	Released Date
1.	NDRC and NEA	14th Five-Year Plan on Modern Energy System《"十四五"现代能源体系规划》	29 January 2022
2.	The State Council	14th Five-Year Plan on Energy Saving and Emission Cutting Work《"十四五"节能减排综合工作方案》	24 January 2022
3.	MOF, MIIT, MOST and NDRC	Circular on New Energy Vehicles Promotion and Fiscal Subsidy Policies《关于 2022 年新能源汽车推广应用财政补贴政策的通知》	31 December 2021
4.	MIIT	14th Five-Year Plan for the Green Development of Industrial Sectors《"十四五"工业绿色发展规划》	15 November 2021
5.	NDRC, MOHURC and MEE	14th Five-Year Plan on Urban Sewage Treatment and Recycling《"十四五"城镇污水处理及资源化利用发展规划》	11 June 2021
6.	NDRC and MOHURC	14th Five-Year Plan on Urban Trash Sorting and Disposal《"十四五"城镇生活垃圾分类和处理设施发展规划》	13 May 2021
7.	The State Council	Plan for Developing New Energy Vehicle Industry (2021-2035)《新能源汽车产业发展规划（2021—2035 年）》	20 October 2020
8.	MOF	Circular on Budgeting of Additional Funding Relating to Renewable Energy Electricity Tariff Allowances《财政部关于下达可再生能源电价附加补助资金预算 的通知》	17 June 2020
9.	MOF	Circular on Auditing Project Lists of Subsidising Renewable Energy Power Generation《财政部办公厅关于开展可再生能源发电补贴项目清单审核有关工作的通知》	12 March 2020
10.	MOF, NDRC and NEA	Viewpoints on the Promotion of Non-hydro Renewable Energy Power Generation《关于促进非水可再生能源发电健康发展的若干意见》	20 January 2020
11.	NDRC	Circular on Improving On-Grid Electricity Price System for Solar PV Power Generation《国家发展改革委关于完善光伏发电上网电价机制有关问题的通知》	1 July 2019
12.	NDRC	Circular on Promoting Solar PV Industry by Leveraging the Price Mechanism《关于发挥价格杠杆作用促进光伏产业健康发展的通知》	16 August 2013

Note: NDRC: National Development and Reform Commission; NEA: National Energy Administration; MOF: The Ministry of Finance; MIIT: The Ministry of Industry and Information Technology; MOST: The Ministry of Science and Technology; MOHURC: Ministry of Housing and Urban-Rural Construction and MEE: The Ministry of Ecology and Environment.
Source: Authors' compilation from the Chinese official announcement.

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Best regards,
East Asian Institute,
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