Towards Zero Emissions

China's Climate Pathway

and its Implications for the Transport Sector

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Since China's announcement in late 2020 that it would peak its carbon dioxide emissions by 2030 and attain carbon neutrality by 2060, the debate on how to decarbonize the transport sector has been heating up. Given growing demand for passenger and freight transport and rising motorization, the sector will be a hard nut to crack. Various decarbonization technologies are already on the table. Among the most promising solutions for reducing emissions and increasing efficiency is electric transport powered by clean energy. But the path to zero-carbon freight, aviation, and maritime transport will be difficult. In order to align the Chinese transport sector with the country's 2030 and 2060 targets, clear strategies and ambitious measures are needed. This includes not only the adoption of innovative technologies but also an accelerated shift to climate-friendly transport modes and a stronger focus on trip avoidance through holistic urban planning.

At the same time, it must be ensured that sector transformation leaves no one behind and remains socially and economically sustainable. International cooperation, the sharing of expertise, and in-depth dialogue can positively contribute to the sustainable and climate-friendly development of the transport sector – in China and elsewhere.

This paper provides a general description of the role of the transport sector in achieving China's carbon peaking and neutrality goals. In addition, it aims to foster debate on the policies, technologies, measures, and partnerships needed to achieve those objectives. This discussion is not exhaustive, however. It focuses on just a few approaches and measures that can help achieve China's targets.

Background

Over the past few decades, the People's Republic of China (PRC) has undergone a rapid and comprehensive socio-economic transformation. With this transformation have come new industries, cities, and infrastructure, as well as the eradication of absolute poverty [1].

Urbanization has played a key role in China's development. In the past 20 years alone, China's urban population has grown by about 390 million people. By the end of 2019, the country's urbanization level had reached 60.6%. During the same 20-year period, China's gross domestic product (GDP) grew from 1 trillion euros to 13.1 trillion euros.

The draft of China's 14th Five-Year Plan (2021–2025) [2], which was approved during the Two Sessions (两会) [3] in March 2021, sets an urbanization target of 65% for the end of 2025. This means that in the next five years alone another 69 million people will relocate to cities (see Figure 1).

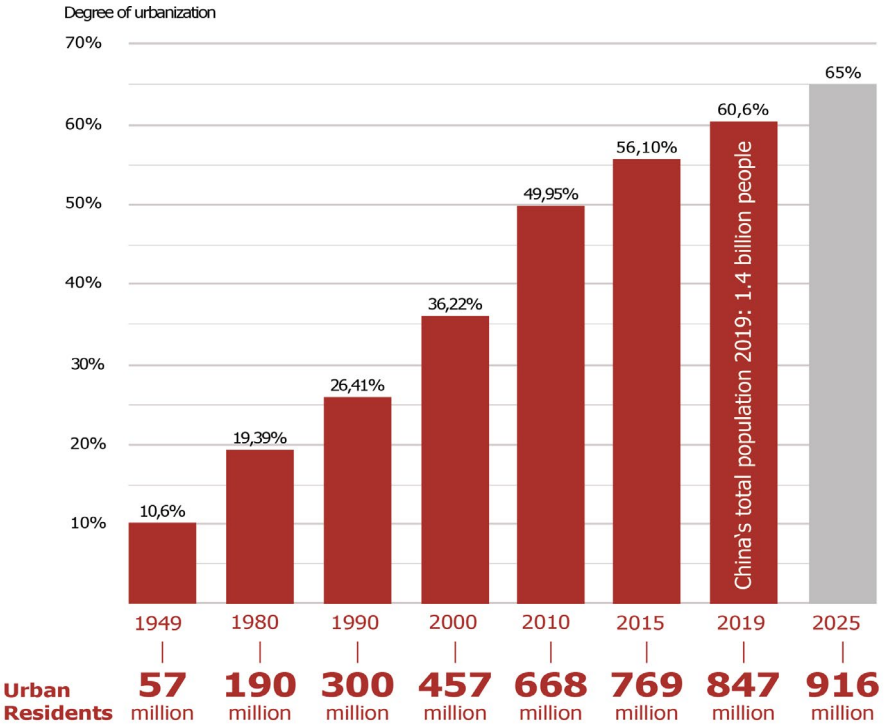


Figure 1. Development of China's urban population

Source: GIZ

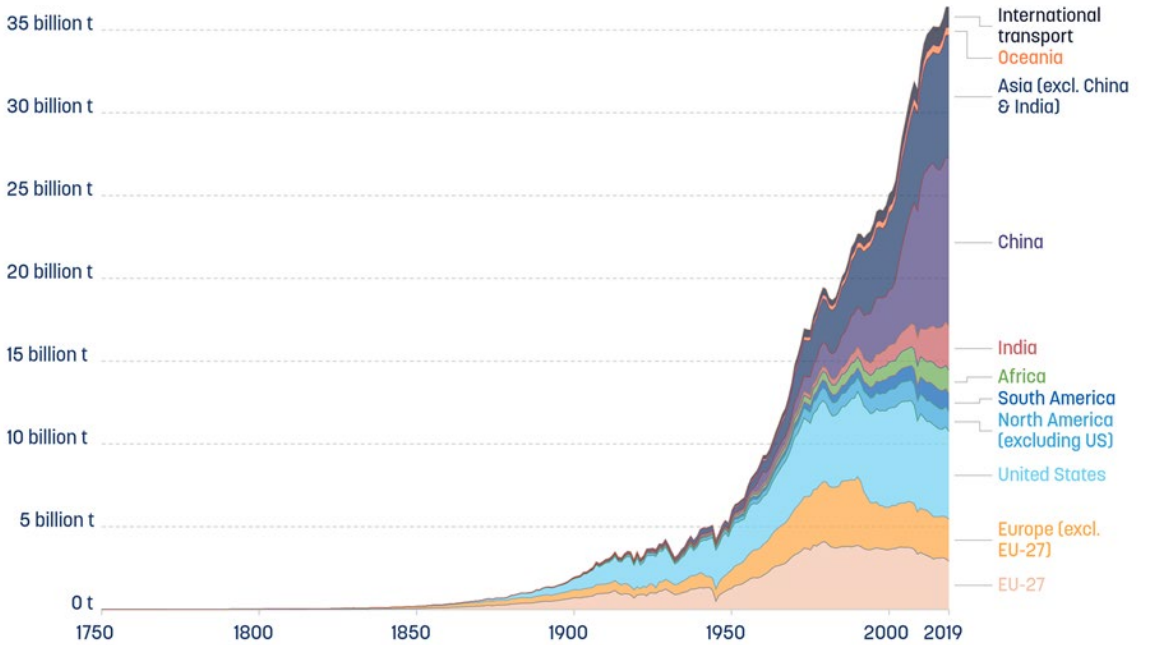
[1] See http://english.www.gov.cn/archive/statistics/202102/26/content_WS603858f0c6d0719374af99ab.html

[2] See the outline of the 14th Five-Year Plan and long-range objectives for 2035.

[3] The "two sessions" refer to the annual plenary sessions of China's National People's Congress NPC and the Chinese People's National Consultative Conference CPPCC.

China's climate pathway

China's economic growth and urbanization have brought environmental problems and high carbon emissions. Today, China is the world's largest emitter of greenhouse gases (GHG). The 10.5 Gt of CO_2 it released in 2018 accounts for about one-third of global emissions (Figure 2)[4]. Climate change is a key challenge for China because a large part of its population is concentrated along the coastline, which is vulnerable to rising sea levels as well as harvest and food insecurity caused by extreme weather. Increasingly, climate risks are pushing China to adopt a sustainable, low-carbon development pathway. The pathway's goal is to build a "Beautiful China"[5] by the middle of the 21st century while also continuing the urbanization process, striking a balance between urban and rural development, and attending to the country's aging population.



Note: This measures CO_2 emissions from fossil fuels and cement production only— land use change is not included. 'Statistical differences' (included in the GCP dataset) are not included here.

Source: Our World in Data based on the Global Carbon Project

Figure 2. Annual total CO_2 emissions, by world region

Source: Our World in Data, based on the Global Carbon Project

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[4] See China Academy of Transportation Sciences (CATS).

[5] The Communist Party of China (CPC) has incorporated the idea of a "Beautiful China" in its "two-stage development plan". In the first stage, from 2020 to 2035, China aims to achieve "socialist modernization". In the second stage, from 2035 to the middle of the 21st century, China aims at building a "great modern socialist country that is prosperous, strong, democratic, culturally advanced, harmonious, and beautiful".

Since its 12th Five-Year Plan (FYP) (2010–2015), China has set a course to green and low-carbon development [6]. The year 2020 represents an important milestone, particularly for the calibration of China's climate protection roadmap (see Figure 3, Step 3). On Tuesday, September 22, 2020, during his speech at the General Debate of the 75th session of the UN General Assembly, Chinese President Xi Jinping announced that China aims to peak its CO_2 emissions before the year 2030 and achieve carbon neutrality by 2060. On December 12, 2020, at the 2020 Climate Ambition Summit, Mr Xi further announced that China will lower its CO_2 emissions per unit of GDP by over 65% from the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 25%, increase the forest stock volume by 6 billion cubic meters relative to the 2005 level, and bring the total installed capacity of wind and solar power to over 1.2 billion kilowatts. These targets go above and beyond China's Nationally Determined Contributions (NDCs), which were submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in June 2015. [7]

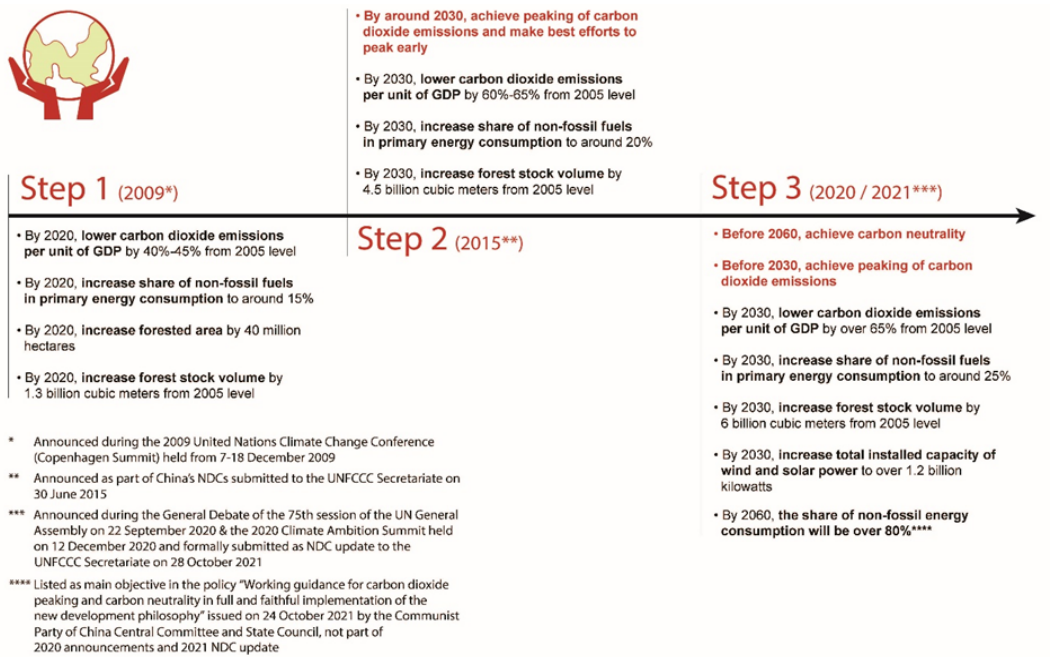

Figure 3. China's climate roadmap (selection)

Source: GIZ

[6] At the Copenhagen Summit in 2009, China put forward a 40%-45% reduction target in CO_2 emissions per unit of GDP by 2020 relative to 2005. In its 12th Five-Year Plan, China pledged a 17% reduction of CO_2 emissions per unit of GDP by 2015 relative to 2010.

[7] In its 2015 NDCs, China pledged to "peak CO_2 emissions around the year 2030 while making best efforts to peak earlier" See https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/China%20First/China's%20First%20NDC%20Submission.pdf

The new 2030 and 2060 goals were submitted as updated NDCs to the UNFCCC on September 28, 2021, three days ahead of the 26th UN Climate Change Conference of Parties (COP26)[8]. While a 2030 peaking target (with best efforts to peak earlier) was already part of China's 2015 NDC to the Paris Agreement, China's September 2020 announcement was its first carbon neutrality target to go public. China joined a group of 137 countries that have now committed to carbon neutrality[9] (Figure 4). Besides its deep impact on the global climate agenda, the announcement has far-reaching consequences for China's domestic policy over the coming decades. For China to meet its target, it will have to phase out conventional coal, oil, and gas by 2060. Doing so will require no less than the complete transformation of the country's socio-economic structure, with deep and ambitious reforms across all sectors.

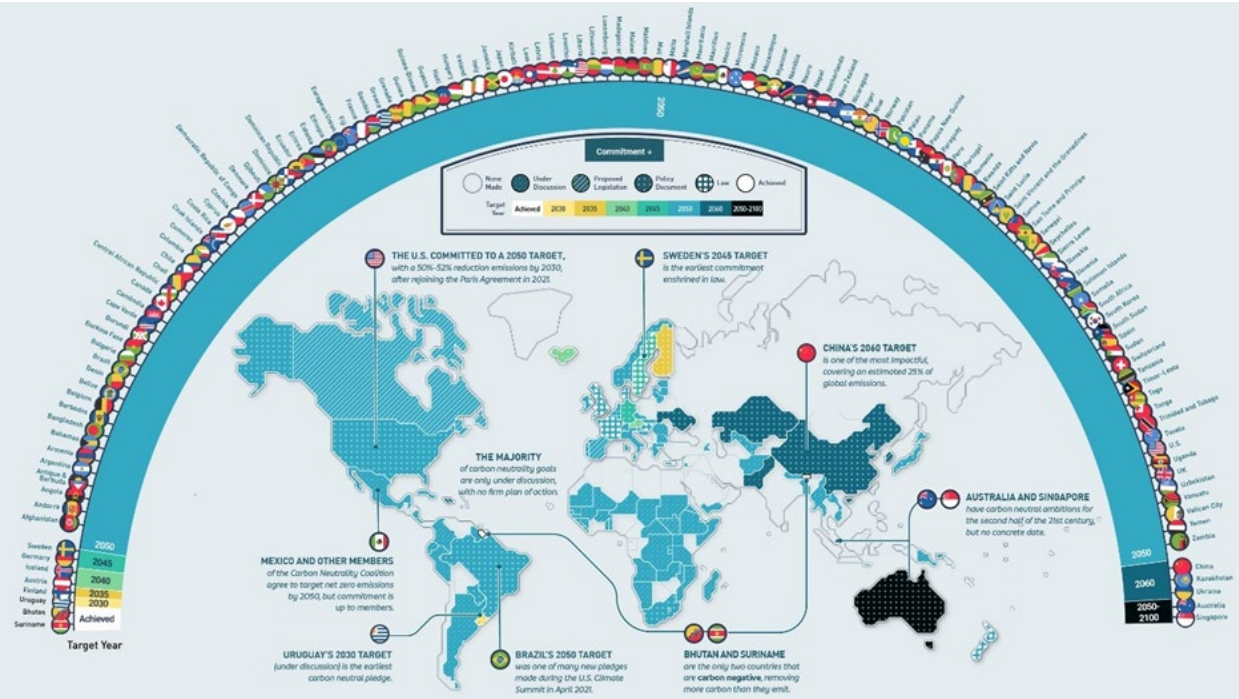

Figure 4. Carbon neutrality goals

Source: Visual Capitalist

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[8] See https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=CHN

[9] https://www.visualcapitalist.com/race-to-net-zero-carbon-neutral-goals-by-country/

Along with the announcement came the first calls for action. On September 27, 2020, the Tsinghua University's Institute of Energy, Environment and Economy, one of China's top climate research institutes, presented a 12.7 trillion euro, 30-year roadmap for ending the use of coal for electricity generation by around 2050, drastically increasing nuclear and renewable power generation, and electrifying 80% of China's energy consumption by 2060 [10].

If China wants to deliver on its pledges to peak CO_2 emissions before 2030 and achieve carbon neutrality by 2060, ambitious and binding goals have to be set in every sector, and effective policies, roadmaps, and measures have to be implemented.

This is particularly true for the 14th FYP (2021–2025) and 15th FYP periods (2026–2030), which are key to steering China's development over the next four decades. The Outline for the 14th Five-Year Plan and the Long-Range Objectives Through 2035 set various targets shaping the climate roadmap, including a binding 18% CO_2 intensity reduction target (CO_2 emissions per unit of GDP), a binding 13.5% energy intensity reduction target (energy consumption per unit of GDP) by 2025, and an increase in the share of non-fossil energy in total energy consumption to 20%. (The last goal was set in 2009. The reported share in 2020 was 15.8%). The outline does not include a specific GDP growth target for 2025 (although a target of over 6% for 2021 was set in the Report on the Work of the Government, presented by Premier Li Keqiang during the Two Sessions [11]). A CO_2 emission cap or coal cap are also not foreseen [12].

In order to align the 2030 and 2060 climate targets with the requirements for China's overall socio-economic development and its individual sectors, the National Development and Reform Commission (NDRC), together with various other ministries and institutions, is currently developing the 1+N Policy System for CO_2 Peaking and Carbon Neutrality (Figure 5). The policy system covers guidance for 2030 CO_2 peaking and 2060 carbon neutrality along with descriptions of the policies and action plans for key areas including energy, industry, transport, and the circular economy.

[10] See https://www.japantimes.co.jp/news/2020/09/29/asia-pacific/science-health-asia-pacific/china-climate-change-road-map-2060/

[11] See http://www.npc.gov.cn/englishnpc/c23934/202103/ed3ca743486b43acabbdce4323466937/files/a54ecbc67f2c4ef78b8fc12c5717e85b.pdf

[12] A detailed briefing by CarbonBrief on what the 14th FYP means for climate change can be found here: https://www.carbonbrief.org/qa-what-does-chinas-14th-five-year-plan-mean-for-climate-change

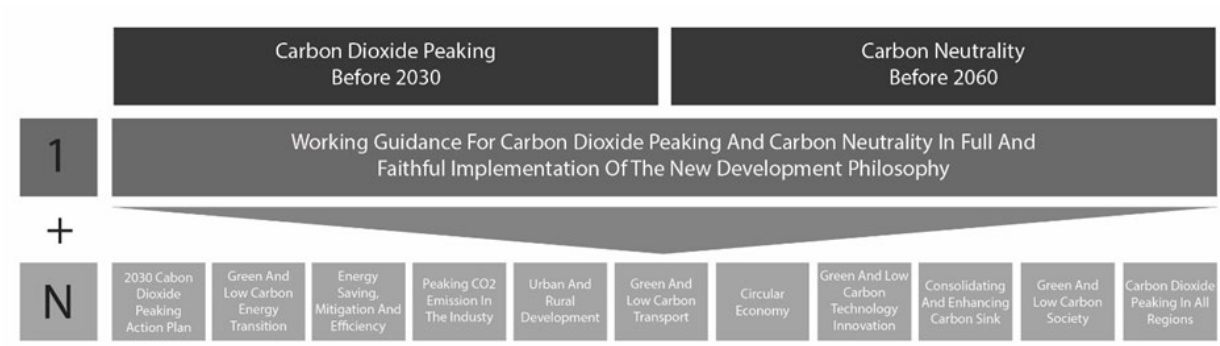

Figure 5. 1+N policy system for CO_2 peaking and carbon neutrality
Source: GIZ

On October 24, 2021, the Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy [13] was released by the Central Committee of the Communist Party of China (CPC) and the State Council of the People's Republic of China. The policy, the first of the 1+N policy system for CO_2 peaking and carbon neutrality, provides high-level guidance for China's national and international development strategy. The policy aims to align China's 2030 and 2060 climate targets with its socio-economic development, individual sector development, technology roadmaps, standards, laws and regulations, policies, and implementation mechanisms.

The Working Guidance policy has the following main objectives:

1. By 2025, in line with the targets outlined in the 14th FYP and the updated NDCs, the aim is to create an initial framework for a green, low-carbon, and circular economy and greatly improve the energy efficiency of key industries, laying a solid foundation for carbon dioxide peaking and carbon neutrality.
2. By 2030, make significant inroads into the comprehensive green transformation of the economy and society, with energy efficiency in key energy-consuming in-dustries reaching advanced international levels as CO_2 emissions peak and then decline.
3. By 2060, achieve carbon neutrality

[13] See https://en.ndrc.gov.cn/policies/202110/t20211024_1300725.html

by establishing a green, low-carbon, and circular economy and a clean, low-carbon, energy system whose efficiency is on par with international levels and whose share of non-fossil energy consumption is over 80%.

The policy requires that the 2030 and 2060 goals be incorporated into the country's medium- and long-term development plans and be balanced with the requirements of the energy sector, industry, supply chain, food security, and "daily life".

Under the guidance of the policy, the State Council of the People's Republic of China on October 26, 2021 created the Action Plan for Carbon Dioxide Peaking before 2030 [14]. Other relevant "N" policies and action plans for key areas (including transport) will be released in the coming months as part of the 1+N policy system.

In order to ensure that the 2030 and 2060 targets align with the requirements for socio-economic development and reinforce overall climate work coordination, China's central government established the Leading Group on Carbon Peaking and Carbon Neutrality, which consists of the leaders of the country's national ministries and agencies [15]. The office of the leading group is part of the NDRC. The first plenary meeting of the group, presided by Vice-Premier Han Zheng, took place on May 26 in Beijing (see Figure 6).

Mr Zheng stressed that efforts should be made to guide and supervise local governments and key areas, industries, and enterprises in setting goals and formulating action plans. He stated that targeted and operable policy measures are needed to optimize China's industrial structure, promote the adjustment of the energy structure, and support the research and development of green and low-carbon technologies. Mr Zheng also highlighted the responsibilities of local authorities and the leading role of state-owned enterprises (SOEs) in achieving

[14] See https://en.ndrc.gov.cn/policies/202110/t20211027_1301020.html

[15] https://www.carbonbrief.org/explainer-china-creates-new-leaders-group-to-help-deliver-its-climate-goals. The meeting was attended by four other top-level officials including Vice-Premier Liu He, State Councilor Wang Yong, State Councilor Wang Yi, and the director of the National Development and Reform Commission NDRC He Lifeng. According to CarbonBrief, Minister of Finance Liu Kun, Minister of Science and Technology Wang Zhigang, Minister of Ecology and Environment Huang Runqiu, governor of China's central bank Yi Gang, China's special envoy for climate Xie Zhenhua, and the director of the National Bureau of Statistics Ning Jizhe participated in the plenary meeting.

the 2030 CO_2 emission peaking goal [16].

The leading group is the top-level coordinating and steering political body overseeing China's climate roadmap development. It makes sure that the 2030 and 2060 targets remain the highest priority for the central government and an integral part of the overall effort to create a "Beautiful China" by mid-century.

China's provinces, autonomous regions, and municipalities have also established their own leading groups on carbon peaking and carbon neutrality to aid the coordination and implementation of the 2030 and 2060 climate targets (e.g., formulating plans to implement provincial carbon emissions control targets and the tasks of controlling GHG emissions).

Furthermore, China has set up a carbon emissions statistical accounting working group, jointly led by the NDRC and the National Bureau of Statistics. The group's purpose is to accelerate the establishment of a standardized carbon emission statistical accounting system and to coordinate its work across different regions and industries [17].

Figure 6. Plenary meeting of the leading group on carbon peaking and carbon neutrality

Source: State Council of the People's Republic of China

[16] See http://english.www.gov.cn/statecouncil/hanzheng/202105/27/content_WS60af990bc6d0df57f98da4d7.html

[17] See https://www.chinadaily.com.cn/a/202108/31/WS612e15eda310efa1bd66c648.html

China's current transport sector development

The transport sector will be instrumental to the achievement of China's 2030 and 2060 goals. China's transport CO_2 emissions have witnessed average annual growth of 5.4%, increasing from 505 million tons in 2005 (8.1% of the country's total CO_2 emissions) to 1.11 billion tons in 2019 (10.7% of the country's total CO_2 emissions). Of those emissions, freight transport accounts for a 65.8% share, and road transport accounts for a share of 76.7% (2019)[18]. Due to increasing motorization[19] and rising passenger and freight transport volumes, the transport sector is likely to be the only sector in China that does not peak its CO_2 emissions by 2030[20]. Accordingly, the policies and measures for decarbonizing the transport sector need to be much more ambitious if China is to achieve its 2060 target. This includes the sustainable steering of future transport demand, the promotion of low-carbon transport modes, and the adoption of low-carbon technologies. At the same time, the holistic transformation of the transport sector must be implemented in a way that is sustainable and that leaves no one behind.

To better understand the future of the transport sector in China, one must first consider its past.

The rapid economic growth and urbanization of the past decades have been accompanied by the large-scale expansion of the country's transport infrastructure and a rapid increase in passenger and freight transport volumes. The number of civilian airports increased from 138 in 2012 to 238 by the end of 2019, and the share of total passenger transport by air increased from 0.8% in 2012 to 3.7% in 2019. By the end of 2019, China's high-speed rail (HSR) network totaled 35,000 km compared with 10,000 km in 2012. The share of HSR in total rail passenger transport rose from 4.5% in 2007 to 65.4% in 2019, while the proportion of total passenger transport by railway increased from 5% in 2012 to 20.8% in 2019. The urban rail passenger volume grew from 8.73 billion trips in 2012 to 23.88 billion trips by the end of 2019, and a total of 40 cities had opened

[18] See China Academy of Transportation Sciences (CATS).

[19] Currently, the motorization rate in China is relatively low (211.8 passenger cars per 1,000 people in 2021). If China were to reach the motorization rate of Germany (about 579 passenger cars per 1,000 people), another 515 million cars would hit the roads.

[20] World Energy Outlook 2017, IEA.

urban rail transit lines, with a total track length of 6,172 km. More than 70 cities have issued administrative measures to regulate bike-sharing, and more than 360 cities provide bike-sharing services. Fueled by digitalization and e-commerce, express delivery volumes have soared. In 2012, the total number of delivered parcels was 5.69 billion. By the end of 2019, the number rose to 63.52 billion, an eleven-fold increase (see Table 1).

With its accelerating digitalization and the emergence of new industries and technologies, China has become an important global player in fields such as electric vehicle transport, battery and energy storage technologies, shared mobility, and traffic management systems based on smart and big data. In order to modernize and transform its transport sector, China has implemented various programs, plans, and policies to guide development. Specific targets for short-term development are set in China's FYPs (see Table 2).

Year	2012	2019	Factor
High-speed rail (HSR) network length	10,000 km	35,000 km	3.5
Expressway network length	96,000 km	150,000 km	1.56
Navigable inland waterway	125,000 km	127,000 km	1.01
Civilian airports	138	238	1.72
Urban rail passenger volume	8.73 billion trips	23.88 billion trips	2.73
Rail freight volume	3.9 billion tonnes	4.39 billion tonnes	1.12
Postal and express delivery services network length	10.92 million km	40.86 million km	3.74
Express delivery volume	5.69 billion parcels	63.52 billion parcels	11

Table 1. Selected statistics from China's transport infrastructure, 2012–2019

Source: White Paper on the Sustainable Development of Transport in China

Target	11th FYP (2006–2010)	Status 2010	12th FYP (2011–2015)	Status 2015	13th FYP (2016–2020)	Status 2019	14th FYP (2021–2025)
Grade of urbanization	47%	**47.5%**	51.5%	**56.1%**	60%	**60.6%**	65%
Reduction in energy consumption per unit of GDP	20%	**19.1%**	16%	**18.2%**	15%	**13.2%**	13.5%
Reduction in CO_2 emissions per unit of GDP	-	**-**	17%	**20%**	18%	**18.2%**	18%
Share of non-fossil fuels in primary energy	-	**8.6%**	11.4%	**12%**	15%	**15.3%**	20%
Railway network length	90,000 km	**91,000 km**	120,000 km	**121,000 km**	150,000 km	**139,000 km**	170,000 km [21]
High-speed rail network length	-	**8,358 km**	-	**19,000 km**	30,000 km	**35,000 km**	50,000 km [22]
Highway network length	2.3 million km	**4 million km**	4.5 million km	**4.58 million km**	5 million km	**5.01 million km**	-
Civilian airports	190	**175**	230	**207**	260	**238**	268+
% villages with access to paved roads	-	**81.7%**	90%	**94.5%**	99%	**100%**	-

Table 2. Comparison of selected transport development targets in the 11th, 12th, 13th, and 14th Five-Year Plans
Source: GIZ

[21] These are expert projections, and are expected to be included in the transport section of the upcoming 14th Five-Year Plan. See https://baijiahao.baidu.com/s?id=1693528477794435890&wfr=spider&for=pc

[22] Ibid.

In its 13th FYP period (2016–2020)[23], China aimed to make its green transport sector more efficient, integrated, and safe, in addition to further expanding its basic transport infrastructure (see Table 2 and Figure 7). This included the promotion of public transport, smart and intelligent transport, new energy vehicles (NEVs)[24], intermodal transport, cycling, and walking. It also included the better integration of transport infrastructures and services in city clusters such as Beijing–Tianjin–Hebei (Jing-Jin-Ji), the Yangtze River Economic Belt, and the Guangdong–Hong Kong–Macao Greater Bay Area (GBA).

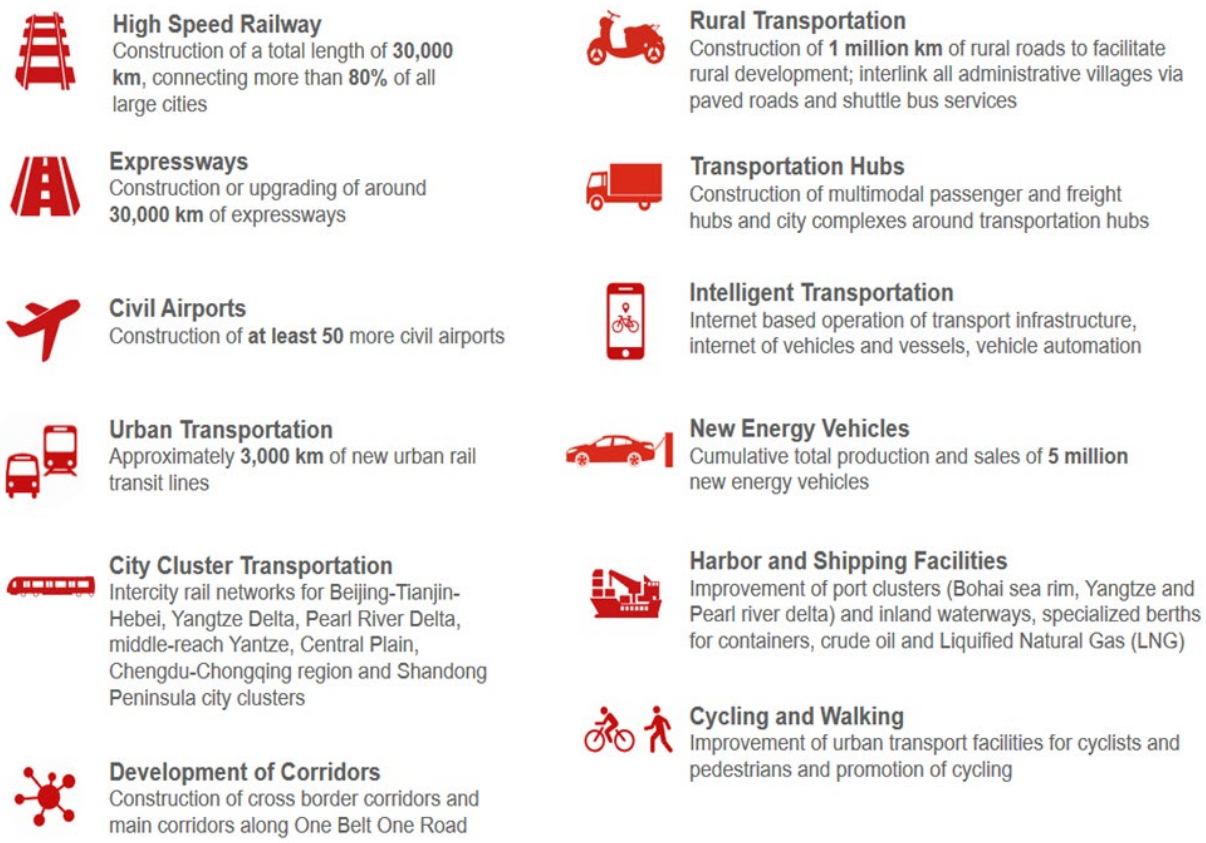

Figure 7. Key targets for transport in the 13th Five-Year Plan for Economic and the Social Development of the People's Republic of China, 2016–2020
Source: GIZ

[23] The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China, 2016–2020, was issued on March 17, 2016. More information can be found here.

[24] NEVs include battery-electric, (plug-in) hybrid, and fuel-cell vehicles.

Key policies for China's transport sector development

To further guide the development of the transport sector, China has recently introduced various short-, medium-, and long-term top-level policies (Figure 8). Some of the most important include:

1. **Outline for Building China's Strength in Transport (2020–2050)**

   The outline, released on September 19, 2019, and approved by the Communist Party of China Central Committee (CPCCC) and the State Council of the People's Republic of China, is a long-term plan for the transformation of China's transport system from a speed- and scale-centered model to a quality- and efficiency-centered integrated model. The plan provides a roadmap for China to become a global transport superpower by 2050. A detailed briefing on the policy can be found here.

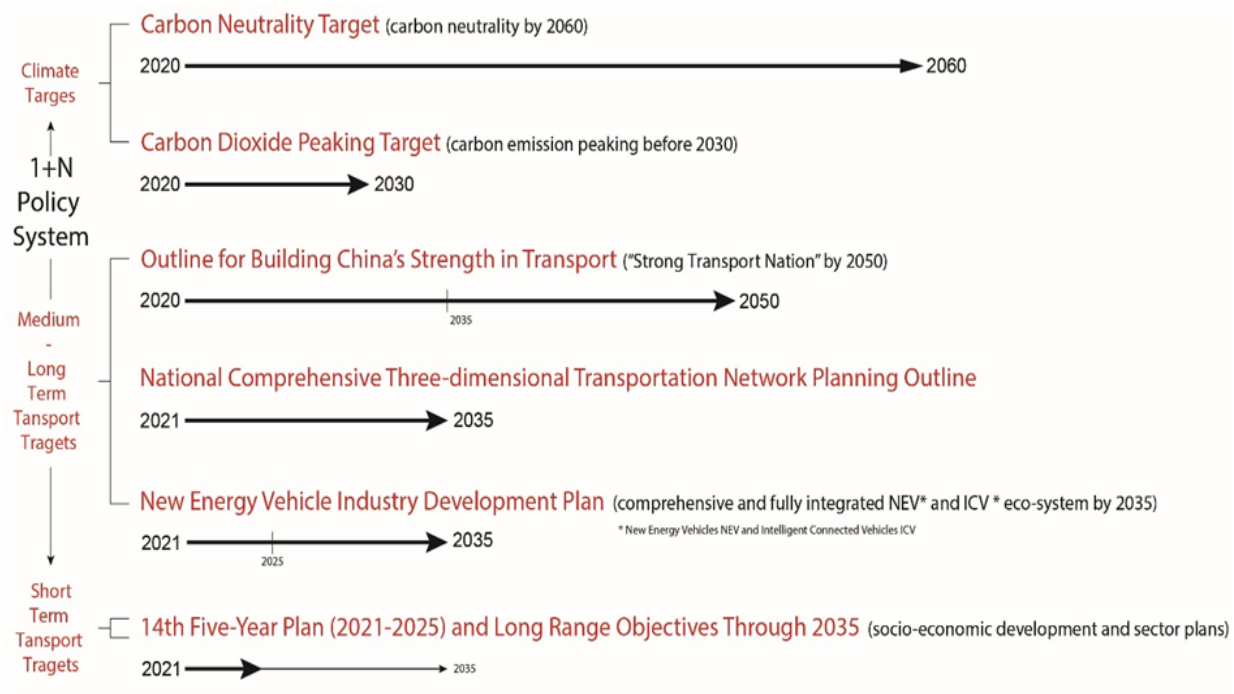

Figure 8. China's transport sector development roadmap (selected policies)
Source: GIZ

2. **National Comprehensive Three-dimensional Transportation Network Planning Outline (2021–2035)**

   The policy, released on February 24, 2021 by the Central Committee of the Communist Party of China (CPC) and the State Council of the People's Republic of China, is a strategic top-level policy guiding the development of a comprehensive and fully integrated transport system during the 2021–2035 period. It also presents a vision for subsequent development until mid-century. The policy is based on the Outline for Building China's Strength in Transport and is aligned with the country's 2030 and 2060 climate targets. Its goal is to ensure that transport sector emissions peak as early as possible. A detailed briefing on the policy can be found here.

3. **New Energy Vehicle Industry Development Plan (2021–2035)**

   The plan, released on November 2, 2020, by the State Council Office of the People's Republic of China, is a strategic top-level policy guiding the development of a comprehensive and fully integrated new energy vehicle (NEV) and intelligent connected vehicle (ICV) ecosystem in China by 2035. The plan is part of a comprehensive roadmap to help China become a global automotive powerhouse. The plan follows the Energy Conservation and New Energy Vehicle Industry Development Plan (2012-2020), [25] which was issued by the State Council of the People's Republic of China in 2012. A detailed briefing on the policy can be found here.

4. **14th Five-Year Plan (2021–2025) and Long-Range Objectives Through 2035**

   The 192-chapter long *14th Five-Year Plan* (FYP) is a top-level policy blueprint for China's national economic and social development over the next five years. For the first time in China's FYP history, the plan does not set a GDP growth target.

[25] See http://www.gov.cn/gongbao/content/2012/content_2182749.htm

(Compare this to the 6.5% target set in the 13th FYP for 2016–2020.) The FYP calls for a transition from speed- and scale-centered development to a more sustainable development model based on quality and efficiency. The 14th FYP emphasizes the central role of technology and innovation (including artificial intelligence, big data, and 5G) and foresees an increase in R&D spending of more than 7% per year. The transport sector is key to achieving more integrated development in the 14th FYP period. Over the next 5 years, China will develop its coastal areas and hinterland, strengthen its urban agglomerations and city clusters, push rural development and urban-rural integration, and improve its transport infrastructure (see Figure 9).

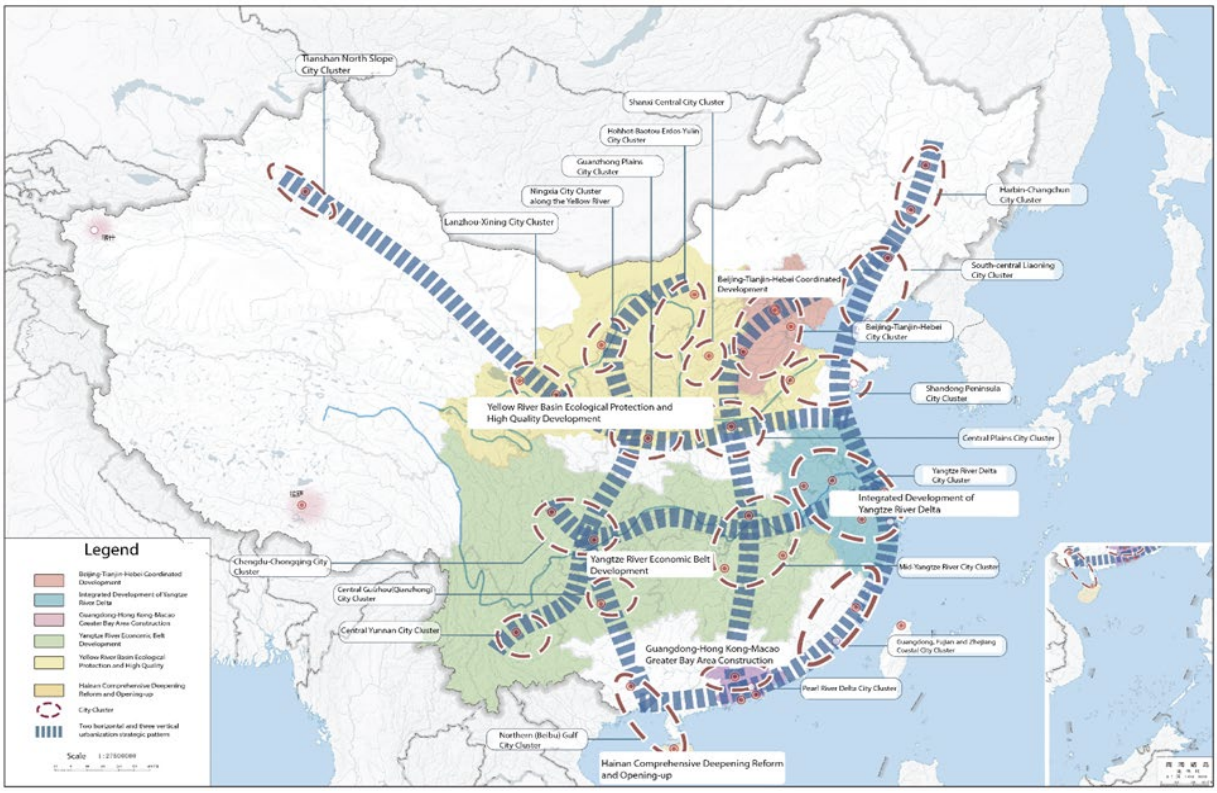

Figure 9. Diagram of the spatial patterns of urbanization in the 14th FYP

Source: 14th FYP

In line with the Outline for Building China's Strength in Transport (2020-2050) and the National Comprehensive Three-dimensional Transportation Network Planning Outline (2021–2035), the 14th FYP sets the following targets (among others):

1. build 30+ new civilian airports by 2025;
2. build 3,000 km of new intercity railways and suburban railways and complete the rail transport network in Beijing, Tianjin, the Hebei region (Jing-Jin-Ji), the Yangtze River Delta, and the Greater Bay Area, with 3,000 km of new urban rail transit;
3. accelerate the shift from road to rail and road to waterways for bulk cargo and long-distance freight transport;
4. promote the electrification of urban public transport and logistics distribution and give priority to the development of urban public transport and active mobility networks (i.e. cycling and walking) in Chinese cities;
5. develop in-depth NEV and charging facilities and intelligent connected vehicles (ICVs);
6. support innovative technologies that can deliver energy savings and emissions reductions; develop applicable standards; market electric vehicles, ICVs, and smart ports; and digitally transform traditional transport infrastructure.

The policy can be found here.

Based on the 14th Five-Year Plan (2021–2025) and the Long-Range Objectives Through 2035, further transport sector-specific policies will be released in the coming months at the national and sub-national levels (e.g., Modern Comprehensive Transportation 14th FYP, Comprehensive Transportation Services 14th FYP, Urban Public Transport 14th FYP, Water Transport 14th FYP, Highway Development 14th FYP).

5. Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy

Section VI of the 1+N policy ("Accelerating the construction of a low-carbon transportation system") identifies transport as a key sector. In line with the goals of the above policies, the section outlines the importance of bringing down transport

energy consumption and carbon dioxide emission intensity. The 1+N policy seeks to optimize the transport structure and accelerate the construction of an integrated, multi-dimensional transportation network. Its measures include the promotion of low-carbon mobility (public transport, cycling, walking), green logistics, low-carbon equipment, low-carbon infrastructure (hydrogen refueling stations, charging and battery swapping network systems), intelligent transportation, the improvement of energy-efficiency standards for fossil-fuel vehicles and vessels, and the phase-out of obsolete vehicles and vessels with high energy consumption and emissions.

The policy can be found here.

6. **Action plan for carbon dioxide peaking before 2030**

This policy is the first "N" of the 1+N policy system. Section 5 of 1+N ("*The action for promoting green and low-carbon transportation*") identifies the transport sector as a key sector in achieving 2030 targets. These aim to

1. reach peak petroleum consumption for land transport;
2. attain a 40% share of incremental vehicles fueled by new and clean energy;
3. cut the carbon emission intensity of commercial vehicles (measured by converted turnover) by about 9.5% relative to 2020;
4. reduce the energy consumption of national railways/unit of converted turnover by 10% relative to 2020; and
5. conduct no less than 70% of travel through environmentally friendly means in cities with populations of one million or more.

The policy can be found here.

Recommendations

Transport emission peaking and decarbonization strategies

As part of the 1+N policy system, a national-level climate action strategy for the transport sector based on emission caps is needed to provide a clear low-carbon development pathway for regional decision-makers, the transport industry, and markets. The strategy should be foresight-based and address emissions from road, rail, water, and air

transport. The strategy should further address propulsion technology pathways (in particular for heavy-duty freight, aviation, and maritime transport), the clean-energy supply, the charging and refueling infrastructure, the benefits of co-control for GHG emissions and air pollutants, the interlinkage between transport and other sectors (including urban development, energy, and information sectors), carbon market pricing, fuel and emission standards, internal combustion engine (ICE) phase-out roadmaps, data collection, measurement, reporting and verification (MRV) frameworks, green financing and the promotion of innovation.

The strategy should harness the avoid–shift–improve approach. This approach aims to

1. avoid trips, e. g. through efficient land-use planning;
2. shift trips to climate-friendly means such as public transport, cycling, and walking; and
3. improve system efficiency and advance low-carbon technology.

The strategy should include pathways to a "just transition". That is to say, the strategy should fully explore the potential for positive economic growth, innovation, and new jobs and ensure that no one is left behind. In this way, China can bring about a transition with broad public support.

Aligning the transition in the transport and energy sectors

If China is to decarbonize its transport sector, creating a zero-emission energy sector is crucial. Moreover, it is important to ensure that transition in the energy sector is fully aligned with transition in the transport sector. Electric transport must be zero emissions from well-to-wheel, using clean energy only. The direct electrification of transport should be implemented wherever possible. Green hydrogen and green synthetic e-fuels (power-to-X) should be used only when direct electrification is not technically or economically viable in the near term (such as in aviation and maritime transport). The energy, transport, and information sectors should be fully integrated in an "energy internet" to tap the potentials of vehicles as energy storage units (vehicle-to-grid, V2G) and new business models (e.g. battery-as-a-service, BaaS).

The *Four Nows!*

The authors of this report have identified four areas of high priority for decarbonizing the transport sector. The *Four Nows*! are crucial to reaching CO_2 peaking by 2030 and carbon neutrality by 2060. Immediate, holistic, and coordinated ambitions and measures are needed to steer the development of the transport sector to a zero-emission pathway, particularly given the long investment cycles for research and development, propulsion technology adoption, and infrastructure construction.

1. Green freight now!

China should play a leading role in the decarbonization of freight transport. Freight transport accounts for about 65% of total transport emissions in China, of which road freight transport makes up the largest share. The freight sector, including long-distance, inter-city, and inner-city freight, needs to be decarbonized as soon as possible. China should focus on accelerating the promotion of intermodal transport to shift freight transport volumes from road to rail (incl. high-speed freight trains) and inland waterways. Vehicle electrification will play a key role in decarbonizing road freight. A focus should be placed on battery-electric propulsion and innovative solutions such as catenary trucks for long-haul transport. The further advancement of battery technology, standardization, and the development of charging and battery swapping infrastructure are also needed. Fiscal and non-fiscal support measures, including vehicle purchase subsidies and right-of-way lanes for NEVs, should be adopted. Smart logistics solutions, digital freight and logistics platforms, and autonomous driving can lead to higher efficiency and lower emissions. Green delivery solutions (e.g. cargo bikes for last-mile deliveries, cargo trams or subways for passenger and goods) should be promoted.

2. Green aviation now!

China should play a leading role in the decarbonization of air travel. As described above, the 14th FYP envisions the construction of more than 30 new

airports. Right now, China's per capita aviation-related CO_2 emissions are low (0.09 tons compared with 0.57 tons in the US and 0.86 tons in the UK). If China remains on its current course, however, emissions in its aviation sector emissions may quadruple by 2050.[26] Therefore, a focus should be placed on the long-term deep decarbonization of the domestic and international aviation sector. This includes cross-border solutions, the development of aircraft and engine technology, the use of sustainable aviation fuels, efficiency in air traffic management, green on-ground operations, and the promotion of green airports and related infrastructure. It also includes promoting HSR instead of flying wherever possible and raising awareness for the environmental and climate impact of the aviation sector.

3. Green shipping now!

China should play a leading role in promoting the 4th energy revolution in shipping (from rowing to sailing to oil to clean fuels). Shipping is a capital-intensive industry with long-life assets, thin margins, and a high dependency on the global supply of energy-dense fuels. Immediate action is therefore needed to decarbonize maritime and inland waterways transport. To this end, more resources should be channeled into research on the role of alternative fuels such as green ammonia and into the development of scalable and cost-competitive uses. In the meantime, China should develop short-term solutions such as a clean onshore power supply and clean-energy applications for ports while exploring wind propulsion technologies (e.g. inflatable sail systems, sea wings) and other innovative solutions.

4. Green cities now!

To decarbonize urban transport, holistic approaches are needed. These include the alignment of urban development with the transport sector and climate targets (e.g. by promoting sustainable urban mobility planning, or SUMP); the promotion of people-centered, space-

[26] See https://theicct.org/sites/default/files/ICCT_Global-Aviation-CO2-Inventory-2018.xlsx, https://www.carbonbrief.org/emissions-from-chinese-aviation-could-quadruple-by-2050

saving, mixed-use, barrier-free, and public transport-centered cities (such as the “15-minute city” and transit-oriented development ToD); the pricing of road and parking spaces; the promotion of public transport as an urban mobility backbone (network expansion and service improvement) and its integration with new carbon credit-based mobility-as-a-service platforms (e.g. ride-hailing and smart bike-sharing) [27] ; the prioritization of cycling, walking, and other forms of micromobility; and the promotion of low-speed electric vehicles (LSEVs).

International cooperation

No country can fight climate change alone. Five years after the Paris Agreement, more and more countries are committing themselves to climate neutrality targets. Strengthening national climate targets will lead to increased ambitions in the transport sector. Practical international exchange and intensified dialogues between governments, research institutions, and industries can foster the alignment of climate strategies and roadmaps, and the sharing of best practices and can support the international community in exploring opportunities and synergistic effects for decarbonizing transport at the global level.

Examples of international cooperation in the field of transport decarbonization are the NDC Transport Initiative for Asia (NDC-TIA) and the Sino-German Cooperation on Low-Carbon Transport (CLCT). These projects, which have been commissioned by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and implemented by GIZ, seek to support the Ministry of Ecology and Environment of the People’s Republic of China (MEE) and the Ministry of Transport of the People’s Republic of China (MoT) in decarbonizing the Chinese transport sector and to foster knowledge sharing between stakeholders in China and other Asian countries.

[27] Mobility-as-a-Service (MaaS) is a concept that facilitates the integration of transport services into single mobility platforms.

If you want to know more about what we are doing to promote low-carbon transport in China, please contact Mr Sebastian Ibold (sebastian.ibold@giz.de), the project director of the sustainable mobility team of GIZ China, or Ms. Xia Yun (yun.xia@giz.de), the China technical advisor at the NDC Transport Initiative for Asia at GIZ China.

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