
# Towards zero emissions

## Overview on China's climate pathway and implications to the transport sector

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# Imprint

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Since the announcement of China's new 2030 carbon dioxide emission peaking and 2060 carbon neutrality targets end of 2020, the debate on how to decarbonize transport is heating up among experts in the field of policy making, academia, and the transport industry. With increasing motorization and both passenger and freight transport demand still growing, the sector is a hard nut to crack from a climate action perspective. A wide range of technologies is already on the table, with clean energy-based electric mobility being among the most promising solutions for bringing down emissions in road transport and digitalisation offering pathways to increased traffic efficiency. But in particular, the pathway towards zero-carbon freight, aviation, and maritime transport poses big challenges. In order to align the Chinese transport sector development with the 2030 and 2060 targets, clear strategies and action plans are needed and ambitious measures must be implemented now. This does not only include the adoption of innovative technology, but also the accelerated shift to climate-friendly transport modes, as well as a stronger focus on avoiding trips through holistic urban and transport development strategies.

At the same time, it must be ensured that the needed transformation of the transport sector will be implemented in a way that no one is left behind and that this transformation is fully socially and economically sustainable. In particular, international cooperation, experience exchange, and in-depth dialogues can positively contribute to the sustainable and climate-friendly development of the transport sector in China and beyond.

This paper has the aim to provide an overview of China's climate protection pathway with regards to the role of the transport sector in achieving carbon dioxide emission peaking by 2030 and carbon neutrality by 2060. The paper further aims at fostering debates on the policies, technologies, measures, and partnerships needed to achieve those targets. The paper does not claim to be exhaustive and only lists a few selected approaches and measures that can contribute to achieving the set climate goals.

# Background

Over the past decades, the *People's Republic of China* (PRC) underwent a rapid and holistic socio-economic transformation. This transformation came along with the development of new industries, cities, and infrastructures, as well as the eradication of absolute poverty [1], contributing to China's and global economic development. In particular, urbanisation played a key role in China's development. In the last 20 years alone, China's urban population grew by about 390 million people, reaching a degree of urbanisation of 60.6 percent at the end of 2019. In the same period, China's GDP grew from EUR 1 trillion to EUR 13.1 trillion. Nevertheless, urbanisation has not come to an end yet. According to the 14th *Five-Year Plan* (2021-2025)[2] draft, which was approved during the *Two Sessions* 两会 (annual plenary sessions of China's *National People's Congress* NPC and the *Chinese People's National Consultative Conference* CPPCC) in March 2021, the target of 65 percent of urbanisation was set for the end of 2025. This means that in the next five years alone, another 69 million people will become urban residents (see *Figure 1).*

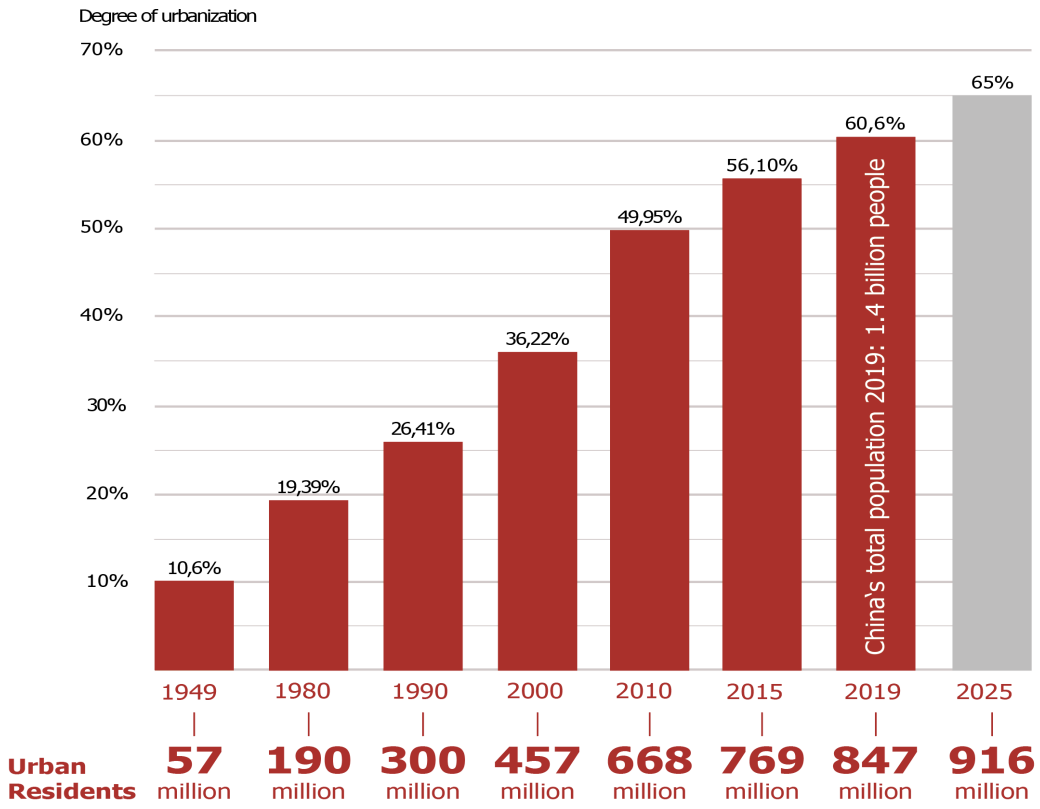


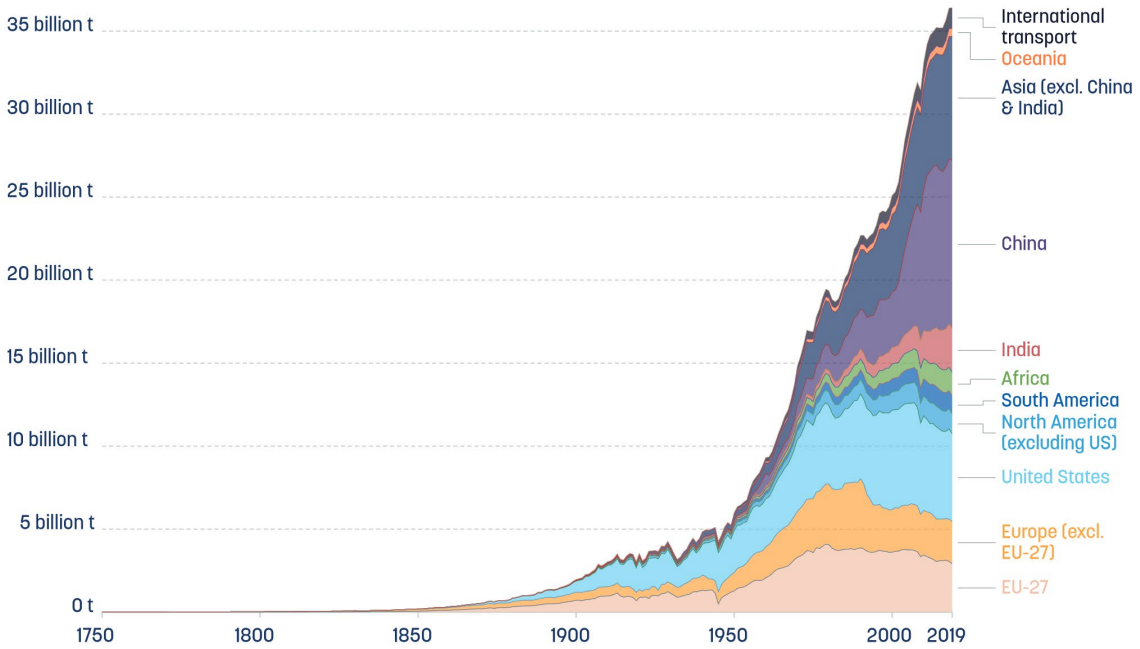

*Figure 1. Development of China's urban population, Source: GIZ*

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

[2] Outline for the 14th Five-Year Plan and long-range objectives 2035

# Overview on China's climate protection pathway

Along with economic growth and urbanisation came environmental problems and high carbon emissions. Today, China is the world's largest emitter of Greenhouse Gases (GHG) with 10.5 Gt of $CO_2$ in 2018, accounting for about a third of global emissions (see *Figure 2*)[3]. Climate change is a key challenge for China because a large part of its population is concentrated along the coastline, which is threatened by rising sea levels and potential risks for harvest and food security caused by extreme weather. The climate risks are increasingly pushing China on to a more sustainable and low carbon development pathway, which is shaped not only by continuing urbanisation, the need for balanced urban-rural development, and an aging population, but also by the political goal to build a beautiful China[4] by the middle of the 21st century.




*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 CO2 emissions, by world region, Source: Our World in Data based on the Global Carbon Project*

[3]China Academy of Transportation Sciences (CATS)

[4] The Communist Party of China (CPC) has incorporated the idea of a "Beautiful China" into its "two-stage development plan". In the first stage from 2020 to 2035, China aims at basically realizing "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".

Lately, since its 12th Five-Year Plan (FYP) (2010-2015), China has set the direction for its pathway towards green and low carbon development[5]. On that pathway, the year 2020 was an important milestone, particularly for the calibration of China's climate protection roadmap (see *Figure 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 achieve carbon neutrality by 2060 and to peak its $CO_2$ emissions before the year 2030, which is an increased ambition compared to China's *Nationally Determined Contribution* (NDC) submitted to the *United Nations Framework Convention on Climate Change* (UNFCCC) on June 30, 2015[6].

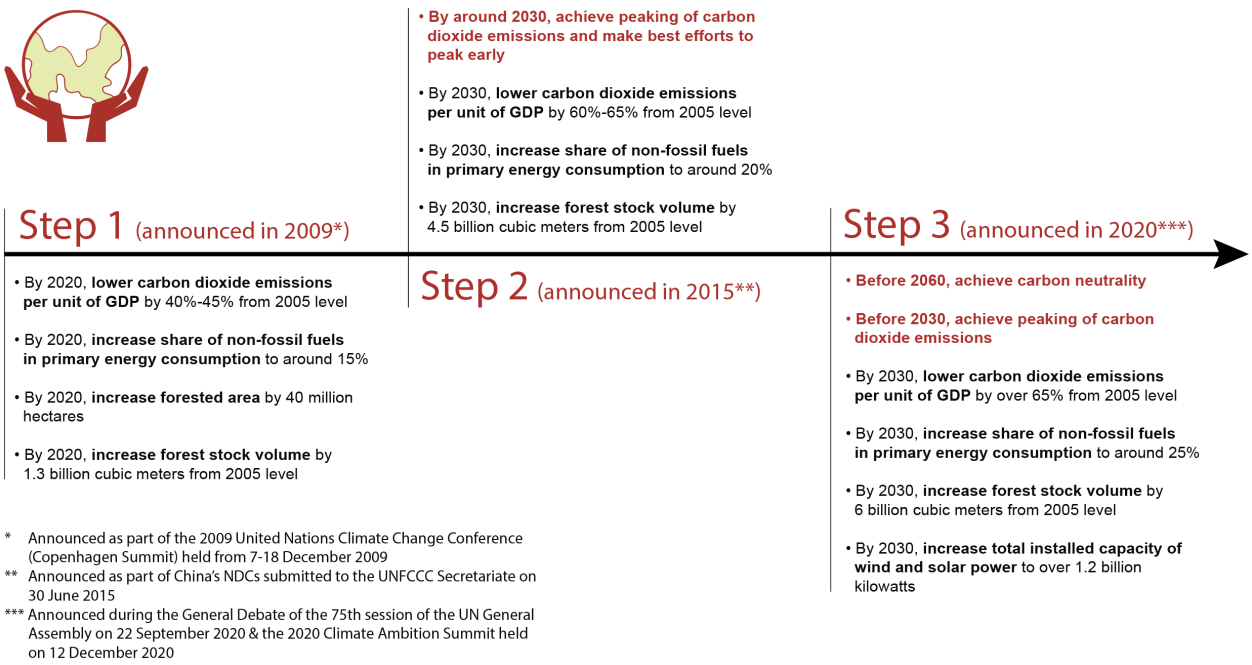



*Figure 3. China's climate protection roadmap (selection), Source: GIZ*

While a 2030 $CO_2$ emission peaking target was already part of China's 2015 NDC to the *Paris Agreement*, on September 22, 2020, it was the first time that China announced a carbon neutrality target. With the made pledge, China joins a group of 137 countries that have, by today, committed to carbon neutrality [7] (see *Figure 4*). Besides its deep impact on the global

[5] At the Copenhagen Summit in 2009, China put forward the target of a 40%-45% reduction in $CO_2$ emissions per unit of GDP by 2020 compared to 2005, and in the subsequent 12th Five-Year Plan, the emission reduction target of 17% reduction in $CO_2$ emissions per unit of GDP by 2015 compared to 2010 was included as a binding target for the first time.

[6] In its 2015 NDCs, China pledged to "peak $CO_2$ emissions around the year 203 while making best efforts to peak earlier". https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/China%20First/China's%20First%20NDC%20Submission.pdf

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

climate protection agenda, the announcement also has far-reaching impacts on China's domestic policy-making in the coming decades. To put the 2060 carbon neutrality announcement into perspective: for China to reach climate neutrality would mean it has to phase out the conventional use of coal, oil, and gas by 2060. This will require no less than the complete transformation of the country's socio-economic structure, and thus deep and ambitious reforms in all sectors.

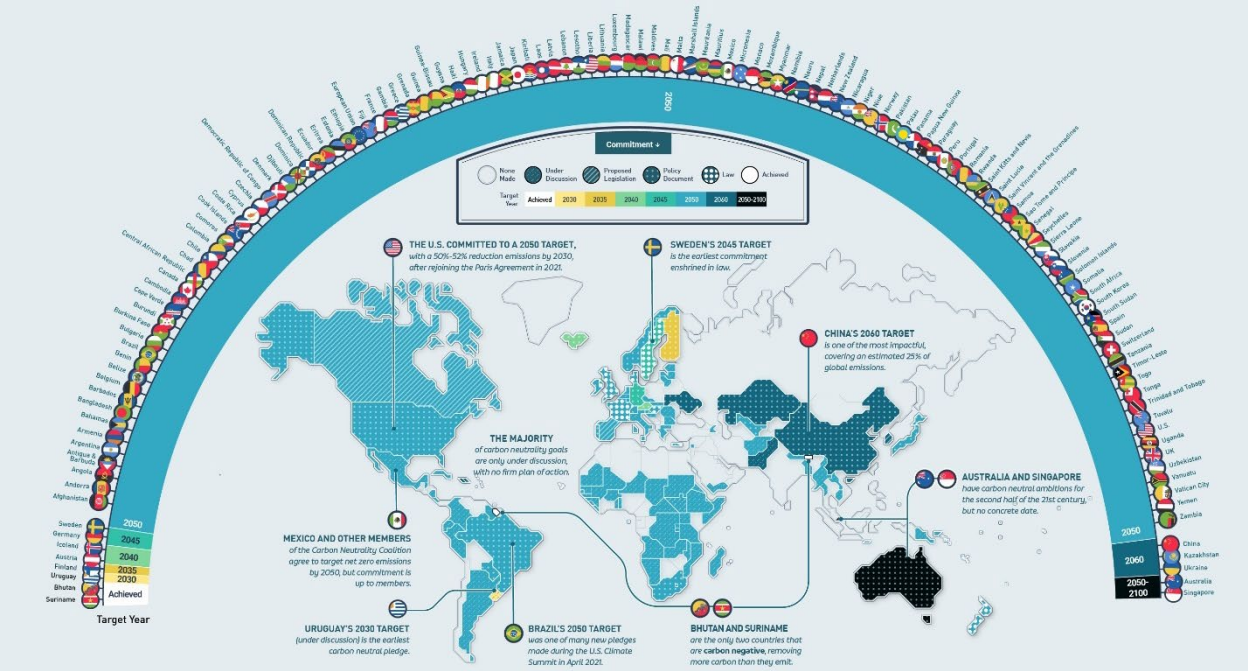



*Figure 4. Carbon Neutral Goals, Source: Visual Capitalist*

Along with the announcement came first calls for action. On September 27, 2020, one of China's top climate research institutes, the *Tsinghua University's Institute of Energy, Environment and Economy*, presented a EUR 12.7 trillion, 30-year roadmap, calling for ending the use of coal for electricity generation around 2050, drastically increasing nuclear and renewable power generation, and relying on electricity for 80 percent of China's energy consumption by 2060.[8] 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 for every sector, and effective policies, roadmaps, and measures have to be implemented accordingly. This is particularly true for the 14th FYP period (2021-2025), which is key to

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

steer China's development direction towards achieving high-quality 2030 peaking (peaking on a low level) as a foundation for achieving carbon neutrality only 30 years later by 2060. In the Outline for the *14th Five-Year Plan and Long Range Objectives Through 2035*, various targets shaping the climate protection roadmap are set, including an 18 percent $CO_2$ intensity reduction target ($CO_2$ emissions per unit of GDP), a 13.5 percent energy intensity reduction target (energy consumption per unit of GDP) from 2021 to 2025, as well as the aim to increase the share of non-fossil energy in total energy consumption to 20 percent (set goal in 2009 for 2020 was around 15 percent, reported share in 2020 was 15.8 percent). The plan outline does not include a specific GDP growth target for 2025 (a target of over 6 percent for 2021 was set in the *Report On The Work Of The Government* presented by Premier Li Keqiang during the *Two Sessions*[9]) or a $CO_2$ emission or coal cap.[10] The plan outline further mentions the development of a peaking roadmap [11] as a top-level guiding climate blueprint for the development of (sector) specific 14th FYPs on national, provincial, and local level in 2021 and beyond.

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

[10] 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

[11] The roadmap is currently being developed by the National Development and Reform Commission (NDRC) and the Ministry of Ecology and Environment (MEE)

# Status quo of China's transport sector development

The transport sector is a key to reach the 2030 and 2060 goals. China's transport $CO_2$ emissions, with an average annual growth rate of 5.4 percent, increased from 505 million tons in 2005 to 1.11 billion tons in 2019, accounting for about 10.7 percent of the country's total $CO_2$ emissions (8.1 percent in 2005). Of those emissions, freight transport accounts for a share of 65.8 percent, and road-transport accounts for a share of 76.7 percent (2019). [12] It is expected that due to further increasing motorisation [13] and transport volumes in both passenger and freight transport, the transport sector is likely the only sector in China that will not peak $CO_2$ emissions by 2030[14]. This means that the ambitions to decarbonise transport and the respective set policies and measures need to be fundamental and much more ambitious if the 2060 target shall be achieved. This includes the sustainable steering of future transport demand, the promotion of low carbon transport modes, and the adoption of low carbon technology. At the same time, it must be ensured that the holistic transformation of the transport sector will be implemented in a way that no one is left behind and that this transformation is economically sustainable.

To better understand the future orientation of the transport sector in China, it is important to first look into the past. Along with the rapid economic growth and urbanisation of the last decades came the large-scale expansion of the country's transport infrastructure and the rapid increase of both passenger and freight transport volumes. The number of civil 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 percent in 2012 to 3.7 percent in 2019. By the end of 2019, China's high-speed rail (HSR) network length totaled 35,000 km compared to 10,000 km in 2012, the share of HSR in total rail passenger transport rose from 4.5 percent in 2007 to 65.4 percent in 2019, while the proportion of total passenger transport by railway increased from 5 percent in 2012 to 20.8 percent 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 urban rail transit lines, with 6,172 km of total track length in the same year. More than 70 cities have released administrative measures to regulate bike-sharing, and more than 360 cities provide bike-sharing services. Fueled by digitalisation and e-commerce, express

[12] Source: China Academy of Transportation Sciences (CATS)

[13] Currently, motorisation rate in China is relatively low (172 passenger cars/1,000 capita in 2018). If China would reach the motorization rate of Germany (about 578 passenger cars/1,000 capita), another 567 million cars would hit the roads.

[14] World Energy Outlook 2017, IEA

delivery volumes soared. While the total number of delivered parcels was 5.69 billion in 2012, this number increased to 63.52 billion by the end of 2019, an increase by a factor of 11 (see *Table 1*).

With accelerating digitalisation and the emergence of new industries and technology, China has become an important global player in fields such as electric mobility, battery and energy storage technology, shared mobility, and smart and Big Data-based traffic management systems. In order to modernise and transform its transport sector, China has implemented various programs, plans, and policies to guide short-, medium-, and long-term development. Specific development 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 |
| **Civil 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 tons | 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. Development of China's transport infrastructure 2012 to 2019, selected numbers, Source: White Paper 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 urbanisation** | 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[15] |
| **High-Speed Rail network length** | - | **8,358 km** | - | **19,000 km** | 30,000 km | **35,000 km** | 50,000 km[16] |
| **Highway network** | 2.3 million km | **4 million km** | 4.5 million km | **4.58 million km** | 5 million km | **5.01 million km** | - |
| **Civil 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 Plan, Source: GIZ*

[15] Expert predictions, expected to be included in upcoming 14th Five-Year transport plans. https://baijiahao.baidu.com/s?id=1693528477794435890&wfr=spider&for=pc
[16] Ibid.

In its 13th FYP period (2016-2020)[17], besides the further expansion of its basic transport infrastructure, China has set the course for the development of the green transport sector to be more efficient, integrated, and safe (see *Table 2* and *Figure 5*). This included the promotion of public transport, smart and intelligent transport, new energy vehicles (NEVs) [18], intermodal transport, and cycling and walking. This 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).

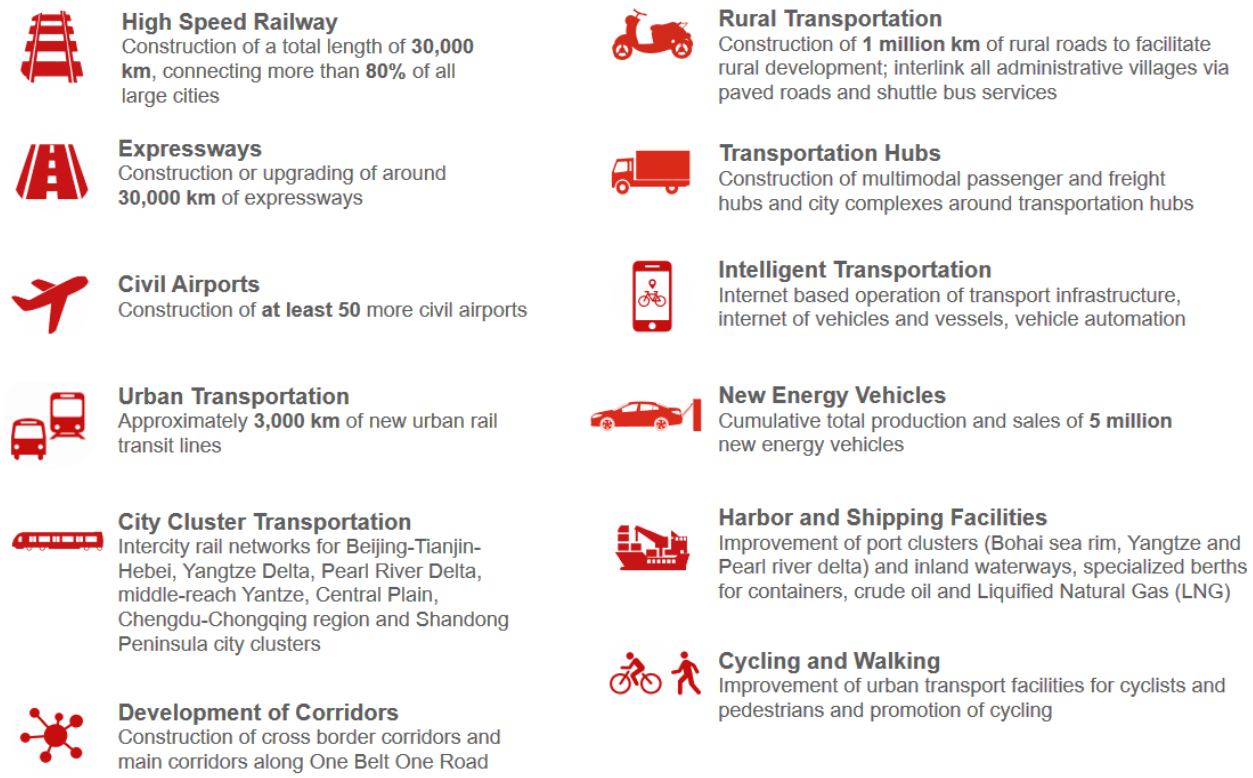



*Figure 5. Key targets for transport in the 13th Five-Year Plan for Economic and Social Development of the People`s Republic of China 2016-2020, Source: GIZ*

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

[18] Battery-electric, (plug-in) hybrid and fuel cell vehicles

## Key policies for China's transport sector development

In order to further guide the development of the transport sector, based on the made achievements, China has recently issued various short-, medium-, and long-term top-level policies (see *Figure 6*).

Selected policies of high relevance for the short-, medium-, and long-term development of China's transport sector are:

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

   The outline, which was released on September 19th, 2019, and has been approved by the *Communist Party of China Central Committee* (CPCCC) and the *State Council,* is a long-term oriented top-level and systematic guidance plan laying the foundation of China's ambition to transform from a speed- and scale-centered and comparatively isolated development model towards an innovative, quality- and efficiency-centered integrated transport model and describing the future vision and roadmap of China to become a global transport superpower by 2050. A detailed briefing on the policy can be found here.

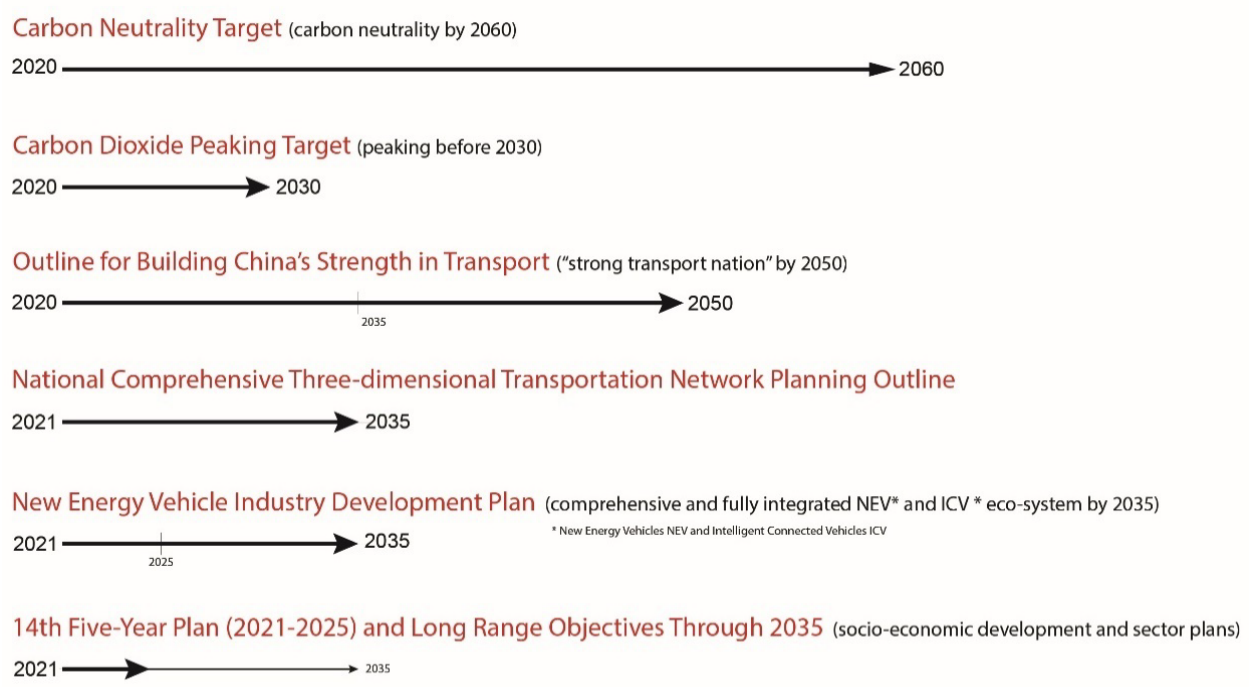



*Figure 6. China's transport sector development roadmap (selected policies), Source: GIZ*

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

   The policy, which was 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 in China with a planning period from 2021 to 2035 and a vision to the middle of this century. The policy builds upon the above-listed Outline for Building China's Strength in Transport. The policy is aligned with China's 2030 and 2060 climate targets and highlights that transport sector emissions should 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, which was released on November 2nd, 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) eco-system in China until 2035 and is part of the 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)[19], which was issued by the State Council 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 chapters 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. As mentioned above, for the first time in China's FYP history, the 14th FYP does not set a GDP growth target (compared to the average 6.5 percent target in the 13th FYP (2016-2020)), indicating a focus on the transition from speed- and scale-centered development to more sustainable, quality- and efficiency-centered development. The 14th FYP strongly emphasises the important roles of technology and innovation (incl. frontier technologies such as Artificial Intelligence, Big Data, 5G) and of strengthening research and development (R&D), intending to increase R&D spending by above 7 percent per year. The transport sector is a key to achieve more

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

integrated development in the 14th FYP period. With further qualitative development of coastal areas and economic development of its hinterland, China will further strengthen its urban agglomerations and city clusters, push rural development and urban-rural integration. and expand and improve its transport infrastructure accordingly (see *Figure 7*).

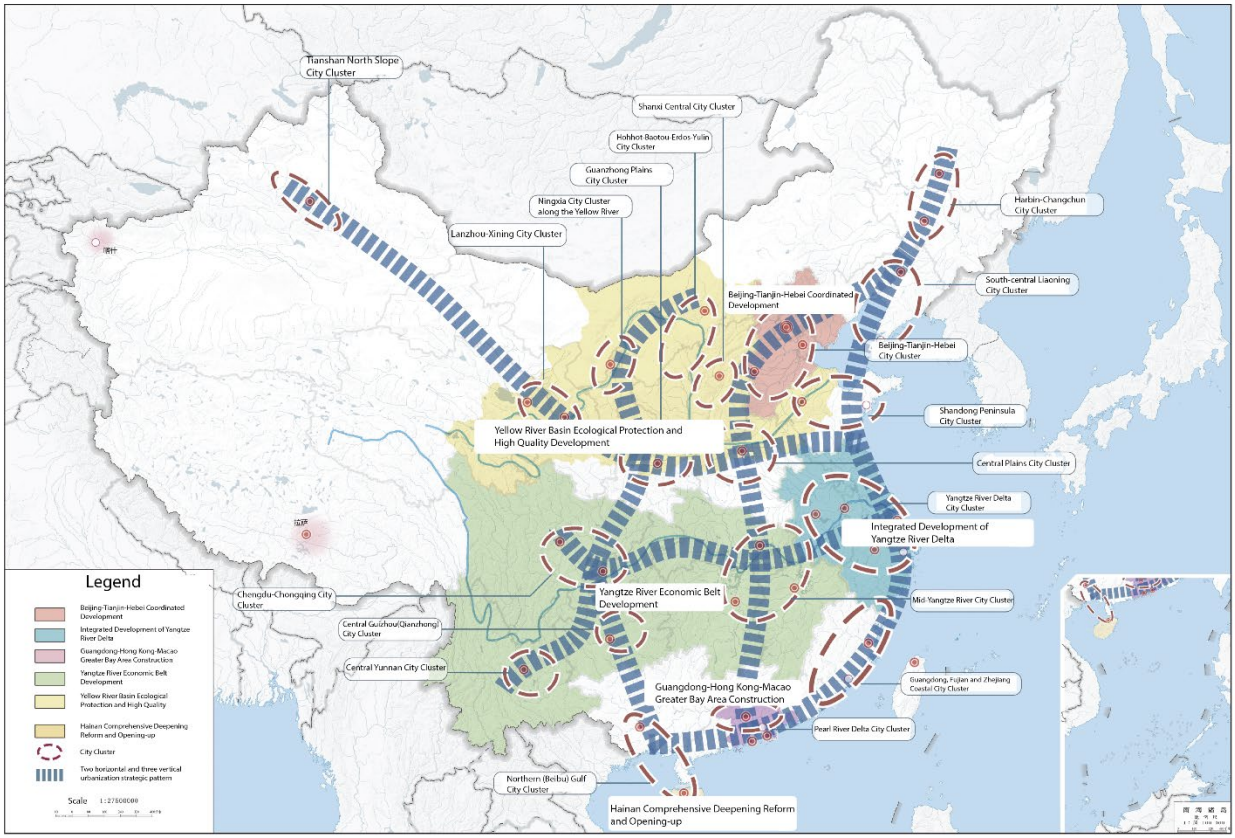



*Figure 7. Diagram of the spatial patterns of urbanisation in the 14th FYP, Source: 14th FYP*

In line with the above-listed medium- and long-term transport development blueprints *Outline for Building China's Strength in Transport* (2020-2050) and *National Comprehensive Three-dimensional Transportation Network Planning Outline* (2021-2035), the 14h FYP sets the below-listed targets (selection):

1. Build 30+ new civil airports by 2025,
2. Build 3,000 km of new intercity railways and suburban railways and complete the rail transport network in Beijing, Tianjin, and Hebei region (Jing-Jin-Ji), the Yangtze River Delta, and the Greater Bay Area. 3,000 km of new urban rail transit will be added.
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 (cycling and walking) networks in Chinese cities,

5. Develop in-depth NEV and charging facilities, and Intelligent Connected Vehicles (ICVs),
6. Strongly support the R&D of innovative technologies with potential for energy saving and emission reduction, the development of relevant standards, and the marketisation of products, such as electric and ICVs, smart ports, and the digital transformation of traditional transport infrastructure.

The *14th Five-Year Plan (2021-2025) and Long Range Objectives Through 2035* can be found here.

Based on the *14th Five-Year Plan (2021-2025) and Long Range Objectives Through 2035*, further transport sector-specific 14th FYPs and implementation policies will be released in the coming months on national and sub-national level (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). In order to align the above-listed policies and their implementation with the 2030 and 2060 targets, a top-level leading group on carbon emission peaking and carbon neutrality has been established by the central government comprising leaders of national ministries and agencies.[20] The first plenary meeting of the group, presided by Vice-Premier Han Zheng, took place on May 26 in Beijing (see *Figure 8*). Mr. Zheng highlighted that efforts should be made to guide and supervise local governments and key areas, industries, and enterprises in scientifically setting goals and formulating action plans and targeted and operable policy measures are needed to optimize the industrial structure, promote the adjustment of the energy structure and support research and development of green and low-carbon technologies. Mr. Zheng further highlighted the responsibilities of local authorities and the leading role of State-owned enterprises (SOEs) in achieving the 2030 $CO_2$ emission peaking goal.[21] The establishment of the leading group, which functions as the top-level coordinating and steering political body overseeing China's climate roadmap development and implementation, indicates that the 2030 and 2060 targets are of highest priority for the

[20] 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 director of the National Development and Reform Commission NDRC He Lifeng. According to CarbonBrief, also 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, director of the National Bureau of Statistics Ning Jizhe participated in the plenary meeting.

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

central government and that they must be achieved as an integral part of the overall modernisation and socio-economic transformation towards the establishment of a “beautiful China” by mid-century as outlined above.

A centerpiece of the ambition to achieve 2030 $CO_2$ emission peaking is the formulation of a peaking action plan. The plan is developed by the NDRC, one of China’s most powerful policy-making bodies, together with the Ministry of Ecology and Environment. Based on the plan, sector-specific plans are formulated in close coordination with responsible line ministries. Also, a transport sector peaking plan is currently in development.

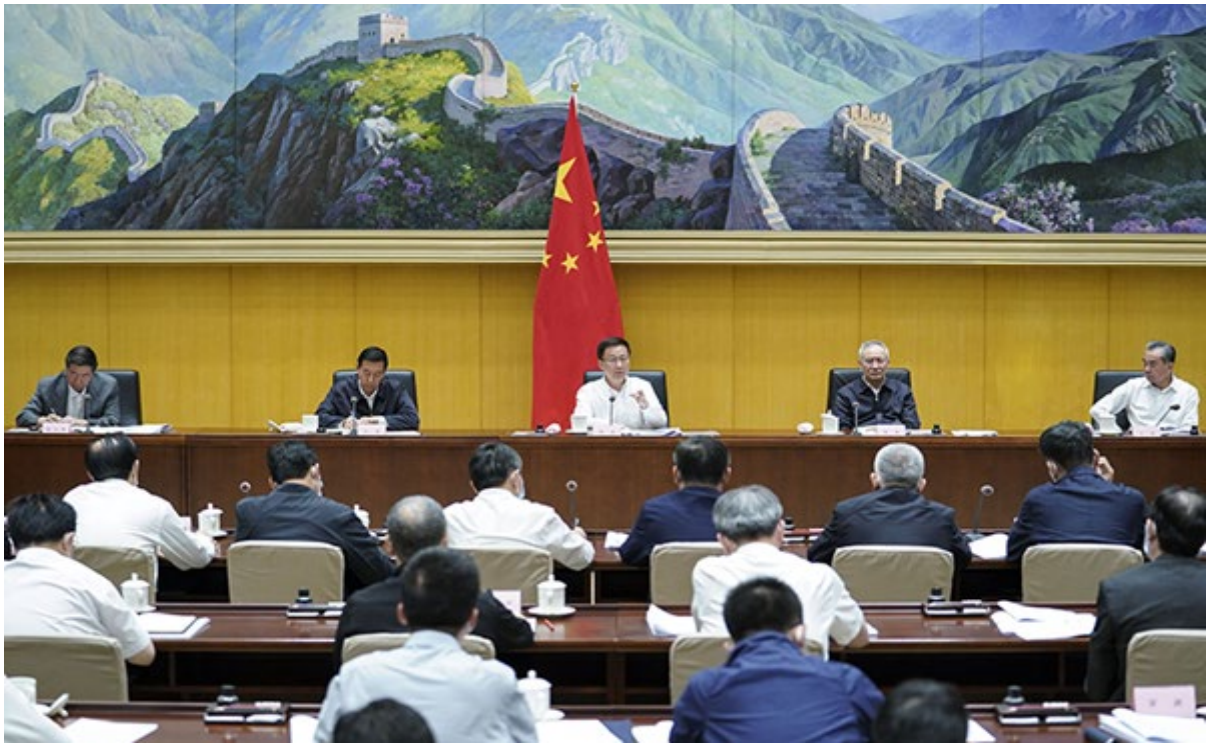


*Figure 8. Plenary meeting of the leading group on carbon peak and carbon neutrality, Source: State Council*

# Recommendations

## Transport emission peaking and decarbonisation strategies

A national-level guiding climate action strategy for the transport sector that is based on emission caps needs to be developed to provide a clear low carbon development pathway for sub-national level 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), clean energy supply, charging and refueling infrastructure, the benefits of co-control of GHG emissions and air pollutants, the interlinkage between transport and other sectors (including urban development, energy, and information sectors), as well as carbon market pricing, fuel, and emission standards, internal combustion engine (ICE) vehicle phase-out roadmaps, data collection, measurement, reporting and verification (MRV) frameworks, green financing and innovation promotion.

The strategy should focus on the Avoid-Shift-Improve approach, aiming 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 further develop low carbon technology.

The strategy should include pathways to a “just transition”. This is to ensure that the potentials of the transport transition for positive economic growth, innovation, and new jobs are fully explored and used and that no one is left behind, to build the needed transition on a broad fundament of social acceptance.

## Aligned transport and energy transition

To decarbonise transport, the transformation of the energy sector towards zero emissions is crucial. The clean transition of the energy sector should be fully aligned with the transport sector transition. Electro-mobility must be zero-emission mobility from well-to-wheel by using clean energy only. Wherever a direct electrification of transport is possible, it should be applied. Green hydrogen and green synthetic e-fuels (Power-to-X) should only be applied where direct electrification is not technically or economically viable in the near-term future (e. g. aviation and maritime transport). The energy, transport, and information sectors should be fully integrated (“energy internet”) to tap the potentials of vehicles as energy storage units (vehicle-to-grid V2G) and

respective new business models (e. g. battery-as-a-service BaaS).

## *Four Nows!*

The *Four Nows!*, which are proposed by the authors, are fields of high priority when it comes to the decarbonisation of the transport sector. The *Four Nows*! are crucial to reach the 2030 $CO_2$ peaking and 2060 carbon neutrality targets. Immediate, holistic, and coordinated ambitions and measures are needed to steer the development of the transport sector onto a zero-emission pathway, particularly against the background of long investment cycles related to e. g. research and development, propulsion technology adoption, and infrastructure construction.


1. **Green freight now!**

   China should play a leading role in the decarbonisation of freight transport. Freight transport accounts for about 65 percent of the total transport emissions in China, of which road freight transport accounts for the biggest share. Thus, the freight sector, including long-distance, inter-city, and inner-city freight transport, needs to be decarbonised as soon as possible. A focus should be laid on the accelerated promotion of intermodal transport aiming at shifting freight transport volumes from road to rail (incl. high-speed freight trains) and inland waterways. Vehicle electrification plays a key role in decarbonising road freight, focusing on battery-electric propulsion and innovative solutions such as catenary trucks for long-haul transport. Further advancement of battery technology, standardisation, and the development of charging and battery swapping infrastructure is needed. Fiscal and non-fiscal support measures, including vehicle purchase subsidies and preferential right-of-way 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 on the last mile, integrated passenger and goods delivery transport solutions, such as cargo trams or subways) should be promoted.

2. **Green aviation now!**

   China should play a leading role in the decarbonisation of air travel. As described above, in the 14th FYP period alone, more than 30 new airports will be built. With still low per capita aviation-related $CO_2$

emissions (0.09 tons compared to 0.57 tons in the US and 0.86 tons in the UK), there is significant potential for China's aviation sector emissions to quadruple by 2050[22]. Therefore, a focus should be laid on the long-term deep decarbonisation of the (domestic and international) aviation sector. This includes cross-border solutions, the further advancement and 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 infrastructures. This further includes the promotion of HSR use over flights wherever possible and the general raise of 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). With shipping being a capital-intensive industry with large long-life assets, thin margins, and high dependency on the global supply of energy-dense fuels, immediate action is needed to decarbonise maritime and inland waterways transport. More resources should be channeled into research on the role of alternative fuels such as green ammonia and their scalable and cost-competitive development and use in the (domestic and international) maritime and inland waterways transport sector. Short-term solutions including clean onshore power supply and clean port measures should be adopted, and innovations such as wind propulsion solutions (e. g. inflatable cargo ship sail systems, sea wings) should be explored.

### 4. Green cities now!

To decarbonise urban transport, holistic approaches are needed, including the effective alignment of urban and transport planning (e. g. by promoting sustainable urban mobility planning SUMP) with climate targets (based on the Avoid-Shift-Improve approach) as well as the promotion of people-centered, compact, space-saving, mixed-use, barrier-free and public transport-oriented cities (e. g. "15-minute city", transit oriented development ToD). This also includes pricing of road and parking space use, the accelerated promotion of public transport as urban mobility backbone (both in terms of network expansion and service improvement) and its integration with new mobility services (e. g. ride-hailing or smart bike-sharing) into carbon credit-based Mobility-

[22] 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

as-a-Service platforms [23], the priorisation of cycling, walking and other forms of micro-mobility, 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 needed alignment of climate protection strategies and roadmaps, best practice sharing, and learning, and can support the international community in exploring opportunities and synergies in decarbonising transport at the global level. Examples of international cooperation in the field of transport decarbonisation are the projects NDC Transport Initiative for Asia (NDC-TIA) and Sino-German Cooperation on Low Carbon Transport (CLCT), which are commissioned by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The projects seek to support the Chinese Ministry of Ecology and Environment (MEE) and Ministry of Transport (MoT) on the low carbon development of the Chinese transport sector and to foster related knowledge exchange between stakeholders in China and other Asian countries.

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), Project Director in the Sustainable Mobility Team of GIZ China and Ms. Xia Yun (yun.xia@giz.de), Technical Advisor in the China Component of the NDC Transport Initiative for Asia at GIZ China.

[23] Mobility-as-a-Service (MaaS) is a concept which aims at promoting ecosystems, facilitating the integration of all transport services into a single mobility platform.

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