BRI International Green Development Coalition
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Research on Green Development of Transportation in BRI Countries

In April 2019, Chinese and international partners officially launched the BRI International Green Development Coalition (BRIGC) at the Second Belt and Road Forums for International Cooperation. BRIGC aims to establish a policy dialogue and communication platform, an environmental knowledge and information platform, and a green technology exchange and transfer platform, so as to advance global consensus, understanding, cooperation, and action of a green Belt and Road Initiative (BRI).

Transportation is an important element of the BRI cooperation and is the basis for Interconnectivity. This report reviews the good practices and experiences of China, United States, Japan, United Kingdome and Germany in promoting green development of transportation. Considering the economic development level, location, transportation development conditions, bilateral transportation cooperation potential, etc., Kazakhstan, Kenya and Myanmar are selected as typical countries along BRI. This report compares these countries` current situation of green transportation development, and recommends the green development paths for the selected BRI participating countries.

The report puts forward three periods for medium- and long-term green transportation development in selected countries: country-specific green transportation preparation phase, green transportation system formation phase, and green transportation system improvement phase. In the end, several policy recommendations for the green development of transportation of selected countries have been provided in terms of strengthening green transportation planning, facilitating the construction of green transportation infrastructure, enhancing capacity building, improving green transportation systems, and promoting publicity and training, which can provide reference for other BRI participating countries.

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Executive Summary

Cooperation in transport sector has been an important component of Belt and Road Initiative. This research on green development of transportation in BRI selected countries can enable BRI countries to learn from the practices and experiences of China and advanced countries and China in promoting green development of transportation, and greatly facilitate their green transition.

This report summarizes the best practices and experiences of developed countries including the United States, Japan, United Kingdom and Germany in green transportation, in terms of energy conservation and carbon emission reduction, pollution control, ecological protection and restoration, and response to climate change. Related areas include green transport infrastructure, green equipment, clean energy, green system and standards, green market mechanism and public behavior. China has also achieved good results in promoting green transportation system by improving the top-level design, adjusting the transportation structure, applying clean energy, promoting green infrastructure, controlling pollution, carrying out scientific and technological innovation and international cooperation.

Based on factors such as the regional economic development status, location, transportation basis, and bilateral cooperation with China, this report selects Kazakhstan, Kenya and Myanmar as selected countries to review the current status of green development in transportation, and by taking into account their basis and conditions, proposes a green development pathway and put forward policy recommendations for green development of transportation.

According to the current situation of transport infrastructure and foundation of green transport in selected countries, the medium and long-term green development of transportation can be divided into three phases, that is, the country-specific preparation phase, the green transport system initial formation phase and the improvement phase. It is proposed to strengthen green transport planning, speed up the construction of green infrastructures, enhance capacity building, improve green systems and promote publicity and training programs.

1 Research Background

Since the inception of Belt and Road Initiative (BRI), it has brought tangible benefits to all countries, greatly contributing to international development and cooperation. Positive progress has been made in various fields and a large number of cooperation projects been successfully implemented. Extending from Eurasian continent to Africa, America and Oceania, the building of BRI has opened up new space for world economic growth, set up a new platform for international trade and investment, expanded new practice of global economic governance, made new contributions to improving the well-being of all nations, and became the road of opportunity and prosperity.

BRI is not only the road to economic prosperity, but also the path of green development. At the Belt and Road Forums for International Cooperation (BRF), participating countries advocate to uphold the principle of openness and green development in the building of BRI to promote green infrastructure, green investment and green finance, so as to protect our planet. In global response to climate change and economic recovery after COVID-19, the idea of putting ecology first, green and sustainable development has become the consensus, roadmap and vision of all countries. It also serves as an important bridge to forge a community of a shared future for mankind. On November 2020, Chinese President Xi Jinping pointed out in the keynote speech at the APEC CEO Dialogue Conference that under the new development pattern, China's external cooperation will continue to deepen and achieve win-win results with other countries. China will continue to be integrated into the global industrial chain, supply chain and value chain. It will continue to hold up high the banner of opening up, adhere to the principle of multilateralism and mutual consultation, and promote high-quality development of BRI. China will facilitate the integration of transport strategies and planning with other countries and regions, achieve synergies in policies, regulations and standards, and deepen cooperation in the fields of infrastructure, industries, trade, science and technology and human exchange, so as to establish BRI into a road of cooperation, recovery and growth that contributes to global development and building of a community of shared future for mankind through green development cooperation.

Cooperation in transport sector is an important part of BRI. New progress has been made in major transportation projects in the global fight against the epidemic and promoting economic recovery. China-Laos railway is completed. The contract for the first phase of China-Thailand railway project has been agreed, the interim goal of the construction of Jakarta-Bandung High-speed Railway been achieved, and the main contract for Hungary section EPC of Hungary-Serbia Railway project has come into effect. Lahore Orange Line Project in Pakistan was put into operation. China-Europe Railway Express gained momentum despite the adverse impact of the pandemic. As of November 2020, 10, 180 China-Europe express trains have been operated, transporting 927 thousand TEUs of goods, a year-on-year increase of 54%, and the comprehensive heavy container rate has reached 98.3%. The transportation network has been continuously expanded, reaching 21 countries and 92 cities in Europe. Since the beginning of this year, nearly 8 million items of medical supplies, totaling more than 60000 tons, have been transported, which has become a "life channel" for China-EU anti epidemic cooperation and provided important support for maintaining the stability of the international supply chain and industrial chain.

Deepening BRI transport cooperation is more important in the context of global epidemic prevention and control. According to the forecast of the International Monetary Fund, emerging economies and developing countries will experience negative growth for the first time in 60 years. The World Bank predicts that the global per capita income would decline by 3.6% in 2020, and 88 million to 115 million people would fall into extreme poverty due to the epidemic. Epidemic prevention and economic stability are urgent tasks for all countries. We should strengthen macroeconomic policy coordination, promote the implementation of the initiative to facilitate the cross-border flow of people and goods, ensure safe and smooth operation of the industrial chain and supply chain, and help countries resume work and production and restore the economy.

China's transportation sector follows the BRI initiative, and has actively promoted the transportation cooperation among various countries along the route, and has achieved remarkable results. This study can provide references for BRI countries to draw experiences of developed countries and China in promoting green development of transport, which will enable them to effectively promote green development of transportation and better implement the requirements of the 2030 Agenda for Sustainable Development while taking into account their local conditions.

This report reviews the best practices and experiences of US, Japan, UK, Germany and China in promoting green transport development, analyzes the current situation of green transport development in BRI selected countries. Built on the basis and conditions for green development of transport of BRI selected countries, this report recommends the green development pathways, and puts forward strategies, objectives and national suggestions for medium and long term green development of transportation.

Literature review, expert consultation and case studies have been conducted in this report to analyze the current status of green transport development of BRI selected countries, draw relevant practices and experiences of developed countries and China, and identify the green development pathways based on their local conditions. Literature review includes collecting materials related to green transport strategies, planning and featured practices of developed countries, China and BRI selected countries. Experts from the State Railway Administration, Research Institute of Highway of Ministry of Transport, Water Transport Research Institute, China Communications Construction Group, The International Council on Clean Transportation (ICCT), research institutions, enterprises and international organizations have been invited to guide this study. Case study analyzes the selected cases of green transportation development in BRI selected countries, and identify the foundation and characteristics of the green development of the transportation industry in the selected countries. Then, the suggestions for national green transport development are proposed.

2 Practices and Experiences of Developed Countries in Green Transport Development

This chapter reviews the practices and experiences of developed countries such as the United States, Japan, United Kingdom and Germany in green development in the field of transportation in terms of energy conservation and carbon emission reduction, pollution control, ecological protection and restoration, and response to climate change. Related areas include green infrastructure, green transportation equipment, clean energy, green logistics, green system and standards, green market mechanism, and public behavior.

2.1 United States

The Strategic Plan for Year 2014-2018 issued by the U.S. Department of Transportation has the strategic objectives on environmental sustainability as follows: strengthen policies and capital investment for environmental sustainable development, and reduce carbon emissions and other harmful substances from transportation; reduce dependence on oil and carbon emissions by studying and adopting new technologies, including alternative fuels, and promoting more energy-saving modes of transportation; avoid and mitigate the impact of transport on climate, ecosystems and communities by analyzing acceptable solutions; promote the adaptability of infrastructure to extreme weather events and climate change through research, guidance, technical assistance and federal direct investment.

According to the Beyond Traffic: Trends and Choices 2045 by the US Transportation Development to achieve transportation energy conservation and emission reduction requires the following work: carry out research on alternative fuels and infrastructure, and invest in the research and development of fuel efficient technologies; subsidize for electric vehicles or vehicles using alternative fuels; tax carbon emissions; support pricing and operational strategies that can reduce road congestion; improve and promote the fuel efficiency standards of various transportation industries; support regional planning and development policies to prevent urban sprawl; invest in public transport, railways and marine infrastructure to support mode switching; and enhance the participation of international governments in the commitment to jointly control greenhouse gas emissions.

Environmental protection policies have been integrated into the transportation development policies of the United States. In 1955, the United States formulated the Air Pollution Control Act, which listed air pollution as a national key problem to be solved, pointed out that traffic exhaust emission is one of the most important sources of air pollution, and clearly pointed out the importance of preventing and controlling traffic pollution in national laws for the first time. In 1963, the Clean Air Act was formulated, which stipulated the emission standards of stationary pollution points in the process of traffic construction. It has been revised and improved in 1965, 1966, 1967 and 1969 respectively. In 1970, the amendment proposed the need to control the emission of mobile sources like automobiles. The 1990 amendment to the Clean Air Act is a landmark legal document in the United States' transportation environmental protection policy. The Act established strict control measures for mobile sources such as cars, required federal States to formulate plans to reduce air pollution, set air quality improvement standards and deadlines, implement a permit system for large-scale pollution discharge, and allow EPA to impose fines on pollution. It set standards and

time limits for states, local governments and enterprises to meet the standards, encouraged the public to participate in environmental protection, formulated incentives for air protection, and required transportation projects funded by the Federation to meet clean air standards.

2.2 Japan

The basic concept of sustainable transport development in Japan is to continue to give priority to public transport, and strive to build an efficient green urban transportation system dominated by rail transit and supplemented by cars and non-motorized transportation. Under the guidance of this concept, Japan has vigorously developed green and low-carbon transportation. Guided by the National Energy Strategy issued in 2006, Japan is committed to promoting public transport and conducting research on new energy vehicles, in an effort to reduce the adverse impact of transport on the environment through green transport and relevant control measures.

2.2.1 Improved Laws and Regulations

In 2002, the Ministry of Land, Infrastructure, Transport and Tourism of Japan first put forward the earth warming countermeasures of the transportation sector as the guidance for Japan to achieve CO2 emission reduction. The countermeasures taken by Japan mainly focus on two aspects: automobile transport measures and building a transport system with minimum environmental load. The specific contents include: popularizing and applying cars with low environmental load, and promoting the transformation of residents' travel mode from small cars to public transport.

In 2013, Japan implemented the Basic Law on Transport Policy, which mainly focused on transport related air pollution, noise and climate change problems, and Article 4 clearly stipulates reducing the environmental impact caused by transport. In addition, the Ministry also promoted the popularization of vehicles with good environmental performance, and encouraged the application of new energy vehicles through tax preferential policies and financial subsidies. At the same time, Japan has vigorously promoted the use of public transport and strictly controlled the impact of transport on the environment. Japan's fuel tax covers a wider range than that of other countries, including gasoline tax, diesel tax, local road tax and natural gas tax. Japan has developed voluntary emissions trading system (J-VETS) and Tokyo total volume limit and trading system to reduce the emission of aviation and water transportation. Tax measures and financial subsidies are also used to encourage the development of new energy vehicles. Japan has formulated a number of laws and regulations related to traffic noise, exhaust emission, waste vehicle recycling and so on.

2.2.2 Unified Standard System

The Japanese government and enterprises are committed to formulating a unified standard system for the industry. Since the 1980s, the Japan Electric Vehicle Association has issued more than 60 standards on new energy vehicles, forming a relatively complete standard and regulatory system for pure electric and hybrid electric vehicles. In 2012, Japan Electric Vehicle Charging Association, led by automobile enterprises like Toyota, Nissan, Mitsubishi and Tokyo Electric Power, was officially established which aimed to promote Japan's electric vehicle charging technology to be a global standard, thus consolidating its advantages in the field of electric vehicles. In addition, Japan implements the world's most stringent automobile fuel economy standards.

2.2.3 Strengthened Transportation Energy Management

Japan is not only a country with serious shortage of energy resources, but also a country that attaches great importance to energy conservation and environmental protection. Japan has strengthened transportation energy management, especially in the road transport, by adopting market, administrative and financial measures.

Encourage new energy research and development. Japan has developed measures to address the long-term supply of transport energy. These measures include the development and application of alternative fuels, biomass fuels, hybrid electric vehicles, electric vehicles and hydrogen fuel cell vehicles, conducting training on energy-saving driving skills, and encouraging and prioritizing the research and development of the second generation biofuels. In the short term, the Japanese government believes that it should seize the opportunity to improve fuel efficiency and encourage the use of energy-efficient technologies through a package of engineering, economic and financial incentives.

2.2.4 Improved Urban Transport Network

Japan has long been giving priority to public transport development by vigorously developing rail transit, improving urban public transport network, paying attention to the seamless connection between different transport modes to enhance the service capacity of transportation hubs. It has also increased government financial subsidies to promote the sustainable development of railway industry, and rolled out flexible ticket fare according to transport demands to change behaviors.

2.4.5 Continued Low-carbon Transport Technologies and Actions

Through improved organizational structure and information technologies, various transport modes have been optimized and a seamless connection been established. Japan also promotes the use of efficient freight transportation modes such as railway, inland water and short-distance sea transportation, puts forward the concept of more efficient logistics, encourages walking, cycling and other non-motorized transport modes in big cities, puts forward measures to manage traffic demand and reduce congestion, further integrate traffic planning with land use, and reduce traffic congestion and emission through scientific planning.

2.3 United Kingdom

2.3.1 Strategies and Policies

The Energy White Paper 2003: Our Energy Future, Creating a Low-carbon Economy issued by the United Kingdom (UK) in February 2002 not only put forward the concept of low-carbon economy for the first time, but also determined the overall strategic framework for the national development of low-carbon economy. In 2005, UK issued Strategic Framework for Hydrogen Energy Activities, and the national strategy and related measures to support the development of hydrogen energy were formulated.

UK enacted the Climate Change Act in November 2008, becoming the first country in the world to legislate to deal with climate change. Under the requirements of the Act, the British government issued the Low carbon Economic Transformation Plan: National Strategy for Climate and Energy (hereinafter referred to as

the Transformation Plan) in July 2009, covering emission reduction objectives and scope of work for the transport sector. Thus, the all-round development of British low-carbon transportation system was started. The policy measures include market tools, mandatory measures, financial support, information release and awareness raising. The policy objects include automobile and fuel manufacturers, retailers, road users and public institutions.

After entering the era of low-carbon economic transformation, the British Department of Transport issued Low-carbon Transport: a more Environmentally Friendly Future in 2009, formulating an overall strategic plan for the construction of low-carbon transport system in the next decade as an integral part of the transformation plan. The Transformation Plan defines the goal of transforming transportation and puts forward key policy directions for the building of an integrated low-carbon transportation system, including energy efficiency improvement of new and traditional vehicles, support for future low-carbon vehicles and fuels, promoting low-carbon travel decisions, requiring international aviation and navigation to reduce carbon emissions, and ensuring the security of oil supply during the transition. In 2010, the UK promulgated the National Renewable Energy Action Plan which made carbon emission reduction commitment and energy efficiency system. In 2012, the green investment bank was established to finance low-carbon investment. Subsequently, laws, regulations and fiscal and tax policies were formulated to promote the use of low-carbon fuels.

2.3.2 Main Polices

2.3.2.1 Developing Low-carbon Fuel Technologies

The UK has adopted a series of policies to encourage the transport sector to develop low and ultra-low carbon fuel. In terms of ultra-low carbon fuel, the British government focuses on the development of bioenergy and hydrogen energy, encourage and promote the sustainable use of biofuels in the aviation industry. For the use of vehicle electric fuel, the planning and construction of charging infrastructure have been strengthened and the fuel cell bus hydrogenation demonstration projects carried out.

2.3.2.2 Improving Transport Equipment Efficiency and Carbon Emission Standards

Develop low-carbon transportation equipment technology, carry out pilot projects of low-carbon vehicle, train and aircraft technologies, improve carbon emission standards of transportation equipment, and facilitate the decarbonization of passenger cars, commercial vehicles, trucks, trains, aircraft and ships. Encourage the promotion of low-carbon vehicles through business models and fiscal incentives including battery leasing, subsidies for the purchase and operation of low-carbon buses. Electric vehicles do not pay fuel tax or vehicle consumption tax, and enjoy the lowest proportion of corporate vehicle tax. In addition, Transport for London exempted the payment obligation of low-carbon vehicles in the London traffic congestion charging scheme. Through information publicity, consumers are encouraged to buy low-carbon cars. The government provides consumers with information to help them understand the energy efficiency and carbon emission of various cars and fuels. Set mandatory targets for the use of low-carbon vehicles in the public sector.

2.3.2.3 Improving the Efficiency of Transport System

Rational planning of land use, the Ten Year Plan for Transport issued by the British government puts forward the goal of reducing traffic demand and subsequent environmental impact through sustainable land use. Improve transportation infrastructure, formulate large-scale railway electrification plan, and carry out high-speed railway project. Encourage freight transport to shift from roads to railways and waterways. The UK Department of Transport provides subsidies to companies that transfer goods from road to rail and water transport with freight model transition funding programs. Strengthen the organization and management of aviation operations, including optimization of flight planning, speed management, coordination between aircraft and flight mission, weight reduction, etc. Improve the level of informatization, and provide information technology to enable people to deal with passenger, goods and services without travel, so as to reduce travel and carbon emission caused by traffic congestion. Improve the capacity of infrastructure to cope with climate change. The UK Department of Transport made great efforts to deal with climate change, by revising track specifications and improving drainage in the railway industry to adapt to high temperature and rise in rainfall. The Highway Bureau has completed the research on highway engineering materials and technologies and began to take some measures, such as formulating new pavement specifications to minimize the impact of high temperature climate on highway network in the future, and revising drainage standards to increase rainfall bearing capacity by 20% - 30%.

2.3.2.4 Encouraging Low-carbon Travel

Encourage the public to choose low-carbon public transport travel mode, and explore a subsidy system for public transport service providers that has nothing to do with fuel consumption; encourage cycling and walking; promote individuals and transport enterprises to choose low-carbon driving methods. Carry out environmental training for drivers in bus, freight and logistics industry, promote environmental driving technology to reduce carbon emissions. Encourage governments, enterprises and individuals to reduce unnecessary travel. The British government has urged the public institutions to reduce business travel and launched the smarter choice activity since the 1990s to encourage people to voluntarily reduce car use.

2.3.2.5 Developing Market Mechanism

The original plan of the UK was to include traffic emissions into the carbon emissions trading scheme, but in the first PFV annual report, the transport department changed its plan to join the emissions trading scheme and placed its hope on the EU emissions trading scheme. The UK has applied to the European Commission to expand the transaction scope to transport and other sectors in the second phase of EU ETS.

The UK is at the forefront of EU countries in formulating an effective emission trading mechanism for the international aviation and shipping industry. British Airways was incorporated into the EU emissions trading system in 2012. The UK will also formulate an international agreement on reducing marine emissions through the International Maritime Organization (IMO) or the United Nations Framework Convention on climate change (UNFCCC), integrate the shipping sector into global efforts to deal with climate change, and address shipping greenhouse gas emissions through economic measures (such as the global emissions trading scheme). In addition, the British government promises to work with international organizations, the European Commission and other EU Member States to integrate road transport into the EU emission trading system.

2.3.2.6 Strengthening Government Supervision

In terms of low-carbon fuels, the UK promotes the use of sustainable biofuels through various regulations. In terms of freight logistics, the Department of Transport formulates unified standards for carbon measurement, reporting and implementation for the freight and logistics industry. In terms of bus preferential policies, England has formulated a compulsory bus preferential policy, so that 11 million people can travel by bus for free.

2.4 Germany

2.4.1 Strategies, Policies and Legislation

The three major policy frameworks of the EU Climate Change Plan (ECCP), the German Energy Efficiency Action Plan (EEAP) and Integrated Energy and Climate Package (IECP) are the common guidance for the low-carbon economic transformation of the Germany, covering eight categories of measures and emission reduction targets with transportation as one category.

In addition to the above three medium and long-term strategic action plans, the German government has also successively issued a number of strategic documents on energy, environment and sustainable development, and constantly revised and improved energy conservation and emission reduction targets. In 2004, the German government issued the National Sustainable Development Strategy, which formulated the fuel strategy featured by alternative fuels and innovation driven technologies aimed at reducing fossil energy consumption. In June 2009, the BMUB released the strategic document on developing low-carbon economy, emphasizing that low-carbon is the guiding principle of economic modernization, and low-carbon technology is the stabilizer of the current German economy and will become the key to Germany's economic revitalization in the future. In September 2010, the German federal government issued the long-term strategy of the energy program, which aims to make Germany a leader in the world in energy efficiency and green economy. The strategy puts forward the greenhouse gas emission reduction targets by 2020, 2030, 2040 and 2050, and puts forward relevant action plans and measures. In 2011, the German federal government put forward the draft German Energy Plan including 39 development tasks and relevant development goals for buildings, transportation, energy and other industries.

In terms of building a legal framework to promote the development of low-carbon economy, Germany is one of the European countries with the most comprehensive legal framework. The legislation of resource utilization and environmental protection in Germany is divided into three levels: federal law, state law and local legislation. Since the 1970s, the German government has launched a series of environmental policies, states and local governments have also formulated energy conservation and emission reduction, low-carbon development regulations and incentives as a supplement to federal laws. So far, there are more than 8000 federal and state environmental laws and regulations in Germany, and more than 400 EU regulations also have legal effect in Germany.

2.4.2 Main Policies

2.4.2.1 Promoting the Use of Low-carbon Fuels

The German government attaches great importance to the application of renewable energy technology in the field of transportation. The draft German Energy Plan puts forward the application goal of renewable energy in the field of transportation. Despite CO2 emission in 2020 dropped by 281,000 tons compared to 2005. Germany has been studying electric vehicles and hydrogen fuel cell vehicles.

2.4.2.2 Elevating Transport Equipment Efficiency and Carbon Emission Standards

Develop low-carbon technologies for transportation equipment. Germany is at the forefront of the world in the innovation of energy-saving and emission reduction technology of transportation equipment. For railway transportation, Germany plans to optimize the overall manufacturing technology, improve the transportation efficiency of long and short distance trains to reduce pollution through technology and operation management. In aviation transportation, Germany has put forward measures such as fuel consumption optimization, reduction of additional flight distance, technological innovation and so on. In road transportation, Germany has put forward various measures for vehicle technology innovation. In terms of waterway transportation, it is also committed to studying how to use renewable energy such as solar energy to provide power for ships. Wind driven ships have been put into operation step by step. Germany is very active in the research of on-board fuel cells and develops special inland ships using fuel cells.

Support the development of new energy vehicles. In 2009, the German government adopted the Electric Vehicle Development Plan, which puts forward the goal of obtaining 1 million electric vehicles by 2020. It is planned to spend 500 million euros to support the research and development of vehicle batteries and build 8 electric vehicle pilot zones.

Adopt fiscal and tax incentives to encourage the use of low-carbon transportation equipment. Since July 1, 2009, Germany has implemented the policy of levying automobile tax according to engine emission and CO2 emission to encourage consumers to pay more attention to environmental protection when buying cars, and automobile manufacturers to adopt environmental technologies.

German government has given a 10-year tax reduction or exemption for the purchase of electric vehicles, to encourage people to choose energy-saving travel tools. In addition, every year, the federal government allocates special funds to the Federal Freight Transportation Bureau, which is distributed to enterprises as subsidies for installation of safety and environmental protection devices.

In addition, Germany also adopts the method of levying high fuel tax and highway toll to promote the use of low-carbon transportation equipment and promote consumers to use more lead-free and low sulfur fuel.

Germany has taken measures to guide and encourage the structural adjustment of inland ships. When the transport capacity is relatively insufficient, subsidies will be given to ship manufacturers and medium and small sized ship owners, and taxes such as fuel tax, ship navigation tax, navigation mark fee and berthing fee in port be reduced or exempted. When the transport capacity is in surplus, ship dismantling subsidies are given to phase out the old ships. These shipping structural adjustment measures have promoted the large-scale, professional and standardized development of ships, playing a positive role in maintaining the stability of inland shipping market and strengthening its competitiveness.

Develop mandatory standards and specifications to promote the use of low-carbon transportation equipment. The road transport accounts for a lion's share of German transport. Therefore, the German Federal Freight Bureau has put forward relevant environmental requirements for the freight vehicles, including: (1) formulate the most stringent standards or conditions to prohibit the use of unqualified vehicles; (2) advocate for environment-friendly vehicles and engines; (3) promote transport licenses, and continuously improve standards according to technological improvement to encourage the development of environment-friendly vehicles; and (4) mandatory inspection.

2.4.2.3 Improving Transportation Efficiency

Improve transport planning and layout. Actively promote the transfer of road transportation to low-carbon transportation modes such as waterway and railway. At present, the most important way to shift from road transportation to railway and water transportation is to charge. Environmental protection factors are considered in the charging standard, which is formulated according to the tail gas pollutants per kilometer. Before the implementation of the charging policy, the transportation volume ratio of road, railway and water transportation in Germany was 7:2:1, but now about 3% of road transportation has turned to railway or water transportation. Germany will further study the charging scheme for cars and introduce more environmental protection elements into the current charging policies.

Actively develop waterway transportation. Germany regards the construction of inland waterway network as an important part of national transportation infrastructure. It has made remarkable achievements through unified planning, standards and phased implementation. Improve the competitiveness of inland shipping by exempting fuel tax. Develop new modes of transportation. In urban areas with dense population and large ground traffic flow, Germany has launched a pilot project to develop new transportation modes. In Essen City of Ruhr district in North Wales, it has carried out a pilot of freight package pipeline transportation. This mode is similar to pipeline transportation which adopts the form of conveyor belt to deliver goods underground. However, due to high cost, it cannot be applied all over the country. It is only applicable to the transportation of goods in big cities.

Accelerate the development of multimodal transport. The German government has made great efforts to promote the development of multimodal transport through fiscal policies and regulations. It promulgated the Outline for the Development of Multimodal Transport Transfer Facilities and Equipment in 2009, focusing on financial support for multimodal transport, so as to promote green and sustainable development of multimodal transport. The drop and pull transportation in Germany is highly developed, with the ratio of tractor head to trailer up to 1:3. The drop and hitch transportation can be realized in logistics centers all over the country, which provides convenient conditions for multimodal transport. In terms of mode composition, Germany strives to increase the proportion of railway and waterway multimodal transport by providing financial support, such as giving certain incentives to enterprises switching from road transport to railway transport, so as to adjust the transportation structure and reduce energy consumption and emission.

Carry out research on key technologies in green logistics. Germany is carrying out key technology research

on energy conservation and emission reduction in logistics, and puts forward a plan to develop green logistics. The federal government, German railway, Deutsche Post and other domestic logistics giants and United Parcel Service (UPS) launched the joint research on green logistics in 2010, which mainly focuses on energy utilization and consumption and GHG in the process of transportation and storage. The key areas include GHG calculation methods and standards, emission reduction technologies and energy-saving technologies.

Optimize the highway transportation network and develop an efficient transportation organization model. Road transportation has played a dominant role in German comprehensive transportation system. The road transportation in Germany is highly market-oriented, and the transportation market is highly organized and specialized. At present, the road transportation in Germany has realized information and automation.

2.4.2.4 Promoting Low-carbon Travel Mode

Encourage the public to choose low-carbon transport. In Germany, the best way to travel is to use a highly mature public transport system, especially trains and buses. In cities, the German government has paid attention to the establishment of walking and bicycle networks. In densely populated areas, pedestrian traffic is put in the first place, and the driving speed of vehicles is strictly limited. Cultivate energy-saving driving habits. Research shows that a safe and fuel-saving driving behavior can save fuel by 6% - 25%.

2.4.2.5 Facilitating the Development of Emission Trading System

The EU implemented carbon emission trading system in 2005, and set up carbon emission trading centers in Paris, London, Munich and Leipzig, stipulating that enterprises with high-energy consumption and emission must participate in carbon emission trading.

The transport industry in the EU, including Germany, has also been integrated into the carbon emission trading system. The way and timing for the integration varies for different transport modes. Railway transportation is not directly included in the system, but since electricity used by railway transportation is included in the ETS, which means the railway industry is indirectly included. Aviation transport has been incorporated into the system since 2012, and certain fees must be paid for the taking off and landing of aircraft across EU. In terms of ship transportation, navigation was determined to be included in the carbon emission trading system in July 2011. The integration of road transportation into the ETS is relatively slow, mainly due to complex composition of cost, in which the fuel cost accounts for only 26% of the total cost, while the carbon price based on the fuel cost has little impact on the overall cost. However, Germany is still considering integrating road transport into the ETS as soon as possible, by setting up a special account for vehicle users, that is, certain carbon credit is deducted from the account for each refueling. If the annual refueling volume is too much and the carbon credit in the account is insufficient, they need to buy emission credits from others.

2.4.2.6 Strengthening Government Supervision

Strengthen the construction and supervision of energy conservation consulting institutions. The German government attaches great importance to the construction of energy-saving consulting institutions. One of the main functions of the German Energy Agency established in 2002 is to provide energy-saving consulting

services for enterprises and the public. At present, there are nearly 400 energy-saving consulting institutions in Germany. Strengthen energy conservation publicity. Strengthen the supervision of waterway transport market. Strengthen vehicle maintenance and test. The test focuses on safety and environmental performance. The inspection agencies mainly conduct regular inspection and emission performance test after maintenance, and carry out performance test on old vehicles which will be traded in the market until they meet the requirements of performance test.

2.5 Experiences of Developed Countries in Green Transport Development

To sum up, the experiences of green development of transportation in developed countries mainly includes the following aspects:

First, pay attention to top-level design. Continuously optimize the green development strategy of transportation, and improve the green development plan and standards.

Second, continue to promote multimodal transport. Improve the proportion of railway and waterway transportation in the freight transportation.

Third, improve green transportation equipment. Continue to increase energy efficiency of traditional vehicles and ships driven by traditional energy continues to improve. Give priority to the development of clean energy vehicles and ships powered by wind, solar and hydrogen fuel.

Fourth, be market-oriented to facilitate transition towards green transportation.

Fifth, strengthen capacity building for green development of transportation.

Sixth, attach importance to international exchange and cooperation in green transport.

3 China's Practices and Experiences in the Green Development of Transportation

China has made great efforts to improve the green transportation system which achieved favorable results. These measures include improving the top-level design, restructuring the transportation, applying clean energy, promoting green infrastructure, controlling pollution, enhancing innovation and international cooperation.

3.1 Green transport top-level design has been improved

During the 13th Five Year Plan, in order to promote green transportation, China formulated a comprehensive top-level design on green transportation, accelerated the formulation and revision of green transportation regulations, further improved the green transportation standard system, and promoted the assessment and management of regional thematic projects. Green transport policies, regulations and standards have been improved while the assessment and management system needs to be further improved.

In terms of policies and regulations, a series of top-level policies such as the Implementation Plan for Promoting the Construction of Ecological Civilization in Transportation, the Opinions of the Ministry of Transport on Comprehensively Implementing Green Transport Development, and the Implementation Opinions on Comprehensively Strengthening Ecological and Environmental Protection and resolutely Fighting the Tough Battle Against Pollution have been issued. Special policies have also been introduced including the adjustment of transportation structure, the development of multimodal transport, green travel, ship berthing and use of shore power, ship emission control area, ship pollutant collection, transfer and disposal, diesel truck pollution treatment, green transportation infrastructure construction, promotion of new and clean energy vehicles and ships, capacity building for oil spill emergency and urban green distribution. These policies provide an institutional support for comprehensively promoting the green development of transportation.

In terms of standard and specification system, the Green Transport Standard System 2016 was issued which integrated 221 standards related to green transportation development from the aspects of energy conservation and carbon reduction, ecological protection, pollution prevention and control, resource recycling, monitoring, evaluation and supervision. With the release of the Energy Conservation Specifications for Highway Engineering, Technical Specifications for Recycling of Highway Asphalt Pavement, and the revision of relevant standards and specifications such as Design Specifications for Highway Environmental Protection and Specifications for EIA of Highway Construction Projects, the green standards are incorporated into the standard system of highway engineering. The formulation of Technical Specifications for Highway Environmental Protection Construction, Technical Specifications for Highway Ecological Conservation and Restoration, Technical Specifications for Highway Ecological Conservation and Restoration in High Cold Altitude Areas, Technical Specifications for the Utilization of Construction Waste in Highway Engineering and Technical Guidelines for the Recycling of Highway Cement Concrete Pavement has been launched to promote the application of green standards and specifications in highway engineering

feasibility, design, construction, operation and maintenance. The development and revision of Green Waterway Transport Engineering, Evaluation Standards for Green Ports Grades, as well as the release of standards and regulations including Energy Consumption of Port Equipment, Online Monitoring of Energy Consumption of Inland Ships, Technical Rules for Statutory Inspection of Domestic Marine Ships 2020, Technical Rules for Statutory Inspection of Inland Ships 2020, have guided the construction of green ports and green channels, and improved the environmental protection of domestic ships. The adoption of the Service Specification for Urban Distribution Logistics Enterprises and the Technical Requirements for the Selection of Electric Operating Trucks has contributed to promoting the standardized development of urban green freight distribution.

In terms of assessment and management, the assessment of regional thematic projects has been carried out through the issuance of assessment documents, including the Notice on Publishing the Assessment and Acceptance Results of Green Transportation Pilot Projects, the Notice on the Assessment of Regional Thematic Transportation Energy Conservation and Emission Reduction Projects 2017-2019, and the Guidelines for Performance Assessment and Grading. Those projects with good performance are awarded green projects.

3.2 Positive Results Achieved in Transportation Restructuring

Clarify the top-level design of transportation structure adjustment. Adjusting the transportation structure is important to fight the tough battle against pollution and secure the blue skies. It is an effective way to deepen the supply side structural reform and promote the cost reduction and efficiency increase of the logistics industry. It is an inherent requirement of constructing a modern integrated transport system and building a transport power. In September 2018, the general office of the State Council issued the Three-year Action Plan for Promoting the Adjustment of Transportation Structure (2018-2020), focusing on Beijing-Tianjin-Hebei and its surrounding areas, the Yangtze River Delta and Fen-Wei Plain. It aims to take three years to increase the national railway freight volume by 1.1 billion tons from 2017 to 2020, the waterway freight volume by 500 million tons, and the road transport volume of bulk cargo in coastal ports decreased by 440 million tons. The national multimodal freight volume increases by 20% and the container hot metal transport volume in key ports rises by more than 10%. Therefore, related actions have been implemented nationwide, including railway capacity improvement action, water transportation upgrading system, road freight management system, multimodal transport speed-up action, information resource integration action and urban green distribution action.

Establish organizational mechanism for transportation structure adjustment. The Ministry of Transport, together with the Railway Administration, the Civil Aviation Administration, the Post Office and the State Railway Group, established a working group on transportation structure adjustment, and jointly issued the Notice on Implementing the Three-year Action Plan for Transportation Structure Adjustment (2018-2020), and the Implementation Plan for the Construction of the Transport Structure Adjustment Demonstration area in Beijing-Tianjin-Hebei and Surrounding Areas has been formulated. In conjunction with NDRC, we issued the Guiding Opinions on Accelerating the Construction of Special Railway Lines, focusing on solving the problem of “the last mile” of railway transportation. China also coordinate the Ministry of Natural Resources to include the railway special line into the acceptance scope of land occupation of permanent

basic farmland, and solve the problem of land approval. 31 provincial governments and the Xinjiang Production and Construction Corps have distributed the Implementation Plan for the Adjustment of Transportation Structure. All localities have actively issued relevant supporting policies. Jiangsu Province and Tangshan city set up special funds to provide subsidies to relevant enterprises. Beijing, Hebei, Shandong provinces established dynamic monitoring system and joint working mechanism for transportation structure adjustment. The scale of the first phase of blue sky fund in Tangshan reached 1.852 billion yuan, including 463 million yuan invested by Jinfa Group on behalf of the government and 1.389 billion yuan invested by 12 iron and steel enterprises. After the establishment of blue sky fund, it is exclusively used to support the switch from road transport to rail transport for cargo distribution of large iron and steel enterprises in Tangshan, so as to control dust scattering, reduce motor vehicle exhaust emission and alleviate the pressure on roads. According to estimation, after the implementation of the project, only ore transportation witnessed a reduction of 100000 tons of dust pollution, 1104 tons of PM from tail gas and 8832 tons of nitrogen oxides.

Speed up the switch from road transport to rail transport for freight. From 2018 to 2019, China's railway freight volume totaled 8.414 billion tons, an increase of 642 million tons over 2017; while the waterway freight volume reached 14.499 billion tons, an increase of about 790 million tons over 2017, exceeding the target of the first two years. In 2019, the coal gathering ports of major coastal ports around the Bohai Sea, Shandong Province and the Yangtze River Delta and 17 ports such as Tangshan port and Huanghua port have been changed to railway and waterway transportation, and the railway and waterway dredging of bulk goods such as ore and coke has increased to 52%, an increase of 5.1% over 2017. The scale and proportion of railway-waterway intermodal transport have been continuously improved. In 2019, the national ports completed 5.155 million TEUs of containers, a year-on-year increase of 14.2%, and the container intermodal transport volume of seven key ports such as Tianjin increased by 25.5% year-on-year. The road transport volume of bulk goods in coastal ports has decreased by about 240 million tons. The project list of 143 special lines to be built in 8 provinces, regions and or cities in Beijing-Tianjin-Hebei and surrounding areas has been clarified. By the end of 2019, 25 special lines have been built, including 4 special railways for ports, 8 special railways for logistics parks and 13 special railways for large industrial and mining enterprises.

Efficient transportation organization is advancing rapidly. The Ministry of Transport, together with NDRC and other departments, has organized pilot projects and information sharing. These projects include drop and hitch transportation, multimodal transport, green freight distribution and vehicle free carrier. It has successively organized and implemented four batches of 209 pilot projects for drop and hitch transportation, three batches of 70 multimodal transport projects, and two batches of 46 green freight distribution cities. MOT has carried out three batches of 70 multimodal pilot projects and achieved good results. By the end of 2019, the MOT and NDRC jointly issued a document naming 12 national multimodal transport demonstration projects, guiding 21 provinces to formulate implementation plans for multimodal transport development. Standards and specifications such as Domestic Container Multimodal Transport Waybill and Domestic Container Multimodal Transport Electronic Waybill have been issued to provide standards for the development of multimodal transport. In 2019, the first three batches of multimodal transport demonstration projects achieved about 4.8 million TEU of container transport, reducing cost by about 15 billion yuan compared to road transport.

3.3 Application of Clean Energy Achieved Rapid Progress

Accelerate the promotion and application of new energy vehicles. The MOT has compiled a series of standards and specifications, such as Configuration Requirements for Electric Buses, Technical Conditions for Pure Electric City Buses, Daily Inspection Methods for Pure Electric Vehicles, and Passenger Service Specifications for Urban Buses and Trolleybuses, which improved the standard system for the application of new energy vehicles and further improved the application technology of new energy vehicles in the industry. It also issued the Implementation Opinions on Accelerating the Application of New Energy Vehicles in the Transportation Industry, supported the promotion of new energy equipment and the construction of supporting facilities, and the construction of electric vehicle charging and replacement infrastructure, and promoted the popularization and application of electric vehicles. Specific measures have been defined in implementing support policies, improving systems and mechanisms, and strengthening safety management. In cooperation with the Ministry of Finance and other departments, the Notice on Supporting the Promotion and Application of New Energy Buses was issued to further optimize the utilization environment, promote the transformation and upgrading of public transport. "China-US zero emission bus competition" were carried out to accelerate the use of new energy buses. MOT also cooperated with the State Taxation Administration to distribute the Notice on the Exemption of Vehicle Purchase Tax for Urban Public Transport Enterprises, which clarified the working procedures for the exemption of vehicle purchase tax. By the end of 2020, demonstration project for urban delivery vehicles has been launched in 46 cities across the country. The number of new energy transit buses, taxis and urban delivery vehicles has reached 466,000, 132,000 and 430,000 respectively. Buses in Shenzhen and taxis in Taiyuan have all adopted pure electric vehicles. Among 31 provinces, more than 1,500 pairs of expressways service areas (including parking areas) have been covered by electric charging and changing facilities.[1]

Actively promote the use of shore power by ships berthing at the port. Using shore power is the most effective way to reduce air pollution during ship berthing. In order to implement national laws and regulations and relevant requirements for pollution prevention and control, in the 13th Five Year Plan, various measures have been taken to promote the use of shore power by ships docked in ports with top-level design, financial incentives, improved standards and specifications, and coordinated actions. The MOT issued the Port Power Layout Plan in July 2017, proposing the layout objectives for five types of specialized berth shore power facilities in major ports and emission control areas by the end of 2020, with regular guidance and supervision. From 2016 to 2018, MOT in partnership with MOF awarded the construction of shore power facilities, with a total fund of 740 million yuan, which supported 245 shore power projects for berthing ships, and facilitated the transformation of shore power facilities for 62 ships. In February 2019, six departments, including MOT and MOF, issued the Notice on further Promoting the Use of Shore Power for Ship Berthing, so as to further strengthen the use of shore power for ship berthing. The issuance of Technical Specifications for the Construction of Wharf Shore Power Facilities, the Technical Specifications for the Detection of Wharf Shore Power Facilities, as well as the Management of Port and Ship Shore Power, further improved the shore power standard system and regulated the construction and use of shore power.

In order to promote the construction and use of shore power facilities, some local governments have also issued supporting policies. For example, Guangdong Province has actively implemented the shore power

price preferential policy, issued the Notice on the Price of Shore Power at Ports, and implemented large industrial electricity prices for port shore power operators with power receiving transformer capacity above 315 kVA. Before the end of 2025, port shore power operators with double electricity prices will be exempted from volume-based charges. The Plan for Comprehensively Promoting the Construction and Use of Port power in Guangdong Province was issued, and the provincial financial funds were used to subsidize the shore power projects. The Shenzhen municipal government attaches great importance to the promotion of shore power, and has issued the Five-Year Action Plan for the Construction of Green and Low-carbon Port in Shenzhen (2016-2020) and the Layout Plan for the Promotion of Shore Power in Shenzhen Port, which defined the objectives and implementation plan of shore power promotion, and formulated financial subsidy policies to encourage port enterprises to build shore power facilities and shipping companies to use shore power. Compile the Manual of Shore Power of Shenzhen Port to share the technical parameters, cases and subsidy policies with the foreign enterprises. Tianjin issued the Notice on Accelerating the Port Power Layout, required port operating companies to formulate shore power facility transformation plans, and assigned tasks and time nodes. Tianjin also issued the Notice on the Incentive Funds to Support the Project Application of Port based Power Supply Facilities in 2018-2019, to reward the port power projects. In order to strengthen the coordinated action for the use of shore power, Tianjin Port and Shipping Administration, Tianjin Maritime Safety Administration and Tianjin Port (Group) Co., Ltd. established a reporting mechanism for the use of shore power in September 2019 to enhance information sharing. It also strengthened supervision on the use of shore power to improve its efficiency.

With concerted efforts of various departments, China's port shore power facilities have taken initial shape. According to statistics, by the end of 2019, more than 5400 sets of port shore power facilities have been built across the country, covering more than 7000 berths (including water service areas). The completion rate of Port Power Layout Scheme has exceeded 80%. The utilization rate of shore power facilities is also increasing. Among them, the utilization rate of shore power facilities of Yantian international container terminal can reach 20%, with a total power connection of about 11000 hours and total power consumption about 14 million kwh, which exceeds the level of Long Beach port in the United States.

Actively promote the application of LNG in the water transportation. The Ministry of Transport coordinated with the Ministry of Housing and Urban-rural Development in developing the Design Standard for LNG stations. The pilot demonstration of LNG application in water transportation was carried out, and the Code for Design of Inland LNG Ports (Trial) was issued. MOT issued the Opinions on further Promoting the Application of LNG in the Water Transportation, accelerated the upgrading of ship energy consumption structure, promoted the green development of water transportation and the adjustment of energy structure, and further promoted the use of LNG in the water transportation industry. The Layout Plan for LNG Terminals along the West River Channel of Grand Canal of Yangtze River (2017-2025) was issued to guide the construction of LNG terminals for inland ships. The Ministry of Transport, together with the Ministry of Finance, the State Taxation Administration and the Ministry of Industry and Information Technology, issued the Notice on Preferential Policies for Energy-Saving Vehicles and Ships, and ships with pure natural gas engines will be exempted from tax. By the end of 2020, 20 LNG stations have been built in inland rivers, of which 4 have been put into operation, and more than 290 LNG powered ships built. Four LNG powered tugboats, more than 2000 LNG powered container trucks and more than 20 LNG stations have been built in

coastal ports. The MOT has made great efforts to address emergencies, used the funds to subsidize the inland LNG powered ships, issued the tax reduction policies for LNG powered ships, and given priority to LNG powered ships to get through the Three Gorges. In coordination with NDRC, the Ministry of Housing and Urban-rural Development, MOT helped solve the difficult problem of getting approval for construction and operation of LNG stations. It has satisfied the requirements to use clean energy machinery, vehicles and tugs to protect the blue sky defense, and guided port enterprises to eliminate high emission tugs and vehicles through replacing oil with gas or electricity measures.

3.4 Green Transport Infrastructure Effectively Promoted

Deepen the construction of green roads. China has distributed the guiding opinions on the implementation of green highway construction and the guiding opinions on promoting the construction of highway steel structured bridges, coordinated the technical requirements for green development in the whole process of highway design and construction, organized the implementation of green highway construction, promoted the resource conservation, ecological environmental protection, energy conservation and efficiency, service improvement of highway engineering, and improved green development. In the revision of highway industry standards and specifications, the concept of green development was implemented, and the code for energy conservation of highway engineering, technical code for recycling of highway asphalt pavement, technical guide for construction of highway conventional span steel structure bridges, technical guide for green highway construction, and technical code for Highway environmental protection were formulated. The code for environmental impact assessment of highway construction projects has initiated, the formulation of technical code for highway environmental protection construction, technical code for highway ecological protection and restoration, technical code for highway ecological protection and restoration in cold and high altitude areas, technical code for highway engineering utilization of construction waste and technical guide for beautiful rural roads continue to promote the application of green standards and specifications in the stages of highway engineering feasibility study, design, construction, operation and maintenance, and accelerated the construction of highway green standard system.

Typical demonstration projects have achieved positive effect. 33 typical demonstration projects of green roads and 9 typical demonstration projects of steel structure bridge construction have been determined in three batches. Of the 33 typical demonstration projects of green roads, 4 green roads have been put into operation, and 24 demonstration projects are under construction. In addition, 22 provinces have issued implementation plans for green road construction. Six provinces have compiled technical guidelines and evaluation standards, and 16 provinces have defined the number of green highway demonstration projects. Through demonstration and guidance, the concept of green development will be further promoted in the industry, and the best practices gained in the trial period will be promoted in all regions.

The construction of green ports and green waterways has been accelerated. In terms of green ports, four green port projects in Liaoning and Shandong Province and 11 green ports pilot projects including Dalian port and Tianjin port have been completed. Eight terminals such as Shenzhen Port Shekou Container Terminal Co., Ltd. have been graded as "four-star" green ports. The port coastline resources have been integrated and special treatment of illegal terminals conducted.

In terms of green channel construction, China has successively issued the implementation plan for pollution prevention and control of ships and ports (2015-2020), the guiding opinions on promoting the development of green shipping in the Yangtze River Economic Belt, the opinions on promoting the high-quality development of shipping in the Yangtze River and the action plan for promoting the green development of water transportation in the Pearl River (2018-2020), China has accelerated the green development of the Yangtze River Economic Belt and the Pearl River Basin, and applied the concept of ecological and environmental protection throughout the whole process of waterway design, construction and maintenance. Ecological banks, beaches and artificial reefs have been widely used. Energy conservation and environmental protection of ship locks have been steadily promoted to improve energy efficiency and protect the landscape The green development of navigation facilities has also been improved.

3.5 Pollution Prevention and Control Deepened

Accelerate the pollution control of diesel trucks. By cooperating with the Ministry of Ecology and Environment, MOT has issued the action plan for tackling key problems in diesel truck pollution control and effectively reduced the pollution emission. In cooperation with MEE and other departments, MOT developed the notice on the implementation of vehicle emission inspection and maintenance system and technical specifications for data exchange of vehicle emission inspection, maintenance and repair, and the transportation industry standard general technical requirements for vehicle emission performance maintenance stations. The introduction of automobile emission pollution control plays an important role in standardizing the construction of automobile maintenance and treatment stations. In accordance with the requirements of the energy conservation law, the regulations on road transport and technical management of operating vehicles, the standard model of road transport vehicles was issued, which can save 1.2 million tons of fuel and reduce 3.5 million tons of carbon dioxide emission each year, contributing to achieving the target of the energy-saving and emission reduction in the transportation industry.

Comprehensively promote ship emission control areas. In December 2015, the implementation plan for ship emission control zones in the Pearl River Delta, Yangtze River Delta and Bohai Sea Ring Area was issued to control the pollution emission of sulfur oxides, nitrogen oxides and particulate matter from ships, which has been implemented step by step according to the requirements of the plan. From January 1, 2016, ships have been required to strictly control the emission of sulfur oxides, particulate matter and nitrogen oxides according to current international conventions and domestic laws. Conditional ports in the emission control area can implement ship berthing measures. As of January 1, 2017, fuel with sulfur content less than 0.5%m/m shall be used during berthing in the core ports of the emission control area (except one hour after berthing and one hour before departure). From January 1, 2019, ships entering the emission control area shall use fuel with sulfur content less than 0.5% m/m. According to the Implementation Plan, on April 1, 2016, the four core ports in the Yangtze River Delta started to use low sulfur oil for berthing ships. Shenzhen implemented the emission control requirements scheduled for 2017 on October 1, 2016.

In December 2018, the Ministry of Transport issued the implementation plan for air pollution control area of ships, further expanded the scope of emission control areas for ships to coastal and inland river control areas. The targeted pollutants expanded to sulfur, nitrogen, particulate matter and volatile organic compounds. The ban on sulfur was implemented in 2020. MOT also formulated the guidelines for the

supervision of ship air pollutant emission control areas, which clarified the inspection requirements for ship fuel supply and use, shore power and clean energy use. The Ministry also helped equip the maritime administrative agencies in coastal and riverside emission control areas with rapid detection equipment for marine fuel sulfur content. A pilot area for the control, monitoring and supervision of ship air pollutant emission has been established in Dapeng Bay of Shenzhen to enhance the capacity of ships in dealing with air pollution with improved information technology. Since the implementation of the emission control policies, about 530000 tons of sulfur oxides and 68000 tons of particulate matter have been reduced, leading to continuous improvement of air quality in the port areas.

Promote the collection of pollutants from ships in ports. In 2015, the Ministry of Transport issued the special action plan for pollution prevention and control of ships and ports (2015-2020), requiring coastal ports and inland ports to meet the construction requirements by the end of 2017 and 2020. Inland ports should complete more than 50% of the construction tasks by the end of 2018. At the end of 2016, the former Ministry of Environmental Protection, together with ten departments including NDRC and MOT, issued the provisions on the assessment of the implementation of the water pollution prevention and control action plan, focusing on the compilation and implementation of the construction plan for port and ship pollutant collection, transfer and disposal facilities. In August 2016, the guidelines for the preparation of plans for the construction of port and ship pollutant collection, transfer and disposal facilities were issued, and a joint supervision system for the transfer and disposal of ship water pollutants was established together with relevant departments. The port ship pollutant reception capacity was greatly improved, and the effective connection between port receiving facilities and urban public transfer and disposal facilities was further strengthened. The "zero emission" treatment mode was implemented focusing on "on-board storage and shore disposal", and the pollutant receiving capacity of ships has been steadily improved. A cooperative mechanism for maritime administrative agencies was established in the Yangtze River to carry out special actions on the treatment of ship water, and strengthen the control of illegal discharge of ship sewage and garbage.

By the end of 2018, 49 coastal ports including major coastal ports and regional ports, had issued construction plans; 166 inland ports and 150 ports have issued construction plans. Of the 49 coastal ports that have issued construction plans, 47 have completed the construction, and of the 150 inland ports, only 6 have not completed more than 50% of the construction. The coverage of ship garbage receiving facilities in coastal ports reaches 100%, the coverage of ship domestic sewage receiving facilities reaches 81%, the coverage of ship oily sewage receiving facilities reaches 87%, and the coverage of inland ports reaches 92%, 70% and 59% respectively.

Approved by the State Council, MOT, together with NDRC, MEE and the Ministry of Housing and Urban-rural Development, issued the remediation plan for prominent environmental problems of ships and ports in the Yangtze River Economic Belt, and the notice on accelerating the construction of water tank washing stations along the Yangtze River. A monthly dispatching system has been implemented to strengthen supervision and assessment. By the end of 2019, ports along the arteries of the Yangtze River has realized the full coverage of ship waste receiving facilities, and all 10 tank washing stations have been put into operation. At present, one station in Wuhan port and two stations in Chongqing port have been put into operation (two stations in

Chongqing port are under expansion), and the construction provider and project site have been selected for other stations.

3.6 Green Transport Innovation and International Exchange Enjoyed Fruitful Results

Remarkable achievements have been made in scientific research and innovation. The Ministry of Transport has issued the detailed rules for the selection of the promotion catalogue of key energy-saving and low-carbon technologies in transportation industry, the inventory of key energy-saving and low-carbon technologies in the transportation industry (2016) and the guide for collection and application of key energy-saving and low-carbon technologies in the transportation industry (2018), encouraging transportation enterprises to apply advanced and applicable low-carbon technologies, so as to promote the efficient use of energy, reduce carbon emissions and promote the development of green transportation. Through demonstration projects, a number of advanced and applicable technologies have been demonstrated and applied. It has also allocated special funds to support research projects, including research and demonstration of the regulation technology of the golden channel of the Yangtze River, on-line monitoring and implementation supervision technology of air pollutants in ship pollution control areas and research and development of risk prevention and control technology and equipment for typical alien biological invasion disasters in China's offshore, cooperative research and development of international green port hub and multimodal transport key support system. China has also accelerated the construction of research platform, built six industrial R&D centers related to energy conservation, emission reduction and pollution prevention of ships and ports, as well as the application of new energy, materials and equipment, built three industrial key laboratories in the control and recycling of traffic network facilities in ecological security area, in an effort to increase the R&D and promote the application of green transport technologies.

Remarkable achievements have been made in international exchanges and cooperation in green transportation. Based on the current mechanisms and platforms like China-US Transportation forum, the China Germany Green Logistics Conference, the China-Japan-Korea transport and logistics ministerial meeting, the Ministry of Transport has carried out exchanges and cooperation with relevant transport departments in Europe, America, Northeast Asia and Southeast Asia on green logistics, green shipping development, transportation energy conservation and emission reduction. The policy dialogue with the developed countries has provided useful reference for China's green transport development in terms of policy formulation and technology innovation. They have actively participated in the global environmental governance of transportation. China have actively engaged in global green transport governance and served as a bridge connecting developing and developed countries. China has participated in the United Nations Framework Convention on Climate Change (UNFCCC) and the International Maritime Organization (IMO) Negotiation on Shipping GHG Reduction. In April 2018, IMO Marine Environmental Protection Committee (MEPC) adopted the preliminary strategy for shipping GHG reduction proposed by China at its 72 session, underling the active role of China to contribute its wisdom.

3.7 China’s Experiences in Promoting Green Transport

China’s experiences in promoting green transport can be summarized as follows:

Stick to the principle of ecological first and green development. Guided by the green development concept,

China is committed to implementing ecological civilization, promoting energy conservation and emission reduction, addressing climate change and strengthening ecological protection and restoration, which greatly contributed to the green, low-carbon and circular development of the industry.

Optimize the top-level design for green development. China has conducted strategic and comprehensive research on green transport and compiled relevant plans, which fully reflect the new development concept by paying attention to the long-term development while sticking to the current situations with great efforts.

Coordinate fiscal and tax policies and market mechanisms to promote green development. Remarkable achievements have been made in areas of transportation structure adjustment, application of new energy vehicles, the use of clean and low-carbon energy, demonstration of low-carbon provinces or cities and low-carbon infrastructure, shared transport and green travel.

Promote advanced transportation organization. Rapid progress has been made in drop and hitch transportation, multimodal transportation, vehicle free transportation, shared transportation and urban green distribution.

Strengthen international exchange and cooperation. China has strengthened international exchange and cooperation by sharing experiences with other countries, making positive contributions to the global response to climate change. It has also made great efforts to promote the connection of infrastructure over the world, which made the international transportation more convenient.

4 Country Report: Kazakhstan

The BRI regions that are close to China and share long-term cooperation with China are selected, taking into account their economic development, location conditions, comprehensive transport infrastructure, and the connection with China. Kazakhstan, Kenya and Myanmar are selected as the selected countries in this study to sort out the current situation of green development of transportation, and evaluate their characteristics.

4.1 Overview of Infrastructure Interconnection between China and SCO Member States

China has been actively promoting cooperation in the field of infrastructure connectivity of the Shanghai Cooperation Organization (SCO), proposing that Member States should strive to adhere to the interconnection projects of railways, highways, aviation, telecommunications, power grids and energy pipelines, further improve the transportation infrastructure, consolidate the legal foundation of transportation cooperation, and give more effective play to the existing transit transportation potential and energy supply potential of SCO member states. So far, in addition to the new Eurasian Continental Bridge, infrastructure connectivity between China and SCO Member States has been carried out at the bilateral level.

The cross-border channels between China and SCO member states are divided into two directions: the East and the West. Within the Chinese territory, the eastern channel is concentrated in Heilongjiang Province and Inner Mongolia Autonomous Region, mainly connecting the Russian Siberian Far East. The western corridor is concentrated in Xinjiang Uygur Autonomous Region, connecting Kazakhstan in Central Asia. In recent years, with the strengthening of economic and trade cooperation between Europe and Asia and the increasing demand for logistics, various schemes for building Eurasian land channel have appeared one after another. On the basis of the original cross-border channels, SCO member states have promoted the construction of a series of new projects. By 2017, China and Russia had built 3 railway channels under transportation, 19 highway channels, 1 crude oil pipeline and 4 DC back-to-back power grids; China and Central Asia have built 3 railway channels under construction, 5 highway channels and 4 oil and gas pipelines.

From the perspective of networking, China-Kazakhstan petroleum cooperation has a good foundation for oil pipeline network and space for radiation expansion. China-Kazakhstan oil pipeline can be smoothly connected with the oil pipeline networks built and under construction in Central Asia and Russia. Most sections of the Asian Railway and highway network system with the new Eurasian Continental Bridge as the core have been completed and have a certain scale of commercial operation. With the continuous improvement of the regional integration and cooperation system, a three-dimensional transportation network connecting railway, highway and pipeline transportation is taking shape.

4.2 Overview of economic and social development in Kazakhstan

Kazakhstan straddles Eurasia, including the north of Central Asia and the southeast of Eastern Europe. The part to the west of the Ural River belongs to Europe, and the west is adjacent to the Caspian Sea. It is the largest landlocked country in the world, with an area of 2724900 square kilometers, accounting for about 2% of the earth's land surface area, equivalent to the sum of the areas of the whole western European

countries, ranking ninth in the world. There is an inland sea in the west, Xinjiang in the southeast, Russia in the north and Uzbekistan, Turkmenistan and Kyrgyzstan in the south.

Fig 4.1 Map of Kazakhstan

Kazakhstan's economic development mainly depends on oil, natural gas, mining, coal, agriculture and animal husbandry, and its processing industry and light industry are relatively backward. Most consumer goods are imported. After independence, Kazakhstan implemented economic reform and phased market economy and privatization. Influenced by the former Soviet Union, Kazakhstan pursued market economy and privatization after independence.

Kazakhstan's processing industry mainly includes petroleum processing and petrochemical industry, light textile industry, building materials, household appliances and automobile manufacturing, mechanical equipment and black and non-ferrous metal material production, as well as research and food industry. Kazakhstan is sparsely populated, with more than 20 million hectares of arable land, about 16-18 million hectares of crops sown every year, and about 18 million tons of grain output. The main crops include wheat, corn, barley, oats and rye. The main grain production areas are Kostanay, North Kazakhstan and Akmola in the north. Rice, cotton, tobacco, grapes and fruits can be planted in the south.

Since 2010, Kazakhstan's economy has developed rapidly, and its GDP has increased from US $50.176 billion in 2010 to US $180.2 billion in 2019. Although the annual growth rate has experienced fluctuations, it still increased by 12.5% in 2019 compared with 2018.

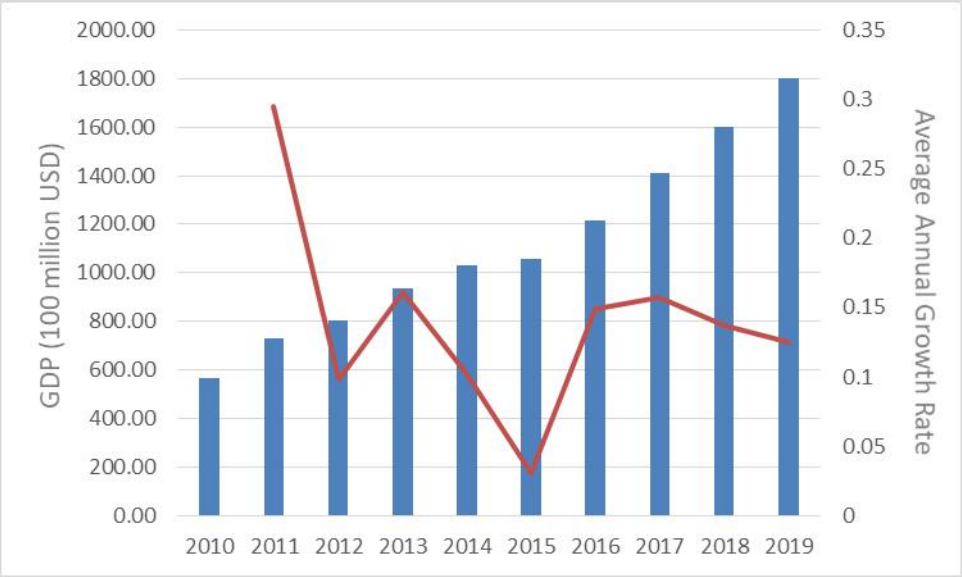


Fig 4.2 GDP and annual growth rate of Kazakhstan

According to the data of the World Bank, Kazakhstan's GDP in 2019 was 180.2 billion US dollars, its population was 18.51 million, and its per capita GDP was about 9735 US dollars, ranking 70th in the world. According to the data of the World Bank, in 2019, the total world GDP was 87.75 trillion US dollars, the total population was 76.74, and the per capita GDP was 11436 US dollars. According to World Bank standards, Kazakhstan is a medium to high income country.

Generally speaking, Kazakhstan has a good industrial foundation. It is an emerging economy and one of the fastest growing countries in the world. It is also the country with the fastest economic development and the strongest strength among the five Central Asian countries.

4.3 Current Status of Transportation Development

4.3.1 The comprehensive transportation infrastructure network has not yet been formed

Kazakhstan is closely connected with Russia and China. Its geographical location makes it the center of Eurasia, a "traffic bridge" connecting Eurasia and a unique traffic channel between Asia-Russia, and Asia-Europe. The transportation channel across Kazakhstan has become one of the biggest advantages of Kazakhstan, which can greatly reduce the transportation distance[2].

4.3.1.1 The highway infrastructure is improved

Road transportation is the most important mode of logistics transportation in Kazakhstan. The total length of roads in Kazakhstan ranks second in the CIS region, second only to Russia. As of 2016, the total mileage of highway operation in Kazakhstan was 96300 km. Among them, the national highway is 23500 kilometers and the state or district highway is 73900 kilometers. There are six international highways in Kazakhstan, with a total length of 8290 kilometers.

4.3.1.2 Railway construction needs to be accelerated

Kazakhstan has low railway density, outdated infrastructure and small railway transportation scale. The railway density in Kazakhstan is only 5.53 km/thousand square kilometers, which is significantly lower than 23-28 km/thousand square kilometers in CIS countries. As the largest landlocked country in the world, Kazakhstan has great room for future development of railway transportation. Kazakhstan's railway operating mileage increased from 14588 km in 2001 to 16104 km in 2016, with an average annual growth of 0.66%.

4.3.1.3 The potential of water transport infrastructure needs to tapped

Kazakhstan is the largest landlocked country in the world, and its water transportation is not developed. Kazakhstan's water transport is mainly concentrated in three ports in the Caspian Sea: Aktau international trade port, baodino port and Kurek port. In 2016, Kazakhstan's water transport mileage was 4151 km, an increase of 4% compared with 3956 km in 2001. Among them, Aktau port is the only international seaport in Kazakhstan, which can load and unload all kinds of goods and oil. It is a hub for air, road, marine and pipeline transportation.

4.3.1.4 Aviation infrastructure has been optimized

As a transfer base for Asia, Europe, North and south, Kazakhstan's Asian air route network almost covers Kazakhstan's airspace. At the same time, Kazakhstan's inland location has led to an increase in air transport demand. There are 58 airlines in Kazakhstan, of which 13 are state-owned, accounting for 85% to 90% of all passenger transport forms. During independence, Kazakhstan rebuilt 15 airstrips and 12 terminals. At present, the airlines passing through Kazakhstan mainly include Europe-Southeast Asia routes.

4.3.1.5 Pipeline transportation mileage increased steadily

Kazakhstan is rich in energy resources, and its crude oil reserves rank 12th in the world. Pipeline transportation has incomparable advantages in oil trade. The development of pipeline transportation in Kazakhstan has experienced three stages: the first stage is from 2001 to 2008, and the pipeline transportation mileage is stable at about 17000 km; the second stage is from 2009 to 2013 when pipeline transportation achieved rapid development, and the operating mileage has increased to 20300 km; the third stage is from 2014 to 2016 when the pipeline transportation mileage increased to 23000 km.

4.3.2 Highway passenger and freight transportation accounts for a relatively high proportion

Domestic passenger transport in Kazakhstan is mainly carried out by highway, railway and aviation. In 2016, highway accounted for 99.87% of the passenger transport volume and is the main mode of transport. Due to the long transport distance of railway and aviation, the proportion of highway in passenger transport turnover is lower than that of highway in passenger transport volume, about 89.04%, which is still in the dominant position.

Domestic freight transportation in Kazakhstan is mainly completed by road, railway, aviation and pipeline. Water transportation is underdeveloped, and the freight volume accounts for less than 0.1%. In 2016, roads accounted for 85.37% of the freight volume and were the main mode of transportation. Due to the long railway distance, railway transportation accounted for the highest proportion of freight turnover, accounting

for 46.22%, followed by road transportation, accounting for 31.52%, and pipeline transportation, accounting for 22.24%.

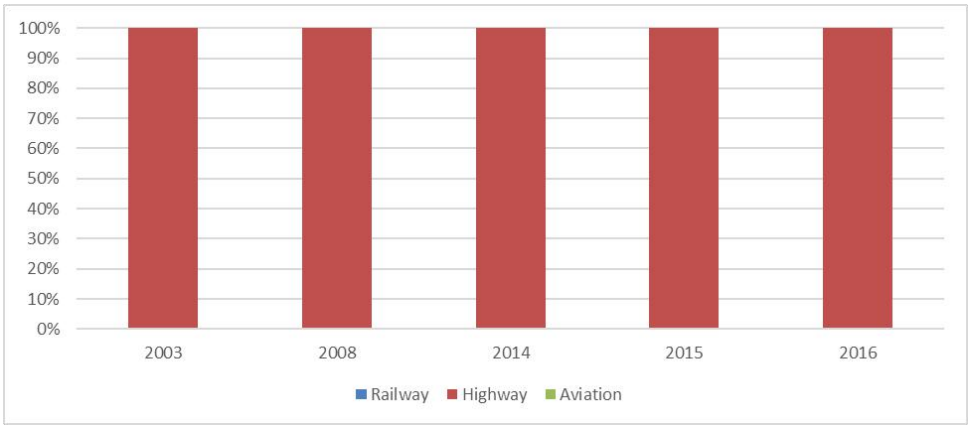


Fig 4.3 Passenger transport volume by modes

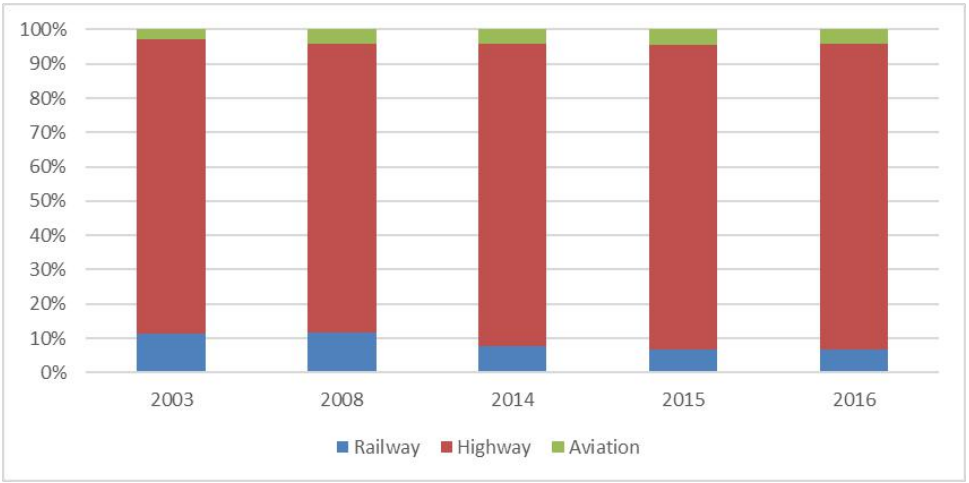


Fig 4.4 Passenger transport turnover by modes

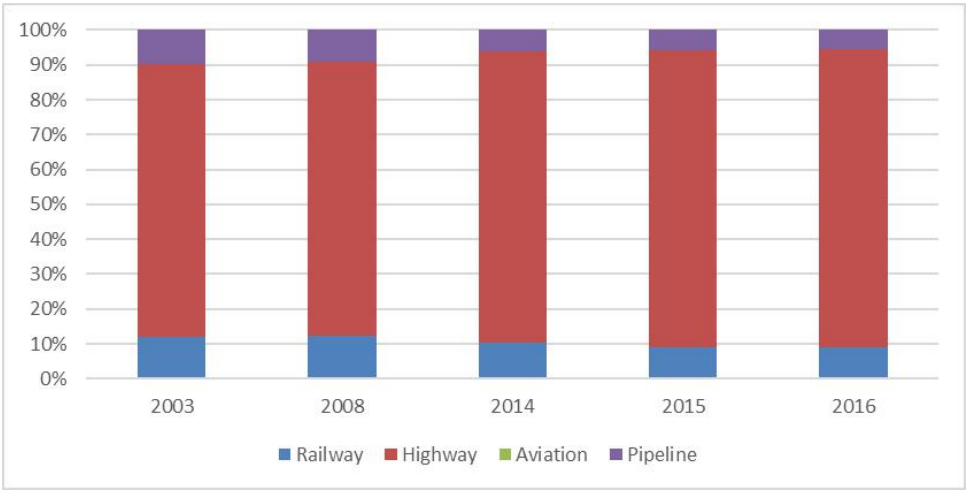


Fig 4.5 Freight transport volume by modes

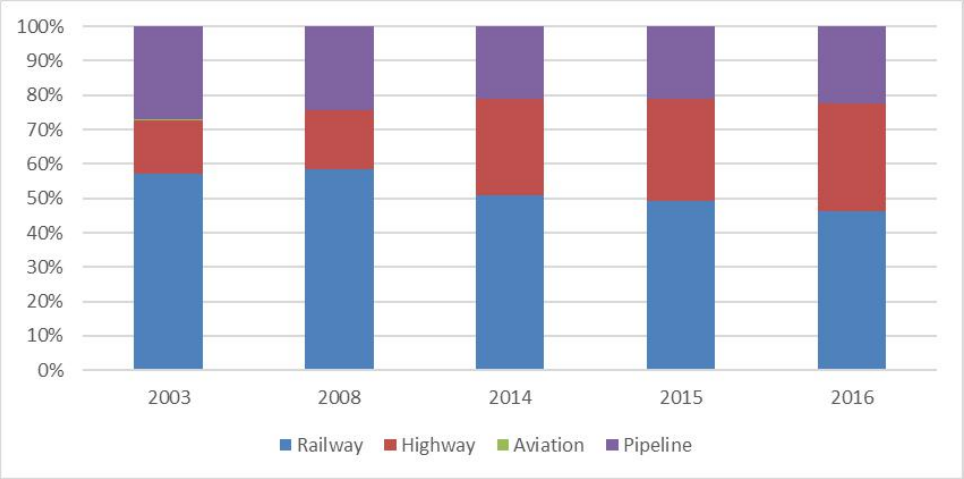


Fig 4.6 Freight transport turnover by modes

Since 2003, Kazakhstan's highway passenger and freight transport have increased rapidly, and the growth rate has slowed down after 2014, but the growth rate of freight transport turnover is significantly higher than that of passenger transport turnover. In 2016, the passenger volume, passenger turnover, freight volume and freight turnover of highway transportation reached 22.3 billion person times, 237.6 billion person kilometers, 3.181 billion tons and 163 billion ton kilometers respectively. Kazakhstan's railway passenger volume and turnover showed an overall growth trend. In 2016, the railway passenger volume and turnover were 23 million person times and 17.914 billion person kilometers respectively. The railway freight volume and turnover showed a trend of growth first and declined afterwards, reaching 339 million tons and 239 billion tons km respectively in 2016. The scale of air cargo transportation in Kazakhstan is small, which shows a downward trend, but the air passenger volume has increased rapidly in recent years. In 2016, Kazakhstan's air passenger volume and turnover were 6 million person times and 11.3 billion person kilometers respectively, and its air cargo volume and freight turnover were 18000 tons and 4.3 million ton kilometers respectively. Pipeline transportation is mainly cargo transportation, and the freight volume tends to be stable after rapid growth, with little change after 2014. In 2016, the freight volume and turnover were 20.6 billion tons and 115 billion tons km respectively.

Tab 4.1 Passenger transport volume and turnover in Kazakhstan

Passenger volume (100 million)					Passenger turnover (100 million people km)				
Year	Total	Railway	Road	Air	Year	Total	Railway	Road	Air
2003	88.94	0.18	88.75	0.013	2003	948.06	106.86	814.65	26.54
2008	113.25	0.18	113.05	0.028	2008	1274.55	147.19	1072.4	54.95
2014	212.81	0.23	212.52	0.054	2014	2469.58	189.99	2173.72	105.86
2015	218.39	0.22	218.11	0.059	201	2512.51	170.12	2230.86	111.53

					5				
2016	223.33	0.23	223.04	0.06	2016	2667.84	179.14	2375.56	113.13

Tab 4.2 Freight transport volume and turnover in Kazakhstan

Freight volume (100 million tons)						Freight turnover (100 million tons km)				
Year	Total	Railway	Road	Air	Pipeline	Total	Railway	Road	Air	Pipeline
2003	17.11	2.03	13.18	0.000242	1.66	3520	1477	400	0.94	700
2008	22.08	2.69	17.21	0.000227	1.96	4380	2150	630	0.69	900
2014	37.64	3.91	31.29	0.000191	2.25	6020	2807	1560	0.49	1160
2015	37.47	3.41	31.74	0.000172	2.15	5870	2674	1620	0.43	1150
2016	37.43	3.39	31.81	0.00018	2.06	5600	2390	1630	0.43	1150

4.3.3 Kazakhstan-China infrastructure connectivity has made rapid progress

After the completion of the Second Eurasian Continental Bridge, China and Central Asian countries have successively built China-Kazakhstan Railway, Chongqing New Europe Railway, Wuhan New Europe Railway and Yiwu New Europe Railway. The railway transportation cooperation between China and Kazakhstan started early, developed rapidly and achieved obvious results. The cooperation between China and Kazakhstan is the fastest developing and most successful cooperation in Central Asian countries [3].

4.3.3.1 Kazakhstan-China highway transportation belt is formed

The cooperation between China and Central Asia in road transportation started relatively early. After years of cooperation, it has achieved positive results, and the cooperation between China and Kazakhstan in road has also had a good cooperation foundation. In 2007, the road transportation departments of Kazakhstan and China held talks. Both Kazakhstan and China proposed to open relevant highway lines. Seven passenger and freight transportation lines (as shown in the table below) have been fully completed.

Tab 4.3 Highway cooperation between China and Kazakhstan

Proposed side	Highway
China	Urumqi-Jimunai port-mehabuchige port-Astana
	Urumqi-Jimunai port-mehabuchige port-Pavlodar
	Urumqi-Jimunai port-mehabuchige port-Karaganda
	Urumqi-Horgos port-Shymkent
Kazakhstan	Zhaisang-mehabuchige port-Jimunai port-Urumqi
	Kurchatov (konechnaya)-mehabuchige port-Jimunai port-Uzbekistan
	Ayagus-bakt port-baktu port-Urumqi

In addition, the Western China-Western Europe Highway completed at the end of 2016, with a total length of more than 8000 kilometers, which starts from Lianyungang, passes through Lanzhou, Urumqi, Almaty and

finally reaches St. Petersburg, creating a transportation corridor connecting China, Kazakhstan and Russia, which is a successful model of road transportation cooperation. So far, more than 60 passenger and cargo transportation lines have been opened between Kazakhstan and China.

4.3.3.2 Kazakhstan and China have close cooperation in railway transportation

Before the BRI, the two countries had a close cooperation. The two countries have achieved great success in railway transportation (see below table).

Tab 4.4 Railway cooperation between China and Kazakhstan

Railways	Operation Time
The Second Eurasian Continental Bridge	1990
"Lianyungang-Almaty" transnational train	2004
"Getken-Horgos" Railway	2007
"Urumqi-Almaty" international container train	2007
Chongqing New Europe train	2011
Wuhan New Europe train	2012
Yiwu New Europe train	2014
"Lianyungang Almaty" Central Asia train	2015

In addition to the "Wuhan New Europe" international special train shown in the table, between 2012 and 2013, Kazakhstan and China also opened the Chengdu Europe Express Railway and the New Silk Road directly to Almaty, the largest city of Kazakhstan. The "Lianyungang-Almaty" line shown in the table is the Central Asia train that opened on February 25, 2015 and can go directly to Almaty, Kazakhstan. The opening of this train plays an important role in the economic development of Lianyungang City and Jiangsu Province of China, and is also of great significance to the transportation, trade, investment and finance between Kazakhstan and China. In 2017, the first freight train passing Kazakhstan, China, Turkey and Iran to Tehran successfully opened, greatly shortening the freight time between countries. In addition, it will also invest in the construction of a new Beineu-Zezganzigan railway line and the development of the second railway channel to China (Altengri-Horgos), so as to build the necessary infrastructure to maximize the attraction of transit transportation from China to the Persian Gulf and Transcaucasia. In 2020, a total of 12,400 China-Europe freight trains put into operation, of which 9,679 pass through Kazakhstan. In the future, Kazakhstan will continue to vigorously develop railway container transport, dig into the potential of international channels such as the "Shuangxi Road" and the Trans-Caspian Sea international transport corridor, and build an international transport multimodal transport system connecting Europe and Asia[4].

4.3.3.3 Kazakhstan- China air transport cooperation has achieved initial results

The cooperation between China and Kazakhstan in air transport started in the early 1990s. The two countries have achieved results in concluding agreements and opening peer routes. The first is the institutional achievements. In 1993, Kazakhstan and China signed a civil air transport agreement, which provides an institutional guarantee for air transport cooperation. As the largest aviation enterprise in Kazakhstan, Astana Airlines opened flights from Almaty to Beijing in December 2002, and has increased to 18 flights a week. By the end of 2016, four airlines between China and Kazakhstan were in charge of flight transportation, operating 13 passenger flights and 21 cargo flights between Beijing, Urumqi, Astana and

Almaty every week. At the same time, China and Kazakhstan can easily transfer to many cities in Europe through Urumqi and Almaty city, and have formed a convenient and fast aviation network.

4.3.3.4 Remarkable achievements have been made in the construction of Kazakhstan-China energy pipeline

Kazakhstan is rich in resources. Due to the differences in energy endowments between China and Kazakhstan, the energy field has long been the focus of cooperation between Kazakhstan and China. After more than 20 years of cooperation and development, Kazakhstan and China have made unprecedented achievements in the construction of energy pipelines.

In 1997, Kazakhstan and China signed an oil and gas cooperation agreement. The overall planning annual oil transportation capacity of Kazakhstan China crude oil pipeline is 20 million tons. It starts from Atyrau in the Caspian Sea in the west, passes through Aktobin, and ends at Alashankou on the Kazakhstan China border, with a total length of 2798 kilometers. The success of Kazakhstan-China oil pipeline is of great historical significance. It is the first cooperation between China and Central Asian countries in pipeline transportation cooperation, setting a precedent. At the same time, it laid a foundation for natural gas pipelines in China and Central Asian countries. Under the BRI, the China-Kazakhstan oil pipeline connection not only provided transportation channels for their oil cooperation, but also supported the development of "Silk Road Economic Belt".

From 2010 to 2016, the annual oil transportation volume of Kazakhstan-China crude oil pipeline exceeded 10 million tons for seven consecutive years. This "first silk road pipeline" has transported more than 100 million tons of crude oil to China. The completion of Kazakhstan China crude oil pipeline has opened up a strategic channel for Kazakhstan's crude oil export to China and formed a new pattern of tripartite confrontation in Kazakhstan's crude oil export from northwest to East. As an important part of Kazakhstan-China oil and gas cooperation, the operation of Kazakhstan China crude oil pipeline has greatly driven the rapid development of Kazakhstan's economy. Meanwhile, the first phase of the south natural gas pipeline cooperation project jointly invested by Kazakhstan and China, has been completed in 2013, and the second phase is being constructed. According to statistics, as of the first quarter of 2017, a total of 6.363 billion cubic meters of gas had been transmitted to the domestic market of Kazakhstan.

4.4 Current Status of Green Transportation Development

4.4.1 Green economy development strategy

In order to change the mode of economic growth, Kazakhstan's first President Nazarbayev put forward proposals on addressing climate change, developing a green economy and implementing the global energy ecological strategy at the opening ceremony of the third Astana Economic Forum on July 1, 2010, advocating the development of clean energy, paying attention to environmental protection and reforming the economic structure and development model. The speech is regarded as a sign of Kazakhstan's transition from traditional economy to green economy. Since then, Kazakhstan officially issued the "2050 strategy" in 2012 and adopted the concept of Kazakhstan's transformation to a green economy, the concept of Kazakhstan's

fuel and energy complex development before 2030 and the national outline of Kazakhstan's water resources management from 2014 to 2040 in 2013[5].

In order to implement the green economy strategy, the Kazakhstan government pays attention to seven key areas and developing clean transportation, improving the grade of refined oil, reducing tail gas emission and protecting the ecosystem is one of the key areas.

4.4.2 Bright Avenue Project

On November 11, 2014, President Nazarbayev announced the "bright avenue" new economic plan, that is, to promote Kazakhstan's economic structural transformation and achieve economic growth through a series of investments, one of which is infrastructure construction. The goal is to establish a single economic market, combine the country's macro regions, implement anti-crisis measures on the basis of the central principle of building effective infrastructure for Kazakhstan's long-term economic growth, and support specific economic sectors in the context of deteriorating market conditions[6]

One of the seven priority areas of the "Bright Avenue" new economic plan is improving transport infrastructure[7] and development of transport and logistics infrastructure. It will be implemented within the framework of a macro region similar to the centre. At the same time, the backbone of infrastructure will be interconnected with Astana, roads, railways, airlines and other macro regions like radiation. First, major road network needs to be implemented, including China-Western Europe; Astana-Almaty; Astana-Ust-Kamenogorsk; Astana-Atone-Atyrau; Almay-Ust-Kamenogorsk; Karaganda-Jezkazgan-Kyzylorda; Atyrau-Astrakhan. A logistics hub should also be established in the eastern and marine infrastructure in western Kazakhstan. The large ferry station yersay, which combines kuryk and borzhakty railway line, will contribute to the growth of export potential in the western direction through the Caspian port, enabling the government to take advantage of the maritime ports of China, Iran, Russia and EU countries.

4.4.3 Green transport development policies

Kazakhstan is the largest emitter of greenhouse gases in Central Asia, while the transport sector is the fastest growing sector. At present, the green development initiatives of transportation mainly focus on the cleaning of transportation equipment and reducing the growth of GHG in major cities.

Car manufacturers in Kazakhstan have begun to produce electric vehicles. By the end of 2014, Asia Auto of ust kamenogorsk plant produced the first Kia Soul ev. In July 2016, the saryarka avtoprom plant in Kostanay produced the experimental brand JAC electric vehicle. Finally, in July 2017, Asian automobile demonstrated LADA Vesta EV on expo-2017. At the same time, the Ministry of Energy of Kazakhstan is actively developing electric vehicle infrastructure, including charging stations. In addition, Kazakhstan has also cooperated with Chinese electric vehicle manufacturers. As early as 2016, the pure electric bus production base jointly built by Hagrid bus and parasat, a well-known scientific research center in Kazakhstan, was officially settled in Almaty, the largest city in Kazakhstan. The scientific research center affiliated to Kazakhstan's well-known National University of science and technology, jointly developed Hagrid bus, a new type of electric bus, which is assembled in Almaty and can operate in cold weather above - 30 ℃, meeting the operation

requirements of most cities in Kazakhstan. In 2020, Kazakhstan introduced 100 Yutong E12 pure electric buses, and the first 20 have been put into operation.

Kazakhstan is a large oil and gas country and also promotes the application of natural gas in heavy trucks. On September 4, 2018, the "China Europe international transportation corridor" natural gas engine fuel vehicle rally with the theme of "ten thousand miles of green energy Silk Road" jointly launched by CNPC, Kazakhstan National Petroleum Corporation and Russia natural gas industry corporation was launched, and the fleets of the three countries used liquefied natural gas (LNG) starting from Rudong County of Jiangsu Province, passing through more than 20 cities such as Xi'an, Wuwei, Hami, Almaty, Orenburg and Kazan. Finally, the vehicle collection ceremony was held in St. Petersburg, Russia, on October 3, covering nearly 10000 kilometers. All vehicles in this rally use liquefied natural gas (LNG) and launch the call for green energy vehicles by driving on the Silk Road, which has played a positive role in the field of road transportation. In addition to demonstrating the advantages of LNG, this rally also tests the ability of natural gas engine fueled vehicles, making a positive contribution to promoting the green development of road transportation in the Silk Road Economic Belt.

Kazakhstan's cities take many measures to reduce vehicle exhaust emissions. Almaty promotes the development of new environmentally friendly transportation and advocates green travel[8]. There are 570000 cars in Almaty, and 270000 outskirt cars entering the city every day. A quarter of vehicles have used natural gas fuel, and the work of changing oil to gas will continue. In addition, the use of bicycles is encouraged by increasing bicycle lanes. At the same time, urban rail transit construction is also carried out, bus fares are reduced by swiping cards, and citizens are encouraged to use public transport.

4.5 Suggestions for the Development of Green Transportation

Carry out top-level design for the development of green transportation. Establish a green transportation development planning system, improve the system and mechanism of green transportation development, and clarify the responsibilities of relevant departments. Carry out research on transportation green development planning, and define green development objectives, main tasks or measures, supporting policies and guarantee measures within a certain period of time.

Promote green transportation infrastructure construction. At present, Kazakhstan is still in the period of large-scale construction of transportation infrastructure. It is suggested to carry out the whole process green management of transportation infrastructure, and introduce green concepts and green technologies in planning, construction, operation and maintenance. Consider multimodal transportation and zero transfer in design, build an integrated passenger transport hub, and fully consider the needs of green development from the early stage of the construction. When building a comprehensive freight hub or logistics station, full consideration shall be given to the construction of local transportation infrastructure, and the site shall be selected in the area where multiple modes are combined as far as possible, so as to maximize the role of transportation infrastructure network.

Continue to promote the clean transportation equipment. On the basis of existing measures together with Kazakhstan's rich oil and gas resources, promote the application of transportation equipment fueled by

natural gas. Cooperate with China to carry out relevant research on pure electric equipment. Introduce relevant plans, policies and measures for the elimination and renewal of transportation equipment.

Promote green logistics. The vast majority of goods from China to the EU are transported by sea. Although the sea route has competitive advantages of low cost and good services, the transportation speed is more than half slower than the land route from East Asia to Western Europe. In this case, Kazakhstan's transport corridor is extremely important to improve the speed of freight transportation. It is suggested that Kazakhstan give full play to its geographical advantages and transportation routes in international logistics, maximize integration of transportation and logistics systems among countries, improve infrastructure and service quality, reduce logistics costs and improve efficiency. At the same time, railway transportation and road transportation using clean energy should be further promoted. In the future planning, consideration should be given to transit logistics, with a focus to build a more reasonable and effective transportation infrastructure network, carry out planning research related to green logistics, and put forward specific measures and policy suggestions.

Improve the data collection and monitoring for the development of green transport. The development of green transport in Kazakhstan is still in its infancy. In the initial stage, it is suggested to carry out research on the statistical monitoring system of green transportation, and improve the statistical monitoring of relevant data from the beginning, so as to lay a solid foundation for setting objectives and roadmaps, identifying problems and potential for Kazakhstan’s future development of transportation.

5 Country Report: Kenya

5.1 Overview of infrastructure connection between China and East Africa

East Africa has unique geographical location and sound development foundation for connecting with China's BRI. Infrastructure connection lays foundation for trade exchange and production capacity cooperation for BRI countries, and it is the main task of East African countries. East Africa is a region with a relatively stable situation, which provides a guarantee for the economic and social development of East African countries. East Africa is one of the most dynamic and potential regions for economic development in Africa. As the largest economy in this region, Kenya has long been regarded as an important economic growth engine. The opening of the Mombasa-Nairobi Standard Gauge Railway (SGR) jointly built by China and Kenya marks a solid step to promote the grand blueprint for the connection of transportation in East Africa. The opening of the SGR undoubtedly has proved the feasibility of developing Railway cooperation between China and East African countries under the BRI initiative.

5.2 Overview of economic and social development in Kenya

The Republic of Kenya is located in eastern Africa, with the equator running through the middle and the Great Rift Valley running north and south. It borders Somalia in the East, Tanzania in the south, Uganda in the west, Ethiopia and South Sudan in the north, and the Indian Ocean in the southeast. The coastline is 536 kilometers long, and the land area is 580,000 square kilometers [9]. Economic and trade exchanges between China and Kenya enjoyed a long history. In 2017, China-Kenya relations were upgraded to a comprehensive strategic partnership. Under the BRI framework, China and East African countries have provided strong impetus for deepening cooperation. At present, Kenya is one of the key countries to promote the strategic development of BRI, which has been regarded as the key area for promoting the construction of "the integrated three networks" and a pilot country for China-Africa production capacity cooperation.

The capital city Nairobi is the largest city in Kenya and it is the national political, economic, cultural, industrial and transportation center, and one of the international cities in Africa. Kenya is consists of seven provinces and one provincial special zone (Nairobi province). The seven provinces are: Central Province, Coast Province, Eastern Province, Nyanza Province, Rift Valley Province, Western Province and North Eastern Province[10].

Fig 5.1 Map of Kenya

In 2019, Kenya's population reached 52.57 million, making it the second largest in Africa, an increase of 1181000 people compared with 2018[11]. Compared with the population data of 2009, Kenya's population has increased by 11.672 million in the past decade, with an average annual growth rate of 2.5%. In terms of urban-rural structure, Kenya's urban population was 14.462 million and rural population was 38.113 million in 2019, with an urbanization rate of 27.51%. In recent years, Kenya's urbanization has been greatly improved, and the urbanization rate has maintained a steady upward trend.

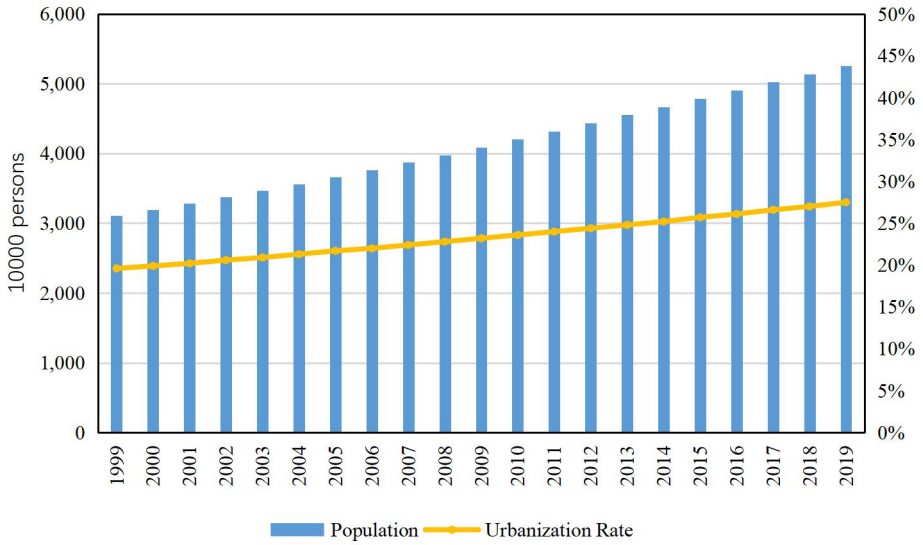
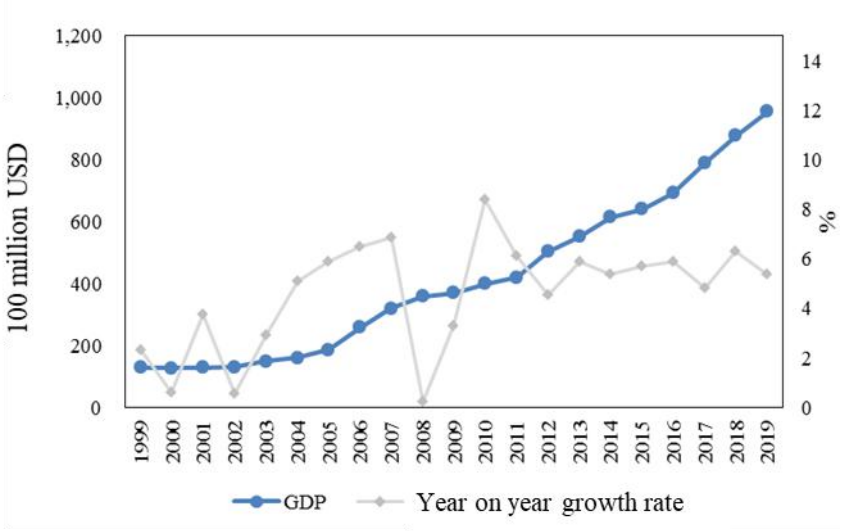


Fig 5.2 Population and urbanization rate of Kenya

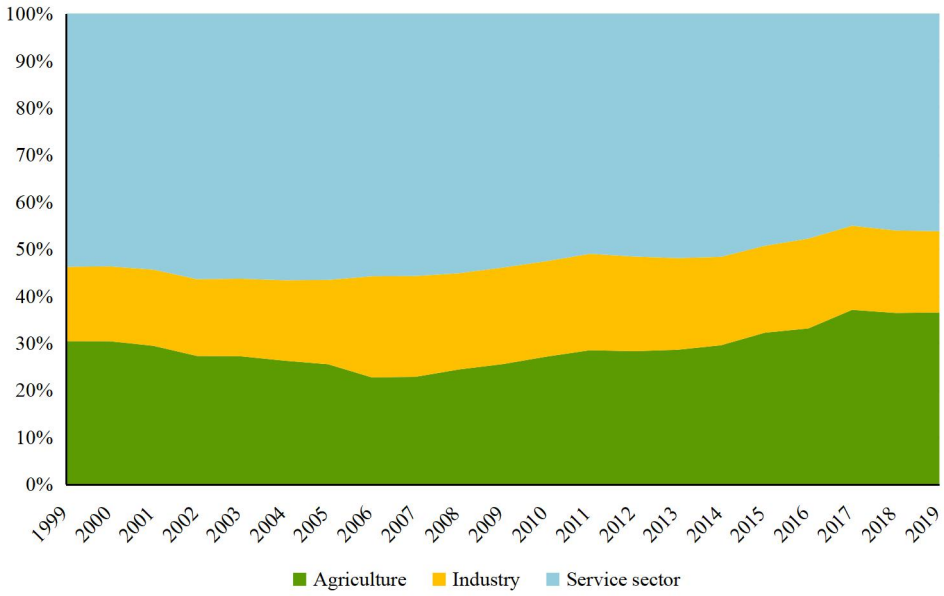
Kenya's economy has maintained an upward trend since 1999, with a growth rate of more than 4% for 9 consecutive years. In 2019, the real GDP increased by 5.4% over the previous year, ranking 67th in the world and 7th in Africa. The per capita GDP was about US $1816, with a year-on-year increase of 5.2%, ranking 144th in the world.



Source：Kenya National Bureau of Statistics

Fig 5.3 Kenya’s GDP and its growth rate

Kenya has a relatively complete industrial structure, which is also the reason why Kenya is a relatively good country in East Africa. As shown in the figure, in 2019, Kenya's primary industry accounted for 34.2%, the secondary industry 16.2%, and the tertiary industry 43.2%. Tourism is the pillar industry of Kenya’s economy.



Source：Kenya National Bureau of Statistics

Fig 5.4 Kenya’s industrial structure

5.3 Current status of transportation development

5.3.1 The existing transportation infrastructure cannot meet the needs of transportation development

In recent years, the total output value of Kenya's transportation and postal industry has maintained a steady growth trend. Kenya's transportation industry accounts for 8.8% of the total GDP. The total output value of highway transportation is much higher than that of other transportation industries. With the rapid development of Kenya's economy in recent years, the construction of domestic transportation facilities cannot keep up with the growth of transportation volume, which is becoming a bottleneck restricting economic development.

Tab 5.1 Total output value of transportation and postal industries Unit: million KSh

	2014	2015	2016	2017	2018
Road transport	595,726	629,045	662,927	698,148	782,881
Aviation transport	139,912	147,447	147,638	161,678	191,723
Railway transport	5,357	6,282	4,927	3,629	11,366
Waterway transport	49,840	55,712	60,845	64,750	67,761

	2014	2015	2016	2017	2018
Pipeline transport	21,030	22,210	24,255	26,840	28,153
Sub-total	**811,865**	**860,696**	**900,592**	**955,045**	**1,081,884**
Postal services	27,179	27,925	27,464	29,244	33,183
Transport related services	54,097	68,246	83,996	107,841	136,939
Total	**893,141**	**956,867**	**1,012,051**	**1,092,130**	**1,252,006**

Source：Kenya National Bureau of Statistics

5.3.1.1 Highway is the main mode of transportation in Kenya

Kenya currently has a highway network of 161000 kilometers, including 75000 kilometers of classified roads and 18,700 kilometers of asphalt roads. The overall road condition in Kenya is poor, but according to the road list and condition report of Kenya Road Commission (KRB), the overall network condition of roads in Kenya has been significantly improved in recent years, and the proportion of roads in good condition has increased from 44% in 2009 to 56% in 2018 [12].

Tab 5.2 Types of Road and classification Unit: km

	Asphalt road					Sand/pebble road				
	2014	**2015**	**2016**	**2017**	**2018***	**2014**	**2015**	**2016**	**2017**	**2018***
Express highway	81	81	81	81	81					
International highway	2772	3238	3917	4191	4609	816	380	3700	3427	3008
Domestic highway	1489	1607	3226	3789	4109	1156	1038	7625	7062	6743
Class I highway	2693	3360	2739	4120	4314	5164	4497	18706	17325	17131
Class II highway	1238	2067	521	1305	1699	9483	8651	10602	9819	9424
Branch road	577	1000	771	1074	1205	26072	25724	13276	12974	12843
Special road	110	106	316	440	504	10376	10399	9310	9186	9122
Other road	2318	2853	1461	2035	2135	96623	96423	85198	84625	84525

	Asphalt road					Sand/pebble road				
	2014	2015	2016	2017	2018*	2014	2015	2016	2017	2018*
Total	11278	14312	13034	17034	18655	149690	147112	148418	144418	142797

Source: Kenya Roads Board

5.3.1.2 Railway development has increased significantly

The total length of Kenya's railway is 2764km. At present, the main railway transportation lines in operation are the narrow gauge railway built in the British colonial era more than 100 years ago and the standard railway---Mombasa Nairobi Railway built and operated in 2017. It is the largest infrastructure project in Kenya since its independence [13]. Both railways pass through Nairobi, connecting Mombasa, the main port city of Kenya, and inland areas. The total length of SGR is 480km, which is much shorter than the existing narrow gauge railway. The maximum speed of passenger train can reach 120 km/h, and the journey from Mombasa to Nairobi takes only 5 hours. The maximum speed of freight train is 80 kilometers per hour, and the total freight volume can reach more than 20 million tons per year, which fully meets the requirements of cargo distribution in Mombasa port and surrounding areas.

5.3.1.3 The aviation industry is at a superior stage

There are international airports in Nairobi, Mombasa, Eldoret and Kisumu. Nairobi Jomo Kenyatta International Airport is one of the busiest airports in Africa. There are 3 international airports, 4 domestic airports and more than 300 small airports in Kenya, with 60 international airlines to 39 countries.

5.3.1.4 Water transportation is gradually expanding

Mombasa port in Kenya is the largest port in East Africa and the main transfer port for import and export. Mombasa port is adjacent to the Indian Ocean in the East and is the gateway to the East African community region. It mainly serves Kenya and the landlocked countries and regions around East Africa. Mombasa port has 17 international airlines and business contacts with 80 ports around the world. There are 21 deep-water berths and 2 large oil terminals, which can berth 20000 ton cargo ships, with an annual bearing capacity of 22 million tons [14]. In 2012, the volume of freight handled at Mombasa port reached 21.92 million tons, of which imports accounted for 85.5%, reaching 18.73 million tons. In 2018, the actual volume of freight at Mombasa port was close to 30 million tons, of which the container volume accounted for 38.3%, and more than 80% of the goods were sent to Nairobi and beyond. Mombasa port has the advantages of large traffic volume, high proportion of containers and long haul distance. However, at present, there are some disadvantages, such as long port coastline, small berth depth, shallow berthing water, and the insufficient bearing capacity of some berths. With the development of urban sprawl to ports, the buildings around the port are close to the berth, the outward expansion of the berth requires for a huge amount of demolition, but there are basically no expansion conditions. With the growth of port transport volume, the storage capacity of the port is insufficient, which has become the bottleneck restricting regional economic development. In addition, the construction of kenlamu new port has been started. It is expected to replace Mombasa port as the largest port in East Africa, with 32 berths, but the progress of the project is slow.

5.3.2 Rapid growth in transportation equipment ownership

By 2018, the total number of registered motor vehicles in use in Kenya was 3.28 million, including 1.497 million motorcycles and 1.048 million vehicles.

Tab 5.3 the ownership of motor vehicles in Kenya

Types of automobiles	**2014**	**2015**	**2016**	**2017**	**2018***
motorcycle	853,670	993,090	1,116,629	1,308,230	1,497,224
cars	779,256	847,745	906,358	973,056	1,047,855
Utility vehicle, scooter, pickup truck	277,324	290,702	303,924	318,172	329,392
Trucks and heavy trucks	128,251	142,036	151,668	159,128	165,642
Buses and minibuses	98,067	100,990	103,268	104,799	106,676
Trailer	42,661	46,566	49,395	51,348	53,431
Other moto vehicles	31,678	36,459	72,242	75,055	80,714
Total	2,210,907	2,457,588	2,703,484	2,989,788	3,280,934

Source: Kenya Revenue Authority/National Transport and Safety Authority

By June 2019, Kenya had registered 1548 aircraft, an increase of 5% over the same period last year. From July 2018 to June 2019, 87 new aircraft were registered, an increase of 81% over the same period last year.

Tab 5.4 Aircraft registration in Kenya

Aircrafts	**2017/18**	**2018/19**	**change**
Total registration	1476	1548	5.0%
New registration	48	87	81%
Phased out	12	15	25%

5.3.3 The demand for transportation services continues to grow

The demand for transportation services in Kenya is growing. Air passenger volume has fluctuated significantly in recent years. In 2018, the air passenger volume was 5,935,831, returning to the level of 2008. The air cargo turnover showed an overall upward trend. In 2018, the air cargo turnover was 295 million ton kilometers, double that of 2008.

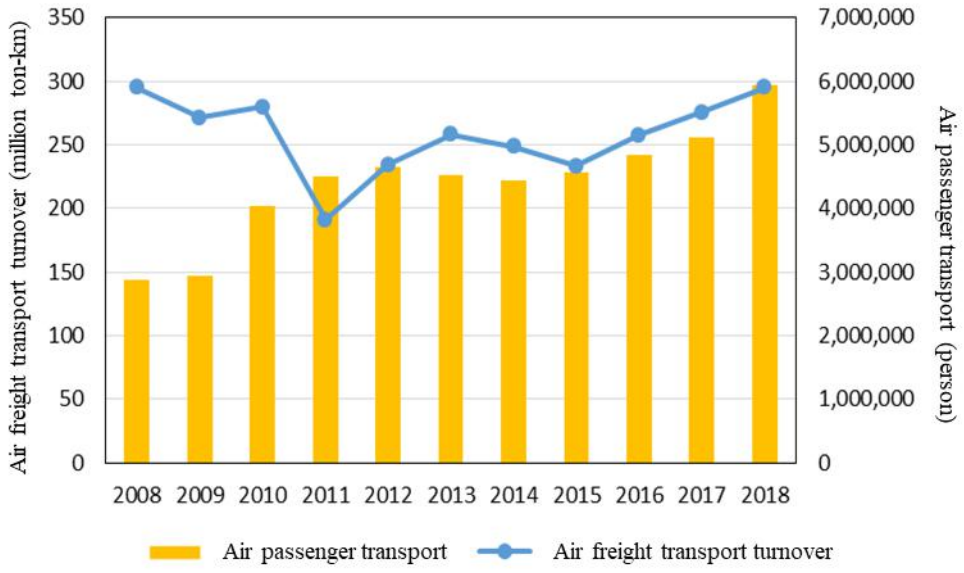


Fig 5.5 Aviation passenger and freight transport turnover

Kenya's port cargo throughput achieved rapid growth. In 2018, the container throughput of Kenya port reached 1.3 million TEU, more than double that of 2008.

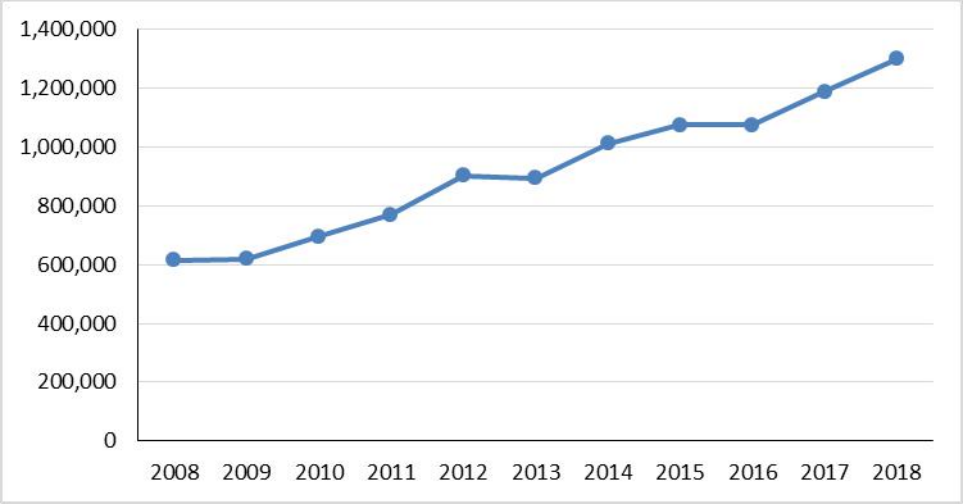


Fig 5.6 Port container transport capacity

5.3.4 China-Kenya infrastructure cooperation has been fruitful

China and Kenya have maintained close cooperation for a long time, especially in the field of transportation infrastructure, which is the highlight of China-Kenya economic cooperation. China's direct investment in Kenya has generally shown an upward trend since 2005. Kenya is a key country for Chinese engineering contracting enterprises to carry out business in East Africa. There are about 110 Chinese enterprises in Kenya, mostly engineering contracting enterprises. In 2016, Chinese enterprises signed a total of 23 project contracts in Kenya, with an amount of US $13.16 billion [15]. On the whole, there is broad space for

China-Kenya trade cooperation. The trade volume between China and Kenya will continue to maintain rapid growth in the next 5 to 10 years.

China's direct investment and project contracting in Kenya are mainly construction and transportation enterprises. In terms of project contracting, China Communications Construction Corporation ranked first, with a total of US $6.37 billion, accounting for 48.4%. CCCC has undertaken more than 25 road projects in Kenya, with a total mileage of 1200 km, as well as three port projects, one inland port project and two railway projects [16]. The Mombasa Nairobi railway, a landmark project of China's financial direct investment and contracting projects in Kenya and Africa, has not only improved the local infrastructure, but also played a leading role in the economic and social development of the areas along the line. It also made a beneficial exploration of the China-Kenya cooperation mechanism. In the process of promoting the construction of Mombasa Nairobi railway, China put forward the idea of "integrated construction and operation", providing Kenya with a package solutions including capital, technology and personnel support [17].

5.4 Development status of green transportation

At present, the green development of transportation in Kenya is in its infancy. Vehicle exhaust emission is still an urgent problem to be solved. Kenya's transportation is mainly by cars and motorcycles, basically relying on imports, covering 380 million consumers in the East African market. The majority of cars are mainly secondhand cars and nearly 2 million are phased out cars from Japan, Europe and the United States. Most of them have been running in Japan, Europe and the United States for about 10 years. Due to the lack of exhaust emission standards, the exhaust gas generated by vehicles cannot be effectively controlled, resulting in huge pollution to the city, which not only affects the environmental quality and residents' health in Kenya, but also damages the tourism industry of Kenya. Kenya urgently needs to introduce vehicle phasing out standards and exhaust emission limits to address the problem. In recent years, the demand for electric vehicles in Kenya has increased at an annual rate of 15%. It is expected that the potential demand for electric vehicles will reach 3 million in the next 10 years [18]. However, at present, the overall infrastructure conditions in Kenya are relatively backward, and there are still many problems in the construction and improvement of roads. There is still great uncertainty about whether there is spare power to plan and invest in the construction of electric vehicle charging facilities. In recent years, Kenya has gradually realized the importance of green and low-carbon development in the transportation sector and put forward a series of policies to promote the green development of transportation in Kenya.

5.4.1 Kenya Vision 2030

The Kenyan government is promoting the Kenya vision 2030[19]. In Kenya's medium and long-term development plan, infrastructure construction such as energy, highway, railway, port and communication are regarded as the basic elements to achieve economic growth and listed as priority development areas. Based on the significant improvement of infrastructure, it will focus on the development of tourism, agriculture, wholesale and retail, manufacturing, mining, service outsourcing and financial services. The planning and construction project of northeast Ring Road and South Ring Road in Nairobi undertaken by China Road and Bridge Engineering Co., Ltd. is an important part of Kenya's "vision 2030". The project has effectively

dredged the serious traffic congestion in Nairobi and provided unprecedented high-grade road services for residential and commercial areas along the line.

5.4.2 Nairobi urban transport comprehensive improvement plan

In 2015, Kenya proposed Nairobi integrated urban development master plan. Nairobi is troubled with traffic congestion, serious air pollution, limited public transport options, and lack of dedicated travel roads for pedestrians and cyclists. The plan proposes to build a bus rapid transit system and railway commuter system, aiming to improve the commuter efficiency of Nairobi, reduce the commuting time and cost, and improve the travel conditions of citizens by public transport [20] .

5.4.3 Integrated planning of urban central transport system

In 2018, the project on detailed planning of integrated transport system and loop line in the Nairobi urban core formulated a more explicit low-carbon transportation policy, and planned to establish a wide range of BRT system and include more pedestrian friendly transportation projects. Promote the connection of urban public transport system and the reform of urban pedestrian roads and parking spaces. This plan makes a detailed assessment of the impact of traffic on air quality in Nairobi in the past, and identifies that there is no urban air environmental quality standard in Nairobi.

5.4.4 New energy vehicle policies

In November 2018, the Kenyan government issued the new energy vehicle policy and planned to invest US $500 million in new energy vehicle projects and vehicles, which will be based on mass production and Government Procurement [18]. Guide domestic automobile consumers to buy new energy vehicles. In addition, the Kenyan government has abolished import tariffs on new energy vehicles, providing a sound environment for the introduction of new energy vehicles. The transportation department also suggested changing road traffic facilities, arranging special lanes for electric vehicles to ensure the safety of users, and planning parking charging facilities in urban construction.

5.4.5 National comprehensive transportation policies

The Kenya Ministry of Transport is currently reviewing and improving the integrated national transport policy. Climate change and other sustainability factors are incorporated into the development planning of the transport sector in the policy report to guide climate change related activities in Kenya's transport field[21]. The report further defines five key tasks of the transportation sector to deal with climate change. (1) Build Nairobi rapid rail transit (BRT); (2) Extension of SGR from Nairobi to Naivasha; (3) 30% of the cargo transportation from Mombasa to Nairobi will be adjusted from highway to railway; (4) Build a non-motorized transport (NMT) across urban areas; (5) Determine the compliance plan of international aviation carbon offset and emission reduction mechanism.

5.5 Suggestions on Green Development of Transportation

Build an energy-saving transportation infrastructure network. At present, Kenya needs to improve the poor road conditions as soon as possible, improve the road quality, strengthen the resilience of transportation infrastructure and improve the resistance of transportation infrastructure to natural disasters. In the process of transportation infrastructure construction and maintenance, strengthen energy-saving design and green

construction management, strive to reduce energy consumption and emission, and strengthen ecological protection, vegetation restoration and greening construction. Actively adopt new structures, new processes and new materials, and promote the application of new technologies such as tunnel energy-saving lighting, pavement material recycling and warm mix asphalt. Through scientific and technological innovation, promotion and application, the technical basis and guarantee capacity of energy conservation and emission reduction in transportation can be continuously enhanced. By improving the specialization, networking level and efficient service capacity of transportation infrastructure, form an energy-saving transportation infrastructure network system, create good traffic conditions for safe, smooth and efficient operation of transportation tools, and promote the reduction of energy consumption and emission. On this basis, speed up the construction of transportation infrastructure, carry out public transport demonstration, improve public transport stations and transfer hubs, and promote the proportion of urban public transport. The construction of charging and other supporting facilities is planned to provide strong support for energy conservation and the promotion of new energy vehicles.

Actively develop energy-saving and low-carbon transportation equipment. Vehicle technology progress is one of the core means to promote emission reduction. In order to promote the application of new energy technology in the field of transportation, Kenya needs to formulate the exhaust emission standard of road transport vehicles as soon as possible and strictly manage the fuel consumption limit. For a large number of imported old cars, it is necessary to strictly control the age of vehicles and establish second-hand vehicle management and energy consumption and emission standards. Establish and improve the fuel consumption detection system of vehicles and ships, strengthen the detection, supervision and management, promote car manufactures to facilitate innovation of energy conservation and emission reduction technologies, and tighten source control. Explore a market exit mechanism and supporting economic compensation mechanism, accelerate the elimination of transport vehicles with high energy consumption and pollution, and promote the exit of old vehicles and ships ahead of schedule. Promote the application of clean energy transportation equipment, establish energy-saving vehicle demonstration projects, and give priority to the use of new energy vehicles in urban public transport, taxies, urban logistics distribution and postal express.

Promote the adjustment of transportation structure. The operation of Mombasa Nairobi railway in Kenya has effectively improved the transportation efficiency and changed the transportation mode to a certain extent. Give full play to the advantages of large volume and low energy consumption of railway transportation, optimize the organization and operation mode, shift unreasonable long-distance highway freight transportation to more economic and environmental railway transportation, and promote the switch of bulk cargo transportation from highway to railway. Speed up the progress of Nairobi Malaba railway and other infrastructure projects under construction in the future, and improve the transportation capacity of the road network. Pay attention to the construction of information platform, strengthen the information exchange and sharing among highway transportation vehicles, railway transportation, market supervision and other departments, and improve the efficiency and service of transportation.

Raise awareness of green transport. Make full use of newspapers, radio, television, Internet and other social channels to raise public awareness of green and low-carbon travel, and improve their understanding on green travel modes and new energy vehicle technologies. Organize regular training, education,

technology and experience exchange on energy conservation and emission reduction, integrate energy conservation and emission reduction in transportation into the vocational education and training system, pay close attention to basic education, professional education, social education and on-the-job training, popularize the scientific knowledge of energy conservation and emission reduction in transportation, and comprehensively improve the capacity of personnel in the whole industry. Give play to the demonstration and guiding role of public institutions in energy conservation and emission reduction. Transportation departments at all levels shall take the lead in using new energy vehicles, and building a green official fleet in the country. Strengthen the government green procurement, and use energy-saving and low-carbon products first. Strengthen the measurement, monitoring and management of energy consumption and pollutant emission, and improve the rules and regulations for energy conservation and emission reduction. Implement new mechanisms such as contract energy management in various transportation public building projects. Government should set examples for energy conservation and emission reduction.

6 Country Report: Myanmar

6.1 Overview of China-ASEAN Transport Infrastructure Connection

With the economic development of ASEAN countries, the construction of infrastructure is also carried out, and many countries have made achievements in infrastructure development. Among them, the transportation infrastructure in Singapore and Malaysia is well-established. It is relatively developed in Indonesia, Brunei and Thailand, and it lags behind in Myanmar, Vietnam, Laos, Cambodia and the Philippines. Myanmar's economic development is relatively backward. The road transportation is the dominant mode of transportation, but the density of roads is the lowest in ASEAN, and ports rank ninth in ASEAN. Vietnam has developed rapidly in terms of highways in recent years, and its ports and aviation are relatively weak. The highway density in Laos is higher than that in Myanmar, and the railway mileage is insufficient.

Tab 6.1 Competitive scores and ranking of transport infrastructure of ASEAN countries[22]

Country	Railway		Road		Port		Aviation	
	Points	Ranking	Points	Ranking	Points	Ranking	Points	Ranking
Brunei	4.84	33			3.92	74	4.5	63
Cambodia	3.20	99	1.64	94	3.69	81	3.72	106
Indonesia	4.10	64	4.23	30	3.99	72	4.80	51
Laos	3.28	94			2.27	127	3.76	101
Malaysia	5.29	23	5.02	14	5.37	20	5.67	21
Myanmar	1.79	96	2.33	136	2.62	123	2.62	132
Philippines	3.10	104	1.90	91	2.94	114	2.94	124
Singapore	6.35	2	5.87	4	6.71	2	6.87	1
Thailand	1.26	59	2.64	72	4.27	63	5.16	39
Vietnam	3.37	92	2.96	59	3.67	82	3.75	103

Source: World Economic Forum, Global Competitiveness Report 2017-2018

The development of road facilities in ASEAN countries is uneven. ASEAN countries signed Transport Strategic Plan 2016-2025 and ASEAN Regional Road Safety Strategy at the transportation ministerial meeting. Among them, ASEAN transport strategic plan 2016-2025 serves as a guiding document for high-level regional connectivity. The document points out that ASEAN countries shall improve and upgrade class II and class III roads more often used into class I roads in 2020.

Railway infrastructure promotes connectivity. The Singapore-Kunming Railway (SKRL) project is a priority project for ASEAN countries in railway cooperation. The project has two lines, the east line and the west line, of which the east connects Vietnam, Thailand and Cambodia. On this basis, it is planned to add branch lines passing through Laos and Vietnam. The west line passes through Myanmar and Thailand. Meanwhile, ASEAN plans to study the possibility of SKRL extending to Surabaya of Indonesia.

A seamless multimodal transport system has been promoted. ASEAN will carry out research on potential multimodal transport corridors and build ASEAN into an important bridge in the global supply line. The East West Economic Corridor (EWEC) has been completed, Myanmar connected to the intermodal network, and the construction of Yangon and Danang ports optimized. The construction of the Mekong-India Economic Corridor as a land bridge has been promoted. By 2020, the construction of Mekong River Bridge has been completed and a large deep-sea port developed. The construction of ASEAN land and port network has been promoted.

An efficient and integrated inland river shipping network has been established. A comprehensive, efficient and competitive shipping system has been built, which increased capital investment, improves the performance and capacity of 47 major ports, strengthened the connection with global routes and domestic routes. The feasibility study of ASEAN roll-on-roll-off network has been conducted.

6.2 Overview of Economic and Social Development in Myanmar

Myanmar is located in the west of Indochina Peninsula. It borders China in the northeast, India and Bangladesh in the northwest, Laos and Thailand in the southeast, and the bay of Bengal and Andaman Sea in the southwest. The coastline stretches 3200 kilometers long. It belongs to tropical monsoon climate, with an annual average temperature of 27 ℃. The country consists of seven provinces, seven states and a federal district. The province is the main inhabited area, the state is inhabited by various ethnic minorities, and the federal district is where capital Naypyidaw locates.

Fig 6.1 Map of Myanmar

Myanmar enjoys superior natural conditions and rich resources. From 1948 to 1962, the country promotes a market economy, from 1962 to 1988, a planned economy and after 1988 a market economy. In July 2016, the Myanmar government promulgated the "12 national economic policies". On October 18, Myanmar's investment law was signed by President Ting Jue and officially entered into force. In fiscal year 2017 to 2018, Myanmar's GDP was about USD 69 billion, with a per capita GDP of about USD 1,300, attracting foreign direct investment of USD 5.8 billion. The main trading partners include China, Thailand, Singapore, Japan and South Korea.

The main industries include oil and gas exploitation, small machinery manufacturing, textile, printing and dyeing, rice milling, wood processing, sugar making, papermaking, chemical fertilizer and pharmacy. Agriculture is the foundation of the national economy, with about 18 million hectares of arable land and more than 4 million hectares of idle land to be developed. The agricultural output value accounts for about 40% of the GDP. The main crops are rice, wheat, corn, peanut, sesame, cotton, beans, sugarcane, oil palm, tobacco and jute. According to the data of Myanmar's Ministry of Commerce, Myanmar exported 1.5 million tons of rice in 2015/2016 fiscal year, and the total export of agricultural products was US $2.5 billion. In the

first ten months of fiscal year 2017/2018 (from April 2017 to January 2018), Myanmar exported 2.82 million tons of rice, with an export volume of US $876 million. According to the data of Myanmar's Ministry of Natural Resources and Environmental Protection, as of 2015, Myanmar's forest coverage was 45%.

Myanmar pursues "non-aligned, active and independent" foreign policy and handle diplomatic relations in accordance with the five principles of peaceful coexistence. It does not depend on any major country or groups, remains neutral in international relations, does not allow foreign troops to be stationed. Myanmar does not infringe upon other countries, interfere in their internal affairs, nor pose threat to international peace and security. It is one of the advocates of the "five principles of peaceful coexistence". After the military government came to power in 1988, western countries led by the United States imposed economic sanctions and trade embargo on Myanmar, terminated economic and technical assistance and prohibited investment in Myanmar. After joining ASEAN in 1997, relations with ASEAN and its neighboring countries have developed greatly. The Myanmar government has actively promoted national reconciliation and gradually eased its relations with western countries. As of May 2013, Myanmar has established diplomatic relations with 111 countries.

China and Myanmar are friendly neighbors linked by mountains and rivers, and the traditional friendship between the two peoples goes back to ancient times. Since ancient times, the people of two countries treat each other as relatives. The two countries officially established diplomatic relations on June 8, 1950. In the 1950s, China and Myanmar jointly advocated the five principles of peaceful coexistence. The bilateral relations have developed steadily.

6.2 Status of Transportation Development

6.2.1 Infrastructure Construction Lags Behind

In February 2015, Myanmar's first national transportation master plan was drafted, involving land, sea and air transportation fields. A total of 10 major transportation channels were planned, and the transportation system was improved on this basis. The plan includes 142 projects, including 32 air transport plans, 15 inland water transport plans, 33 international marine transport plans, 14 railway transport plans and 48 road transport plans. These projects will be implemented step by step.

6.2.1.1 Highway infrastructure construction has been underpinned

In the 1960s, Myanmar began to implement the planned economic system. The state implemented relatively strict control over public service products such as roads, and the investment in highway infrastructure was relatively limited. In the 1980s, affected by economic sanctions and isolation policies of western countries, Myanmar's road traffic development was even more difficult. Since 2010, Myanmar has carried out economic reform. The government has gradually attached importance to the role and status of highway transportation in the national economy, opened up various channels to attract funds for highway infrastructure construction, including increasing the financial budget, attracting social capital, seeking foreign assistance and preferential loans from international development banks, The level of highway infrastructure has been developed to a certain extent. As of September 2018, the total length of paved roads in Myanmar was 83000 miles [23].

Tab 6.2 Highway mileage and types of Myanmar

Time	2005-2006	2010-2011	2014-2015	2015-2016		2016-2017		2017-2018		2018 (Up to Sep)
Length of Roads (miles)	19021	22307	25212	25881	(r)	26561	(r)	81614	(r)	82815
1.Bituminous	9296	10943	14285	15491	(r)	16134	(r)	18346	(r)	18117
2.Metalled	3487	4296	2681	2325		2131		6626	(r)	7100
3.Surface	2971	3223	3085	3296		3040		10340	(r)	10785
4.Earth	3267	3845	4244	3409		3543	(r)	35788	(r)	35692
5.Mule	-	-	161	161		161		7215	(r)	7107
6.Concrete	-	-	756	986	(r)	1019	(r)	2148	(r)	2372
7.AC	-	-	-	213	(r)	381	(r)	1121		1547

At present, there is only one expressway in Myanmar, namely Yangon Naypyidaw Mandalay, running through its economic center, political center and the second largest city. The construction started in 2008. The first half of the section was completed in March 2010 and the second half was completed in December 2010. It is a two-way four lane highway with a total length of 400 miles. Each mile is divided into eight sections, ranging from 0-7. The speed limit is 100km/h. There are two lanes on one side and four lanes on both sides, which is equivalent to the level of China's class II Highway. It is built by Asia World Company [24].

6.2.1.2 The railway mileage needs to be expanded

Myanmar's railway system is exclusively operated and managed by Myanmar National Railway Corporation, a state-owned enterprise under the Ministry of Railway of Myanmar. In the past two decades, the railway network has been expanded to a considerable scale, from 3336km in 1991 to 6112km in 2018, an increase of nearly 83%. Most of the expanded railway lines are extended to remote areas and provide passenger and cargo transportation services. This practical action is the embodiment of the national policy of integration of all ethnic groups throughout Myanmar. This growth rate reflects that the Myanmar government has paid more attention to transportation infrastructure in recent years, especially the railways. However, compared with Myanmar's important neighbors with economic exchanges, the total length of railway lines in Myanmar needs to be continuously expanded in a long time. In terms of the length of railway network per thousand square kilometers of land, Myanmar is much lower than India and Bangladesh, and slightly lower than Pakistan and Thailand.

Railways in Myanmar are an important part of transnational railway planning, such as Pan Asian Railway West Line (Kunming-Yangon), Singapore-Kunming Railway (Singapore-Kunming) and Kunming-Kyaukpyu railway. At present, the Myanmar government is concerned about the railway connection with the economic centers and remote regions. For example, Yangon-Mandalay-Myitkyina and Bago-Moulmein part of the

railway section. Foreign investment in the railway sector mainly comes from China, Japan and India. In 2017, Myanmar Railway Bureau announced that it would reconstruct and upgrade the Yangon-Mandalay railway, in which the Japan International Cooperation Organization would offer assistance. After the project, the running speed of Yangon-Mandalay train will be greatly improved, which takes only 8 hours. The project is officially funded by Myanmar with kyat 428 billion, and the Japan International Cooperation Agency will provide a loan of 270.67 billion yen.

6.2.1.3 The transformation of old airports needs to be facilitated

There are 73 large and small airports in Myanmar, including three international airports, namely Yangon, Mandalay and Naypyidaw. Yangon's Mingaladon International Airport has been built for a long time and is overloaded, but there is no more location for expansion, so the country chose to build a new international airport near Bago city. In addition, due to the continuous development of Myanmar's tourism and frequent trade exchanges at border ports, the Myanmar government also plans to build new airports and transform some old airports in some cities.

At present, the main international airlines operated in Yangon can reach Beijing, Kunming, Guangzhou, Nanning, Hong Kong, Bangkok, Chiang Mai, Singapore, Kuala Lumpur, Hanoi, Ho Chi Minh City, Tokyo, Seoul, Doha and Frankfurt. Major domestic cities and tourist attractions have been navigable. Major airlines include Myanmar airlines, Myanmar International Airlines, Mandalay airlines, Yangon airlines, Gamboza airlines, Bagan airlines, Asia wing airlines, golden Myanmar airlines, etc.

6.2.1.4 Port infrastructure construction is expected to achieve breakthrough

Myanmar's convenient transportation location and excellent long coastline are very conducive to the development of ports and have the opportunity to develop into another new maritime intersection behind the Mariga Strait. Therefore, the construction of Myanmar's port infrastructure is particularly important. Along the western and southeastern coastal areas of the country, Myanmar has 9 ports, including Yangon, Kyaukpyu, Sittwe, Bosheng, dandui, Tuwa, maoqingmian, Gaodong, Dandao and so on, all of which are ship ports. Among them, Yangon port is the largest, with 24 international ship berths and 18 wharfs, and Dilova port has 6 wharfs, with a total of 24 wharfs and 3 warehouses.

6.2.2 Motorcycle is the Main Transportation Equipment

By 2018, the total number of registered motor vehicles in use in Myanmar was 7.09 million, including 5.89 million motorcycles and nearly 540000 cars [25].

Tab 6.3 Ownership of motor vehicles in Myanmar

Classification	2005-2006	2010-2011	2014-2015	2015-2016	2016-2017	2017-2018	2018 (Apr-Sep)
Total	979288	2308521	5077699	5541361	6337002	6853995	7092843

Yangon	168533	261330	679485	756865	824068	873666	893877
Others	810755	2047191	4398214	4784496	5512934	5980329	6198966
Passenger	193940	265642	429493	462199	512144	530728	536647
Truck (Light Duty)	23364	28068	139784	194541	261386	313786	343369
Truck (Heavy Duty)	31437	36820	53775	55989	61147	60501	56105
Bus	18038	20944	26746	25937	26801	28010	27552
Other	11307	15862	44460	52366	69834	84779	95070
Two Wheeler	641777	1883958	4276696	4631107	5271105	5690773	5889577
Three Wheeler	2374	13424	65164	74272	84405	97326	100758
Trawlergi	57051	43678	40344	43570	48595	46312	41904
Heavy Machine	-	125	1237	1380	1585	1780	1861

Source: Department of Road Transport Administration.

6.2.3 Passenger and Freight Transportation by Railway Accounts for a Relatively High Proportion

Passenger transportation is mainly by railway. In 2017, Myanmar completed 70.63 million passenger trips and 305.568 million person miles. It can be seen that in Myanmar's passenger transport structure, the proportion of railway transport is the highest and increasing year by year, reaching 65.9% in 2017, and the proportion of air transport is the lowest but growing rapidly, reaching 2.0% in 2017[25].

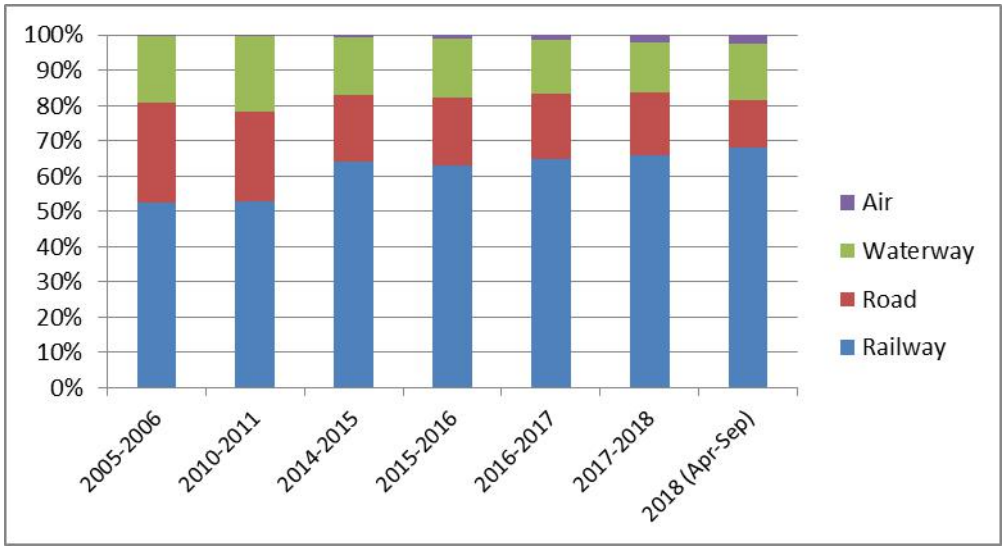


Fig 6.2 Passenger transport proportion by modes

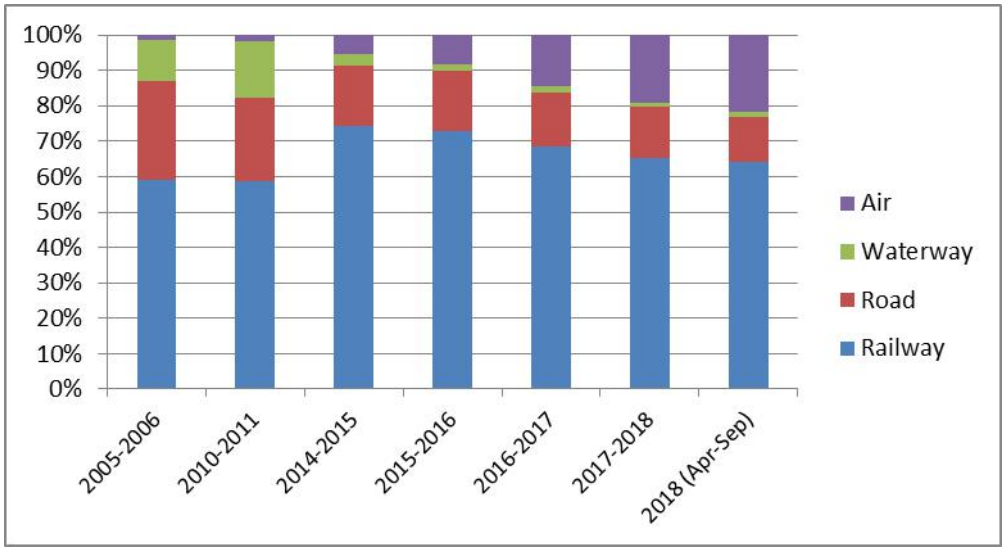


Fig 6.3 Passenger transport turnover by modes

Freight has been mainly transported by railway. In 2017, Myanmar completed a cargo transport volume of 3.61 million tons and 73.128 million tons miles. It can be seen that in Myanmar's freight structure, railway transportation takes up the highest proportion and increases year by year, reaching 49.8% in 2017.

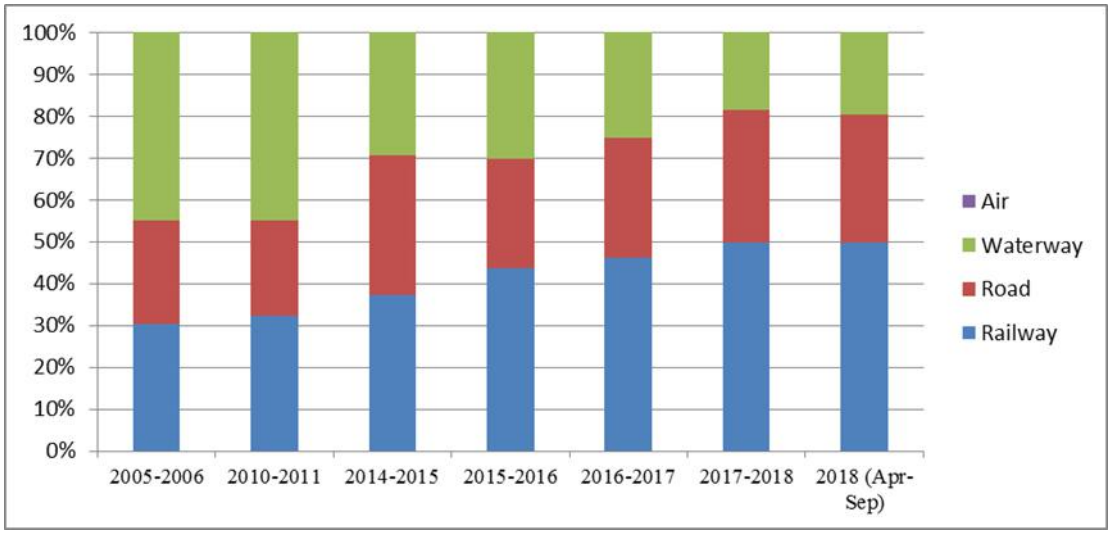


Fig 6.4 Freight transport turnover by modes

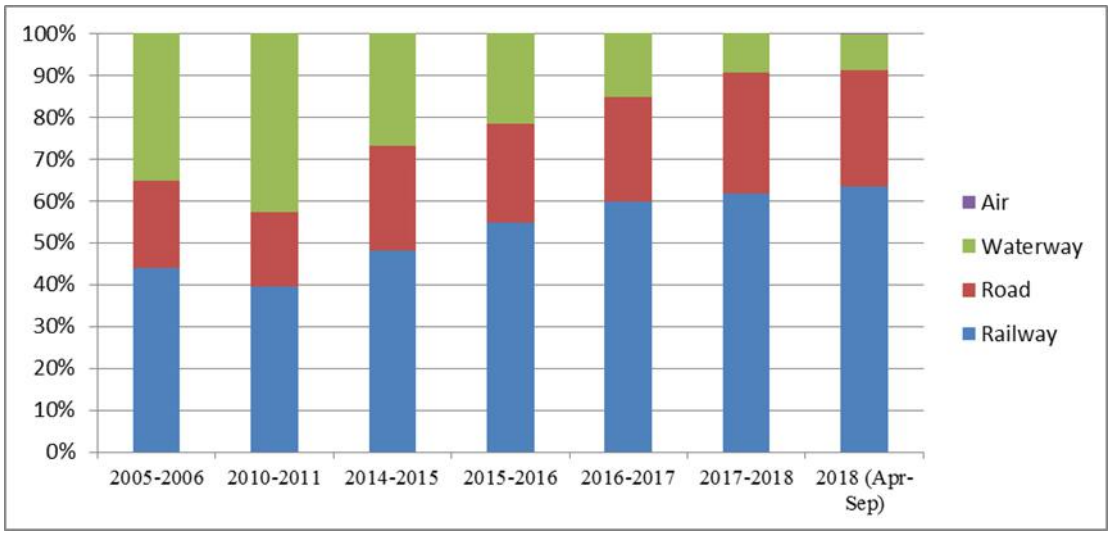


Fig 6.5 Freight transport turnover by modes

6.2.4 Positive progress has been made in infrastructure connectivity

The Southern Silk Road existed between China and Myanmar more than 2000 years ago. The interconnection projects in the modern sense included the Yunnan-Myanmar highway and Stilwell highway during World War II. After the reform and opening up, the interconnection between China and Myanmar can be traced back to the construction of Pan Asian Railway ASEAN channel, China Myanmar integrated land-water transport, Kunming-Kyaukpyu economic corridor, etc. These plans are an exploration of the China-Myanmar "herringbone" economic corridor, which starts from Kunming and is composed of two lines through Mandalay, one extending to Yangon new town and the other to Kyaukpyu special economic zone. Kunming-Yangon economic corridor is one of the three vertical economic corridors proposed at the Ministerial Conference on Greater-Mekong Sub-regional Cooperation in 1988. It coincides with the west line of the Pan Asian Railway ASEAN channel. The trans-Asian Railway ASEAN channel is divided into three lines of East, Middle and West lines. The west line starts from Kunming, passes through Myanmar, Thailand and Malaysia, and finally reaches Singapore. The land water intermodal transport between China and Myanmar, which was proposed by China and Myanmar in 1996, is also similar to one route of China Myanmar economic corridor. The Kunming-Kyaukpyu economic corridor proposed in 2011 is the origin of the "herringbone" economic corridor, which contributes to a freight railway transportation network connecting ASEAN and Eurasia.

In addition to bilateral cooperation, China and Myanmar have also conducted relevant cooperation in multilateral cooperation mechanisms such as China ASEAN Free Trade Area, Greater Mekong Subregion Economic Corridor and Bangladesh China India Myanmar economic corridor. The highway channel of the northern economic corridor of the Greater Mekong Subregion (Kunming-Dali-Ruili-Myanmar) is about 820km long. Since September 2010, China and Myanmar have established a joint working group on the channel project and started the overall planning of the channel. Through the Greater Mekong Subregion Economic Corridor, the two countries have strengthened communication and docking in the field of connectivity, especially cooperation in highway network. The Bangladesh-China-India-Myanmar economic

corridor is also an important platform for cooperation between China and Myanmar. It has actively explored cooperation in promoting regional infrastructure connectivity, export trade and industrial cooperation. The preliminary practice and exploration provided planning ideas for the multi field and all-round cooperation in the China Myanmar economic corridor, and also laid a foundation for the China Myanmar International Corridor, Kyaukpyu Special Economic Zone, Ruili Muse cross-border economic cooperation zone, Yangon smart new city and other projects under China Myanmar economic corridor.

6.3 Status of Green Development of Transportation

In recent years, Myanmar's transport department has actively carried out urban public transport planning to improve the share of green travel. By upgrading and eliminating old equipment and improving the cleanness of transportation equipment, positive results have been achieved in the green transport development.

Myanmar actively carried out the planning of urban public transport system. Yangon carried out the planning and design of public transport from November 2017 to December 2018, and put forward comprehensive urban transport improvement schemes including public transport, walking and parking.

Myanmar purchased 2000 buses in 2017 and put into use the YPS bus card payment system imported from Chongqing, China in 2020, gradually getting rid of the scrapped cars from Japan and South Korea, which helped reduce the pollution emission and improve road safety and passenger comfort. The YPS system is jointly implemented by Yangon Transport Authority and Asia Starmar Transport Intelligent. YPS machine is imported from Chongqing, China. It will also launch a smart card to swap in public transport, and in restaurants and shopping malls, to meet the daily needs of the people.

6.4 Suggestions for Green Development of Transportation

Strengthen the top-level design of green transportation development. Study and formulate the medium and long-term development strategy of green transportation, meeting the needs of economic, social and transportation development, coordinate the objectives of industrial development, poverty eradication, land and resources development, trade and transportation facilitation and sustainable development, formulate the medium and long-term development strategy of green transportation in Myanmar, and establish a hierarchical, classified and mode based green transportation planning system.

Build green transportation infrastructure. To promote the interconnection of China-Myanmar transportation infrastructure, it is suggested to build up the Kunming -yaukpyu corridor through the construction of Ruili/Mujie-Mandalay highway and Kyaukpyu port, and construct three green transportation corridors, Kunming-Ruili-Mandalay-Kyaukpyu, Kunming-Ruili-Irrawaddy River-Yangon, Kunming-Yingjiang-Myitkyina-Lei redo. In the process of highway construction, integrate the concept of green development, strengthen the protection of ecological environment, and carry out ecological route selection, prevent and control water and soil loss, set up corridors for animal migration and ecological drainage ditches, etc. Strengthen environmental protection during construction and carry out treatment for sewage, noise, dust and solid waste. It is suggested to accelerate the construction of green ports and carry out ecological restoration, resource recycling and pollution control. The sewage, noise, dust and solid waste

generated during port and wharf construction and channel dredging construction shall be treated. Accelerate the construction of a new international channel and a logistics system for land water intermodal transport between China and Myanmar.

Strengthen green transport supervision and management. Comprehensively strengthen environmental protection management, energy conservation and emission reduction in the transportation industry, gradually establish a green transport management system, clarify the management responsibilities and carry out industry management through planning EIA, project EIA, environmental protection acceptance, etc. Establish and improve the system of environmental protection laws and regulations in the transportation industry, and formulate rules and regulations related to the management of construction projects, environmental monitoring and statistics, energy conservation of transportation equipment and pollution prevention and control. Carry out green development statistics in the transportation industry, national green development investigation and statistics, to keep track of the development of green transportation.

7 Policy Recommendations

In order to implement 2030 Agenda for Sustainable Development, and actively participate in the international cooperation of green transport under BRI, policy recommendations have been proposed based on the status quo of transportation infrastructure and the basis of green transportation in selected countries, recognizing that transportation infrastructure is not only an important foundation for green transport, but also an important component of green transportation system. Infrastructure problem should be solved step by step, and green development should be integrated little by little. Based on these principles, this report advised medium and long-term green development of transportation in selected countries in three stages.

First is country-specific green transportation country-specific stage. From 2021 to 2025, the main characteristic of this period is to accelerate the construction of transportation infrastructure and the green transportation takes shape;

Second is initial stage of green transportation system. From 2025 to 2030, the main characteristic of this period is to form a comprehensive transport system and a preliminary green transport system;

Third is green transportation system improvement period. From 2030 to 2050, the main characteristic of this period is to promote the connection of the transport system and accomplish a green transportation system.

Based on the analysis of the current situation of green development of transportation in selected countries, it can be seen that the green development of transportation in Kazakhstan, Kenya and Myanmar is in its infancy, and large-scale transportation infrastructure construction will be carried out in the future. In terms of the development of transportation itself, it shows that the national strength is limited, the comprehensive transportation system is imperfect, and there are many differences among domestic regions. The development of transportation modes is unbalanced and insufficient, and there is still much room for improvement in facility connectivity and international transportation with neighboring countries and regions, including China. In terms of green development of transportation, there are generally insufficient top-level design guidance, insufficient investment capacity, insufficient capacity-building, insufficient international participation, lack of characteristics and development path. Therefore, suggestions can be put forward in terms of transportation planning, infrastructure construction, capacity-building, system construction, publicity and training.

Tab 7.1 Characteristics of green transport in selected countries

Countries	Main problems	Measures
Kazakhstan	The largest emitter of greenhouse gases in Central Asia; The fastest increase of GHG emission	Cleanness of transportation equipment; GHG reduction in urban transport
Kenya	Serious vehicle exhaust emission; overall infrastructure lags behind	Integrate climate change and sustainable factors into the

		planning; Promote new energy vehicles; GHG reduction of urban transport
Myanmar	The laws and regulations on environmental protection were issued late; a lack of regulatory framework and environmental assessment; less attention to the development of green transport	Carry out urban public transport system planning; update and eliminate old transport equipment

7.1 General Suggestions

7.1.1 Strengthen Green Transportation Planning

In accordance with the concept of ecological priority and green development, strengthen green development in all ways, coordinate energy conservation, environmental protection and climate change, and pay attention to ecological protection and ecological restoration. Prioritize comparing with other countries, formulate green transport index system in combination with national conditions, and give full play to the role of indicators in guiding green development. China has formulated several index systems in promoting green development of transportation, which are systematic, constructive and operable. It embodies the concept of green development of transportation, which can be used for reference by selected countries.

7.1.2 Accelerate the Construction of Green Transportation Infrastructure

Improve the connectivity and networking of facilities, and pay attention to green development in the whole process of site selection, design, construction, management, maintenance and operation according to the concept of life cycle. Try to create green highways, ports, airports, international transportation hubs, slow traffic and a green transport digital information platform.

7.1.3 Strengthen the Capacity Building for Green transportation

Build a basic database for energy conservation and environmental protection in transportation, establish energy consumption and emission system, and figure out the basic situation and support planning and evaluation. Strengthen the application of green technologies and standards and specifications in the field of transportation. Strengthen the training of staffs. Strengthen international exchanges and cooperation in green development.

7.1.4 Improve the Green Transportation System

Establish an incentive and restraint system for green development of transportation, accelerate the improvement of green standards and norms, tap the role of green standards and norms, participate in

international exchanges and cooperation in green transportation, and establish corresponding domestic mechanisms.

7.1.5 Strengthen Green Transportation Publicity and Training

Strengthen the publicity, training and education of green transportation development concept, advanced technology and management of energy conservation and environmental protection, and raise the awareness of enterprises and industry employees. Carry out the construction of green transportation pilot projects, widely publicize the concept of green transportation, and promote energy-saving, low-carbon, ecological and environmental protection technologies and products. Organize and carry out publicity activities related to green transportation to guide the public to choose green travel modes.

7.2 Country-specific Recommendations

Kazakhstan's green development of transport is relatively good. It has carried out research on green transport and adopted some measures which achieved positive results. Combined with its geographical location and rich oil and gas resources, the cleanness of transportation equipment and the development of green logistics can be promoted (see Kazakhstan's country report for details).

Kenya's green development of transport has a certain foundation. Combined with its relatively perfect transportation system and the existing development foundation of new energy vehicles, transportation structure adjustment can be promoted to advance its green development of transportation (see Kenya's country report for details).

The green development of transport in Myanmar is relatively low. Therefore, the green development of transportation in Myanmar can focus on planning and design, infrastructure construction, supervision and management system (see Myanmar country report for details).

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