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# Promoting Environmentally Sustainable Transport

in the People's Republic of China

Asian Development Bank



**Climate Change and Transport**

**Promoting Environmentally  
Sustainable Transport in the  
People's Republic of China**

Manmohan Parkash

Asian Development Bank

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This paper draws upon the rapid progress made by the PRC in the development of the transport infrastructure and discusses the key challenges faced by transport planners today. The paper draws on the numerous discussions on issues of climate change, energy efficiency, environment, and resource management with stakeholders including ministry officials, logistics operators, research institutes, transport users and other development partners.

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# Foreword

**T**ransport has played a very important role in developing the People's Republic of China (PRC) national economy and connecting the remote and underdeveloped regions with the more developed regions. However, with increasing oil prices and alarming increase in the greenhouse gas emissions, transport faces competitive challenges of sustainability, affordability, and safety.

This paper is an analysis of challenges faced by the transport sector and discusses the key issues of sustainability, resource optimization, and climate change. Affordability, transportation equity, and environmental sustainability are some of the key issues discussed in the paper. As the personal incomes in the PRC grow, it is important that the transport planners take these important issues into consideration. The paper argues that the business-as-usual approach is no longer a viable option, and there is a need for a new, target-oriented approach that places energy efficiency, environment, and health at the top of the policy agenda for transport and related sectors at all levels. The paper makes six key recommendations for promoting environmentally sustainable transportation that can be considered by the PRC for implementation.

We hope that this publication will generate interest among numerous stakeholders and provide a better understanding of the key issues. We also hope that transport planners, transport operators, policy and decision makers, development partners, and the private sector will find it useful and relevant.



Klaus Gethaeusser  
Director General  
East Asia Department

# Acronyms

BRT	–	bus rapid transit
CNG	–	compressed natural gas
EST	–	environmentally sustainable transport
GDP	–	gross domestic product
LPG	–	liquefied petroleum gas
MOR	–	Ministry of Railways
NEN	–	national expressway network
NITCC	–	National Integrated Transportation Coordination Commission
PRC	–	People’s Republic of China

# Executive Summary

**T**he Government of the People's Republic of China (PRC) has recognized the extreme importance transportation plays in economic development and has promoted the rapid growth of all modes. The challenge is to decouple social progress and economic growth from unsustainable resource depletion and adverse environmental impacts.

The transport system is a major source of greenhouse gas emissions especially in the road and aviation sectors, which are also very energy intensive. Currently, 35% of the PRC's crude oil consumption is for transport. The highway system has increased nearly 300% in 26 years, and the proportion of private passenger vehicles to total vehicles increased from 6.8% in 1980 to 78.2% in 2006. In terms of kilometers (km) traveled, air passenger traffic tripled from 68 billion passenger-km in 1995 to 237 billion in 2006. Air cargo almost quadrupled in the same period. In the past 2 years, the PRC alone accounted for more than 30% of the world's incremental consumption of liquid fuels, and its strong growth in consumption has helped support high oil prices. Consumption is projected to grow 3.5 times over the next 30 years.

Numerous initiatives have been undertaken or proposed to reduce the negative environmental and health impacts of the current transport system. There have been significant gains with respect to specific pollutants, notably carbon monoxide and lead, thanks to regulations controlling vehicle emissions and fuel quality; nevertheless, genuine energy conservation has become an urgent task. The revised Energy Conservation Law includes measures to conserve energy in the transport sector by developing and using clean, alternative fuels and by giving incentives for the development, production, and use of alcohol, hybrid, electrical, and compressed natural gas vehicles. The Eleventh Five-Year Plan also prioritizes the development of public transportation with mass rapid transit as a key mode in megacities.

In addition to these measures, a new, target-oriented approach is needed that places energy efficiency, environment, and health at the top of the policy agenda. Environmentally sustainable transport (EST) focuses on vehicle and fuel technology and on infrastructure on the one hand, and on changes in transport activity and management including land use patterns on the other. The latter involves favoring a higher share and use of environmentally sound, healthy modes; increasing vehicle loading and occupancy; reducing the need for motorized transport; changing mobility patterns and driving behaviors; and providing information and education about the efficient use of transport. EST calls for a much greater emphasis on policies to manage transport demand than was necessary in the past.

To realize EST, six broad policy measures with specific activities are recommended: implement administrative reforms, use economic instruments to promote sustainable transport, integrate planning and optimize transportation structure, promote transport equity, promote public transportation and implement mobility management, and conserve resources and promote environmentally friendly transportation.



The challenge is to decouple social progress and economic growth from unsustainable resource depletion and adverse environmental impacts



# Sustainable Development in the People's Republic of China

## Sustainable Economic Growth

In the wake of the United Nations (UN) Conference on Environment and Development in 1992, the People's Republic of China (PRC) published its national Agenda 21 as a platform for guiding social and economic development. That document marked the beginning of sustainable development in the PRC. To help implement the sustainable development strategy, a program for action was promulgated in February 2003. It summarized achievements and problems in sustainable development in the past 10 years; put forward guidelines, principles, and focal areas for progress; and focused on growing capacities for sustainable development, restructuring the economy, controlling population growth, improving the environment, and increasing the efficient utilization of resources. The program simultaneously aimed to achieve rising productivity, a prosperous economy, and a well-preserved environment.

To implement the national strategy, government authorities under the State Council formulated various sector-specific Agenda 21 components and plans of action. Other government authorities also formulated action plans in line with the country's Eleventh Five-Year Plan (2006–2010) including the following:

- the Program for Controlling the Total Amount of the Twelve Main Pollutants;
- the Trans-Century Green Project that specifically targets areas with critical pollution problems particularly the Huaihe, Haihe, and Liaohe rivers; the Taihu, Dianchi, and Chaohu lakes; acid rain in southwestern, central, southern, and eastern PRC; and air pollution in 20 key cities; and
- land and water conservation projects in the seven largest river valleys and in 33 key areas.

From 2002 to 2007, the PRC's economy moved to a high-growth, high-investment, and high net-export structure, yet three major imbalances indicate that the current growth model is not sustainable.<sup>1</sup>

- **Internal versus external demand:** The large and rising current account surpluses have aggravated relations with major trading partners while domestically the accumulation of foreign exchange reserves causes excess liquidity and leads to a suboptimal allocation

The program simultaneously aimed to achieve rising productivity, a prosperous economy, and a well-preserved environment

<sup>1</sup> [www.adb.org/Documents/Books/ADO/2008/PRC.pdf](http://www.adb.org/Documents/Books/ADO/2008/PRC.pdf)



Rising fuel costs should stimulate investments in innovation and technology and influence policy makers to make the paradigm shift in planning from the conventional to the sustainable

of resources. Since 2003, the Government has been trying to restructure the economy toward a sustainable growth model by promoting consumption, but the share of household consumption in the gross domestic product (GDP) has continued to fall while the share of capital formation and net exports has increased.

- **Energy and environmental constraints:** The country's heavy reliance on industrial growth has increasingly strained energy supplies and the environment. The PRC improved the efficiency of its energy use between 1978 and 2002, but the trend was subsequently reversed. The energy use intensity of PRC industry is 1.5–2 times as high as in advanced economies, and the current growth model results in the steeply rising consumption of fuels and increasing imports of petroleum, triggering concerns about energy security. Reliance on coal for 70% of total energy consumption and a rapid increase in the number of vehicles is intensifying air pollution and greenhouse gas emissions.
- The PRC is currently the world's third largest energy producer (after the United States [US] and the Russian Federation), accounting for 10.6% of the world's annual total energy production. In 2006, however, the country was the second largest energy consumer after the US which accounts for 10.8% of the world's total annual energy consumption. This level of demand has resulted in the PRC becoming a net energy importer. The PRC is estimated to have to double its electricity-generating capacity every decade to keep up with the country's rate of economic growth.
- **Income inequality:** Whether measured in terms of the urban–rural income gap, the differences between the top and bottom income groups, or coastal versus interior regions, social inequality is increasing. Accumulating capital in urban industries has led to large income inequalities. To address these imbalances, the Government has launched a raft of new policies and programs since 2003, many of them aimed at helping the rural sector and protecting the environment. However, rebalancing faces several constraints, including soaring rates of enterprise savings, local officials who value economic growth over environmental and social sustainability, low energy prices and weak pollution-abatement measures, and the household registration system that hinders the free movement of labor (Table 1).

In 2004,<sup>2</sup> the Government announced three new tools for reducing rural poverty in the next few years: integrated village-level poverty reduction and development planning; training for potential migrants from rural areas; and the development of local enterprises, typically in agro-industry. While farmers' incomes will remain the focus of the "development-based poverty alleviation"

<sup>2</sup> National Poverty Alleviation and Development Working Conference, November 2004. Beijing, PRC.

**Table 1: Constraints to Rebalancing Economic Development**

Imbalance	Government's Policy and Program
Internal vs. external demand	Investment is still very much encouraged by high saving rates and local government incentives to pursue growth. A high level of domestic investment has been supported by an even higher savings rate. More importantly, the increase in savings did not come from households but mainly from enterprises, so that increasing consumption might not solve the imbalance. Enterprise savings have soared in the past decade because state-owned enterprises have laid off excess staff and have reduced their social functions while a rapid increase in the number of foreign and private firms has raised productivity. The decision to require government-owned enterprises to pay dividends was an important step. However, considering that the share of these dividends in total profits is small (5–10%) and that the dividends will be used for further reforms of state enterprises rather than for social programs, the policy looks unlikely to help remedy the investment–consumption imbalance.
Energy and environmental constraints	<p>The system for evaluating local officials impedes rebalancing. Although the Government has adopted a so-called “scientific approach to development” that emphasizes a balance between economic development and social and environmental sustainability, local officials sometimes still value GDP growth over more intangible social and environmental indicators because that is how their predecessors usually achieved promotions. This is likely to continue until local decision makers perceive that there are stronger incentives to do otherwise.</p> <p>Low energy prices and weak pollution-abatement measures hamper measures to save energy and to reduce pollution. Concerned that higher energy prices and strict pollution controls would push up inflation and raise costs for exporters, the authorities are reluctant to raise taxes on energy consumption and to crack down heavily on polluters. If, however, they are to realize national targets on energy efficiency and pollution reduction by 2010, energy prices will likely have to be raised, that taxes will have to be imposed on energy and natural resources, and that monitoring and evaluation systems will have to be strengthened.</p>
Rising income inequality	Regulations such as the household registration ( <i>hukou</i> ) system that hinder the free movement of farm workers leaving their homes to seek higher-paid jobs in cities constrain rebalancing. Income inequality between urban and rural areas is the major contributor to widening national income discrepancies. One way to address this would be to allow a more flexible movement of labor, especially farmers migrating to cities, which would require reforms to the hukou system.

GDP = gross domestic product.

Source: *Asian Development Outlook 2008*, Flagship Report on the PRC. Available: [www.adb.org/Documents/Books/ADO/2008/PRC.pdf](http://www.adb.org/Documents/Books/ADO/2008/PRC.pdf)

strategy, the Government is exploring new social protection approaches to help poor people who lack productive capacity. These include targeting the central and western provinces to support inclusive economic growth; rebalancing development between rural and urban areas; improving the access of rural villages to income-generating opportunities and social services; and connecting (by railways) underserved, less-developed, and poor areas to help create the conditions necessary for developing local resources and generating employment to raise living standards.

Currently, the PRC like the rest of Asia is facing the serious challenges of the US economic slowdown and of unprecedented increases in energy and food prices. The Government has had to reduce fuel subsidies, which in turn will lead to higher transport costs that could cause inflation; efforts to control inflation can add to fiscal burdens. Rising fuel costs should stimulate investments in innovation and technology and influence policy makers to make the paradigm shift in planning from the conventional to the sustainable.

In a sustainable society, every individual is expected to have the right to a better quality of life that includes adequate food, education, employment, and housing. To achieve this, stable economic growth is necessary. The challenge is to decouple social progress and economic growth from unsustainable resource depletion and adverse environmental impacts.

## Sustainable Development of the Transport Sector

An effective and sustainable transport system for people and goods is a prerequisite for sustainable economic growth. Although the PRC has made remarkable achievements in developing its transportation system, many problems in its business, management, and planning remain. In many cases, previous policies have focused on the construction of additional infrastructure and capital-intensive, high-cost public transport systems with little consideration for environmental sustainability and land-use consequences. In 2006, transport infrastructure in the PRC consumed about 42.09 million square kilometers (sq km) or 0.44% of the country's land area of which 63% was farm land (3.06% of the national total of farm land); 15% was forestland, and 22% was land used in other ways. The construction of highways, railways, and civil aviation airports from 2004 to 2020 is calculated to consume 270 thousand sq km of farm land which will result in 3.7 million farmers losing their land (0.07 hectares/person). According to the national development plan, the total area for transport infrastructure construction in 2020 will amount to 46.37 million sq km or 0.48% of the country's area. By 2020, roads will account for 90.2% of land used by transport infrastructure.

Transport networks move both people and goods. For moving people, the challenge is not just to maintain the network but also to make integrated public transport attractive as a mode of urban commuting and of intercity travel. The objective of integrated transport is to achieve a high share of users by using a system of transfers between two or more modes. For moving goods, the challenge is to design the right modal mix to control rising transportation costs without excessively affecting mobility and accessibility. The PRC's sustainable transportation system should not only satisfy the people's growing demands for transportation but should also effectively coordinate all transportation modes to limit resource consumption and environmental pollution. With full-scale, coordinated development that combines government functions and market mechanisms, an extensive and highly efficient transportation system can be built and maintained.

The Government has recognized the extreme importance transportation plays in economic development and has promoted the rapid growth of all modes. Accordingly, by 2004 the rail network was the third largest in the world, the road system the fourth largest, expressways ranked second, and airline passenger volume was the third largest. This growth in transport infrastructure was made possible by rapid increases in public funding especially for highways and ports (Table 2).

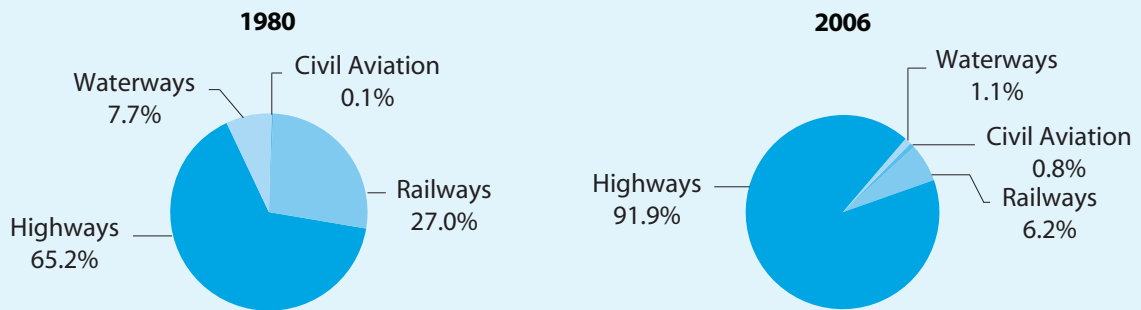
The objective of integrated transport is to achieve a high share of users by using a system of transfers between two or more modes

**Table 2: Investments in Fixed Assets in the Transport Sector in the People's Republic of China 2000–2006**

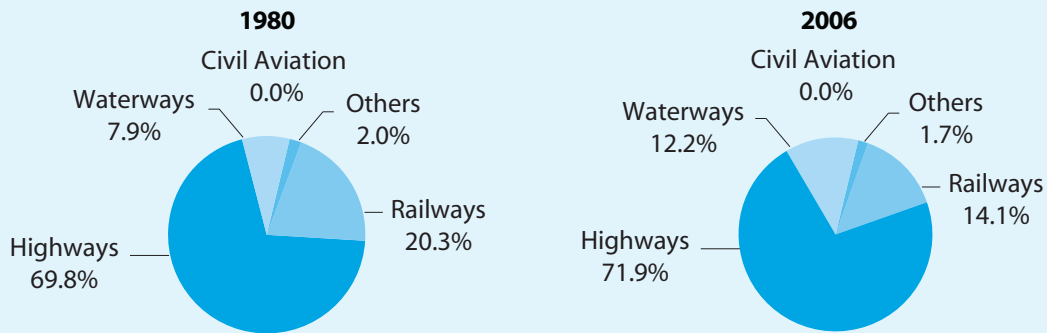
	2000	2001	2002	2003	2004	2005	2006
Investment in Fixed Assets (billions of United States dollars)	41.5	47.7	55.0	61.3	76.1	90.2	103.4
Investments in Transport Fixed Assets (as % of total public investment)			9.8	8.8	8.6	7.3	6.7
Railways	23.5	23.2	21.6	16.7	13.7	10.7	n/a
Highway Construction	68.9	69.1	72.1	74.8	76.3	76.0	87.3
Ports and Other Coastal Construction	2.4	3.2	3.1	4.9	5.5	8.0	9.9
Inland Waterway Construction	1.6	1.3	0.9	1.1	1.2	1.6	2.3
Others	3.6	3.2	2.3	2.6	3.4	3.8	4.0

Source: World Bank. 2007. EASTE Working Paper No. 15.

**Figure 1: Passenger Use of Transport in 1980 and 2006 in the People's Republic of China**



**Figure 2: Freight Use of Transport in 1980 and 2006 in the People's Republic of China**



The transport strategy will be most successful if there is also a long-term, sustainable financing framework for roads. The PRC's high level of investment in roads amounting to about 3.5% of the nation's GDP during the last 6–7 years is exceptional—few countries spend more than 2% of their GDP on transportation infrastructure. Yet funding for secondary and tertiary networks remains insufficient to meet growing needs, and the private sector's share of highway financing is unlikely to increase in the future.

As a result of these significant investments, passenger use of transport by road and air increased significantly from 1980 to 2006 at the expense of railways and inland waterways (Figure 1).

Long-term trends in passenger traffic also reflected the shift to traveling by automobile and airplane (Table 3). This held true in 2006 and 2007 as well (Table 4).

Freight traffic nearly tripled in volume from 1980 to 2006, but once again, the share for rail declined while the share for highways, waterways, and aviation rose (Table 5). This also held true in 2006 and 2007 (Table 6).

**Table 3: Trends in Passenger Traffic in the People's Republic of China from 1980 to 2006 (100 million persons)**

	1980	1990	2000	2001	2002	2003	2004	2005	2006	Change from 1980 to 2006 (%)
<b>Total</b>	<b>34.2</b>	<b>77.3</b>	<b>147.9</b>	<b>153.4</b>	<b>160.8</b>	<b>158.7</b>	<b>176.7</b>	<b>184.7</b>	<b>202.4</b>	<b>491.8</b>
Railways	9.2	9.6	10.5	10.5	10.6	9.7	11.2	11.6	12.6	37.0
Highways	22.3	64.8	134.7	140.3	147.5	146.4	162.5	169.7	186.0	734.1
Waterways	2.6	2.7	1.9	1.9	1.9	1.7	1.9	2.0	2.2	(15.4)
Civil Aviation	0.0	0.2	0.7	0.8	0.9	0.9	1.2	1.4	1.6	

Source: National Bureau of Statistics (NBS), 2008.

**Table 4: Passenger Traffic Growth Rates in the People's Republic of China, 2006 and 2007**

Item	Unit	Volume (2006)	Volume (2007)	Increase over 2006 (%)
<b>Total passenger traffic</b>	<b>100 million persons</b>	<b>202.4</b>	<b>223.7</b>	<b>10.5</b>
Railways	100	12.6	13.6	8.0
Highways	100	186.0	205.8	10.6
Waterways	100	2.2	2.4	9.6
Civil aviation	10,000 persons	1.6	1.9	16.3

Source: NBS, 2008.

**Table 5: Trends in Freight Traffic in the People's Republic of China, 1980–2006 (100 million freight tons)**

	1980	1990	2000	2001	2002	2003	2004	2005	2006	Change from 1980 to 2006 (%)
<b>Total</b>	<b>54.70</b>	<b>97.10</b>	<b>135.90</b>	<b>140.20</b>	<b>148.30</b>	<b>156.10</b>	<b>170.60</b>	<b>186.20</b>	<b>203.80</b>	<b>272.6</b>
Railways	11.10	15.10	17.90	19.30	20.50	22.10	24.90	26.90	28.80	159.5
Highways	38.20	72.40	103.90	105.60	111.60	116.00	124.50	134.20	146.60	283.8
Waterways	4.30	8.00	12.20	13.30	14.20	15.80	18.70	22.00	24.90	479.1
Civil Aviation	0.00	0.00	0.02	0.02	0.02	0.02	0.03	0.03	0.04	3,400.00
Others	1.10	1.60	1.88	1.98	1.98	2.18	2.47	3.07	3.47	

Source: NBS, 2008.

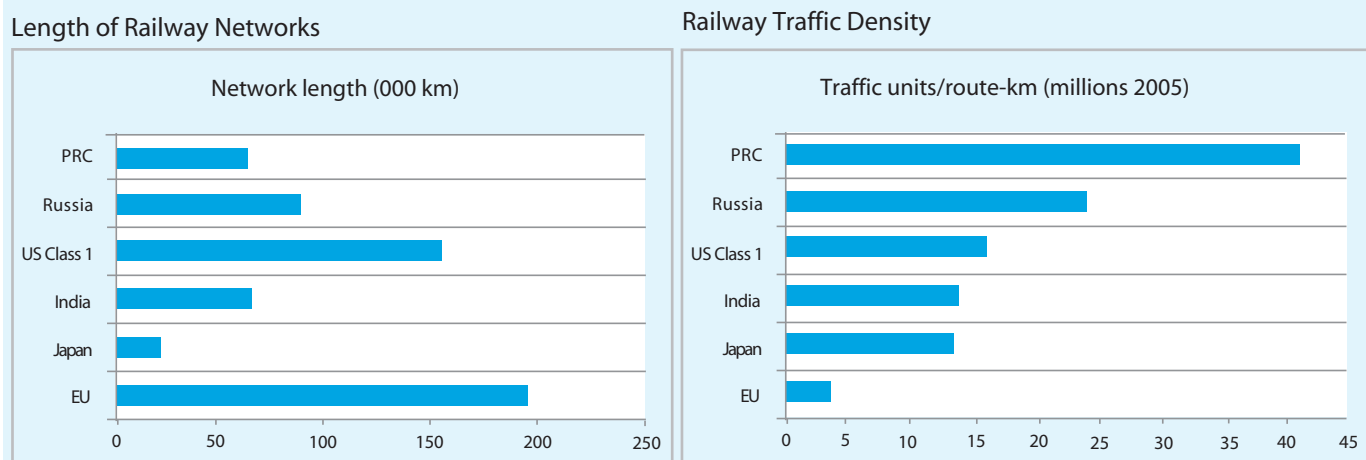
**Table 6: Freight Traffic Growth Rates in the People's Republic of China, 2006 and 2007**

Item	Unit	Volume (2006)	Volume (2007)	Increase over 2006 (%)
<b>Total freight traffic</b>	<b>100 million tons</b>	<b>202.5</b>	<b>225.3</b>	<b>10.7</b>
Railways	100	28.8	31.4	9.0
Highways	100	146.1	162.8	11.0
Waterways	100	24.4	27.3	9.7
Civil aviation	10,000 tons	349.4	401.8	15.0
Others <sup>a</sup>	100	3.2	3.8	17.9

<sup>a</sup> Pipes and pipelines.

Source: NBS, 2008.

**Figure 3: Worldwide Railway Networks and Traffic Densities in 2008**



## Railways

Rail transport is the most commonly used mode of long-distance transportation in the PRC. Almost all rail operations on the mainland are handled by the Ministry of Railways (MOR).<sup>3</sup> The rail network has grown by 45% since 1980 and currently traverses the length and breadth of the country covering a total length of 77,000 km including 25,000 km of double track and 23,000 km of electrified track.<sup>4</sup> The network today serves all provinces except Macau.

Several factors make railway traffic well suited for the PRC and its economy. People and goods move in large volumes over long distances for which well-run railways can provide a safe, low-cost, energy-efficient, less land-intensive, and environment-friendly mode of transport. In terms of freight, the economy depends heavily upon coal and coke, metal ores, iron and steel, petroleum products, grain, fertilizers, and other bulk products. The technology and economics of rail transport are well suited to this traffic.

Globally, the PRC's rail transport volume is one of the largest with 6% of the world's operating railways carrying 25% of the world's total railway workload. The PRC also leads in terms of the growth rate of transport volume and in the efficient use of transport equipment. Taking freight and passenger traffic together, PRC railways is now the busiest railway in the world. In 2006, it transported 29 billion tons of goods with a freight transport density of 28.48 million ton-km/km. The average transit distance of PRC railway's freight was 762 km in 2006 which is relatively high by world standards. PRC railway has been the only major railway in the world to increase its network significantly in recent years, but this increase started from a small size relative to the country's large population and railway traffic. As a result, PRC railway's traffic density (40.5 million traffic units/km of line) remains the highest in the world, nearly twice the next highest which is in the Russian Federation and far higher than in the US, India, and the European Union (EU) (Figure 3).

<sup>3</sup> The executive agency is responsible for passenger services, regulating the rail industry, developing the rail network and rail infrastructure. The MOR is also in charge of the operations of PRC railways which manages the railway bureaus and companies in the provinces.

<sup>4</sup> The length of railways in operation refers to the total length of the trunk lines for passenger and freight transportation (including both full and temporary operations).

Globally, the PRC's rail transport volume is one of the largest with 6% of the world's operating railways carrying 25% of the world's total railway workload





As might be expected, on the busiest routes and during the busiest periods, demand is constrained by capacity. As a result, there is a significant amount of diversion of traffic to higher-cost road transport and probably an even greater suppression of demand.<sup>5</sup>

In 2004, the State Council approved the MOR's Mid- and Long-Term Railway Network Plan,<sup>6</sup> which set out the investments required through 2020 to keep pace with demand. The underlying principles were the following:

- coordinating railway development with that of other transport modes and with energy and other related sectors at both the macro and corridor levels;
- separating passenger transport from freight on busy trunk lines to increase capacity and to improve service levels by developing intercity fast passenger networks in densely populated and developed areas;

<sup>5</sup> World Bank. 2008. China's Railway Developments, Ambitions, and Challenges. China Quarterly Update. February.

<sup>6</sup> This plan, the first of its kind approved by the State, sets out the main steps for expanding rail transport capacity and improving service quality with an emphasis on ensuring maximum value for the proposed investment while supporting both rural and urban development in a sustainable manner. It encourages both domestic and foreign private capital investment with the Government's regulatory role and responsibilities defined within a market framework.

## Box 1: Mass Rapid Transport System in Beijing

In 1998, the rail-based mass rapid transport system (MRTS) was only 44 kilometers (km) long; in 2001, it was still only 56 km, much less than that in other world capitals. Rapid growth in the use of personal transport and slow progress in developing public transport, especially MRTS, caused many problems, including low transport efficiency, congestion, and serious pollution. The Beijing government decided to focus on developing a public transport plan for the new century, and launched a detailed project with a focus on MRTS. Beijing's bid to host the 2008 Olympics added to the project's urgency and importance. The target by 2008 was that MRTS will meet 33% of public transport demands and that by 2020 the share will increase to 55%.

According to the plan, the length of rail lines was to be extended by 50 km per year, with an investment of over CNY10 billion (\$1.2 billion) each year. Before the 2008 Olympics, eight new MRTS routes were built. By 2008, the total length of subway lines in the downtown area is about 200 km. By 2015, a total of 19 lines of rail-based suburban transport with a total length of 561 km will be put in operation linking the central downtown core with 14 satellite towns on Beijing's outskirts and the suburbs of the city.

With the advent of MRTS, downtown traffic congestion has eased. As a rapid, convenient, and reliable transport mode, MRTS has displaced other modes and has reduced oil consumption and air pollution, thus improving the overall environment for the entire urban population. By linking exurban areas to the central downtown, the MRTS has expedited more balanced development between the outskirts and the city center.

- strengthening the links between major economic areas and optimizing line and terminal capacity to ensure the smooth operation of major corridors;
- expanding the coverage of the rail network to support and encourage sustainable economic development, regional development, and national defense;
- raising the local content of railway equipment and promoting local equipment manufacture.

**Public transport:** Until 1989, the PRC had only three metro lines totaling 50 km (two in Beijing and one in Tianjin). The following 15 years saw the construction of 22 metro or light rail lines in 10 cities with a total of 621 route-km opening in the past decade (Box 1). The expansion has been led by Shanghai and Guangzhou which have considerable experience in metro construction. Currently, 36 urban rail transport lines with a total length of 1,500 route-km and a total investment of almost \$67 billion are under construction in 15 cities as part of the Eleventh Five-Year Plan. In the next 10 years, these 15 cities will have a total metro length of 1,700 km and the investment will reach \$83 billion. The high construction costs of metro and light rail, typically \$50–100 million per km, limit the extent and speed of their development.

## Highway Network

The rapid urbanization in the PRC is largely unplanned and has resulted in an unprecedented rate of motorization. Most cities in the PRC lack effective metropolitan land-use planning because of weak institutional capacity, lack of political will, and overlapping or conflicting institutional mandates. They are inadequately prepared to design and achieve citywide urban development that reduces travel demand while coping with explosive growth. This has led to accelerating urban sprawl that together with increased purchasing power, car availability, and relatively cheap fuel has generated pressure for enhanced personal mobility that is being met by rapidly increasing motorization.

The rapid urbanization in the PRC is largely unplanned and has resulted in an unprecedented rate of motorization



**National highways:** The national highways are a series of trunk roads throughout mainland PRC. Although they are called highways, they are not necessarily expressways. Roads are graded into the G-series (national routes), the S-series (provincial routes), and the X-series (county routes). National highways are part of the G-Series. The expressway network is known as the national trunk highway system (NTHS). The highway system has grown from 883,000 km in 1980 to 3,457,000 km 2006,<sup>7</sup> an increase of nearly 300% in 26 years (Table 7).

In December 2004, the Government approved further plans for a national expressway network (NEN). The NEN is also called the “7-9-18 Highway Network” and is to be completed by 2020. Incorporating and expanding the NTHS, this highway network will have some 85,000 km of high-grade expressways consisting of 7 capital radials, 9 north-south major highways, and 18 east-west corridors. The NEN design goal is to reach more than 1 billion people by connecting all provincial capitals and large cities of more than 500,000 inhabitants with cities of more than 200,000 inhabitants. People in eastern areas are intended to have access to an expressway within half an hour, those in central provinces within an hour, and those in western areas within 2 hours. In addition, the system will improve communications between economically developed areas such as the lower Yangtze in the center and the Pearl River Delta in the southeast with the mid-west and northeast. The NEN will also enhance connections with western provinces and will promote the economic growth of central and southeastern provinces.

With the completion in 2008 of the five north-south and the seven east-west national arterial highways totaling 35,000 km, Beijing and Shanghai will be linked by major highways, chiefly expressways, to the capitals of all provinces and autonomous regions creating highway connections with over 200 cities.

<sup>7</sup> The length of highways and waterways refers to the length open to traffic or navigation at the end of the year but does not include highways and waterways under construction or not officially in use.

**Table 7: Growth of the Highway Network in the People's Republic of China, 1980–2006**

	1980	1990	2000	2005	2006	Change (%)
Highways (10,000 km)	88.3	102.8	140.3	334.5	345.7	291.4
Expressway	–	0.1	1.6	4.1	4.5	8,967.8
Proportion (%)	–	0.05	1.16	1.23	1.31	
Expressway and G-X Series Highways	–	91.1	121.6	159.2	228.3	150.7
Proportion (%)	–	88.57	86.69	47.58	66.04	–

Source: NBS, 2008.

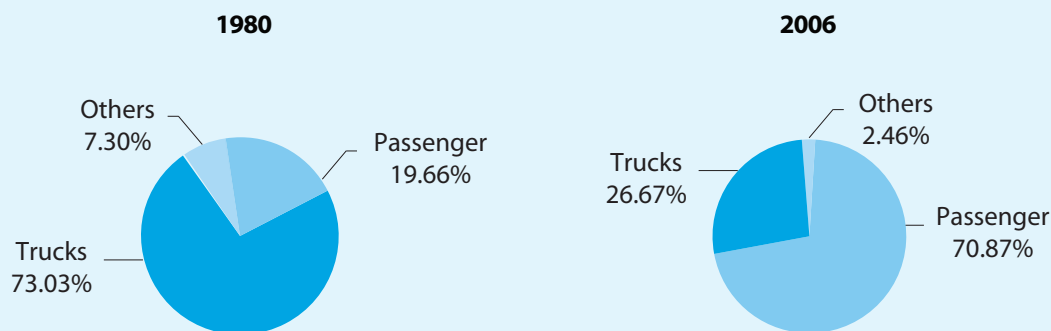
**Table 8: Growth of the Civil Vehicle Fleet in the People's Republic of China, 1980–2006**

Vehicle Type	1980	1990	2000	2001	2002	2003	2004	2005	2006	Change from 2002 to 2006 (%)
Total (million units)	1.8	5.5	16.1	18.0	20.5	23.8	26.9	31.6	37.0	80.1
Passenger	0.4	1.6	8.5	9.9	12.0	14.8	17.4	21.3	26.2	117.9
Trucks	1.3	3.7	7.2	7.7	8.1	8.5	8.9	9.6	9.9	21.4
Others	0.1	0.2	0.4	0.4	0.4	0.5	0.7	0.7	0.9	125.0

Source: NBS, 2008.



**Figure 4: Share of the Civil Vehicle Fleet in 1980 and 2006 in the People's Republic of China**



These growth rates are not conducive to energy efficiency or to controlling vehicle emissions which are a significant source of air pollution

**Rural highways:** Currently, the rural population accounts for 61% of the total, and it is the rural road network that connects the rural population—i.e., the majority of the poor—to local markets and social services. This road network was developed from cart tracks that were originally footpaths. It needs to be improved to enhance rural accessibility. Providing the rural populace with adequate access to social services such as medical care, proper nutrition, and educational facilities will improve their social and economic welfare and reduce their isolation, further reducing their vulnerability and decreasing income variability. Furthermore, agricultural output from rural areas is still a very significant component of the national economy.

Rural roads currently account for over 80% of the total length of the highway network. As a percentage of total road construction, rural road investments rose from 13% in 2000 to 25% in 2005. In fact, during the Tenth Five-Year Plan, newly constructed roads surpassed the total constructed in the first 50 years since 1949. Despite these achievements, rural highways still do not meet the social and economic needs of the rural areas. The major reason is the lack of stable and adequate construction funds as they are mainly raised by local governments, which means farmers bear a heavy burden.

**Vehicle fleet:** The vehicle fleet continues to grow rapidly. In 2006, the PRC's civil<sup>8</sup> vehicle fleet amounted to nearly 37 million vehicles. Of these, 26.2 million were passenger vehicles<sup>9</sup> and 9.86 million were freight vehicles (Table 8). The proportion of passenger vehicles to the total fleet increased from less than 20% in 1980 to over 70% in 2006, and the proportion of freight vehicles dropped from 72.9% in 1980 to 26.7% in 2006 (Figure 4).

The growth in the private vehicle fleet during the same period has been even more dramatic. It increased from 300,000 vehicles in 1980 to 23.3 million in 2006, with passenger vehicles more than doubling every five years (Table 9). The proportion of private passenger vehicles to total vehicles increased from 6.8% in 1980 to 78.2% in 2006 and the proportion of private freight vehicles (trucks) dropped from 92.9% in 1980 to 21.2% in 2006 (Figure 5).

<sup>8</sup> Civil vehicles refer to vehicles that are registered and received vehicle license tags according to PRC's World Standard for Motor Vehicles Registration formulated by the Transport Management Office under the Department of Public Security at the end of the reference period.

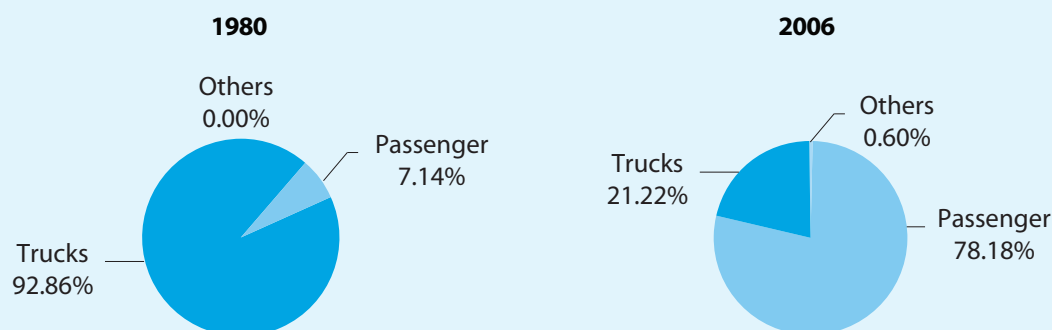
<sup>9</sup> Does not include 2- and 3-wheelers.

**Table 9: Growth in the Private Vehicle Fleet in the People's Republic of China, 1980–2006**

	1980	1990	2000	2001	2002	2003	2004	2005	2006	Change from 2002 to 2006 (%)
Total (million units)	0.28	0.82	6.25	7.71	9.69	12.19	14.82	18.48	23.33	140.76
Passenger	0.02	0.24	3.65	4.70	6.24	8.46	10.70	13.84	18.24	192.31
Large	–	–	–	–	0.10	0.07	0.07	0.08	0.11	10.00
Medium	–	–	–	–	0.36	0.43	0.47	0.51	0.56	55.56
Small	–	–	–	–	4.08	5.87	7.87	10.80	14.91	265.44
Others	–	–	–	–	1.70	2.09	2.29	2.45	2.66	56.47
Trucks	0.26	0.57	2.59	2.99	3.41	3.67	4.03	4.52	4.95	45.16
Heavy	–	–	–	–	0.48	0.44	0.53	0.63	0.64	33.33
Medium	–	–	–	–	0.84	0.95	0.95	1.00	1.09	29.76
Light	–	–	–	–	1.59	1.77	2.04	2.43	2.89	81.76
Others	–	–	–	–	0.50	0.51	0.51	0.46	0.33	-34.00
Others	0.00	0.01	0.01	0.02	0.04	0.06	0.09	0.12	0.14	250.00

– = not available.  
Source: NBS, 2008.

**Figure 5: Share of Private-Vehicle Fleet in 1980 and 2006 in the People's Republic of China**



Again, the increase in passenger vehicles has been more in the small and medium segments and not in the large passenger vehicles (buses) that carry more people and are more energy efficient and environment friendly. Similarly for private trucks, the increase (2002–2006) in the proportion of light trucks was significantly higher at 81.76% than the increase in the medium-sized trucks at 29.76% or large trucks at 33.33%. These growth rates are not conducive to energy efficiency or to controlling vehicle emissions which are a significant source of air pollution (Box 2).

**Maintenance:** While the PRC continues to expand its expressway system, the first generation of highways is reaching the point where they will soon need resurfacing and repairs. Because of widespread overloading of trucks, pavements have deteriorated faster than planned and will need substantial strengthening.<sup>10</sup> Thus provinces will be faced with a need to allocate a growing share of their road budgets to road maintenance, rehabilitation, and strengthening rather than to new construction. The road

<sup>10</sup> Damaged roads affect mobility, and vehicles on such roads consume more fuel, cause more pollution and congestion, and increase wear and tear and accidents.

## Box 2: Air Quality in Shanghai

Tailpipe exhaust pollution from vehicles has become one of the main factors affecting the air quality of Shanghai. In 2002 there were 1.4 million vehicles in the city including about 700,000 automobiles and 700,000 motorcycles, and their numbers were increasing at an annual rate of 14%. The Shanghai government therefore decided to improve air quality by improving the environmental performance of vehicles (mainly by implementing emission standards), by forbidding the operation of motorcycles on main routes, and by controlling the number of vehicle licenses issued for private use through auctions. At the same time, the government adopted a “public transport first” policy including constructing rail transportation, establishing a rail transportation network composed of subways and urban light rail, and new trolley car systems.

Air quality has improved as a result. The emission standards have been effective, and selling vehicle licenses for private use by auction is a market-based, transparent measure that generates revenue that can be used to construct and maintain the highway and transportation system.

Buses provide the majority of public transport services. They form the backbone of the passenger transport network even in quite large cities

maintenance fee currently in operation is expensive to administer, easy to evade, and generates less than half of its potential. Government-owned vehicles are exempt. If all vehicles paid the set rates, the revenue would be enough to fully fund needed maintenance on the national road network; however, of the revenue collected, less than half is actually used for that purpose and more than half is spent on new construction.

The Government is increasingly faced with a need to balance several conflicting priorities: the population’s desire for greater car ownership and personal mobility against the need to manage environmental impacts such as land use, air quality, greenhouse gas emissions, and national energy security; the demand for and benefits of more road infrastructure against the need to achieve the benefits of better regulation of road transport services and traffic including road safety; building expressways to provide for interregional and international trade and economic growth against the demand for more local roads of lower classifications that more immediately serve the mobility needs of poor communities; spending on expanding the road network against spending on maintaining what already exists; and road funding resources available to richer provinces and cities versus those available to poorer provinces and rural areas. These are choices facing all governments around the world, but the rate of change in the PRC’s economy and in the road sector itself adds urgency to the need to ensure that the policy and regulatory frameworks for the sector are able to provide outcomes that promote broad economic and social development rather than just a boost to infrastructure capacity.

**Public Transport:** Buses provide the majority of public transport services. They form the backbone of the passenger transport network even in quite large cities. The network is generally extensive but is not always well matched to rapidly developing parts of a city and thus to changing travel and residential patterns, so reform is required (Box 3).

State-owned enterprises or joint ventures in which the State has a majority stake provide much of the public transport supply. Most bus operators finance bus replacements with loans from local banks, but they often do not have adequate depot facilities for storing buses overnight off the street nor sufficient funds to ensure high levels of maintenance or modern information



### Box 3: Reforming the Bus System in Beijing

To promote public transport, the Beijing government decided to reform the system for operating buses. Before 1996, the system was operated solely by the Beijing Public Transit Company, which the government controls. Since then, other companies have been allowed to offer bus services including the Beijing Bus Company and Yuntong Company. This shift allowed more buses to connect suburban areas with services operated by various county-level transport companies. The number of buses increased from 4,452 in 1995 to 10,077 in 2000 and the number of bus routes grew from 260 to 422. By 2008, the fleet of transit buses will number 18,000 with 650 public transport lines. The focus over the next 7 years is to optimize the transportation network to be highly accessible, rapid, and convenient with the downtown area as the center radiating out to the suburbs and residential areas.

technology equipment for routine business or maintenance and operations. Limited money has been invested in supporting public transport infrastructure, e.g., in high-quality interchange terminals and passenger information systems. Bus priority and bus rapid transit (BRT) have been tried and sustained in only a few places but are catching on.



Inland waterway transport can also have fewer environmental impacts than other transport modes

While most cities in Asia have formal bus services, a greater percentage of passenger trips are conducted informally on smaller vehicles. These provide a cheap, convenient service to the traveler because a large number—far more than would be needed if they were full-sized buses—are willing to pick up and drop passengers at any point along the route. However, these large numbers of informally operated and often inadequately maintained vehicles obstruct the flow of traffic and are a substantial source of local pollutants and greenhouse gas emissions. Furthermore, the informal sector is generally not interested in promoting or accepting long-term transport policies and severely hampers the mobilization of additional capital. While it is now realized that mass transit systems need to be improved in any move forward like introducing BRT, the emphasis needs to be on shifting operators from the informal to the formal sector and on public–private partnerships.

The largely informal nature of public transport in the PRC also restricts modernization in other ways. Most cities do not have any mechanisms in place to monitor the performance of the transport system (which requires data collection and analysis to monitor modal split, passenger- and vehicle-km traveled, activities in subsectors and routes, environmental performance, and safety and access), and often no clear guidance is available on the role of public versus private transport or on the incentives or disincentives for developing public or private transport.

### Inland Waterways

The PRC's inland waterway transport network is the world's largest in terms of length and freight volume.<sup>11</sup> The country has long navigable rivers that link many major cities especially in the central and southern regions where rainfall is high. Moreover, the country's geography and the location of its population are exceptionally favorable to inland water transport. These features create the potential for inland water transport to claim a larger share of the transport market.

The inland waterway system consists mainly of the Yangtze, Zhu (Pearl), and Heilong (Amur) rivers in the northeast (adjoining Siberia) and the Huang (Yellow) River and the Grand Canal and their branches. The 1,747 km Grand Canal completed in 1293 still provides an important north–south corridor from Beijing to Hangzhou. The Huang, which drains the northern plains, has heavy silting, so its navigational use is quite limited.

**Strengths:** Efficient, modern barges can transport bulk goods at a lower cost than either road or rail. Generally, inland waterway transport will be most competitive for consignments that are large enough to justify the regular use of large barges, shipped to/from sources closest to the river, neither perishable nor particularly time sensitive, and most sensitive to transport costs (because of relatively low value). The PRC's economy generates relatively large quantities of traffic that meet these criteria: sand and gravel, coal, bulk oil, timber, cement, and fertilizer, among others.

Except the Grand Canal and coastal routes, most water routes run from west to east, linking inland sources of minerals and agricultural products to the major markets on the eastern seaboard. The inland waterways are therefore well poised to serve the Government's policy and plans to develop

<sup>11</sup> The length of navigable inland waterways refers to the length of rivers, lakes, reservoirs, canals, and ditches open to navigation during a given period that enable transportation by ships and rafts.

the western provinces. Further potential also exists for coastal shipping between major industrial centers such as Dalian, Tianjin, Shanghai, and Guangzhou, all of which are located on the sea coast.

Inland waterway transport can also have fewer environmental impacts than other transport modes. Assuming proper management of water resources and navigation, efficient inland waterway transport can confer advantages in terms of high energy efficiency and low greenhouse gas emissions per ton-km, be safer and less intrusive, and help conserve scarce land resources.

**Weaknesses:** Achieving an integrated inland waterway policy will require sustained policy and management attention. The effective utilization of inland waterway transport generally depends on policies that deliver effective investment in and upkeep of navigational infrastructure (e.g., dredging, navigation aids, and locks) together with an institutional regime that encourages an efficient and competitive private barge industry. For some years, inland waterways were given limited policy or management attention compared with highways or railways, although the Eleventh Five-year Plan has increased attention on them.

Coordinating the multiple uses of rivers often presents conflicts. Rivers are used not only for transport but also for urban water supply, for irrigation, and for generating electricity. In most of the PRC, rainfall is highly seasonal, so river flows must be regulated, and the risk of flooding has to be managed. Dams built for flood protection, electricity generation, and irrigation impose the need for locks and the integrated management of water release throughout the year. Managing rivers for these multiple uses and reconciling conflicting demands is not easy. After reaching a peak of 170,000 km in length (defined as depths of at least 0.3 m) in 1960, by 1979 the network was reduced to about 107,000 km due in part to a lack of maintenance and to the building of dams for irrigation, flood control, and power generation. It has since increased to 123,388 km.

Larger and more specialized barges would improve the economics of the industry. Most vessels are small, self-propelled, family-owned, and operated boats. The families live on board and mostly lack the financing to trade up for larger vessels. Operators therefore need to be encouraged to invest in larger barges and in combinations, including the use of separate barges and pusher units instead of self-propelled, small vessels. There are still no special investments to encourage the construction of navigable waterways.

## Aviation

At the end of 2006, the PRC had 142 airports for civil flights and a total of 1,336 civil flight routes covering 211,400 km, an increase of 984% since 1980.<sup>12</sup> Of those routes, 1,068 were domestic reaching all large and medium-sized cities, and 268 were international connecting the PRC with more than 88 cities overseas. The PRC has signed agreements on air transport with 106 countries, 51 of them with 93 airlines reaching 31 cities in mainland PRC.

Although airline companies for civil flights are mainly state run, more and more backing from the Government is given to private and jointly owned airlines involving both domestic and foreign investment. At present, five private airline companies and six jointly owned domestic-foreign airlines have gone into operation.

<sup>12</sup> The length of civil aviation routes refers to the length of all routes for regular civil aviation flights.

Air transport is the PRC's fastest-growing mode of passenger transport

**Table 10: Growth in Airline Passengers in the People's Republic of China, 1980–2006**

	1980	1990	2000	2001	2002	2003	2004	2005	2006	
Passenger Traffic (100 million person)										
Total	34.2	77.3	147.9	153.4	160.8	158.7	176.7	184.7	202.4	3.39%
Civil Aviation	–	0.2	0.7	0.8	0.9	0.9	1.2	1.4	1.6	4,000%
Proportion (%)	–	0.3	0.5	0.5	0.6	0.6	0.7	0.8	0.8	–

– = not available.  
Source: NBS, 2008.

Air transport is the PRC's fastest-growing mode of passenger transport. Passenger numbers expanded from 51 million in 1995 to 1.60 billion in 2006 (Table 10). In terms of km traveled, passenger traffic tripled from 68 billion passenger-km in 1995 to 237 billion passenger-km in 2006. Air cargo is also a rapidly growing segment of the huge air transportation market potential. Freight, express cargo, and mail almost quadrupled from 2.2 billion ton-km in 1995 to 9.4 billion ton-km in 2006.

The aviation sector is very energy intensive as the energy consumed per passenger-km and ton-km is significantly higher compared with other modes. In addition, aircraft emissions of greenhouse gases contribute disproportionately to global warming compared with equivalent emissions at ground level because in the lower stratosphere where modern jets fly, the air is thin and there is more radiation for greenhouse gases to absorb.

Economic growth that stimulates internal demand requires lengthening supplier and distribution chains; most of this increased capacity in passenger and freight intercity movement will be delivered by road transport

## Sustainable Energy Supply in the Transport Sector

Energy consumption in the transport service sector experienced an annual growth rate of 4.5% from 1991 to 1996 and of 14.5% from 1996 to 2002, and the share of transport energy consumption in the national total increased from 4.5% in 1991 to 7.5% in 2006. The share of vehicles in energy consumption has experienced a continuous increase and has gradually become the dominant component. According to the International Energy Agency, 35% of the PRC's crude oil consumption is consumed by road transport.<sup>13</sup> The growing number of passenger vehicles<sup>14</sup> is a key determinant of fuel use.

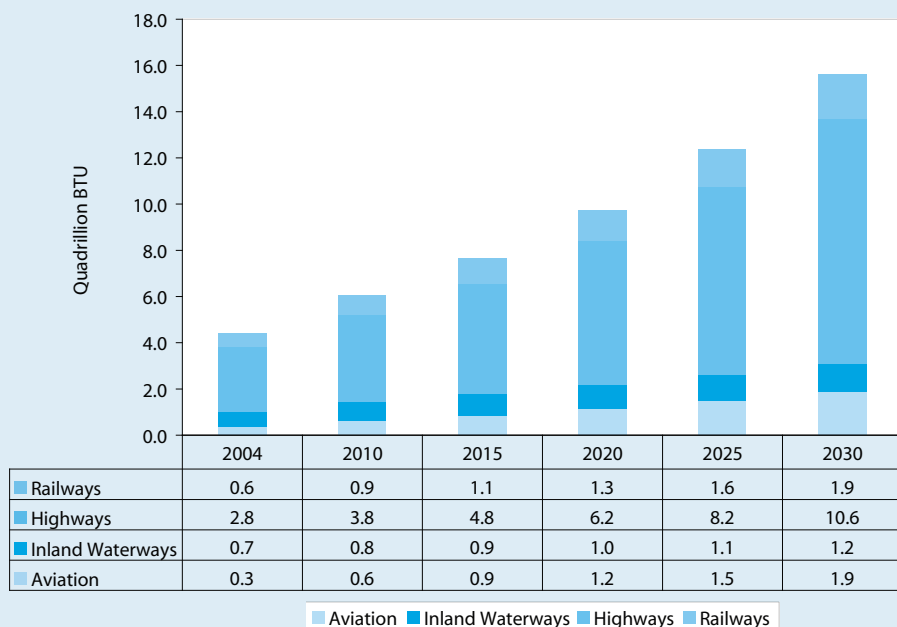
With its rapidly expanding transportation sector, the PRC is the world's fastest-growing oil consumer. In the past 2 years, the PRC alone accounted for more than 30% of the world's incremental consumption of liquid fuels. Its strong growth in consumption has helped support recent high world oil prices.

Economic growth that stimulates internal demand requires lengthening supplier and distribution chains; most of this increased capacity in passenger and freight intercity movement will be delivered by road transport (Figure 6). Thus, the PRC will be faced with increasing energy demands from on-road transport that is based almost exclusively on petroleum fuels whose high prices place an increasingly heavy burden on growth and cause growing concerns for energy security.

<sup>13</sup> International Energy Agency, 2007. *World Energy Outlook 2007*. China and India Insights.

<sup>14</sup> "Passenger vehicles" include cars, motorcycles, three-wheelers, minibuses, and buses. This value does not include freight vehicles, train carriages, water transport, or air transport.

**Figure 6: Projected Transportation Energy Consumption in the People's Republic of China by Mode 2004–2030**



BTU = British thermal unit.  
Source: EIA, 2007.

**Table 11: World Total Oil Consumption for Transportation in Millions of Barrels/Day, 1990–2020**

	Millions of Barrels/Day							Average Annual % Change 1999 to 2020
	1990	1998	1999	2005	2010	2015	2020	
World	32.5	38.0	38.7	45.4	51.6	58.5	65.0	2.5
Total	21.3	24.9	25.3	28.7	31.4	34.0	36.4	1.7
Industrialized								
Developing Countries	7.6	10.9	11.2	13.9	16.9	20.9	24.7	3.8
PRC	0.9	1.5	1.6	2.3	3.2	4.5	5.9	6.4

Source: Transportation Energy Use Projections. Appendix E Projections of Transportation Energy Use in the Reference Case. History: Derived from Energy Information Administration (EIA), *International Energy Annual 1999*, DOE/EIA-0219(99) (Washington, DC, February 2001). Projections: EIA, *Annual Energy Outlook 2002*, DOE/EIA-0383(2002) (Washington, DC, December 2001), Table A2; and World Energy Projection System (2002).

Consumption is projected to grow 3.5 times over the next 30 years and at a faster rate than in industrialized countries (Table 11). More stringent fuel economy standards need to come into force after 2009.

At present, the total emissions of carbon dioxide in the PRC rank second in the world. The emissions of other greenhouse gases such as methane and nitrous oxide are also very high. By 2020, carbon dioxide emissions are estimated to be 2.32 times the current level. The transport system is a major source of these emissions, especially in the road and aviation sectors. It is crucial to reduce them and to keep the concentration of other greenhouse gases in the atmosphere at stable levels.

Numerous initiatives have been undertaken or proposed to reduce the negative environmental and health impacts of the current transport system



# Current Government Policies, Initiatives, and Programs

**T**ransportation systems require long lead times to change because they are interconnected and entail expensive investments in infrastructure. First, there are several links in a fuel chain from fuel production to fuel transport to conversion to distribution to end-use, and ultimately to the service that is desired—mobility and accessibility.<sup>15</sup> A transport system becomes sustainable only when all links in its chain have proved fully commercial and when the related infrastructure has been put in place.

Numerous initiatives have been undertaken or proposed to reduce the negative environmental and health impacts of the current transport system. There have been significant gains with respect to specific pollutants, notably carbon monoxide and lead, from the application of regulations controlling vehicle emissions and fuel quality.

The revised law gives energy conservation the status of a basic national policy

## Energy Policy and Fuel Use<sup>16</sup>

The revised Energy Conservation Law was officially promulgated on 28 October 2007 and became effective on 1 April 2008. Although the Eleventh Five-Year Plan set targets for energy efficiency, they were not met in 2006, and genuine energy conservation has become an urgent task. The aim of the revision is to give more teeth to enforce the Energy Conservation Law that has been in effect since January 1998 but has not functioned effectively and thus to put energy conservation into practice in a reliable fashion.

The revised law gives energy conservation the status of a basic national policy. With its newly created section, the law also defines energy conservation standards and mandates the upgrading of control systems in government agencies and sectors with high levels of energy consumption such as construction and transportation. It also applies stiffer penalties including maximum fines of CNY500,000 for construction designs and contractors that fail to satisfy the standards.

<sup>15</sup> Mobility is physical movement and accessibility is the people's ability to obtain desired goods and services.

<sup>16</sup> IGES. 2007. Revised Energy Conservation Law Promulgated. Top News on the Environment in Asia. China-Japan Environmental Research and Consulting Co., Ltd.

The highlights of the revised law are as follows:

- Energy conservation in transportation has been added. The State is to promote the development and use of clean, alternative fuels and to give incentives to the development, production, and use of high-efficiency vehicles including alcohol-fueled, hybrid, electrical, and compressed natural gas (CNG) vehicles.
- Relevant units of the State Council are to institute numerical limits on fuel consumption for transport vehicles, rolling stock, and shipping vessels and for major facilities consuming energy. They will also stipulate the application of those standards to govern the market entry of automotive vehicles, rolling stock, and shipping vessels and their depreciation and upgrading.
- The Government will use taxation and other policy levers to encourage imports of advanced energy-saving technologies and equipment and will curb the export of products whose production entails high energy consumption or significant pollution. This will be achieved by trimming export duty reimbursements, applying export duty surcharges, and adding items to the schedule of prohibited component products.

Whereas the current law provides that, “the state shall implement a system of culling products (equipment) not in compliance with energy efficiency standards,” the revised law more strictly states that, “the state shall implement a system of culling products (equipment) markedly lagging in efforts for energy conservation or with markedly high energy consumption.”

Other major cities are closely following the move of Beijing to implement stricter standards.

## **Vehicle Emission Standards, Fuel Quality Regulations, and Inspection and Maintenance Systems**

The PRC has adopted a road map for new vehicle standards, laying out a schedule to introduce vehicle emission standards equivalent to the European emission standards for light-duty vehicles. In December 2005, the State Council approved the implementation of phase III (2005) and phase IV (2007) standards for Beijing for light-duty and heavy-duty vehicles. The State Council required Beijing to ascertain the availability of corresponding fuel quality by the time of implementation.

Other major cities are closely following the move of Beijing to implement stricter standards. Guangzhou announced the adoption of phase III standards in September 2006 and became the second city to implement Euro III equivalent standards in the PRC. Shanghai, which has had Euro II equivalent emission standards since 2003, is also considering the adoption of Euro III standards and has requested the approval of the State Council for implementation. Shanghai is also implementing strict measures to restrict the circulation of non-Euro II compliant vehicles on some major road arteries.

While a road map for vehicle emissions has been developed, this is not yet the case for fuel standards. Consequently, the implementation of vehicle emission standards is potentially endangered because of the possibility of the nonavailability of cleaner fuels at the time the stricter emission standards come into force. The key constraint is the sulfur level in gasoline and diesel. To achieve the emission reductions required under Euro IV, sulfur levels in gasoline and diesel must be reduced to 50 parts per million. The reduction of sulfur levels in diesel to the required levels poses a significant challenge for PRC's refining industry.



In the newly issued criteria, the inspection and maintenance system for vehicles in use has been tightened, especially the emission test component. The program requires all vehicles to be periodically inspected, maintained, and repaired as necessary.

## Fuel Economy Standards

With international support, in 2002, the Government decided to enlist research teams to develop vehicle fuel efficiency standards and regulations to help control national total oil consumption and to keep it at less than 400 million metric tons per year. The first fuel efficiency standard, Fuel Consumption Limits for Light-Duty Passenger Vehicles, was published on 2 September 2004 and was implemented in July 2005. The fuel economy standards have maximum values that vary according to vehicle weight.

With the implementation of this fuel economy standard, it is forecast that 13 million tons of fuel will be saved in 2020 and 31 million tons will be saved in 2030. Discussions on more stringent fuel economy standards to be put into force, possibly after 2009, are ongoing. A further 25% reduction in vehicle fuel consumption to 5.6 liters/100 km (the European requirement for 2008) could be established by 2012 for light-duty passenger cars and a fuel consumption level of 4.8 liters/100 km could be developed to catch up with Europe and Japan by 2016. If these recommendations are implemented, an additional 19 million tons of oil will have been saved by 2020 and savings will increase to 60 million tons in 2030.



#### Box 4: Alternative Fuel Vehicles in Shanghai and Beijing

In 1995, after investigating the use in other countries of liquefied petroleum gas (LPG) vehicles, the Shanghai government authorized the Public Utility Administration to organize the conversion to LPG vehicles for Shanghai's public transportation system. In 1997, Shanghai implemented the LPG Vehicle Promotion Program and in 2000, 70 LPG service stations were built and about 1,000 existing public buses were converted to LPG or to compressed natural gas (CNG). The aim is to convert all public buses and taxis. To promote the adoption of LPG vehicles, an LPG Vehicle Promotion Coordination Group was established. High-level officials from the Shanghai government provide leadership to the group to help coordinate planning, decision making, and the design of the transportation system.

In 1998, the Beijing government recognized the serious problem of deteriorating environmental quality, especially increasing air pollution. Emissions from transit buses and taxis account for quite a large share in total vehicle emissions, so the Beijing government decided that they should be the first alternative fuel vehicles. The Public Transportation Corporation received CNG and LPG vehicles, and part of the taxi fleet was converted to LPG use. By the end of 2001, Beijing had 1,630 CNG buses, the most of any city in the world. In addition, 3,000 buses were converted to LPG. There are 24 CNG service stations in Beijing and 71 LPG stations. By the end of 2001, more than 30,000 taxis had been converted to LPG use. The Beijing government and research institutes continue to support research and development in CNG and LPG vehicles. As a result, two new models have been developed and put into use. Recently, several more bus manufacturing companies have provided high-quality CNG buses. Compared with the first generation, new ones perform much more efficiently.

Biofuels are starting to receive more attention in the PRC as in other countries in Asia; however, so far they do not play a major role as a transportation fuel

#### Alternative Fuels for Vehicles

The Government actively promotes the use of alternative fuels, including liquefied petroleum gas (LPG), to address rising prices of conventional fuels and air pollution from vehicles. By 2001, there were 84,673 LPG vehicles in the PRC. Several filling stations have also been constructed in cities to service LPG-fueled vehicles. The PRC also had a total of 97,200 compressed natural gas (CNG) vehicles as of January 2005, with light-duty vehicles (cars) accounting for 48% and buses 52%. Monthly sales for natural gas averaged 92 million cubic meters. The country has a total of 253 public and 102 private natural gas refueling stations; another 230 were under construction in 2006.

Although relatively small in terms of overall numbers, CNG- and LPG-fueled vehicles are starting impact on vehicle emissions in some cities. This is because of the emphasis in government policies targeting buses and other fleet vehicles such as taxis for CNG and LPG use (Box 4).

Biofuels are starting to receive more attention in the PRC as in other countries in Asia; however, so far they do not play a major role as a transportation fuel. The PRC has begun trial use of bio-ethanol gasoline. Currently, eight provinces have made E10—a mixture of 10% ethanol and 90% gasoline—mandatory at local petrol pumps. At the same time, the PRC has become the world's third largest ethanol producer (after Brazil and the US) with an annual output of 10.2 million tons of bio-ethanol gasoline accounting for 20% of its overall gasoline consumption. The country plans to build four major bio-ethanol manufacturing plants with an annual yield capacity of about 1 million tons. The National Development and Reform Commission has proposed that by 2010 the consumption of alternative fuels will reach 2 million tons and by 2020 it will reach 10 million tons accounting for 15% of the demand in the transport sector.

## Electric Bicycles and Scooters

The production and sale of electric bicycles and scooters have soared rapidly in the last 5 years. Annual electric bike sales in the PRC grew from 40,000 in 1998 to 10 million in 2005 largely because of legislation in 1996 banning bicycles and gasoline-fueled scooters on major routes in several cities, including Beijing and Shanghai. In Shanghai, there are an estimated 1 million electric two-wheelers, and in cities such as Chengdu and Suzhou, the numbers of electric bikes have reportedly surpassed those of regular bicycles.

There are several brands of electric bicycles, and fierce competition is ongoing with market leaders such as Fushida, Yadi, and Xinri holding about a 70% share. They have a top speed of 20–30 km per hour and a range of 25–100 km. During operation, they emit zero local air pollution, but they do use about 2 kilowatt-hours of electricity per 100 km. Power ranges between 200 and 600 watts and they take around 6–8 hours to recharge.

## Urban Public Transportation and Nonmotorized Transportation

The Eleventh Five-Year Plan prioritizes the development of public transportation in megacities with mass rapid transit as a key mode. A State Council guideline issued in September 2005 included the following policy directions:

- public-transportation-oriented city development and land allocation;
- integrated modes of transport including buses, bus rapid transit (BRT), and rail;
- BRT systems combined with rebuilding urban street networks;
- operation maps; increased bus density; shorter waiting times; safe, comfortable, energy-efficient, and environment-friendly buses; and no high-polluting, low-technology buses;
- government funds favor public transportation; and
- city governments subsidize public transportation.

The price of public transportation will be determined scientifically and reasonably by paying attention to both economic and social benefits and by considering the business cost of the enterprises and the paying capacity of the public.

Limited municipal government budgets will make it difficult for a large number of cities to develop extensive and comprehensive urban rail projects that typically require substantial investments but that are often still the preferred solution. Instead, the bulk of cities in the PRC will more likely have to focus on improving their bus systems, including the development of BRT systems.

The Eleventh Five-Year Plan prioritizes the development of public transportation in megacities with mass rapid transit as a key mode

EST provides environmental and health quality objectives and criteria with quantified target dates and milestones and specific packages of measures to achieve a sustainable transport future



# The Need for Environmentally Sustainable Transport in the People's Republic of China

Overall, insufficient progress has been made toward achieving environmental sustainability in the transport sector. Many government initiatives have not been effectively implemented, in particular, those targeting structural changes and reductions in noise and carbon dioxide emissions. Ongoing growth in the sector offsets gains achieved through technology, and relentless fuel price increases have exhausted consumers and left them feeling helpless. A new, target-oriented approach is needed that places energy efficiency, environment, and health at the top of the policy agenda for transport and related sectors at the international, national, and local levels.

EST provides environmental and health quality objectives and criteria with quantified target dates and milestones and specific packages of measures to achieve a sustainable transport future. EST uses internationally agreed standards, goals, and guidelines to fulfill local, regional, and global requirements. The goals and standards can be attained through a consistent and balanced package of measures focusing on vehicle and fuel technology and on infrastructure on the one hand, and on changes in transport activity and management on the other. The latter involves favoring a higher share and use of environmentally sound, healthy modes; increasing vehicle loading and occupancy; reducing the need for motorized transport; changing mobility patterns and driving behaviors; and providing information and education about the efficient use of transport. EST calls for a much greater emphasis on transport demand management policies than was necessary in the past.

EST will induce structural changes and will provide increased accessibility through a wider choice of transport modes and thus more individual and collective opportunities for the transport industry, for operators, and for mobility services as well as better and more balanced access to people, places, goods, and services. Expanding sustainable transport modes and avoiding of the costs associated with ill health, accidents, environmental degradation, and resource depletion will

The goals and standards can be attained through a consistent and balanced package of measures focusing on vehicle and fuel technology and on infrastructure on the one hand, and on changes in transport activity and management on the other

**Table 12: Major Development Indicators in the Eleventh Five-Year Plan (2006–2010)**

**Economic Indicators**

- Population increases from 1.30756 billion in 2005 to 1.36000 billion in 2010
- Urbanization rate increases from 43% in 2005 to 47% in 2010
- GDP grows 7.5% annually from CNY18.2 trillion in 2005 to CNY26.1 trillion in 2010
- Per capita GDP grows 6.6% annually from CNY13,985 in 2005 to CNY19,270 in 2010
- Energy consumption per unit of GDP drops by 20% in 5 years
- Per capita disposable income of urban residents grows 5% annually in 5 years from CNY10,493 in 2005 to CNY13,390 in 2010
- Per capita net income of rural residents grows 5% annually over 5 years from CNY3,255 in 2005 to CNY4,150 in 2010

**Transportation<sup>a</sup>**

- Railways: six new passenger lines including one between Beijing and Shanghai and five intercity railways including one between Beijing and Tianjin; upgrading of five existing railways including one between Datong and Qinhuangdao.
- Highways: 14 expressways including one from Beijing to Hong Kong and Macao; 1.2 million km of rural roads will be newly built and upgraded. All towns and administrative villages that have the necessary conditions will have access to highways.
- Ports: transit systems for the transportation of coal and imported oil, gas, and iron ore and container transport systems at 12 seaports including those in Dalian, Tianjin, and Shanghai; coal transit and storage bases in eastern and southern PRC.
- Shipping: the third phase of the project for dredging a deepwater channel at the mouth of the Yangtze River, the course at the mouth of the Pearl River to the sea, channel dredging in the Yangtze and Pearl river valleys and the Beijing–Hangzhou Canal; and acceleration of port construction along inland rivers.
- Airports: expansion of 10 airports including those in Beijing, Shanghai, and Guangzhou; relocation of the two airports in Kunming and Hefei; and airports in central, western, and northeastern PRC to accommodate flights on feeder lines.

<sup>a</sup> Xinhua News Agency. 6 March 2006. Available: [www.china.org.cn/english/2006lh/160316.html](http://www.china.org.cn/english/2006lh/160316.html)



be good for the economy. EST can be used to coordinate across sectors by requiring prioritizing and by implementing appropriate actions including investment policies, financing practices, and pricing and fiscal policies.

## Prospects

When the PRC acceded to the World Trade Organization on 11 December 2001, it committed to opening and liberalizing its economy to better integrate it with the world economy and to offer a more predictable environment for trade and foreign investment. The PRC entered a new era with the Eleventh Five-Year Plan that builds on a gradual shift since 2003 toward policies aimed at balanced, equitable, and sustainable development. The goals cover not only economic areas but also those concerning people's lives, their social development, and their environments. In the industrial sector, the plan makes clear that the main task is not expansion of scale but rather structural upgrading to turn the PRC's big industries into powerhouses. The plan includes the two basic state policies of saving resources and protecting the environment and sets forth the strategic tasks of building a resource-saving, environment-friendly society. The major indicators in the plan are in Table 12.

When measured in terms of vehicle traffic, the main way to improve transportation is to increase roadway capacity and speeds; but when measured in terms of mobility, transit, ride sharing, and nonmotorized transportation improvements are also recognized as potential solutions. When measured in terms of access, however, the widest possible range of solutions can be considered, including strategies that alleviate the need for physical travel and increase effective land use.

**Lack of infrastructure for an integrated transport system:** Many problems in the transport system arise from the lack of a comprehensive master plan: the infrastructure for an integrated transport system lags behind, the layout of the transport network and routes are not rationalized, and the foundation for coordination in urban transport is still weak. Integrated transfer stations are rare, and connections are hard for passengers to make. The objectives of having zero-distance transfers for passengers and seamless transfers for modern logistics are not even close to being met; waste in transport resources is common, and financing for infrastructure is not as effective as it could be. Railways lack capacity, the inland navigable waterways are not used to their full potential, and oil and gas pipeline development is still lagging behind. These individual problems are interrelated and cannot support the requirement that various transport modes should be used according to local conditions.

**Low capacity for innovation and minimal science and technology:** Currently, the level of independent innovation in the PRC is low, and the technological advances needed to support the transport industry come too slowly. Although there is increasingly high market demand, these factors and the lack of an integrated system are major obstacles to creating a high value-added scientific industry and an advanced technology market and significantly hinder the creation of a sustainable transportation system.

The major lessons learned in the past 25 years highlight the advantages of reducing lags in introducing tighter standards as much as possible. The PRC can be seen as catching up in terms of technology standards but still lags 5 or more years behind the European Union.

The goals cover not only economic areas but also those concerning people's lives, their social development, and their environments

## Recommendations

A well-functioning transport system is vital to the success of the PRC economy and to improving the quality of life of its people. The Government's policy of providing long-term public investment support for developing an integrated transport infrastructure, particularly in the poorer central and western regions of the country, must continue; however, there is a need for well-balanced goals that respond to economic, environmental, and social challenges. The focus should be on productivity, carbon emissions, safety, and health. A fundamental goal of the transport policy must be to ensure that the transport sector plays a proper role in mitigating the impacts of climate change. A well-designed strategy can support economic growth and tackle carbon emissions. Policy decisions should be firmly based on evidence of the costs and benefits of these policies. The greater the attention to evidence, the greater the impact that policies will have.

Fundamentally, to encourage technical innovation, to promote behavioral change, and to make intelligent investment decisions, prices must cover the environmental and congestion costs of transport. There is a need to adopt a stronger passenger and user focus in transport policies. The needs of pedestrians; cyclists; road users; rail, bus, and aviation passengers; and of international and domestic freight transporters/operators must all be considered and understood. Transport policies must improve every aspect of traveling from point of origin to final destination. To realize this strategic vision, six specific policy measures are recommended.

A well-functioning transport system is vital to the success of the PRC economy and to improving the quality of life of its people

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### **Policy Measure 1: Implement Administrative Reforms Through a Two-Stage Process**

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The Government has initiated the process of creating an integrated organization for transportation (Ministry of Transportation). Except railways, the ministry is responsible for the uniform management of the transportation system (highways, waterways, aviation, pipelines, and urban transport). In the first stage, a centralized, comprehensive transportation administrative organization—the National Integrated Transportation Coordination Commission (NITCC)—should be established. NITCC should improve consistency and coordination in developing strategies, development planning, and industrial policies and the financial management of different transportation modes.

In the second stage, when appropriate conditions have been created, all modes should be brought under the Ministry of Transportation, which will help realize a more efficient and integrated transportation system.

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### **Policy Measure 2: Use Economic Instruments to Promote Sustainable Transportation**

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**Implement the fuel tax system:** Fuel tax is an important measure because it reflects the “user-pays” principle; it implements macroeconomic controls over transportation development; it encourages the development of different transportation modes, vehicles, and energy sources; and it curbs excessive vehicle use. It also promotes research on new types of vehicles and ensures adequate funding for developing sustainable transportation. The PRC has already enacted fuel tax legislation: implementation should be sped up. All revenues derived from the fuel tax should be used to fund maintenance and macro-control costs.

**Establish a national transportation fund:** Specific implementation planning should be developed by the Ministry of Transportation (MOT) (or led by the National Development and Reform Commission and Ministry of Finance) and should be implemented after the approval of the Government.

- The fund should be financed by revenues from existing transportation taxes, all the revenues from the forthcoming fuel tax, and a share of revenue from the proposed increase in the value-added land tax.
- MOT/NDRC, as suggested here, should centrally administer and allocate the fund and should oversee its use. To ensure transparency and accountability, MOT/NDRC should publish an annual statement outlining planned expenditures and the reasons for selecting particular projects. It should also evaluate the progress of ongoing projects and the impact of completed ones.
- The fund should focus on transportation modes and relevant plans promoting sustainable transportation development. It should assign priority to those areas in greatest need of assistance, such as urban public transportation, rural road construction and maintenance, the development of sustainable transportation technology, transportation for the disadvantaged, and safer bicycle and pedestrian ways.

**Internalize the external impacts:** Appropriate subsidies and incentive policies should be granted to transportation modes that have low external costs, such as railways, waterways, and urban public transportation. Unsustainable transportation imposes very high costs on society (delays, ill health, global warming, injuries, and death). These externalities should be taken into account in the cost accounting and pricing of transportation modes according to the polluter-pays principle. Only when prices reflect true costs will market mechanisms be able to ensure that individuals and businesses make sustainable transportation choices. Taxes should be levied on cars according to the costs that they impose on the environment in terms of energy use, traffic congestion, pollution, and traffic accidents.

Appropriate subsidies and incentive policies should be granted to transportation modes that have low external costs, such as railways, waterways, and urban public transportation

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### **Policy Measure 3: Integrate Planning and Optimize Transportation Structure**

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**Develop an integrated spatial planning system:** Land use and infrastructure have a huge effect on mobility needs. By developing an urban structure that provides all kinds of services locally for inhabitants, less transportation is needed. Furthermore, mobility choices like good access to public transportation are easier to achieve when integrated planning is the norm.

**Develop integrated transportation planning that reflects government policies and priorities:** Such planning should take into account the rational utilization of corridor resources; it should strengthen the planning and construction of intermodal terminals and hubs, and should realize coordinated development between transportation modes.

**Formulate new policies for transportation:** Policies that are designed to promote the development of sustainable transportation must be based on such concepts as the circular economy and the green economy and should incorporate relevant scientific and technical innovations.



The Government should have explicit responsibility for providing financial support for the construction and operation of the rail lines that are relevant to poverty reduction, or regional development

**Speed up railway development:** The legal and regulatory systems with regard to railways should be improved and the Railway Law should be amended to make clear the relationship between government functions and commercial operations and to provide a legal foundation for further railway development.

The reform of the railway investing and financing system should be promoted and accelerated. Multiple investing and financing channels should be adopted to facilitate the construction of high-speed rail lines for intercity passenger transportation, urban rail transit, and heavy transportation corridors for freight. The current railway construction fund should be preserved as a stable and sustainable funding source for railway development by levying service fees on passengers and freight.

Government investments in railways should be increased. The Government should have explicit responsibility for providing financial support for the construction and operation of the rail lines that are relevant to poverty reduction, or regional development. The Government should allocate more financial support to the western region and to coal transportation.

**Support inland waterway transportation:** The central and local governments should establish special funds for inland waterway transportation to ensure a stable source of financing for its development. To that end, an appropriate legal and regulatory system should be established as rapidly as possible. For example, the Law on Navigation Channels should be amended based on the currently effective “Regulations Concerning Management of Navigation Channels” to provide a legal basis for investments in inland water transportation. Coordination between relevant departments should be strengthened and problems relating to water conservation and hydroelectric power generation should be resolved to realize a more efficient utilization of water resources.

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#### **Policy Measure 4: Promote Transportation Equity**

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**Enhance public awareness of EST and strengthen public supervision and participation in transportation planning and decision making:** The public should be given appropriate opportunities to provide inputs when legislation concerning EST is under consideration. Opportunities for participation and supervision by the public and by social entities, including nongovernment organizations, should be strengthened at all stages of policy development, including the implementation of laws and regulations.

Transportation information facilitating public participation in policy making should be widely disseminated. The results of inspections and legal processes should be reported promptly and accurately to increase public awareness and participation and thus strengthen the inspection and regulatory process.

**Enhance public consciousness of transportation safety and strengthen the accident investigation and accountability system:** Educational programs on all aspects of sustainable transportation including safety should be strengthened and expanded. Various educational channels and activities should be used to reach students at all levels, thus forming a comprehensive national educational system for sustainable transportation. The transportation

safety management functions of government authorities at all levels should be consolidated, and accident investigations and the accountability system should be strengthened as well.

**Provide convenient transportation for disadvantaged groups:** Such groups should be accorded special opportunities and benefits. Laborers from rural areas (with certificates) should enjoy an inexpensive trip home every year. The disabled and the elderly should enjoy discounted bus tickets. Compensation should be provided for people whose livelihoods are threatened by land expropriation and removal.

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### **Policy Measure 5: Promote Public Transportation and Implement Mobility Management**

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**Integrate transportation and land use development:** Develop modern urban mobility management concepts and provide guidelines for the design of new cities and the development of existing ones. Synchronized master planning and comprehensive transportation planning should be developed according to integrated land use and transportation policies and plans that incorporate transit-oriented development measures (e.g., multiple-mode transportation corridors).

Urban development should be strategically shifted to avoid the overexploitation of central urban areas and to minimize urban sprawl. The traffic impact assessment system should be strengthened and a transportation impact compensation mechanism should be formulated and implemented. Integrated transportation corridors with interoperability between different transportation modes should be developed to ensure that the development of public transportation guides urban and land development. Establish a mechanism that levies land value-added tax to feed back into public transportation investment.

Urban development should be strategically shifted to avoid the overexploitation of central urban areas and to minimize urban sprawl



Demand for public transportation and for nonmotorized vehicle use should be prioritized in urban road design and planning to ensure resources. Establish public hearings for large-scale urban infrastructure and transportation projects.

**Public transportation should be given first priority:** Efforts to improve public transit should be integrated with a larger vision of the city's future. Public transportation infrastructure should be improved to create an efficient, integrated service network for public transportation. The share of public transportation should be set as an index to evaluate the achievements of urban leaders.

Both urban and intercity rail transit should be promoted. Policies governing licensed operators should be adopted in areas along rail lines to promote the development of rail transportation in megacities and city clusters. Bus rapid transit (BRT) deserves careful consideration because it is financially viable, increases speed and safety, and diminishes pollution. Promote BRT wherever possible. In addition, intelligent technology systems and other technologies should be used to improve the efficiency and quality of service of regular bus systems.

**Manage mobility effectively to avoid congestion through balancing travel demand and supply:** There can be no doubt that steps should be taken to encourage people to use public transit and/or nonmotorized vehicles to the greatest possible extent. Car use should be a choice, not a necessity. This means managing mobility in such a way as to reduce demand for unnecessary travel and providing viable alternatives to car use. Car users should pay the true cost of using a car in crowded urban environments either through parking charges, congestion charges, or other forms of road pricing.

The time structure of traffic should be regulated and controlled, and flexible work times should be used to stagger peak hours. With advanced traffic management methods and intelligent transportation system technology, updated transportation information can easily be provided so that citizens who have to travel by car can choose the most appropriate routes to take before and during their travel so that they can reach their destinations in the shortest possible time and not contribute to congestion. The Government should centrally coordinate the transportation information service to ensure that it is timely and accurate.

**Set up a special account for urban transportation:** The account should be composed of revenues from different taxes and fees including, for example, revenues from urban land leases, transportation impact compensation fees, consumption taxes, fixed asset taxes, vehicle purchase taxes (e.g., a surcharge for limousines), congestion charges, parking fees, and traffic fines. To ensure transparency and accountability, annual reports should be published to identify measures that have been funded and their impacts.

Public transportation infrastructure should be improved to create an efficient, integrated service network for public transportation

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### **Policy Measure 6: Conserve Resources and Promote Environmentally Friendly Transportation**

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**Improve environmental protection systems and strengthen government monitoring and supervision:** Implement strategic environmental assessments for policies, plans, and programs to recognize environmental effects early on in decision making thereby contributing to a cost-

efficient and highly benefit-sustainable transportation system. Establish implementation guidelines for environmental impact assessments of integrated transportation planning. Require environmental impact assessments while formulating national and regional integrated transportation planning.

Strengthen the environmental protection responsibilities of transportation management departments at all levels and establish an accountability system. Strengthen public participation and promote the development of nongovernment environmental organizations. Formulate environmental damage compensation laws and optimize environmental dispute resolution regulations. Develop systems to disseminate environmental information and formalize public hearings on environmental issues.

**Slow the growth in energy use, especially oil consumption:** Optimize motor vehicle fuel consumption standards. Establish fuel oil consumption standards for all new motor vehicles by 2010 and enforce the limits on fuel consumption by passenger cars. The fuel consumption of new motor vehicles should be reduced by 40–50% per 100 km by 2015.

Develop policies for the research, popularization, and use of clean alternative energies. Clean alternative fuels should be first used in buses and government vehicles. Optimize the development of high-efficiency vehicles and formulate relevant policies to focus on the introduction, research, and industrialization of the hybrid synergy drive.

**Conserve land use:** Develop technical standards with a strong scientific basis for transportation facilities. Based on the principles of full cost and environmental protection, flexible technical standards for the construction and maintenance of transportation infrastructure should be established, taking regional differences into consideration. Shorten the period of standard revision and ensure a practical, timely, and authoritative technical standard. Implement stricter use, compensation, and restoration systems for natural resource conservation. Amend the transportation land compensation system and carry out on-site or off-site excess compensation for nature reserves, wetlands, forests, and grasslands. Limits on temporary land use should be set for land occupation by transportation construction projects.

**Control air pollution:** Adopt and implement vehicle emission standards as soon as possible to help enterprises reach the technical level of vehicle emission control in developed countries. Establish and carry out strict fuel quality standards to facilitate the implementation of emission standards for new motor vehicles. In particular, promote the supply of gasoline and diesel oil with sulfur contents below 50 parts per million and 10 parts per million respectively in the entire country by 2010.

Coordinate transportation development and air quality improvement according to local conditions. Implementation plans for reaching pollutant emission standards in each city should be formulated through the joint efforts of different departments, and the deadlines to reach the standards should be set to meet the overall demands of urban air quality.

Strengthen the environmental protection responsibilities of transportation management departments at all levels and establish an accountability system

EST is the new, target-oriented approach that is needed to place energy efficiency, environment, and health at the top of the policy agenda for transport and related sectors at all levels



# Conclusions

**W**ith oil prices at an all-time high and the alarming rates of melting of the polar ice caps, business-as-usual policies in energy consumption are no longer viable options for the PRC or for any other nation. EST is the new, target-oriented approach that is needed to place energy efficiency, environment, and health at the top of the policy agenda for transport and related sectors at all levels. EST policies are evolutionary rather than revolutionary. Many elements required are already known or even in place in the PRC; however, their implementation must be strengthened and must be more effective. With a few new and innovative measures and the proper implementation of currently available instruments, EST can be achieved within 15–20 years. Overall, the key to success will be well-designed, coordinated, and broadly supported implementation strategies.



EST policies are evolutionary rather than revolutionary

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## Promoting Environmentally Sustainable Transport in the People's Republic of China

Asian Development Bank (ADB) is assisting the development of transport sector in the People's Republic of China since 1986, by providing lending and non-lending support. Considerable progress has been achieved since then. However, with increasing fuel prices and greenhouse emissions, issues of affordability, environmental sustainability and resource optimization are becoming increasingly important. This paper analyses these key issues and recommends a new, target-oriented approach that places energy efficiency, environment, and health at the top of the policy agenda for transport and related sectors at all levels. The paper makes six key recommendations for promoting environmentally sustainable transportation that can be considered by PRC to overcome these challenges.

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