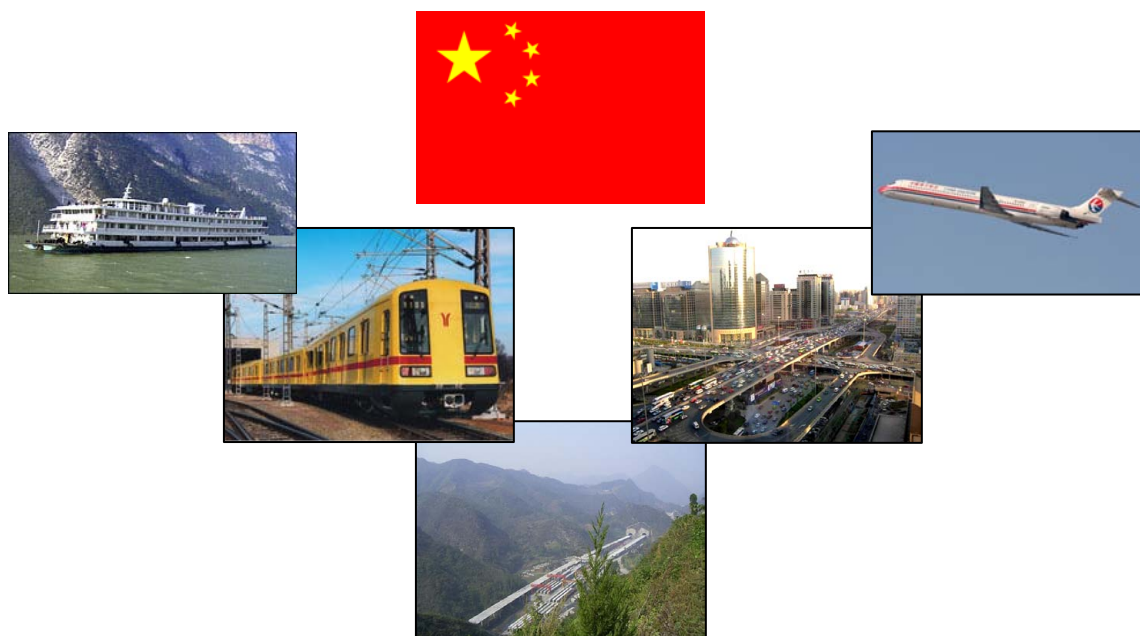




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Work in Progress  
For public discussion

**EASTE WORKING PAPER No. 15**  
*Transport, Energy and Mining Sector Unit,  
Sustainable Development Department  
East Asia and Pacific Region  
December 2007*

## **An Overview of China's Transport Sector - 2007**



**FINAL REPORT – 19 December, 2007**



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# **An Overview of China's Transport Sector - 2007**



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## Foreword

As in many other parts of the economy, China's transport infrastructure has been undergoing rapid development in recent years. All sectors of transport—roads, urban, railways, air, inland waterways, ports and logistics—have seen major investments to meet the growing demands for transport services. This has resulted in a transformation of China towards world class transport infrastructure in all sectors.

This report presents a summary of the current state of transport in the seven sectors above, together with an outline of some of the energy and climate change issues across the transport sector as a whole. It catalogs many of China's achievements, while also identifying issues that need to be addressed for China to ensure that transport infrastructure does not act as a bottleneck on development.

This report does not give a full treatment of the sector issues but a summary of the key statistics and challenges with the aim of providing a brief overview. It is hoped that this will be part of a wider platform for policy dialog between the Bank and the Government of China so that the Bank can continue to assist China meet its development goals.

The report was prepared by Christopher R. Bennett, Fei Deng, Emily Dubin, Li Kai, Graham Smith, and Mariana Torres with inputs from a number of individuals including Paul Amos, Masami Kojima, Ranjit Lamech, Shomik Mehndiratta, Aurelio Menendez, Alberto Nogales, John Scales, Wenlai Zhang and Yan Zong. Jeffrey Lecksell prepared the maps. It is a 'work-in-progress' and intended to be updated on a bi-annual basis as new information is generated.

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Sector Manager  
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## Acronyms

3PLs	Third Party Logistics Firms
BRT	Bus Rapid Transit
CAAC	Civil Aviation Administration of China
CR	China Railways
CTL	Coal-To-Liquids Technology
E10	Fuel mixture of 10% ethanol and 90% gasoline
EIRR	Economic Internal Rate of Return
EU	European Union
GEF	Global Environmental Facility
IFI	International Financing Institution
IWT	Inland Waterway Transport
JV	Joint Venture
LPI	Logistics Perception Index
MOC	Ministry of Communications
MOCn	Ministry of Construction
MOR	Ministry of Railways
MoST	Ministry of Science and Technology
NDRC	National Development and Reform Commission
NEN	National Expressway Network
NTHS	National Trunk Highway System
OECD	Organization of Economic Cooperation and Development
PCD	Provincial Communications Department
SEPA	State Environmental Protection Agency
SOE	State Owned Enterprise
TEU	20-foot equivalent unit – The international standard measure of containers
WTO	World Trade Organization



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## 1 Introduction

1. China's outstanding achievements in economic growth and poverty reduction over the last fifteen years have been well documented. One contributor to that success has been on the development of its transport infrastructure. All modes of transport have seen their networks expanded and/or improved, to provide the capacity needed by the transport and logistics industries to offer services that support broader development goals.

2. The transport infrastructure improvements have been made possible by rapid increases in public funding (Table 1.1).

**Table 1.1: Investment in Transport Fixed Assets**

Investment	Year						
	2000	2001	2002	2003	2004	2005	2006
Investment in Transport Fixed Assets (\$ billion)	41.5	47.7	55.0	61.3	76.1	90.2	103.41
Investments in Transport Fixed Assets (as % of total public investment)			9.83%	8.75%	8.62%	7.27%	6.72%
1. Grouped by Function							
1.1 Ports & Other Coastal Construction	2.4%	3.2%	3.1%	4.9%	5.5%	8.0%	9.9%
1.2 Inland Waterway Construction	1.6%	1.3%	0.9%	1.1%	1.2%	1.6%	2.3%
1.3 Highway Construction	68.9%	69.1%	72.1%	74.8%	76.3%	76.0%	87.3%
1.3.1 Trunk Highways <sup>1/</sup>	32.2%	29.7%	29.1%	27.4%	28.4%	35.8%	43.6%
1.3.2 Other Road Networks	27.6%	30.1%	32.0%	31.0%	27.7%	20.8%	21.2%
1.3.3 County and Township Roads	9.1%	9.3%	11.1%	16.5%	20.2%	19.4%	22.4%
1.4 Railways	23.5%	23.2%	21.6%	16.7%	13.7%	10.7%	N/A
1.5 Others	3.6%	3.2%	2.3%	2.6%	3.4%	3.8%	4.0%
2. Grouped by Source of Funds (excluding Railways)							
2.1 State Budget	12.4%	15.4%	19.3%	15.5%	14.3%	15.2%	15.2%
2.2 Domestic Loans	34.2%	38.4%	41.0%	41.3%	40.4%	45.1%	45.1%
2.3 Foreign Investment (mainly IFIs)	3.7%	3.1%	2.7%	2.6%	1.3%	2.0%	2.0%
2.4 Self-Financing and Others <sup>2/</sup>	49.8%	43.1%	37.0%	40.6%	44.0%	37.6%	39.6%

Source: Based on Chinese Highway and Waterway Transport Statistical Yearbook (2006) as reported in Wood (2006) and World Bank data

Notes: 1/ 'Trunk Highways' are predominantly the NEN. However, in a small number of instances the data include Class I and Class II.

2/ This consists of the contribution of provinces, counties, local townships, villages, and the private sector, and debt taken on by the secondary and tertiary levels of government. While there is no hard data on the provincial and tertiary government debt levels for road financing, the authors estimate that debt represents about 60% of that category of investment, which represents a reasonable overall debt to equity ratio of approximately 2:1.



3. Figures 1.1 and 1.2 show that all modes of transport have experienced rapid growth in demand in recent years. Highways now carry the most passengers, while railways are by far the dominant mode for freight transport—especially bulk goods. Table 1.2 shows the transition between 1980 and 2005 between modes.

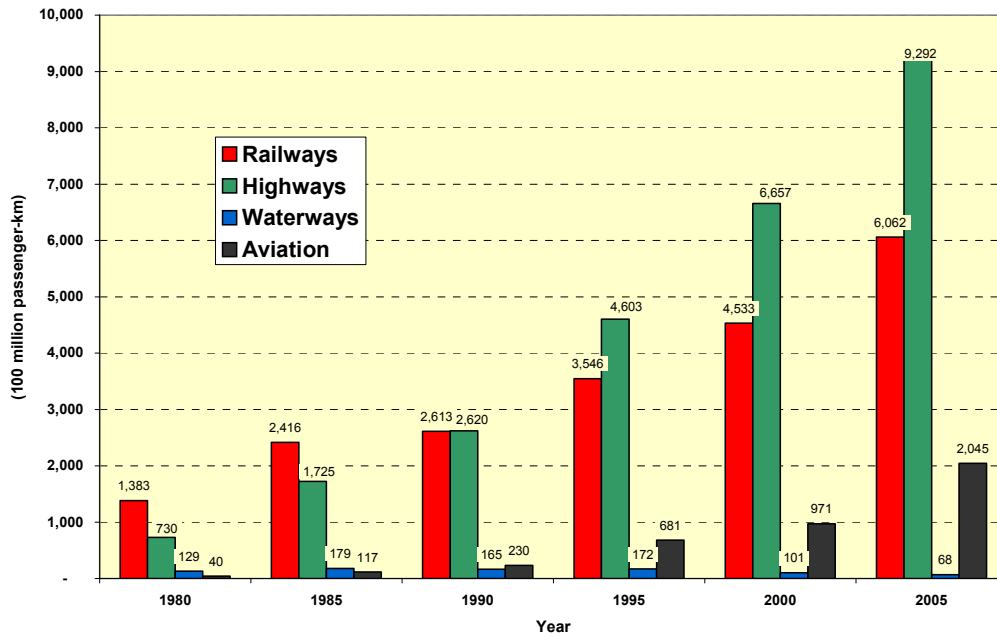


Figure 1.1: Passenger Travel by Transport Sector

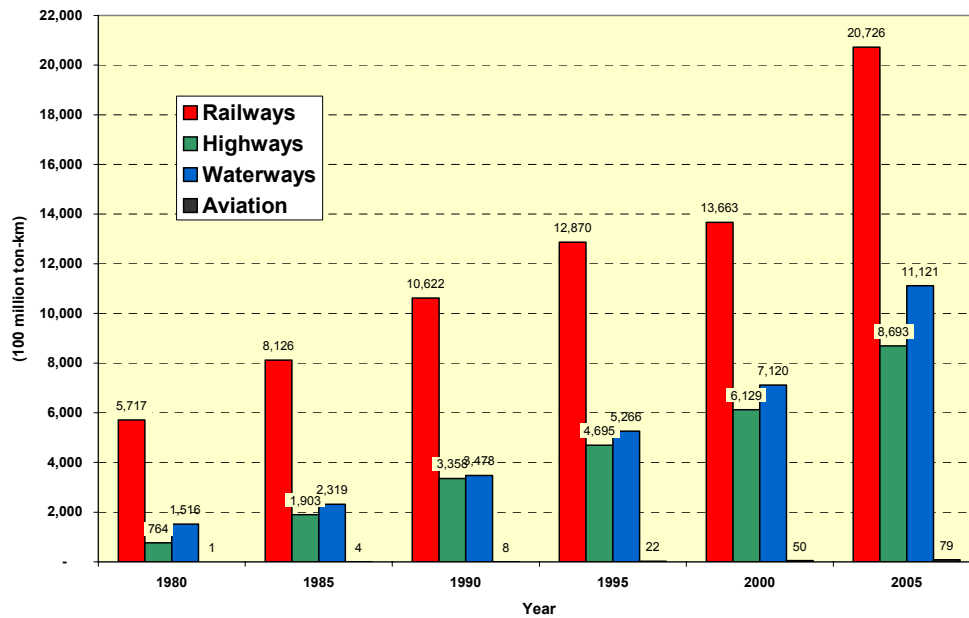


Figure 1.2: Freight Ton-Km by Transport Sector

**Table 1.2: Modal Transition 1980 - 2005**

<b>Year</b>	<b>Highways</b>	<b>Railways</b>	<b>Waterways</b>	<b>Airports</b>
<b>Percentage of Total Passenger-km by Mode</b>				
1980	32	60	6	2
2005	53	35	0.4	12
<b>Percentage of Total Ton-km by Mode</b>				
1980	10	71	19	0.02
2005	21	51	27	0.2

4. During 2006-2007, the World Bank updated its own Transport Strategy, which sets out the Bank's agenda for interventions in the transport sector in the years 2008-2012. It is a broadly-based agenda because transport makes a multi-faceted contribution to development that includes passenger and freight operations, spans urban and rural areas, includes public and private transport, meets economic and social needs, and serves domestic and international demands. Nowhere is this diversity more evident than in China. The Bank's Strategy Update also sets out the Bank's objective in the transport sector, in China as elsewhere, which is:

*'to help partner countries to establish the governance, strategies, policies and services that will deliver transport for development in a way that is economically, financially, environmentally and socially sustainable.'*

5. This Overview of China's Transport Sector report is produced in the context of the Bank's Strategy Update but is focused on the particular circumstances of China and the ways in which China is endeavoring to create sustainable transport systems. It deals with each of the main sub-sectors of transport in turn: road transport; urban transport; railways; inland waterways; air transport; ports; and transport logistics. Within each sub-sector it provides a brief description of the sector and an assessment of some of the main challenges facing the sector in terms of the principles of sustainability set out in the Bank's strategy. Greatest attention is given to the sectors in which the Bank is most actively engaged in China: roads, urban transport, railways and inland waterways. However, summary sections on aviation, ports and overall transport logistics are added for completeness. The report also considers in broad terms the impact of transport on energy and emissions in China, although more work will be carried out on this important topic in the years ahead.



## 2 Road Transport

### 2.1 Sector Description

**4. The road transport sector has contributed greatly to, and has also been strongly stimulated by, China's continuing economic and social development.**

Among the surface modes, road transport has seen its modal share grow over the last ten years from 45% to 60% in terms of passenger-km and from 24% to 30% in terms of freight ton-km (excluding pipelines or waterways).

5. From 1990 to 2006, during the period of the 8th, 9th and 10th Five-Year Plans, China completed the construction of nearly 44,000 km of high-grade tolled expressways, the main portion of which comprised the National Trunk Highway System (NTHS). During that period about 400,000 km of local and township roads were also improved. From 2000 to 2005, investment on the highway sector amounted to almost \$45 billion/year, with about one third allocated to development of the NTHS.



6. The creation of the expressway network was accompanied by the continuing development of intermediate Class I and II roads, under the coordinated efforts of the central government and the governments of China's 31 provinces and municipalities. No other country has created such a major increase in the capacity and value of its national road asset base in such a short period. These public works have helped to develop supporting skills in financing, management, construction, and operation of roads. The projects also contributed to employment generation; for example in Guangdong under the World Bank financed Second National Highway Project, some one-third of the labor force in its locality was employed in one or more related construction activities; many services including hotels, restaurants and repair shops were also started by the residents in smaller towns along the expressway route.



**7. The expansion of the road network during the last two decades was made possible by rapid increases in public funding.**

These increases were both in absolute terms and as a share of the total investment in transport infrastructure. Since 1990, China's road assets have grown faster than its GDP, helping to close the estimated roads 'infrastructure gap'<sup>1</sup> that existed at the beginning of the period. Since 1998, total expenditure on transport infrastructure has

exceeded 5% of GDP, of which roads have accounted for about 3.5% of GDP.<sup>2</sup>

<sup>1</sup> The 'infrastructure gap' is the difference between the existing road asset base by road class and the asset base required by the economy.

<sup>2</sup> In 2005 the GDP was adjusted to take into account growth in the service sector, which raised it by 17%. Using this revised GDP level, the road spending was 3% of GDP.



8. The total road network in 2006 was some 3.46 million km, with about 90,600 km of expressways and other first-class high-grade highways in operation. Roads are classified by administrative responsibility—as national, provincial/municipal, county, township and access roads—and by design standard and pavement strength. Generally expressways carry traffic in the range of 25,000–55,000 vehicles per day, Class I roads 10,000–30,000 veh/day, Class II roads 5,000–15,000 veh/day, Class III 2,000–6,000 veh/day; and Class IV less than 2,000 veh/day.

9. As noted above, at the core of the highway investment program was the NTHS, the backbone and most important element of the national road transportation network. With an estimated cost of \$150 billion, the 44,000 km NTHS was completed in 2005 and now connects all provincial capitals and cities with populations exceeding 500,000 inhabitants (100 major cities). The NTHS is composed of 12 major highways in five north-south corridors and seven east-west corridors (see Figures 2.1 and 2.2).

**10. In December 2004, the Chinese government approved further plans for the 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 in China by connecting all provincial capitals and large cities



of more than 500,000 inhabitants with cities of more than 200,000 inhabitants. It is intended that people in eastern areas should have access to an expressway within half an hour, the central provinces within an hour, and the western areas within two hours. In addition, it will improve the communications between economically developed areas, such as the lower Yangtze in central China and the Pearl River Delta in the southeast, and the mid-west and north-east areas. The NEN will also enhance the connections with western China, and will promote the economic growth of central and south-eastern provinces.

**11. China has adopted a decentralized model of road infrastructure delivery.**

The Ministry of Communications (MOC) gives guidance and technical support in the form of national policies, regulations, design and construction standards, and plans for the roads sub-sector. Responsibility for road administration, which includes road transport regulation and management, as well as road infrastructure development and maintenance, was decentralized to the provincial governments under the 1997 Highway Law. Provincial Communications Departments (PCD) are responsible for road-related functions at the provincial level and they regulate the road transport industry by licensing transport operators, trucks, buses, drivers, and inter-city bus services through their transport administration bureaus. The PCDs also plan, develop, and maintain the highway networks in provinces, with the provincial planning commission approving plans on most large projects. Lower-level network responsibilities lie with county and township communications bureaus.

12. Decentralization has been a key factor in the successful delivery of road network improvements. As in all decentralized structures, this also represents a challenge for the center in terms of providing effective guidance and policy. The central government is currently seeking financial and non-financial mechanisms to



influence policy decision making at the provincial and municipal levels on such matters as toll rates and project choices.

13. **Roads are financed from a range of sources.** Road expenditures are financed from national, provincial, municipal and local government budgets; user charges and fees; foreign investments and loans (including from international aid agencies); and domestic banks.

- **Tolls.** Tolls are an important source of finance for expressways. The legislation allows tolls on highways built using loans or funds provided by enterprises, but not on wholly government-funded highways. Tolls can be used to service debt and recover operating expenses. Therefore, rates must be set on the basis of: (i) an appropriate return on funds invested; (ii) the rates charged on other toll roads; (iii) the potential users' ability to pay; and (iv) expected traffic flows. The MOC sets out the regulations governing tolls, but these are applied at the provincial level. Along main transport corridors there may be several independent, although inter-connected, toll-roads, charging various rates, and amounting to a large direct cost to long-distance transport operators—enough to persuade many trucks to stay on the old, inferior quality highways.
- **Road user charges.** In addition to tolls, road users pay three other charges: (i) a fee, levied by highway authorities on the revenues of passenger transport enterprises and vehicles' registered load capacity, and intended for road maintenance—\$12 billion in 2004; (ii) a vehicle purchase fee, levied at the rate of 10% of the retail price of vehicles, also intended to pay for road maintenance—\$4.5 billion; and (iii) a highway transport management fee—\$2.5 billion. However, the road maintenance fee is expensive to administer, easy to evade, and currently 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 road maintenance; more than half is spent on new construction.

14. Until very recently, the provincial governments received funds from the central government only for large projects of national significance. Municipal and provincial road management operations are funded from municipal and provincial government budgets, the above user fees and tolls, loans and bonds. Expressways are expected to use toll revenues to cover their operating and maintenance cost and debt service. Domestic debt has become an important source of road financing given the large supply of funds from local savings. County and township administrations also receive a portion of the road funding from the central government, via provincial governments. After many years of leaving provinces to find their own funds for local roads, the central government is now developing mechanisms for contributing national funds for developing village and other local roads, and has approved a national program of up to \$25 billion for the period 2006-2010.





15. This strategic shift is consistent with the results of recent papers and articles that indicate higher economic returns from investment in lower-class roads in comparison to higher-class roads and the additional impact in reducing rural poverty in China. The MOC has embarked on a major effort to define the strategy and allocation criteria for this program, being piloted with World Bank support in Fujian Province.



16. **Private sector participation in financing road infrastructure is also considerable.** Private sector participation in the growth of China's highway system is high by world standards; indeed in absolute terms China has probably attracted more private finance to roads than any other country. Over the last decade, more than 80 joint venture transactions between Hong Kong and mainland developers and their mainland-counterpart highway agencies in 14 provinces have raised an additional \$10 billion from private sources. Further, asset securitization<sup>3</sup> raised a further \$2 billion through 19 transactions. However, public investment dominates; private financing has contributed less than 10% of China's total commitment to new construction since the early 1980s.

17. **The government is opening up road transport services to foreign participation.** As part of its World Trade Organization (WTO) commitments, the Chinese government now allows foreign participation in the provision of transport services. These include: road transport enterprises, warehousing, road freight stations, terminals, and vehicle maintenance and repair services. Foreign investors may participate in road transport, through either an equity joint venture with a Chinese company in the case of passenger transport, through an equity or contractual joint venture, or as a 100% foreign owned company in the case of road freight transport, cargo handling, storage and other services relating to road transport and vehicle maintenance.

18. **The vehicle fleet and road traffic continues to grow rapidly.** In 2006, China's civilian vehicle fleet amounted to almost 36 million vehicles. Of these, 26.2 million were passenger vehicles and 9.7 million were freight vehicles. The private car fleet has been growing at 20-30% per year. The number of passenger vehicles has more than doubled every five years during the last two decades (1985-0.8 million; 1990-1.6 million; 1995-4.2 million; 2000-8.5 million; and 2006-26.2 million) and is expected to continue growing rapidly with rising incomes. Some analysts forecast that by 2010 China will surpass the USA as the largest market for new vehicles.

<sup>3</sup> The sale of highway equity through initial public offerings and private placements, as a substitute for long-term debt financing)

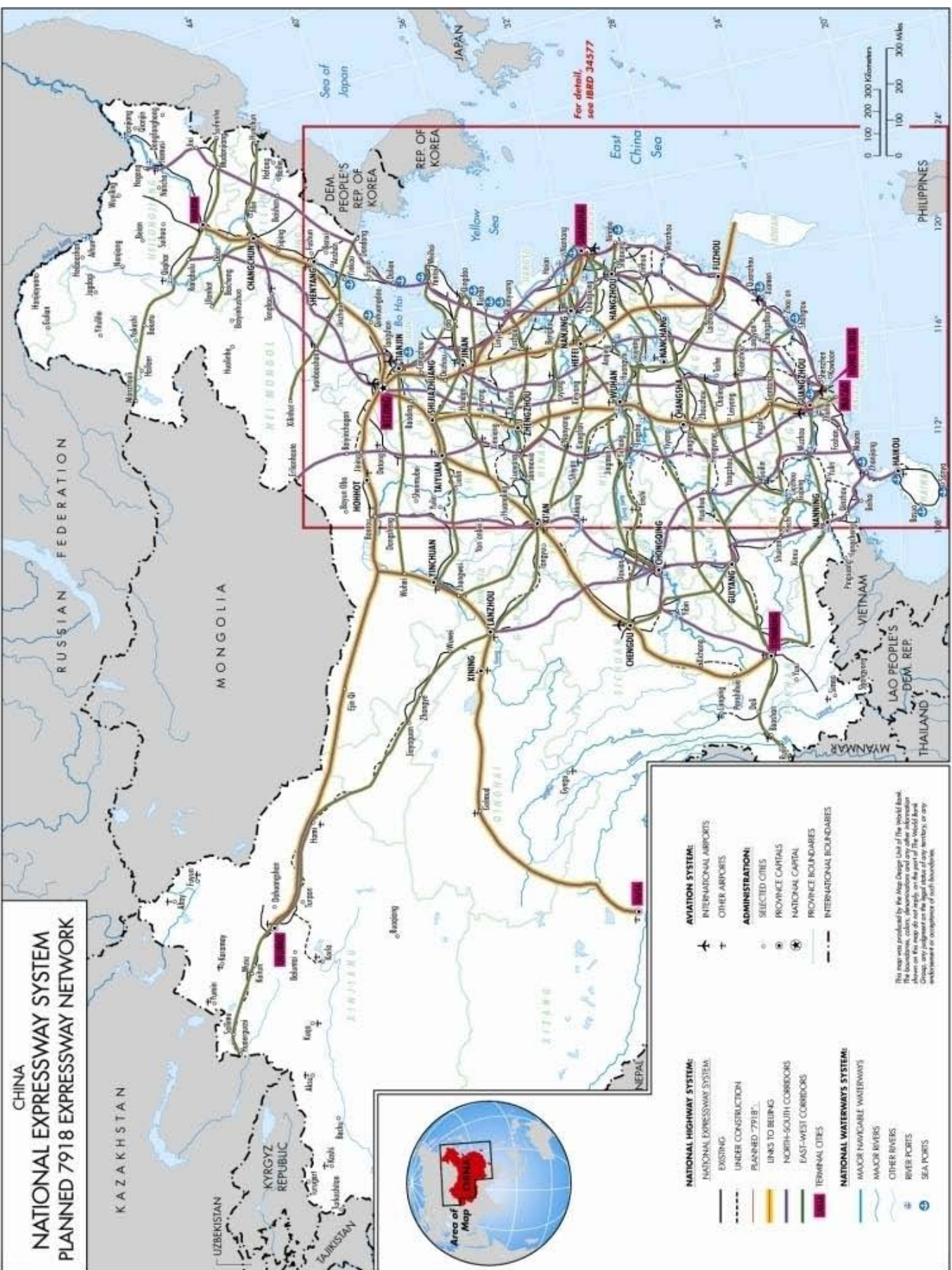


Figure 2.1: China Expressway Network





Figure 2.2: Eastern China Expressway Network



## 2.2 Sector Issues

19. **The government is seeking to balance the strong need and demand for road transport with other public policy goals.** China has other very strong surface transport systems in terms of railways and inland waterways but has put greatest emphasis on highway construction in its public investment program in recent years. This is partly because China started from a very low asset base in the sector. It is also because roads are multi-functional and can be readily accessed by a wide range of users. Roads provide the infrastructure used by private passenger transport (cars and motorcycles), buses, trams, taxis, paratransit services, own-account goods transport, commercial road haulage services, emergency services (ambulances, police vehicles, fire vehicles), utility vehicles (such as for refuse collection) and a variety of personal and freight transport functions carried out by foot, bicycle or animal-drawn vehicles. Roads also frequently provide convenient rights of way for utilities. It is because of their high and diverse functionality, versatility and wide range of beneficiaries that roads have become such a central and essential component of all national transport systems, usually consuming the greatest proportion of public and private investment resources in both infrastructure and services.

20. However, as the backlog in modern road infrastructure is reduced, the government is being increasingly faced with a need to balance several conflicting priorities: (i) the population's desire for greater car ownership and personal mobility against the need to manage environmental impacts such as land take, air quality, greenhouse gas emissions, and national energy security; (ii) the demand for, and benefits of, more roads infrastructure against the need to achieve the benefits of better regulation of road transport services and traffic, including road safety; (iii) building expressways to provide for inter-regional 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; (iv) spending on expanding the road network against spending more on maintaining what already exists; and (v) the relative road funding resources available to richer provinces and cities against those available to poorer provinces and rural areas.



21. These are choices facing all governments around the world but the rate of change in China's economy and in the road sector itself add urgency to the need to ensure that the policy and regulatory framework for the sector are able to keep up, to provide outcomes that promote a widely-drawn concept of economic and social development rather than just a boost to infrastructure capacity.

22. **There is increasing awareness of the environmental consequences of road traffic.** The rate of private vehicle ownership and travel, and its modal share, is much lower in China than in most developed countries. But private vehicle growth has inevitably had some adverse environmental impacts, such as the level of vehicle emissions, and social impacts such as higher numbers of traffic accidents (discussed

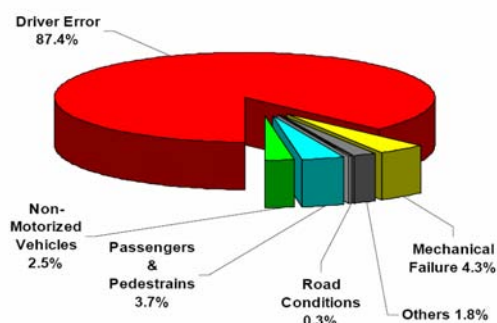


below). Mitigating these impacts somewhat, China's vehicle assembly and manufacturing industry has improved rapidly in quality, often with the assistance of foreign joint venture partners. By replacing older, less efficient vehicles, modernization and expansion of the fleet also has the effect of raising vehicle efficiency and safety, reducing fuel consumption and vehicle emissions, and bringing in designs and technologies better suited to the evolving needs of the Chinese market. However, balancing the desire to meet demand for increasing accessibility and mobility with action to mitigate its adverse impacts is a key issue being considered by China's policy makers.

**23. China also has a very high traffic accident rate.**

China has one of the highest rates of road traffic deaths in the world. According to official statistics, there were about 450,000 road accidents in 2005, with about 99,000 deaths, 470,000 injuries and direct economic losses of over \$2 billion. This corresponds to a rate of 7.6 deaths per 10,000 vehicles, to be compared with 4.2 in Malaysia, 1.6 in the USA and 0.9 in Japan. Cyclists, pedestrians and motorcyclists account for 60% of the fatalities and injuries. Road accidents are the leading cause of death for people up to the age of 45, and road accident injury patients take up more than 25% of hospital beds.

**Causes of Fatalities - 2004**



24. Road safety is the responsibility of the Ministry of Public Security, which administers the 2003 road traffic safety law. Its offices are also responsible for licensing drivers and vehicles, including driver testing and vehicle inspections. However, the PCDs and other road authorities also have a responsibility with regard to traffic safety, for example by ensuring that the road infrastructure is designed and maintained to a safe standard.



**25. The government's new road transport services strategy will complement its roads infrastructure strategy.**

The economic efficiency of road transport and its environmental and social sustainability depend not just, or even mainly, on the provision of infrastructure; they depend on the performance of transport services that use road infrastructure and which deliver the ultimate benefits of roads to people and to industry. Performance has economic,

environmental, safety and social dimensions. These are all reflected in the government's new strategy for road transport services as recently been presented by MOC.

26. This eight-point strategy reflect the goals of: strengthening of the sector's ability to respond to changing and growing demands; improved integration and coordination of regulations at all levels of government; reducing the incidence of truck overloading and illegal operations; and establishing a fair, competitive market in the supply of transport services. The points are:



- ❑ **Road transport market.** Consolidate the road transport industry, improve the regulatory framework, establish transparent rules governing management and operations, and accelerate the change of ownership from State-owned enterprises to joint-stock companies.
- ❑ **Road passenger transport.** Improve the quality and speed of passenger services, rationalize route structures, improve accessibility in rural areas, and provide better conditions for passengers.
- ❑ **Road freight transport.** Raise the quality and speed of freight services, reduce overloading, raise vehicle standards (with greater use of containers and larger, multi-axle trucks) and foster the development of integrated logistics service providers.
- ❑ **Road terminals.** Improve the planning, location and management of passenger and freight terminals, and open up opportunities to private investors.
- ❑ **Road transport safety.** Strengthen safety management through market-entry licensing, tighter controls over movements of dangerous cargoes, monitoring enterprise safety standards more effectively and upgrading standards of driver training, vehicle repair and road safety engineering.
- ❑ **Road pricing.** Establish a more appropriate balance between tolls and other fees as the basis for infrastructure cost recovery.
- ❑ **Technology.** Increase the acquisition of IT and other technologies, improve the efficiency of energy use and reduce pollution.
- ❑ **Management.** Develop more effective ways of integrating policy formulation, regulation, planning, operations and enforcement.

27. The road transport services strategy is comprehensive and timely. While the proposed road infrastructure construction program is set to continue, each component of the eight-point transport services strategy is also important to the sustainable development of China's road transport system. It will be important to maintain progress in these areas in the years ahead.



**28. The transport services strategy will be most successful if there is also a long-term sustainable financing framework for roads.**

China's high level of investment on roads, amounting to about 3.5% of the nation's GDP maintained during the last six to seven 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 the needs. The private sector's share of highway financing is

also unlikely to increase in the future.

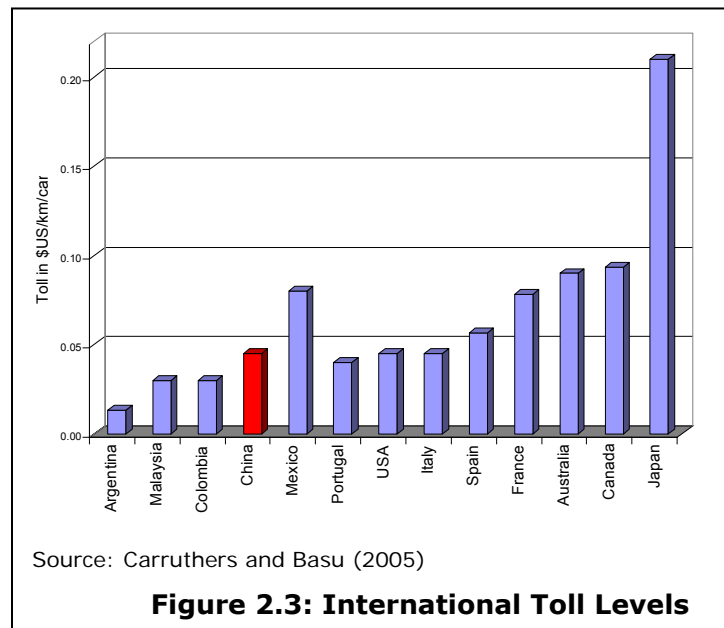
29. To sustain the value of assets will also require some re-balancing of resources from new construction to maintenance. While China continues to expand its expressway system, the first generation of highways is reaching the point where they will soon need resurfacing and repairs. Due to widespread overloading trucks, pavements have deteriorated faster than planned and will need substantial strengthening. 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.



30. There is a strong case for revising the sector finance so that it is efficient to collect, related to road usage, and, if possible, reflects relative emission levels. This would best be achieved through implementing fuel taxation. The State Council approved a gasoline surcharge concept in principle in 1999 that would achieve these aims, but implementing legislation has yet to be passed because of strong objections from many stakeholders. This reform would entail a far-reaching restructuring of several major tax revenue sources, public spending powers, and the balance between national and provincial mandates. However, if it could be implemented, the long-term gains to the financial and environmental sustainability of the road system would be substantial.

31. **China's direct pricing of toll-roads is also beneficial although it is facing some problems.** User tolls on expressways are a key feature of China's roads program. This is due to the fact that the percentage of public investment is relatively low and that loans are a high portion of the total investment. The tolls have been instrumental in the success of the expressway development which is unlikely to have occurred, or to have occurred in such a brief period, had it relied on budget funding. Expressway tolls should therefore remain a key component of sustainable roads financing. However, the high level and wide range of tolls have some adverse consequences.

32. Toll levels in China have been set at levels similar to or higher than equivalent tolls charged in developed countries.<sup>4</sup> In many instances, lower than forecast traffic on expressways has been caused by the inability or resistance of travelers to pay the toll; there has sometimes been continuing high use by through-traffic of local roads where environmental and safety impacts are usually higher. High toll levels may also be contributing towards truck overloading as drivers try to maximize the revenue from the trip to cover the high costs of tolls. The attention that is to be given to road pricing in the eight-point plan implies recognition that the optimum tolls from a public policy viewpoint may not mean charging the highest possible tolls. Again, a broadly-based fuel tax would give greater flexibility to optimize toll levels.



33. **There is scope for saving costs and improving connectivity through improved management of infrastructure planning.** In terms of management of the road system, highways of national importance, funded by the state, will provide the greatest benefits if they are coordinated with road networks of cities and

<sup>4</sup> Germany is now charging trucks an average of about US\$0.15/km. This compares to the average for China for heavy goods vehicles of US\$0.12-0.21/km.



municipalities through which they run. For example, many Chinese cities urgently need bypasses but their design, especially the spacing and capacity of interchanges, can only be optimized by taking account of the capacity of, and traffic projected for, nearby national highways. This does not always seem to be done, implying a need for better co-ordination to achieve continuity in road networks without either excessive duplication of capacity or sudden 'gaps' due to absence of co-ordination in planning.

34. More broadly, road transport system management also requires good traffic data and modeling, shedding light on where people want to go, especially their origin-destination patterns and turning movements. Some cities have built very high capacity multi-layer interchanges even with scant information on future turning movements, where simpler and cheaper two-level structures with on- and off-ramps would suffice for at least a decade.

35. Finally, as noted in Lee and Guangbin (2006), China follows a formal procedure for deciding in what roads to invest: the long-term strategic plan, five-year program and annual plans reconcile strategic objectives with needs at national, provincial and local levels. However, once a project is in the planning pipeline it is unlikely to be rejected or altered at the feasibility study stage. This can result in 'optimism bias' in terms of underestimated costs, overestimated utilization projections, or both, with the result that the actual investment return at opening is found to be less than that forecast. A review of 41 projects with domestic and international funding found that 76% had a lower Economic Internal Rate of Return (EIRR) at opening than forecast, with an average return of 18.5% versus the 24.9% forecast. It is important that the quality of evaluations at feasibility stage is closely monitored and that analysts learn from the experience of actual outcomes. However, this will only be effective if it is possible to carry out the evaluations prior to commitment to their inclusion in the plan, or with a willingness to adjust programs at the feasibility stage to exclude or defer those found to have low returns.



## 3 Urban Transport

### 3.1 Sector Description

36. **China's people are increasingly living in cities.** As recently as 1985, China's urban population was less than a quarter of the total. By 1995 it had reached 30% and by 2005 43%. The government expects 20 million people to migrate from the countryside to urban areas each year for the next 20 years<sup>5</sup>. This urbanization has seen the growth of a large number of major cities and a restructuring of their land-use distribution—both of which have created more complex patterns of transport demand that present a formidable development challenge.



37. In the early 1980s, China had only 28 cities with over 1 million people. By 2005, there were 43 such cities, of which 24 were metropolitan areas with a population of more than 2 million. The number of cities with between half a million and one million people had increased to 45.

38. This has been accompanied by expansion of the urban area and structural changes in land use patterns. The breakdown of conjoined work-residential locations that were prevalent under the centrally planned economy has triggered a reduction in gross residential population density in the city centers, increased the job density in city centers, and contributed to the general decline of overall population density across urban areas. Other trends are emerging, such as residential location by income level (large-scale residential development in suburban areas for middle- to high-income groups; large informal residential settlements for floating populations in urban fringe areas) and, perhaps most importantly, the emergence of cross-jurisdictional metropolitan areas and conglomerations. Trips have increased in both time and distance, with an unprecedented increase in motorization as mode shares shift from non-motorized transport to more convenient private cars and public transport.



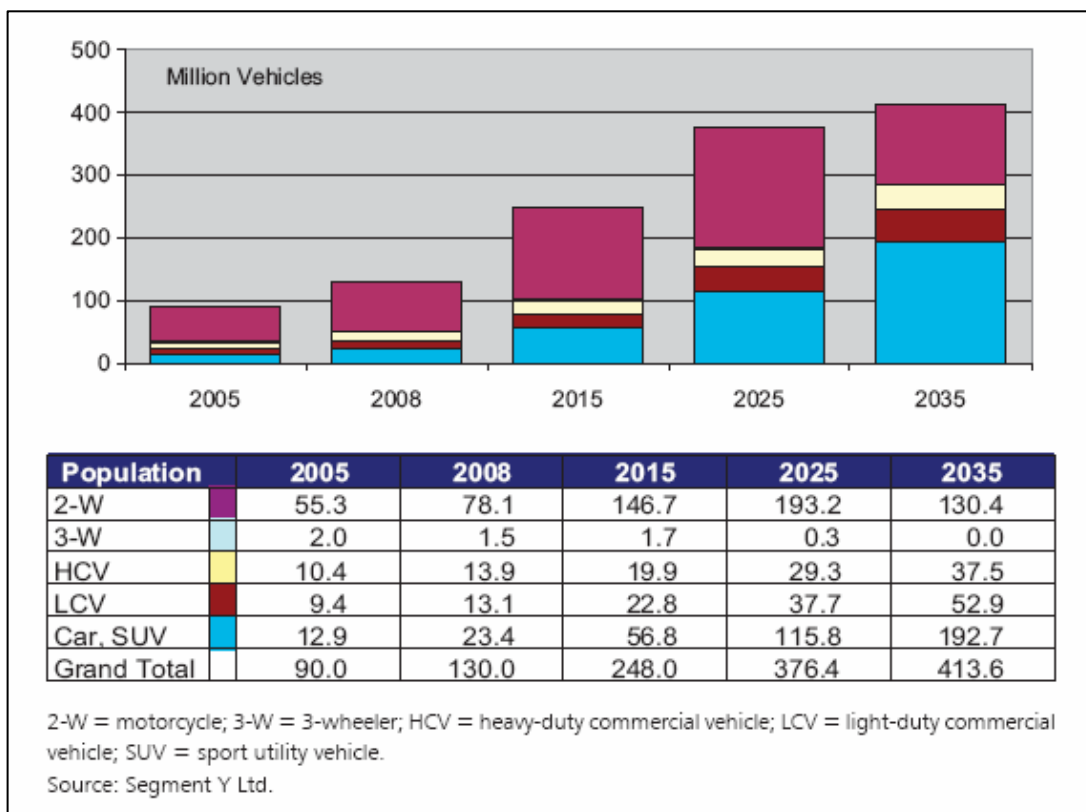
39. **Urbanization has been accompanied by an unprecedented rate of motorization.**

Large numbers of newly middle-class urban households have bought their first car. As noted in Section 2, there is still very little tax on automotive fuels. Car availability and relatively cheap fuel offer huge advantages in terms of enhanced personal mobility. In response, the private car fleet has been growing at 20-30% per year (see paragraph 18). At present,

<sup>5</sup> The urbanisation rate currently stands at 1.4%, which means that about 20 million farmers become urban residents each year. On the assumption that the urbanization drive maintains a growth of 1% annually, Chinese cities and towns will be absorbing about 300 million people from rural areas in 20 years.



national level private car ownership remains relatively low by the standards of other middle-income countries at about 11 per 1,000 persons, but in the richer cities the level is already 80-100 per 1000 people. The explosive growth in car ownership and use is expected to continue for the foreseeable future, with a predicted seven-fold increase predicted from the 27 million today (see Figure 3.1).



**Figure 3.1: Projected Motor Vehicle Growth, 2005 - 2035**

40. **City transport authorities have mainly responded by building urban roads.** China's cities have invested massively in building and improving urban street and expressway networks in the last decade. This impressive implementation program brought immediate benefits of mobility for private vehicles and for users of road-based public transport. However, it is recognized by city planners that it will not be physically possible in the long term to cater for a wholly unrestrained use of private vehicles. Their travel surveys and projections show that private car users will remain only a minor proportion of total urban travelers for the foreseeable future. Even more than in the roads sector generally (Section 2), urban road infrastructure requires supporting strategies for transport services and transport management to ensure that its benefits are realized and sustained.

41. With rising motorization and a road system that encourages sprawled urban development, traffic congestion has become a serious problem in the biggest cities and an increasing concern in other large cities. Car owners are therefore finding their new mobility from car ownership and urban expressways to be short-lived, at least





so far as city travel is concerned. At the same time, the last decade has seen a decline in mobility for many classes of city dwellers. Pedestrians and cyclists in particular have suffered from longer trips and lower safety levels, especially at intersections which are designed primarily to maximize car throughput. The speed and reliability of road-based public transport has, in many locations, been undermined by road traffic congestion. Increasingly, these mobility concerns, amplified by concerns about road safety, local and global vehicle emissions, and land consumption have created a sense of urgency at the national level to find more sustainable long-term strategies for urban transport.



**42. Public transport is now receiving more attention.** Despite improvements by cities in the last two decades, recent attention from central government reflects their concern that urban public transport systems need to be improved. Buses provide the majority of public transport service in China. They form the backbone of the passenger transport network, even in quite large cities. The bus network is generally extensive but is not always well-matched to the fast developing parts of the city and the changing travel and residential patterns.

43. Much of the public transport supply is provided by State-owned enterprises or joint ventures in which the state has a majority stake. Most bus operators achieve adequate financial results to finance bus replacement 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 technology equipment for routine business, maintenance and operations functions. Limited money has been invested in supporting public transport infrastructure, e.g. high quality interchange terminals and passenger information systems. Bus priority and bus rapid transport have been tried and sustained in only few places—but are catching on.

**44. More metro systems are being built.** Up to 1989, China had only three metro lines totaling 50 km (two in Beijing, 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. The expansion has been led by Shanghai and Guangzhou, which have built up 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 11th Five-Year Plan (2006-10)<sup>6</sup>. In the next 10 years these 15 cities will have a total metro length



<sup>6</sup> The 15 cities which will have metro rail lines are: Beijing, Changchun, Chengdu, Chongqing, Guangzhou, Hangzhou, Harbin, Nanjing, Shanghai, Shenyang, Shenzhen, Suzhou, Tianjin, Wuhan, and Xian. Shenzhen, Wuhan and Nanjing have completed at least one line each and are now starting their next projects. Beijing, Guangzhou, Shanghai and Tianjin already have extensive networks and are planning rapid expansion in the short term, driven by the 2008 Olympics in Beijing, the 2010 World Expo in Shanghai and the 2010 Asian Games in Guangzhou. Currently, 22 lines have been put into operation with a total mileage of 602.3 km. A further 36 lines are under construction.



of 1,700 km and the investment will reach some \$83 billion. The high construction costs of metro and light rail, typically \$50-100 million per km, limits the extent and speed of development of such systems. Nevertheless, they have been embraced by many Chinese cities in the context of an almost total absence of conventional suburban rail lines. Sometimes the aspiration to build metro lines has drawn management attention and resources away from urgent needs in the bus system.



**45. Transport systems will be enhanced in preparation for the 2008 Olympics in Beijing.**

Beijing plans to spend some US\$10.8 billion developing its transportation system for the 2008 Olympics. Construction will include highways, city expressways, subway lines, and an intra-city light rail. Approximately 150 km of new subway/rail lines will be added, including direct lines to the Olympic stadiums. The Capital Airport will also be expanded. Bicycle lanes and pedestrian areas will be

constructed, particularly in old town areas. Further investments include expanding the capacity and optimization of bus lines. Taxis will also be upgraded to conform to technical standards for special vehicles; clean energy vehicles will account for 70%. Public parking facilities will also be constructed. These works are currently in progress, and it is expected these programs will be completed and operational in 2008.

### 3.2 Sector Issues

**46. Getting urban transport right is important for China.** In the coming 25 years, China's urban population will double, its urban economy will quadruple, and its motor vehicle fleet will be six times greater than today's. China's leaders and planners have a huge opportunity to shape tomorrow's cities and there is much to be learned, good and bad, from international experience. High population density and shortage of space suggest the benefit of sustainable urban transportation strategies that give a central role to public transport (mass transit) and not to a land-consuming, car-based urban sprawl pattern. In this respect cities, such as Hong Kong, Singapore, London, Tokyo, Seoul, etc. that have put public transport at the center of urban transport strategy, seem to offer more appropriate models for China than some of the car-based cities of the world.<sup>7</sup>



47. Sustainable urban transport requires strong city institutions and management capacity. The last two decades have seen a process of fiscal decentralization that has devolved planning and investment of urban transport largely to municipalities. This decentralization has helped drive the successes of the Chinese urban transport evolution in the last 20 years. Mayors have

<sup>7</sup> Japan, Germany and South Korea are all world-class auto manufacturers, but at home rely heavily on public transport.



been able to respond to unprecedented urbanization and change at a pace and to an extent previously unimaginable. As has been shown, this has proven successful for delivering infrastructure. But decentralization has not yet led to the kind of city-level institutional and management systems for transport that would underpin and sustain a world class public transport system.

48. The central government, without a financing role, has over this period generally stayed away from urban transport matters. In the last two years, however, concerns from the central government regarding equity, productivity, oil security and climate change have resulted in increased recognition of the importance of developing sustainable urban transport practices. As a result, the need for public transport priority in cities has been promoted by the highest levels of Chinese leadership including the State Council and the Ministry of Construction in their official documents and public announcements. Opinion #46, approved by the State Council in October 2005, is a very important step. The current challenge for China's city planners and managers is to find ways in which cities can be designed and managed for people, not for cars.

49. Giving priority to public transport is critical. Despite the rapid growth in car ownership, the majority of urban households are car-less and likely to remain so for the next 10-15 years. Indeed, it would simply not be practical to provide for them all to use their cars for all their urban trips. A large element of the solution to China's complex urban transport problems therefore lies in the development of an efficient and affordable public transport system.

50. Many modes of public transport can contribute to making cities work better: metro rail systems, light rail, buses and mini-buses. They contribute most effectively when the service offered to the public is integrated to create physical connectivity, spatial coverage and ease of transfer.

51. As in the developed world, road-based public transport, and in particular buses, will inevitably need to play the major role in most cities in China and will need supporting policies that give priority to buses and trams over private cars. Promisingly, Bus Rapid Transit (BRT) Systems have the potential to provide high quality cost-effective public transport systems in many cities. They combine the advantages of buses-relatively low costs, flexibility in scheduling and operations, with the advantages of rail-dedicated segregated rights-of-way, and fast boarding/alighting. More attention is needed on improving bus services in general and, in cities where this alternative is most appropriate, implementing effective BRT systems.

52. New urban rail and metro lines require very dense passenger flows to justify the costs relative to other transit options. They can be effective and affordable mainly in the densest corridors of the larger and richer cities, and in concert with land-use development policies that create high density of usage and where enhanced property value may be captured to help offset capital cost. But international experience suggests that buses will remain the backbone of public transport even in cities where considerable rail networks will be developed.

53. **Non-motorized travel can be made more attractive and safer.** In many cities, road space traditionally used for non-motorized traffic, especially cyclists, has been taken to cater for motorized traffic. Although bicycle use has been decreasing in past years, China's tradition of walking and bicycling persists, and remains the mainstay of transport for the poor. Between 50% and 60% of trips in most Chinese cities even today are made on foot and by bicycle. International experience suggests that there can be significant reductions in congestion (and all the co-benefits



associated with lower auto use) if people who have choices are encouraged to choose bicycles and walking, especially for short trips. Achieving this will require a focus on improving facilities for pedestrians and cyclists and inculcating a culture of respect for pedestrians and cyclists, particularly at intersections and crossings.

#### Listening to the People

Participatory planning methods have the potential to help governments design projects that maximize the distribution of benefits and minimize concentration of costs. The experience with the World Bank-financed Urban Transportation Project in northeastern China provides an example of a successful pilot. The experience of this project, currently under implementation, was that a series of public meetings, workshops, surveys and interviews significantly influenced the project design and raised city leaders' sensitivity to the public's needs. The participatory process in part led to a shift in project focus from expansion of major roads to improvement of secondary roads that served the interests of the predominant group of bicycle and pedestrian trips. The process also sensitized local leadership to the priorities of non-auto users and vulnerable urban social groups including women. This consultation process has now been adopted and replicated in other Bank-financed urban transport projects in China.

54. **Private car users impose costs on cities that can be 'priced' and recovered.** Improving public transport and non-motorized modes will have only limited success unless measures are taken to ensure that private vehicles users pay for the costs they impose on cities in the form of congestion, traffic accidents, air quality and other environmental impacts. Successful efforts to align auto user incentives with those of cities can come in the form of different kinds of charges including parking charges, higher vehicle registration charges, fuel taxes, and congestion charges; and restrictions such as limitations on speed and vehicle entry in designated downtown areas. But care needs to be taken that any restrictions are designed to avoid encouraging people to hang on to old cars rather than buying newer less polluting models.

55. **Land-use and transport planning can be co-coordinated in ways that help manage private car travel.** In the long-run, the nature of the demand for private automobile transport will be heavily influenced by the urban structure and the dynamics of urban expansion. Cities that grow in a compact manner along well-defined corridors with high density development, concentrated about nodes, will support a larger share of public transport than cities that grow in a sprawled manner. This will only occur with co-ordination between the management of urban expansion, the disposition of land-use, overall transport strategy and specific plans for public transport networks.

56. The dynamics of expansion that dominate China's cities at present are driven by the revenues obtained by municipal government from converting fringe rural land to urban land. This makes it harder to attain the configurations of development that enable creation of effective public transport systems. Cities often do not have the incentives to expand in measured, controlled ways that would minimize the need for private transport. Indeed, roads are sometimes built expressly for the purpose of urbanizing land.



## 4 Railways

### 4.1 Sector Description

57. **Railway transport is essential to China's economic development and social cohesion.** People and goods in China move in large volumes over long distances for which well-run railways can provide a safe, low cost, energy efficient and less land intensive mode of transport. In terms of freight, China's economy depends heavily upon coal and coke, metal ores, iron and steel, petroleum products, grain, fertilizers and other bulk products to which the technology and economics of rail transport is well suited. Moreover, the average transit distance of rail freight is 832 km (2006), one of the highest of any national railway system in the world. As a result, the Chinese rail system carries about two-thirds of the country's inland freight (that is including inland waterways but excluding coastal shipping). China also has a high population density in its settled areas and numerous large cities. With increasing purchasing power to back up their growing propensity to travel this is fuelling some of the most intense inter-city passenger flows in the world, as well as heavy demand for suburban and regional travel within the larger conurbations.

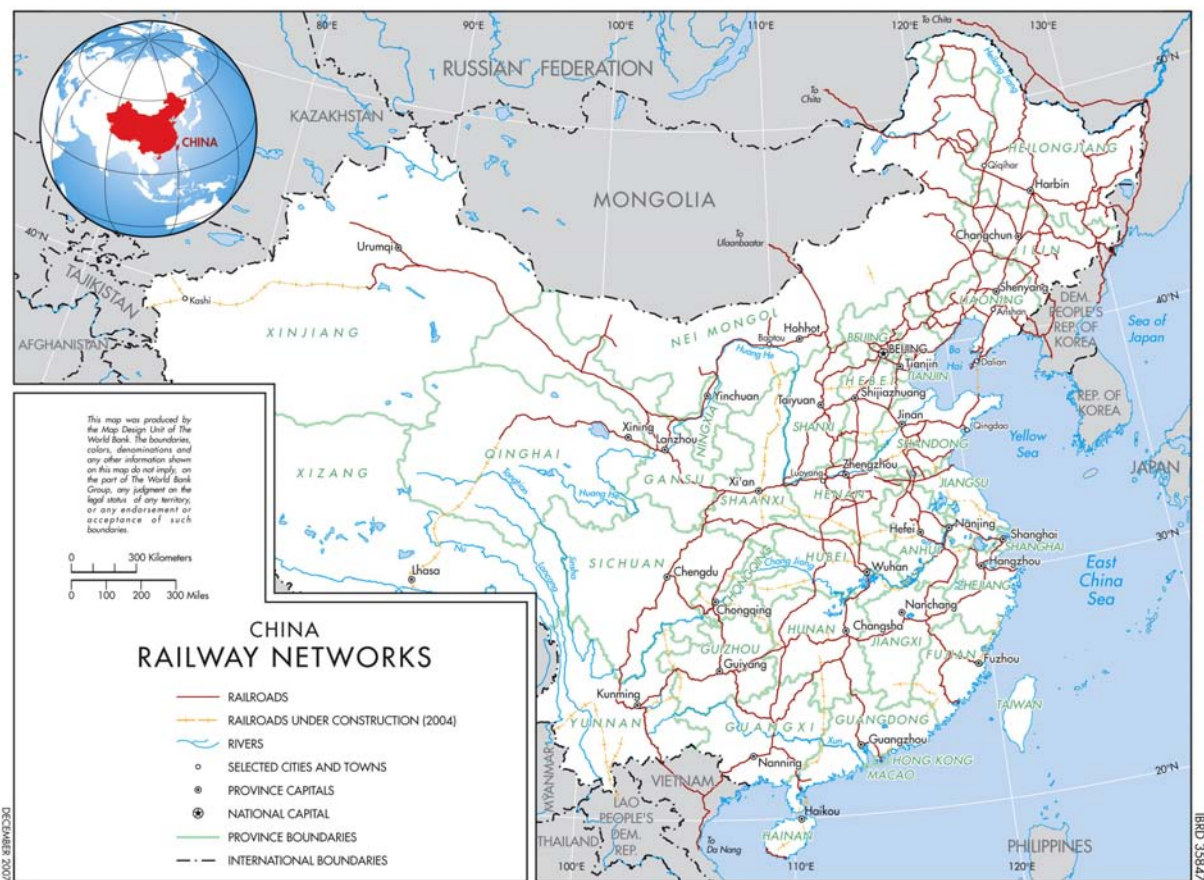


Figure 4.1: China's Railway Network



58. **Railway traffic has been rising rapidly.** Over the last decade, passenger traffic (measured in passenger-km) grew by 70 percent and freight (in ton-km) grew by 60 percent. In 1980, China Railways was the third largest rail freight carrier globally, accounting for 8.5 percent of the world's rail freight traffic; by 2005, it was the second largest freight carrier (after the US Class I system). In 1980 China Railways was the fourth largest railway in the world in terms of passenger traffic; by 2005 it had become the largest passenger carrier. Taking freight and passenger traffic together, China Railways is now the busiest railway in the world.



59. **China also has the highest utilization of railway infrastructure.** China Railways now carries a quarter of the world's traffic on 6% of the world's track length. Despite being the only major railway in the world to increase its network significantly, China Railway's traffic density (40.5 million traffic units/km of line<sup>8</sup>) remains the highest in the world, nearly twice the next highest (Russia at 23.8) and far higher than the US (16.1), India (15.5) and the European Union (3.7). 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. Not surprisingly, in its 10<sup>th</sup> and 11<sup>th</sup> Five Year Plans the central government has given increased emphasis to the role of railway transport in order to prevent railways from becoming a serious bottleneck to economic growth.

60. China's 10<sup>th</sup> Five-Year Plan (2001-2005) expanded the size of the rail network, speeded up railway construction in western China, and added capacity in the main corridors of the eastern network. The Plan emphasized expansion as much as modernization of the system; upgrading of track and signaling to allow operation of express passenger trains on prominent corridors, like Beijing-Guangzhou and Beijing-Shanghai; creating an express freight network initially between 30 major cities; and raising capacity on busy routes. The Plan provided for an investment of \$42 billion for rail construction and modernization.

61. **A freight surcharge has been the main source of development funds in recent years.** Presently, financing for the railway sector is primarily sourced from the Ministry of Railways (MOR) internal sources, comprising profits from operation and a construction surcharge on freight moved by railways. In addition, the MOR capital construction program is supported by loans from domestic financing institutions, and loans from multinational development banks that are borrowed by the central government and re-lent to the MOR. The number of cases in which the MOR has raised financing from the capital markets is still limited.

62. **China has now embarked on the biggest program of railway building in any country since the nineteenth century.** In 2004 the State Council approved

<sup>8</sup> A traffic unit is a passenger-km or a ton-km of freight.



the MOR's 'Mid and Long-Term Railway Network Plan', which sets out the investments required through 2020 to keep pace with the demand. 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 central government's regulatory role and responsibilities being defined within a market framework. The underlying principles are:

- ❑ Coordinating railway development with that of other transport modes, as well as energy and other related sectors at both the macro and corridor level;
- ❑ Separation of passenger transport from freight on constrained busy trunk lines to increase capacity and improve service levels, with the development of inter-city fast passenger networks in densely populated and developed areas;
- ❑ 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, territory development and national defense; and
- ❑ Raising the local content of railway equipment and promoting local equipment manufacture.



63. By 2020, the total operational length of China Railways is expected to reach 100,000 km, with separate high-speed passenger and freight routes on the main corridors and 50% of the network either double-tracked or electrified or both. The high-speed passenger-dedicated network is based on four north-south and four east-west corridors, with three regional inter-city systems; the target speed in these latter corridors is over 200 km/h. Because of the dominant role that coal plays, and will continue to play, in China's energy structure, it also includes high-capacity coal transport corridors, together with the double-tracking and electrification of other trunk corridors where required, and the development of container transport. It also sets detailed schemes for strengthening the network in the western region

64. **Passenger-dedicated network.** To meet the demands of rapidly increasing passenger transport, express passenger transport corridors will be built along the "four vertical and four horizontal" railway passenger corridors with maximum train speeds of 200-300 km/h. To serve the three major conurbations, so-called 'inter-city' regional passenger networks are planned for the Bohai Sea ring (Tianjin, Beijing, Qinhuangdao), the Yangtze River delta (Shanghai, Nanjing, Hangzhou), and the Pearl



River delta (Hong Kong, Guangzhou, Shenzhen), covering the major cities and towns in each area. By 2020, the dedicated passenger railway lines will cover 12,000 km.

65. **Upgrading the existing railway network.** The existing railway network and terminals will be upgraded to increase the capacity of the existing corridors. About 13,000 route-km will be double-tracked and some 16,000 km of existing lines will be electrified.

66. As mentioned above, in parallel with the construction of dedicated passenger lines, high-capacity coal corridors will be created based on the ten major coalfields. Immediate priorities are expanding the capacity of the Datong-Qinhuangdao Railway<sup>9</sup>, upgrading the Beitongpu Railway, construction of Huanghua-Dajiawa Railway, and expanding the capacity of the Shijiazhuang-Taiyuan line by constructing a separate passenger line.



67. The double-tracking and electrification of seven major corridors will be completed: including Beijing-Harbin, Beijing-Shanghai, Beijing-Kowloon, Beijing-Guangzhou, Lianyungang-Alashankou (border with Kazakhstan), Shanghai-Wuhan-Chengdu and Shanghai-Kunming; and terminal, marshalling and depot facilities will be modernized.

68. **Western developmental network.** Regional economic development will be supported through major expansion of the western railway network and improvements in the central and eastern areas. In total, about 16,000 km of new lines are planned. These include new links to international borders in the north-west and south-west.

69. **In terms of industry structure, railways in China remain largely monolithic and centrally controlled.** A small proportion of traffic is carried by local railways and joint-venture railways in which ownership is shared with provincial governments and others. However, the great majority is carried by the 18 regional railway bureaus of the MOR. Their management of the railway network and the operation of trains are carried out with high operational discipline and efficiency. But the central government and Ministry of Transport have long recognized the need for railways to become more market-oriented in their approach to customer service, more competitive with road transport in terms of passenger speeds and freight delivery times, and more commercial in their management of the railway business.

70. **There have nevertheless been significant reforms and management improvements within the existing structure.** The case for the reform of the China Railways system from its historical structure as a vertically and horizontally integrated, state-owned monopoly, has been widely accepted for a number of years. The MOR has adopted a step-by-step approach to industry reforms, concentrating on reforms within (or grafted on to) existing institutions rather than breaking up China Railways itself. These reforms have included:

<sup>9</sup> The Datong-Qinhuangdao Railway was floated on the Shanghai stock exchange in August 2006 as a public company.





- ❑ **Non-core businesses.** Separation of non-core activities as enterprises (construction, manufacture, telecoms, design, education and social activities) and staff reductions from 3.4 million in 1992 to 2.1 million in 2006, a period during which traffic increased by over 70%. Many of these enterprises now provide services to China Railways on a competitively tendered basis.
- ❑ **New industry participants.** From the mid-1990s the MOR has supported the establishment of 34 new joint-venture railways that are owned by national and provincial governments and private investors. In 2006 these accounted for 75.6% of the new railway projects. About two-thirds of these railways are understood to be independently profitable. The central government is seeking to expand this approach, with greater private participation, to new high-speed dedicated passenger lines that would free up freight capacity on existing lines.
- ❑ **Commercialization.** Implementation in 1999 of the Asset Operation Liability System has made managers of regional railway administrations accountable for return on capital, output, profitability and safety. It also gives incentives if agreed performance levels are exceeded. China Railway's operating labor productivity (excluding non-core business) has doubled since 1992 and it has earned profits since 1998, despite controlled tariffs, and is a major net contributor of taxes to the budget (\$1.5 billion in 2004).
- ❑ **Management restructuring.** In 2004, the MOR took out a whole layer of management by eliminating the 44 sub-regional administrations. Management was consolidated at the level of the 18 regional administrations and some 60,000 staff positions were removed. This change brought together management responsibility and accountability at the regional level. It also facilitated and encouraged higher utilization of locomotives and crews, which had normally been changed at sub-regional boundaries. There has also been some separation of management of low-density lines with emphasis on reducing losses.
- ❑ **Passenger services.** Since 1992, the MOR has made passenger fares more flexible, introducing higher fares for fast and premium services and a surcharge for peak season. Also passenger business has been separated on an accounting basis.
- ❑ **Freight services.** In 2003 specialist companies were formed to operate container services, mail and parcels, and special freight. In 2007 the MOR completed negotiations with several private firms, including large foreign companies, to set up a joint venture to develop and operate 18 expanded regional container hubs.
- ❑ **Information technology.** In the mid-1990s the MOR introduced a new world-class Traffic Management Information System with World Bank finance and the Bank is now financing a specification of the next generation upgrade of the system.
- ❑ **Train operations.** China Railways has begun upgrading specific routes to make them capable of carrying double-stack containers. It is building to higher axle loads on a trial basis for heavy-haul freight. China Railways managers hope to obtain the large benefits that have been demonstrated by these approaches in North America.



## 4.2 Sector Issues

### 71. **System development and system reform both pose great challenges.**

China's railway sector strategy in the future will remain dominated by these two key elements. One objective is to reform the industry to become more responsive to the market economy. The other is to achieve an order of magnitude change in the capacity and quality of infrastructure and services in a system that is already the busiest, by a wide margin, of any in the world; and which is still facing rapidly growing demand. Pursuing these two goals at the same time adds up to perhaps the most daunting rail industry challenge facing any government in the world.

### 72. **The risks of financial and technical overreach in implementing the Mid-to Long-Term Plan need careful management.**

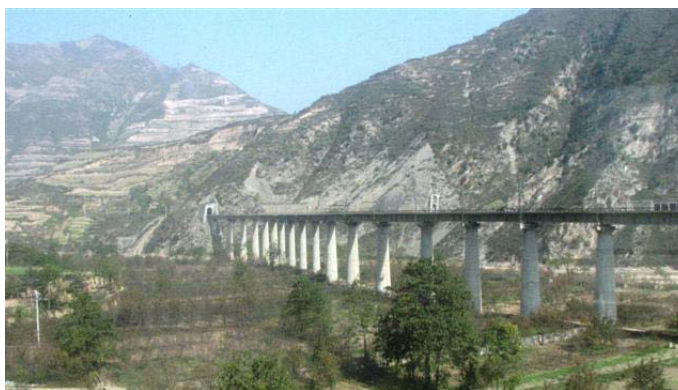
Even allowing for contracting out and mobilization of international specialist skills, the resources and capacity simply to supervise, deliver and monitor such a huge and diverse program is not assured. As with any large and long-term program, there is a risk that, as pressure on resources and timetables increases, the delivery costs will start to escalate. On the other hand, there should be some countervailing economies of scale and of experience as the program progresses. There is also a concern because railway skills, such as in train signaling, power supply, locomotive engineering, systems integration, rail safety and so on, are very specialized and may create bottlenecks or impact on quality.

### 73. **At this point, system development seems to have been given priority over structural change.**

In response to strategic goals set by the national leadership, the National Development and Reform Commission (NDRC) has decided the framework for future reform of the rail industry, among others, and set out the underlying policy principles in "*State Development and Reform Commission: China's Key Reforms in Seven Fields in 2004*". This document identified three key principles:

- ❑ separation of government administration of the railways from enterprise management;
- ❑ introduction of competition where suitable; and
- ❑ effective industry regulation

74. It falls on the MOR to specify actions and timing that will implement the principles set by the NDRC. As has been shown, the MOR has undertaken many reforms over the past two decades and is committed to changes that will enable it to meet the challenge of functioning in a market economy amid growing competition from other modes. Reform will also help it access capital from the private sector, as it makes itself more investor-friendly.





75. **Deferral of structural change creates tension with the need to access new sources of capital.** The central government has not yet separated the policy and regulatory functions of the MOR from the commercial functions of China Railways. This reluctance is thought to be due to:

- ❑ concern about a possible diminution of the state role in railway management decisions at a time when railway capacity and coverage are being seen as an increasing constraint on development;
- ❑ concern that rail service might be disrupted during institutional change at a time when its capacity is already stretched; and
- ❑ higher priority of management resources given to system expansion and upgrading.

76. However, the Mid to Long-range Plan requires a substantial increase in infrastructure investment from about \$10 billion/year in the decade 1995-2004 to around \$16 billion/year over the Plan period. China's traditional sources of funds for railway development since 1990 have been dominated by revenue from the Railway Construction Fund, which is accumulated by a surcharge on rail freight rates, and by domestic loans and bonds. The Joint Ventures with Provincial Governments are also providing a useful way of attracting some additional funding. But there is widespread agreement that the successful delivery of such an ambitious railway development plan will also require non-traditional sources of funding including private sector loans and equity.

77. The quest for private finance for rail projects, particularly private equity, does not sit well with the MOR being responsible simultaneously for railway policy, regulation and the commercial operation of rail transport services (through its 18 regional railway bureaus). In terms of dealing or competing with China Railways, external investors in new rail entities might reasonably question whether their rights will be protected and obligations fairly administered when one party controls entry to the playing field, makes the rules, referees the game and manages the other team. Some observers therefore argue that a separation of the Ministry's policy-making functions from the commercial interests of China Railways is a pre-requisite to attracting private investment in the railway system on any significant scale. Separation would also enable it to consider alternative industry policy options from the point of view of the public interest as a whole without the overriding responsibility for the commercial results of particular participants.

78. It therefore seems inevitable that at some stage that the government will split the policy-making functions of government from the commercial functions of railways. At the same time it would be desirable to establish a separate regulatory mechanism, independent of either policy-makers or commercial operators that will protect rights and enforce obligations of a wider range of participants in a fair and transparent way. Such rights and obligations are themselves not yet well defined in regard to matters such as track access rights and charges, arrangements for interchanging rolling stock between adjacent operators, and division of revenue from a through passenger trip or freight consignment between say a China Railways operation and an adjacent private operation.

79. **Railway transport will continue to improve service quality and differentiation.** In the past, China Railways management tended to emphasize maximizing volumes carried rather than generating net revenue or improving the

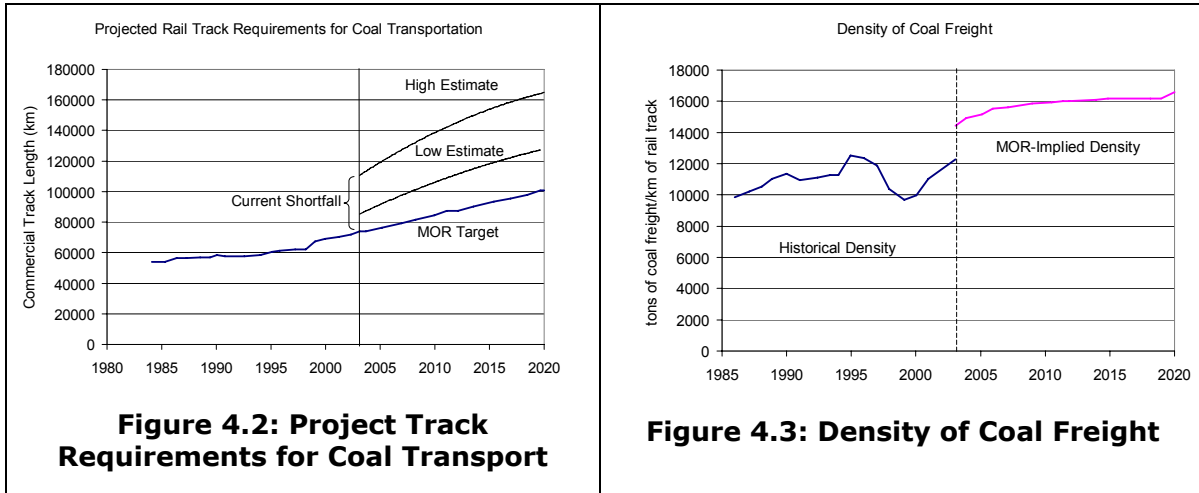


value of services. That is now changing. Dedicated high-speed passenger lines will provide a much higher level of service and at premium tariffs. Moreover, the capacity freed up by the new dedicated passenger lines can be used to meet projected freight shipper demands in terms of both volume and service levels.

80. Because of the dominant role that coal plays, and will continue to play, in China's energy structure, the Mid to Long-Range Plan also includes high-capacity coal transport corridors, together with the duplication and electrification of other trunk corridors. But the role of railways in China's economy will be optimized by providing cost-efficient and reliable services tailored to a wide range of freight shippers. For example, the currently poorly developed rail container industry is to be boosted with upgrading of those railway lines that have intensive container transport, and the operation of double-stack container trains. Some 18 central container terminals are to be built in the main ports and inland centers, with a further 40 terminals in major provincial centers and at inland border crossings. This strategy clearly recognizes and responds to specific industry needs of container shippers, but all industrial sectors have different and increasingly more sophisticated transport needs to which rail managers will need to respond if rail is to compete with road transport.

81. **Greater flexibility in freight tariffs would support service differentiation and assist capacity management.** In the past, a fixed and rigid tariff served the China Railways well while it had a monopolistic hold on the market. As the market economy develops further, this situation is fast changing. Road and air services are fast expanding to all corners of the country and providing alternatives to railway services. By continuing with a rigid tariff structure, China Railways loses its competitiveness in regional and local markets where road transport agencies operate on a much smaller scale and are able to match prices more flexibly to the circumstances of major customers.

75. **The Mid to Long-range Plan will probably not mark the end of railway infrastructure needs.** Even with the planned investments, China's rail network density will remain very low compared either to country size, population, or traffic, and further network enhancement and technological improvement will be required (Fridley, 2006). For example as shown in Figures 4.2 and 4.3, if coal consumption grows according to the China scenario, there will need to be a major increase in the density of coal transport—to a level well above the historical density. The long-term sustainability of the transport system as a whole suggest that investment in the rail system could beneficially continue at high levels for some time to come. This may at some stage require some relaxation of the government's reluctance to restrict direct public investment only to lower density lines in remote areas.



Source: Fridley (2006)



## 5 Air Transport

### 5.1 Sector Description

82. **Air transport is China's fastest growing mode of transport.** Air travel is becoming more popular and more frequent among the Chinese population, whose income is increasing steadily. Air cargo is also a rapidly growing segment of the huge air transportation market potential.



83. Passenger numbers expanded from 51 million in 1995 to 160 million in 2006, and cargo tonnage from 1 million ton in 1995 to 3.5 million in 2006<sup>10</sup>. Between 1995 and 2006 passenger traffic (passenger-km) tripled (68 billion passenger-km in 1995 and 237 billion passenger-km in 2006) and air cargo (freight, express and mail) almost quadrupled from 2.2 billion ton-km in 1995 to 9.4 billion ton-km in 2006.

84. **China is now the second largest aviation market in the world after the USA.** In addition, in 2006 Beijing was the 9<sup>th</sup> busiest airport in the world with 48.7 million passenger movements. Boeing Commercial Airplanes has estimated that revenue passenger-miles in China will continue to grow about 20% faster than GDP from 2005 to 2025.

85. China is now the most important customer for the world's largest airplane manufacturers, Boeing and Airbus. The current fleet of commercial aircraft of 863 will grow to almost 1,600 by 2010, and it is expected to reach about 4,000 by 2020. To cope with this growth China will need an additional 1,000 pilots a year through to 2010. Between 1995 and 2005 the average trip for air passengers tripled in length (from 100 km to 300 km) so the growth in passenger traffic will lead to the introduction of larger regional aircraft with greater range. These new aircraft will be designed to meet the needs of regional travelers and directly support the central government's policy to further develop the western part of China where, compared with road or rail transport, the



difficult terrain and sparse population tip the economics in favor of air travel.

<sup>10</sup> The overall increase in passenger numbers was constrained by the regional outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003, which caused the number of passengers on international flights to fall to 6.8m from 8.4m in 2002.



86. China's air cargo is mostly carried in the bellies of passenger aircraft. This freight is highly concentrated at Shanghai, Beijing and Guangzhou. In 2006 these airports ranked 6<sup>th</sup>, 20<sup>th</sup> and 25<sup>th</sup> respectively out of the top 30 airports in the world for cargo flows<sup>11</sup>. The Beijing gateway handles air cargo that originates in northern China and Shanghai that from eastern and central China. According to China Customs, electronics, electrical products, and parts are typical products both exported and imported by air. About 60% of all air imports fall into the broad category of machinery and electrical equipment. Among China's exports by air, the most frequent products include mobile phones and video-cameras accounting for 16% of total cargo exports by air. Other high tech products, such as integrated circuits, micro-electronics, computers, and photographic and medical equipment are also shipped by air.



**87. The airline industry has been restructured and is continuing to evolve.**

During the last decade, the Chinese aviation industry has undergone dramatic growth, thanks to the increased competition generated by new airlines and low fares. The older state-owned airlines had to adjust to the new setting and new local airlines have emerged after the opening of the Chinese economy and further globalization. The airline industry has not only increased the quantity, but also the quality of its services. For example, in 2006 the entire Chinese airline industry introduced electronic tickets, which very quickly took over a larger share of total ticketing than in any other country. Other quality improvements have come about through increased service frequencies between destinations, larger and faster aircraft, improved airport facilities and services, as well as overall improvement in passenger and cargo services. However, passenger load factors are consistently high, and flight delays can have disruptive knock-on effects.

88. In 2005, the first truly private commercial airline started up. Regulatory constraints on general aviation (corporate and personal planes), previously tight, have been loosened somewhat. Currently there are seven private airlines, accounting for 4% of domestic market share. At least 10 private air carriers, including three cargo airlines, are preparing to enter the market.

89. The government has been working to restructure the airline industry, which has suffered from fierce competition. However, China's three largest air carriers—Air China, China Eastern, and China Southern, which account for almost 80% of domestic flights—are still majority state-owned<sup>12</sup>.

<sup>11</sup> According to the Airports Council International, the volume transported, and increase from the previous year was: Shanghai 2,168,122 metric tons (16.8% increase); Beijing 1,028,909 tons (31.6%) and Guangzhou 824,907 tons (9.9%). Hong Kong was ranked second after Memphis with 3,609,780 tons (5.1%).

<sup>12</sup> A holding company has been formed to group together China's Beijing-based flag carrier, **Air China**, with China SouthWest (based in Yunnan), Zhejiang Airlines and the China National Aviation Company, which through a subsidiary owns 40% of Hong Kong's second passenger airline, Dragonair, and a majority share in Air Macau. A second group has been formed around Shanghai-based **China Eastern**, which has merged with Yunnan Airlines and China NorthWest. The third has been formed around Guangzhou-based



90. Despite their consistently high passenger load factors, many Chinese airlines have made substantial financial losses in recent years. For example, Chinese airlines lost over \$250 million during the first quarter of 2006, although some turned profitable in 2007. Chinese airlines have much higher unit costs than their competitors in the Asia Pacific region: the unit costs of the above three major Chinese airlines are estimated to be 15-40% higher than Cathay Pacific's costs. One factor is the price of aviation fuel which is controlled by the NDRC. Domestic jet fuel is priced some 25% higher than in Singapore. But there are other management and structural factors. Chinese airlines are using older, less fuel-efficient planes, often on short routes, which by their nature are less fuel-efficient.

91. As China builds its planned network of dedicated high-speed railway lines, it can be expected that the railway will draw some market share from short-haul air passenger transport. This will tend to increase the average length of air journey and, together with gradual fleet replacement, will help to improve fuel efficiency.

92. In response to the need for faster and more reliable transportation of high-value goods, all the major express carriers—DHL, UPS, FedEx and TNT—are now well established in China, and are able to provide door-to-door service using inter-modal transport systems, but mostly air transport.



93. **Over the past ten years considerable effort has been made to improve the quality of China's aviation infrastructure.** Many of China's commercial airports nationwide are old, but as a result of improvements major airports in the country have become better connected to both domestic and international networks. Substantial additions to capacity are being built in Beijing, Shanghai, and Guangzhou airports<sup>13</sup>, the main hubs for international services.

94. The standard of airport and related infrastructure has been an impediment to the growth of the air cargo logistics industry, with most of the operations technology and transportation networks still underdeveloped. The industry is fragmented and operating with few market mechanisms. In response to the rapidly growing demand, improvements have been made in air cargo related infrastructure in the airports of Chengdu, Kunming, Xi'an, Wuhan, and Shenyang, which have been selected to become regional hubs. Moreover, the provincial governments have realized that good airfreight facilities are important in attracting fast-growing, high value-added industries. Several new airports and airport renovations have been prioritized and completed, as well as improvements in facilities for airport management, flight control, fuel supply and maintenance.

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**China Southern**, which owns Xiamen Airlines, China Northern and Xinjiang Air. The government had planned to allow the three groups to dominate China's airline industry, but it now seems probable that a fourth, Hainan Airlines, will also be part of the consolidation process.

<sup>13</sup> In 2005, an entirely new mega-airport was opened in Guangzhou, and a second runway was opened at Pudong airport in Shanghai. At Beijing airport, a third terminal building is under construction, to be opened in time for the Olympic Games in 2008.





95. **Provincial governments are playing an increasing role.** Air space remains under military control. Civil air navigation is the exclusive domain of the General Administration of Civil Aviation of China (CAAC). However, in 2004 CAAC gave the 70 airports under its control to local governments so it could focus on its role as a regulator rather than operator of airports. Consequently, China's provinces are becoming increasingly involved in detailed planning, construction, operation, and financing of civil airways and airports. As an indication, the central government through CAAC typically provides between 20% and 60% of the total airport development cost, depending on the airport's role in the national hierarchy.

96. **Big increases in airport investment are planned.** China will spend more on airport development in the next five years than it did in the last fifteen, opening up investment opportunities for overseas and domestic investors. It will spend about \$17.5 billion on airport development in the period 2006-2010, compared to \$14.8 billion from 1990 to 2005. China plans to build 48 new airports and upgrade the air transport infrastructure over the next five years, which will increase the number of airports to 190 by 2010, with plans to reach 220 airports by 2020. Even with this investment, China will still have much lower density of commercial airports than developed countries<sup>14</sup>.

97. **The industry has been opened up to private participation.** Since China opened the aviation infrastructure sector for foreign and domestic investment there have been many takers. Foreign investors are active in several airports. The French airport operator Aeroports de Paris is playing a major role in the expansion of Beijing Capital International Airport, after buying a 9.9% share in 2000. Copenhagen airport purchased 20% of Hainan's Meilan Airport in 2002.

## 5.2 Sector Issues

98. **The rapid growth of the industry has created environmental and resource strains.** The dramatic increase in passenger and cargo traffic has led to increasing concerns in China for the environmental consequences and for the need to increase the pool of well-trained pilots and air traffic control staff to ensure air safety. The overall past safety record is good. Since the fatal accident in Baotou in November 2004, China's civil air transport has succeeded at keeping more than eight million flight hours safe, a record for China and one of the best three-year safety records in the world.



99. **Growth will create pressures to free up more airspace.** China's military controls 80% of the country's airspace, (compared, for example, to some 5% in the USA). An easing of military controls could open up additional civil capacity. The frequency of take-offs and landings of aircraft has increased to such an extent that some of the main hubs are facing congestion in the skies, and

<sup>14</sup> In 2005, the top 10 countries with serviceable (*ie*, includes non-commercial) airports were: USA 14,893; Brazil 4,223; Mexico 1,832; Russia 1,730; Argentina 1,333; Canada 1,331; Indonesia 668; Germany 552; Ukraine 537; and China 489.



require increased capacity both in the runways and airport facilities to accommodate the imminent growth. While there are fewer than 150 privately owned aircraft in China, this number can be expected to rise with increased prosperity and business needs, thereby creating more demands for air space.

100. **Increasing fuel prices are increasing costs and impacting on affordability.** As elsewhere in the world the fuel price escalation constitutes a challenge to the sector. The rising oil prices worldwide have made jet fuel the biggest expense for airlines, accounting for an average of 35-40% of total costs—a larger share than for any other mode of transport.

101. China's jet fuel consumption has been rising by an average of 15% annually since 1990, reaching a record high of 9.3 million tons in 2005. By 2010 the country will need 15-17 million tons of jet fuel to support its booming aviation sector. One of CAAC's duties is to ensure stable energy supply, but at the same time to develop policies that will lead to fuel conservation in the sector.

102. **There are significant barriers to international participation.** International companies are attracted by the huge potential of China's air cargo market, but there are barriers to entry. A key constraint on the growth of foreign companies is heavy government involvement in the air cargo logistics industry, through its ownership of the main airlines. Furthermore, airports are owned and operated by provincial governments.

103. **Over-flight fees are thought to be excessive compared to cost.** CAAC regulates the negotiation of international operating rights for Chinese airlines wishing to operate to foreign destinations and foreign airlines wishing to fly to China. It has allowed a steady growth in international flights and new routes in response to the market. However, foreign airlines complain about the very high over flight fees charged for use of Chinese airspace, which exceed international benchmarks and may be contrary to ICAO conventions, (which allow such fees to be set no higher than needed to cover the cost of providing the corresponding air navigation services).



## 6 Ports

### 6.1 Sector Introduction

104. **China has more than 1,400 ports.** These include both seaports and inland river ports. Twelve of them handle over 100 million tons/year: Shenzhen, Guangzhou, Zhongshan, together with Hong Kong in the Pearl River Delta region; Shanghai, Ningbo, Xiamen and Fuzhou along China's central coast; Tianjin, Qingdao, Qinhuangdao and Dalian in the north Bohai Rim region. In 2006, there were 35,453 berths for commercial use, including 4,511 seaport berths and 30,942 inland river berths. Among these, 978 seaport berths and 225 river berths have over 10,000-tonnage capacity.

105. **China has become one of the most dynamic global shipping markets in the world.** Ocean shipping handles most of China's huge import and export volumes: China's foreign trade in 2004 was worth \$1.7 trillion, and about 85% of Chinese exports are shipped through ports. China now leads the world in terms of port throughput. China's port industry has experienced significant development in recent years, supported by the buoyant conditions in foreign trade and improvement in freight handling capacity, along with the completion of many new terminals with large specialized berths and deep-water routes. MOC statistics indicate port throughput of 5.57 billion tons in 2006, and increase of 152% since 2000. In 2006, the total container throughput of China's ports stood at 93.6 million TEUs, the highest of any country in the world.



106. The container throughput at Chinese ports continues to grow at 20-30% each year, more than double the growth in GDP. Enhancing transport capacity at the ports has become a key focus of the government. China's port and harbor capacity will be enhanced during the period of the 11<sup>th</sup> Five-Year Plan:

- In 2005, the Chinese government invested about \$5 billion on port-related infrastructure, with 120 new berths set to open the same year.
- The nation's biggest port project—the \$12 billion Yangshan Deepwater Port on an island near Shanghai—is currently under construction. The entire project will take 15 years to complete and will eventually provide capacity of 25 million TEUs. The first phase was completed in December, 2005. Five 70-100 thousand tonnage berths have been built with a capacity to handle over three million TEUs each year; the port offers all-weather service to any type of containership, including the world's largest.

Other major coastal cities, including Ningbo, Tianjin, Qingdao and Dalian, have all aggressively expanded their ports in recent years.



Figure 6.1: China's Ports



## 6.2 Sector Issues

107. **Efforts are being made to improve the efficiency and service quality of ports.** Traditionally there were problems at some ports with clearance times but China has adopted a major program of investment in berths, handling equipments and storage, and a streamlining of procedures. China is improving the import-export documentation process, which includes shortening the processing time of customs as well as licensing.



108. **Deepening of port reforms will also help improve efficiency.** The reform of China's port sector has gone a long way since 1991 when China began to open its ports to the private sector. Hutchison Whampoa took over the development and management of container facilities in Shanghai that year. By 1998, 13 port facilities in China were managed by the private sector generally as joint ventures with the public port authority.

109. Large state enterprises, including COSCO, Sinotrans and China Shipping, still dominate this sector, which tends to diminish effective competition in inter-modal markets. In 2003, China launched a reform package for Shanghai Harbor, the country's largest port, to increase efficiency in port administration and management. The Shanghai Municipal Port Bureau and the Shanghai International Port Group have been established in order to separate the administrative and commercial functions, which were previously handled by the same port authority. Other major ports are likely to adopt similar approaches.

110. **Inland ports are not yet equipped to make best use of inland waterways.** The upgrading of surface transport links to inland ports would support increased use on inland waterways. The time it takes goods to travel from Chongqing to Shanghai (about 900 miles) can equal the length of time these goods take to travel the 7,400 miles from Shanghai to Los Angeles by sea. One problem lies in inadequate road and rail links leading to inland cities from ports. These issues are further discussed in Section 8 under logistics.

111. In addition, shortage of inland container handling facilities has made container transport to and from inland ports difficult and costly. The limited availability of customs clearances does not permit container cargoes to be carried in bond, thus necessitating containers to be inspected again at seaports. Compounding this problem is the limited availability of empty containers and container trucks. Thus, shippers in these cities have to wait for empty containers and container trucks to be relocated from the coast to the interior, which adds to the time and cost.

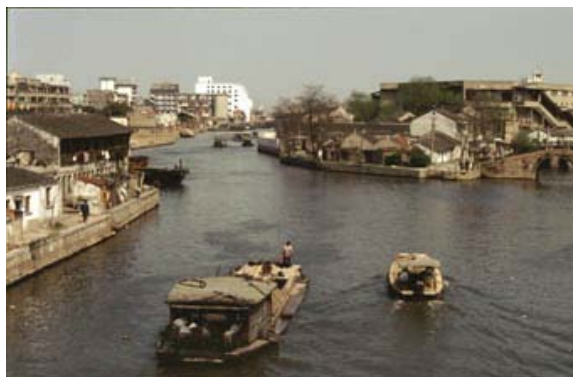


## 7 Inland Waterways

### 7.1 Sector Description

112. **China's inland waterway transport (IWT) network is the world's largest, in terms of length and freight volume.** China has large navigable rivers that link many of its major cities, especially in central and southern China where rainfall is high. Moreover, China'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 China's inland transport market.

113. The inland waterways system of China consists mainly of the Yangtze River, Zhu (Pearl) River, the Heilong (Amur) River in the Northeast (adjoining Siberia), the Huang (Yellow) River, the Grand Canal, and their branches. The 1,747 km Grand Canal, completed in A.D. 1293, still provides an important north-south corridor from Beijing to Hangzhou. The Huang, which drains the north China plain, is afflicted by heavy silting and its navigational use is quite limited.



114. In 2006, the total length of inland waterways was 123,388 km. Among these, half were classified waterways<sup>15</sup>. The length of each class was as follows: Class I 1,407 km; Class II 2,538 km; Class III 4,742 km; Class IV 6,768 km; Class V 8,584 km; Class VI 18,407 km; and Class VII 18,589 km. Four provinces had more than 10,000 km, namely: Jiangsu (24,347 km); Guangdong (11,844 km); Hunan (11,495 km); and Sichuan (10,720 km). Among all the permanent constructions along the navigable inland waterways, there were 2,339 navigable complexes including 833 locks and 42 vessel lifts.



115. The passenger traffic by waterways declined from a peak of 18.3 billion passenger-km in 1989 to 6.31 billion passenger-km in 2003. It has since rebounded to 7.36 billion passenger-km in 2006. Freight transport grew from 350 billion ton-km in 1989 to 1,112 billion ton-km in 2005<sup>16</sup>. A further 3,855 billion ton-km were transported on coastal waterways.

116. **The largest part of the Inland Waterway system is the Yangtze River and its tributaries.** The river extends some 6,300 km from China's Qinghai Province in the west to Shanghai in the east. The trunk line of the river is navigable across

<sup>15</sup> The waterways of Class I to Class VII are navigable for motor vessels with a capacity of 3,000 DWT, 2,000 DWT, 1,000 DWT, 500 DWT, 300 DWT, and 50 DWT respectively.

<sup>16</sup> Of the total inland waterways ton-km in 2005, the Yangtze River system accounted for 56.5%; the GrandJing-Hang Canal 19.1%; the PearlZhu River system 9.3%; and the Heilong River 0.4%.



more than 2,800 km of China's heartland, as far inland as the city of Shuifu in Yunnan Province. The total volume of cargo shipped via the river went up from 310 million tons in 2001 to 990 million tons (including the throughput of Shanghai Port) in 2006, making it the world's busiest river in terms of freight volume. However, it is estimated that only 20% of its navigable capacity is currently being exploited. In the last five years, 97 new berths that have capacity of over 10,000 tons were built at ports along the Yangtze River near Shanghai and downstream from Nanjing. Together, they added 220 million tons of handling capacity. Of the 97 new berths, 32 are container berths with a collective handling capacity of 10 million TEU.

117. Indeed, the Yangtze River and the delta area are major economic districts for China, and a major transport channel for enterprises along its banks. Some 80% of iron ore, 72% of crude oil and 83% of coal demanded by these major enterprises are transported by the Yangtze River. At its mouth deepwater navigation channels have recently been excavated, giving a navigable depth of 10 meters. In 2006, Phase III of the improvement work started and by 2009 the water depth at the Yangtze River mouth will increase to 12.5 meters.



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

119. With the exception of the Grand Canal and the coastal routes, most of the 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 central government policy and plans to develop the western provinces. Further potential also exists for coastal shipping between major industrial centers such as Dalian, Tianjin, Shanghai, and Guangzhou, all located on the sea coast.

120. **Inland waterway transport can also have lower 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 can help conserve scarce land resources.

121. **The central government wishes to increase the role of Inland waterway transport.** As part of the 11<sup>th</sup> Five-Year Plan (11<sup>th</sup> FYP), the central government wishes to increase the contribution of China's waterways to meet its transport needs. During the 11<sup>th</sup> FYP, it is planned to invest almost \$3 billion, in the form of central government subsidy, into the IWT industry development, half of which will go to waterway improvements.



## 7.2 Sector Issues

122. **Achieving an integrated inland waterways policy in China 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, navigation infrastructure (dredging, navigation aids, locks etc) together with an institutional regime that encourages an efficient and competitive private barging industry. For some years, inland waterways were given limited policy or management attention compared with highways or railways, although the 11<sup>th</sup> 5-year Plan is now elevating this attention.

123. **Coordinating multiple uses of rivers is often a conflict.** Rivers are used not only for transport but also for urban water supply, farm irrigation, and generation of electricity. In much of China rainfall is highly seasonal, so river flows need to be regulated, and the risk of flooding has to be managed. Dams built for flood protection, electricity generation and irrigation impose a need for ship locks and integrated management of water releases throughout the year. Managing the rivers for these multiple uses and reconciling conflicting demands is not easy. After reaching a peak of 170,000 km in length of navigable inland waterways (defined as those with depth 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 also to the building of dams for irrigation, flood control, and power generation. It has since increased to 123,388 km.

124. **Larger and more specialized barges would improve the economics of the industry.** Most vessels in China are small self-propelled boats owned and operated by the owner and his family. They live on board and mostly lack the financing to trade-up to larger vessels. Operators therefore need to be encouraged to take advantage of navigation investments in waterways by investing in larger barge sizes and combinations, including the use of separate barges and pusher units instead of self-powered small vessels.

125. This has already started: in 2001 the government promulgated rules on standards for vessels; and management of old and over-age vessels. However, upgrading of the fleet will require a shift from small family-based ownership to larger corporate ownership, a willingness to invest in newer technology, growth of the demand for bulk transport, and access to financing. Provincial governments can help by taking certain measures to speed up this transition to larger vessels including:

- ❑ the creation of a special fund to finance the construction of standardized vessels;
- ❑ differential charges for use of channels and locks to discourage the continuing use of small vessels;
- ❑ restricting the use of locks for small vessels;
- ❑ prohibiting the use of non-standard vessels and crafts with a capacity of less than 60 tons in Class V waterways over a phased period; and,
- ❑ administrative measures to deny the registration of new vessels that are non-standard.

126. **Cost recovery for waterway infrastructure.** Throughout the world inland waterways (other than commercial canals) are owned and administered as public





goods. Cost recovery mechanisms typically include a range of vessel licensing fees, river port dues, navigation fees, lock and other sundry charges. These revenues contribute to cost recovery at a range of levels. They are rarely sufficient to cover all the costs of public resources, but these costs are usually very small compared to other modes in either absolute terms or in proportion to traffic handled.

127. Similarly, in China the central government expects provinces to recover some but not all public expenditures on waterway infrastructure through user charges. Most provinces with large waterway systems levy annual fees on vessels to cover channel maintenance and charges for the use of ship locks. They aim to generate enough revenue from these fees to cover operation and maintenance. The remaining finance has to come from power revenues, or where the ship locks are not combined with power plants, from general revenues available to the province, with some funding also from the national budget. Those provinces in China that have borrowed from the World Bank also aim to cover their debt service on the Bank loans. This results in a level of cost recovery for waterway investment and maintenance that is one of the highest in the world. Although this may to some extent inhibit industry growth, it also helps facilitate the financing of much needed navigation improvements that might not be possible if they depended on budget funding alone.



**128. Industrial trends will influence the demand for inland waterway transport.**

As China's economy matures and shifts toward manufacturing high-value intermediate and finished products, the production of bulk materials suitable for barge transport will decline in relative economic importance, although not necessarily in absolute tonnage. The long-term future of inland waterway transport

must depend principally on its performance in serving these transport markets.

129. A niche market for containers may also develop in places where road and rail service is deficient. The middle reaches of the Yangtze, between Chongqing and Wuhan, is one such niche, since the intervening mountains have so far prevented the construction of any direct railway lines or expressways. It may also play a key role in logistics chains when reduction of transport costs is important.



## 8 Logistics

### 8.1 Sector Description

#### 130. China's international trade has stimulated a rapidly developing logistics industry.

Over the last 15 years China's international trade has grown dramatically and is now approaching \$2,000 billion/year. Since 2003, the GDP has grown at over 10%/year, with goods exports growing at 22-35% per year. In order to support this level of trade China has undertaken major investments not only in its physical infrastructure but also in its logistics industry. In this section, the logistics industry is defined widely to include not only all the individual transport modes described in previous chapters, but also the many ancillary and support industries that facilitate trade in goods.

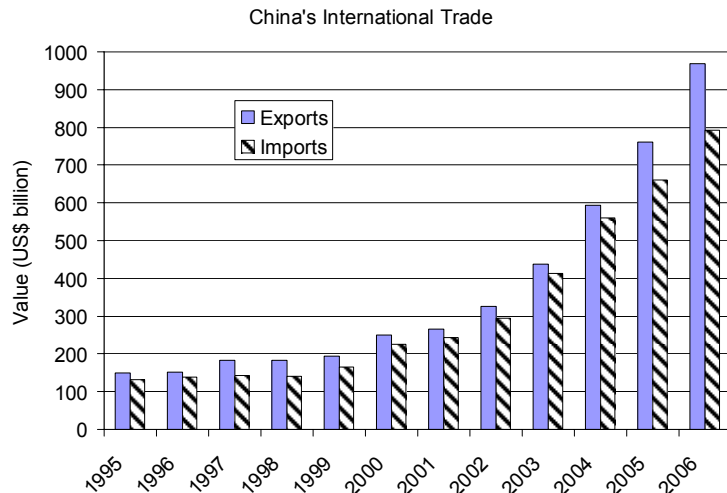


Figure 8.1: China's International Trade

131. The total value of the logistics industry grew by an average of 25% in the period 2000-2006, and resulted in a total value<sup>17</sup> of over \$7.6 trillion in 2006. By 2013 this industry is estimated to reach almost \$29 trillion. The industry has increased five-fold in the last 10 years, and can be anticipated to continue growing rapidly.

The logistics industry invested some \$150 billion in 2006, an increase of 23% from 2005. Over 80% of the investments were in transportation and only 3.9% in warehousing and storage.

#### 132. Industry is centered on the east coast.

The logistics industry is most active along China's east coast, where the manufacturing industry is centered. There are three different areas of major development: the Bohai Rim region in the north, including

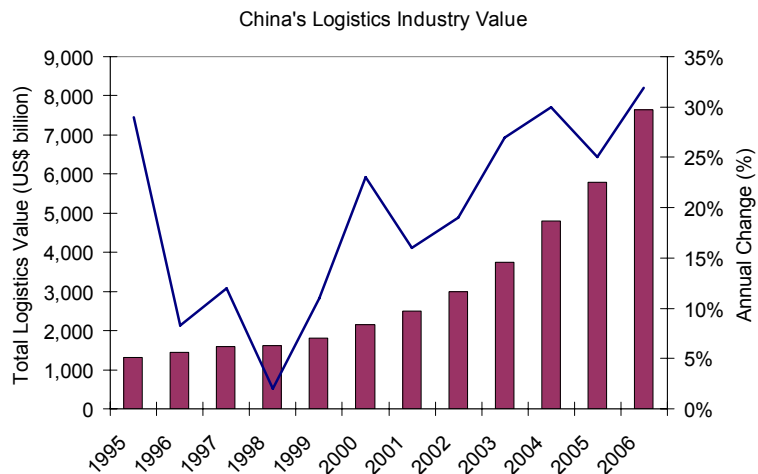


Figure 8.2: Logistics Industry Value

<sup>17</sup> As described in Li and Fung (2007), total logistics value represents the total value of final products (including industrial products, agricultural products, imported products, renewable energy and consumer products) delivered to the end users after using the logistics services.



Liaoning, Shandong, Beijing, Tianjin and Hebei; the Yangtze River delta around Shanghai including Jiangsu and Zhejiang; and the Pearl River delta, centered on Shenzhen and Guangzhou. In each of these areas numerous large logistics parks have been developed or are under construction. Other cities such as Xiamen, Wuhan and Chongqing have been making investments to establish themselves as regional logistics hubs.

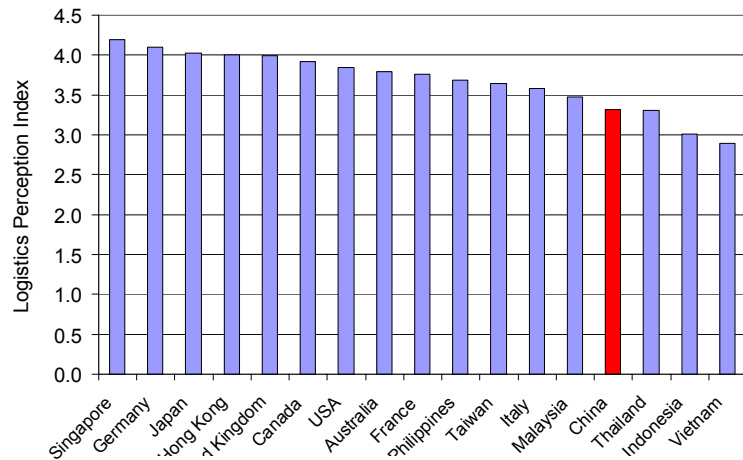


Figure 8.3: Logistics Perception Index

133. The logistics industry is dominated by small-scale operations. In 2006 there were over 300,000 registered logistics companies most of which evolved from local road transport or warehousing companies. There are some 3 million trucking service providers and even the large firms are small by international standards. For example, one of the larger operators Hoau has only 3,000 trucks to serve their 1,100 depots and 56 hubs. These providers transported 13.3 billion tons in 2005, 72.3% of the total freight volume by all means (CBRE, 2006).

134. **Good logistics offer improved potential for economic gains.** Given the structure of the Chinese economy, logistics are very important. Manufacturing, mining and agriculture contribute some 62% of GDP (in contrast they contribute only 25% in USA). Each of these sectors requires transportation of large quantities of freight of low to medium value—about 3 ton-km for each dollar of GDP. This makes the economy very transport-intensive. The cost of logistics is therefore a larger share of final prices of goods than in many economies, offering major savings from measures that can reduce these costs. In 1991 logistics costs accounted for 21.2% of GDP, decreasing to 18.3% in 2006. By comparison, developed OECD countries have logistics costs on the order of 10%.

135. **China's logistics industry has successfully underpinned the country's economic performance.** It is evident that having responded successfully to long-term annual trade growth rates of over 20% the logistics industry has served China well. There are nevertheless some areas where improvements are possible and are being sought by china's logistics policy makers and managers.

136. As part of its annual international business competitiveness study

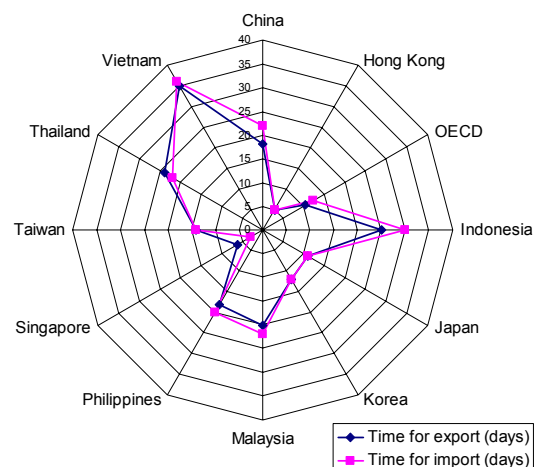


Figure 8.4: Relative Import/Export Performance of Different Countries



([www.doingbusiness.org](http://www.doingbusiness.org)), the World Bank assessed China's cross border trade. The costs and procedures involved in importing and exporting a standardized shipment of goods—starting from the final contractual agreement between the two parties, and ending with the delivery of the goods—were established. China ranked 38<sup>th</sup> out of 175 countries, a drop of 3 places from its 2005 ranking. In the East Asia & Pacific region China ranked 6<sup>th</sup> out of 23 countries. China is comparable with other middle-income countries in the region for the time it takes for imports and exports, despite its larger size, more challenging distribution patterns and larger volumes. It still has some scope for improvement to reach the OECD levels. Nonetheless, its costs are by far the lowest in the region.

137. Another measure of successful trade facilitation is the World Bank's "Logistics Perception Index" (LPI). This is a benchmark of a country's overall performance on several dimensions in trade logistics. Data are collected from logistics providers, buyers and professionals on seven facets of logistics and costs, then combined into the LPI score (see [www.gfptt.org](http://www.gfptt.org) for more details). The 2006, LPI study confirmed that China's logistics performs better than many regional competitors but with some opportunities for improvements.

138. **Policy changes are supporting the logistics industry.** Recognizing the importance of logistics to China's economy, a key pillar of China's 10<sup>th</sup> Five-Year Plan was the development of logistics industry. In 2004 the State Council promulgated its "*Opinions on Promoting the Development of a Modern Logistics Sector in China*". This document encouraged Chinese firms to associate with foreign firms and major foreign logistics firms to establish subsidiaries in China.

139. China has taken significant steps towards liberalizing its transportation and logistics markets. Under its 2001 WTO accession commitments, domestic trucking and warehousing sectors were opened gradually to international investors. Courier and freight forwarding services were opened by the end of 2005. By the end of 2007, with the exception of some protected sectors (cross-border trucking, inland water transport, airfreight and postal services), foreign enterprises will be able to compete freely with domestic competitors. Competition is likely to stimulate improved standards at lower costs.



140. The most innovative change in China's logistics market has been the development of 'Third Party Logistics Firms' (3PLs). These are firms which offer specialized management of most, if not all, of a company's supply chain needs. Traditionally, only international companies used 3PLs, often because of difficulties associated with operating their own logistics operations in China. Chinese firms tended to manage their

own supply chains. According to one estimate, in 2003 3PLs accounted for 2% of the total logistics activities in China. As Chinese firms show a growing willingness to outsource their supply chain activities, rapid growth is expected in 3PLs' business,



with the total market size estimated to be 6% or more of the total logistics activities by 2010.

141. The 3PL market can be categorized into four types of operations:

- ❑ Former Chinese State-Owned Enterprises (SOE) such as Sinotrans;
- ❑ Internal logistics departments of Chinese companies;
- ❑ Private Chinese logistics firms; and,
- ❑ Multi-national logistics firms.

Many of the multi-national firms started in China with joint-venture (JV) operations but since the 2005 full opening of the Chinese market to foreign firms, many have been breaking up or buying out the equity shares of their JV partners. For example, in 2006 FedEx took control of a joint venture begun in 1999 with the Tianjin Datian W. Group. In 2007 TNT announced the completion of the acquisition of Hoau, a leading freight and parcels delivery company in China. Full ownership tends to speed up operations and simplify accounting procedures— e.g. a JV company in China cannot issue invoices itself, needing to do so through a third party.

## 8.2 Sector Issues

### 142. **The logistics record is good but with scope for continuing improvement.**

The investments in infrastructure, greater competitiveness, the entry of foreign firms, the adoption of the latest logistics technology by Chinese firms, have all contributed towards the industry's rapid growth. The areas in which on-going improvements can be targeted are: (i) the capacity of transport infrastructure (particularly railways); (ii) continued modernization of the quality of transport and logistics services; and (iii) reduction in the bureaucratic procedures for processing and clearing import and export consignments. Improvements in all three have been rapid in recent years and China's trade and economic growth will be well served by continuing improvements to try to attain standards that exist in the OECD countries.

143. **Setting up logistics businesses can be very bureaucratic.** The absence of consistent national regulations results in different regulations being applied in different cities. This hinders creation of national networks. In some cities the procedures appear excessive. For example, it is complicated to build a warehouse. The 2007 survey at [www.doingbusiness.org](http://www.doingbusiness.org) estimated the following procedures, time and costs to build a warehouse, including obtaining necessary licenses and permits, completing required notifications and inspections, and obtaining utility connections.

**Table 8.2: Business Logistics by Region**

Indicator	China	Region	OECD
Procedures (number)	37	19.4	14.0
Duration (days)	336	175.3	153.3
Cost (% of income per capita)	840.2	177.2	62.2

Source: 2007 Doing Business survey at <http://www.doingbusiness.org/ExploreEconomies/?economyid=42>



**144. Provinces sometimes protect their local operators.**

Moving goods between provinces can be a challenge. Goods can be subject to unofficial border tolls when moving between provinces. To benefit the local governments, the provincial bureaus may levy fees on the vehicles from outside the province, favoring companies that use locally based logistics service providers. These activities result in unnecessary unloading that causes delays and cost increases.



**145. There is a shortage in China of modern warehousing facilities.**

Much of the warehouse capacity is rather dated, lacking computerized stock supervision systems or the ability to use multiply racking systems. Many warehouses have unsealed loading platforms which expose food products to ambient air temperatures during loading/unloading. It is estimated that some 30% of China's fruit and vegetable harvest is damaged every year by the inability to store and move it appropriately.

**146. Good logistics infrastructure is regionally concentrated.** In the logistics hubs, especially the three major regions along China's east coast, there is good integration between the transport networks, warehousing and distribution facilities. However, the same cannot be said for the rest of China where operations are often hampered by poor quality infrastructure, organizational inefficiencies, and a poor uptake of technology. In some locations there is an inconsistent supply of energy leading to interruptions to communications through power outages.

**147. There is a regional imbalance in flows that increases logistics costs.**

Operators transporting goods from the developed east of the country to the undeveloped west often have difficulties in finding back loads. These imbalances also exist between China and the rest of the world, creating challenges for container traffic. High logistics costs also hamper the development of those regions that sustain high logistics costs because of their location and lack of supporting infrastructure. For example, Carruthers *et al.* (2003) report that 63%



of the cost of shipping a container from Chongqing to the USA west coast was associated with transporting the container to the port—this makes inland companies much less competitive due to their geographic isolation and helps contribute towards the high rates of development in the coastal areas.

**148. The domestic logistics industry is fragmented.** The industry is dominated by small operators. The largest trucking firm has only 3,000 vehicles. No single company commands more than 2% of the market or provides nationwide inter-modal transport service. Small firms are not in a position to take full advantage of information technology, achieve economies of scale, or ensure optimal loading levels. There would be benefits from some industry consolidation and the emergence of more industry leaders with sufficient resources and geographic 'reach' to offer world class service across China and the world.



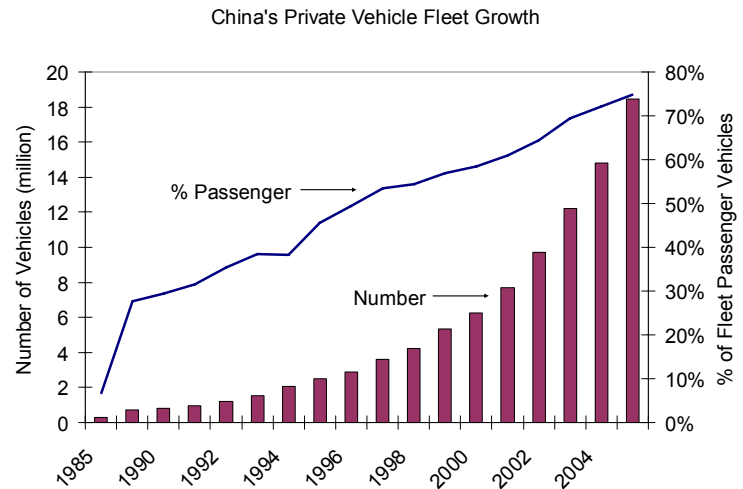
149. **Human resources may become a constraint on logistics industry development.** Logistics enterprises require staff with experience in trading, transportation, logistics, IT competence, operational and modern management skills, and sometimes foreign language and international trade skills. By 2010 China will need estimated 400,000 logistics professionals but local universities usually produce less than 10,000 logistics graduates a year.



## 9 Energy and Emissions

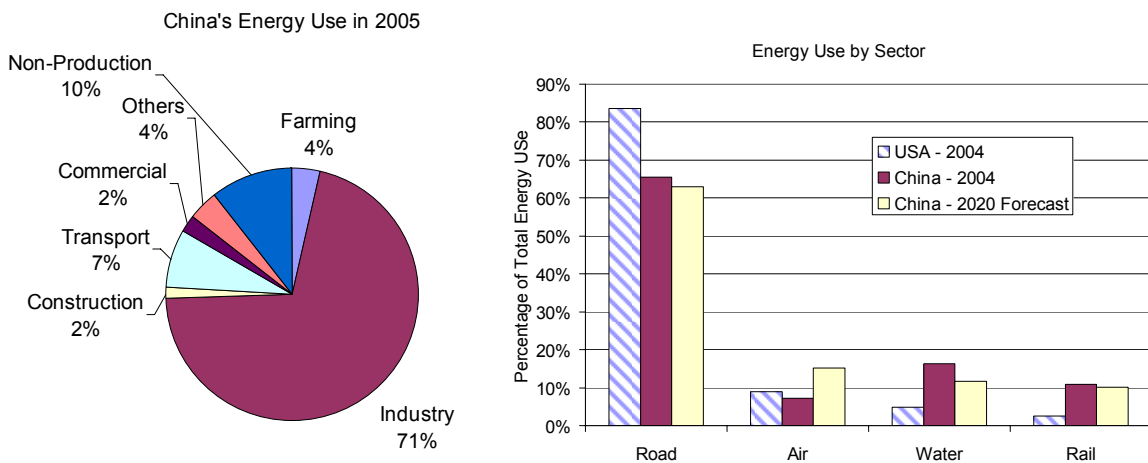
### 9.1 Description

150. **China is the world's fastest growing oil consumer.** In the last two years, China accounted for over 30% of the world's incremental consumption of liquid fuels. The total liquids consumption in China is projected to grow by an average of 3.5% per year, reaching 32 quadrillion Btu (about 16 million barrels oil equivalent per day) in 2030. At that stage China's oil consumption will be about 62% of national consumption (and about one seventh of per capita consumption) of the USA, where consumption is growing at about 1% annually to an estimated 52 quadrillion Btu in 2030. By 2030 China is projected to account for 14% of the world's liquids consumption, double its share in 2004.



**Figure 9.1: Growth in Private Vehicle Fleets**

151. Demand in China is currently driven by three factors: (i) increased demand for personal mobility and goods transport; (ii) the growing chemical industry relying on petroleum products as feedstock; and, (iii) oil-fired generators being used as short-



**Figure 9.2: Energy Use by Industry and Sector**





term solutions for local electricity shortages. Of these three factors, the transport sector will probably be the main determinant of long-term growth in China's liquids consumption.

152. In the period 2000-2005, the transport sector's use of petroleum increased from 24.6% to 29.8% of total use. It is projected to reach 47% in 2030. This reflects the growing number of new vehicles and new roads which will see demand continue to increase.

153. China uses much more energy for water and rail transport than the USA, but at higher energy efficiency than private road transport which dominates both freight and passenger movements in the USA. Air transport is expected to have the biggest increase in fuel usage in the future reflecting the expected high growth in aviation.

154. **China's road vehicle fleet will grow rapidly.** China's vehicle fleet is growing rapidly: from 2001-2005 the private vehicle fleet grew by an average of 23% per year to over 18 million vehicles. At the same time, the dominance of passenger cars continues to grow, and reached 75% of the private fleet in 2005. Small cars dominate the fleet, with 96% of private vehicles in 2005 being small cars or mini-cars. For trucks some 64% of the fleet was light trucks. For cars and trucks the transition to small vehicles is increasing by about 1% per year.

155. It seems likely that, as in developing countries, as China's per-capita income increases passenger mode choice will favor a greater absolute and proportionate use of private cars. While buses, two-and three-wheel vehicles accounted for 42% of energy use in 2004, this is forecast to decline to 26% by 2030, while the energy use of cars is expected to increase from 18% to 33% in the same period. Trucks are forecast to use about 40% of the energy consistently from 2004 – 2030. China's transport energy demand is forecast to more than double from just over 2 million barrels/day in 2003 to over 6 million barrels/day in 2020. The 2020 transportation oil demand alone will be greater than China's entire 2003 oil consumption.

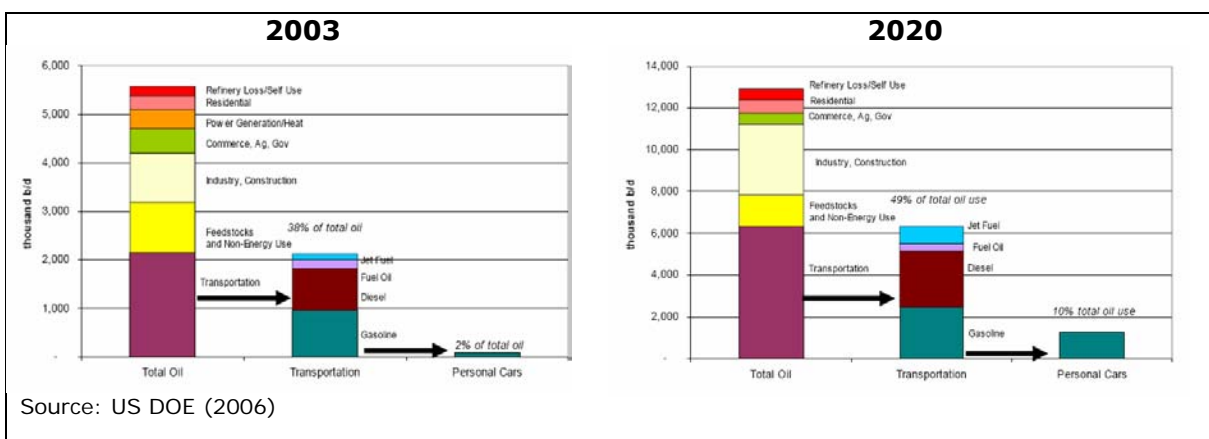


Figure 9.3: Energy Consumption by Mode, 2003 and 2020

156. **Improved fuel economy standards for vehicles will help.** In 2005, China adopted weight-based fuel economy standards to be implemented in two phases: 2005-6 and in 2008. These standards do not apply to commercial vehicles and pickup trucks. The objective of the standards is to bring about a rapid change in the



Chinese vehicle fleet, especially with regard to the adoption of advanced vehicle technologies. Each vehicle sold in China will be required to meet the standard for its weight class. There are 16 classes with standards ranging from 38 mpg in 2005 for the lightest vehicles, to 19 mpg for the heaviest (> 5.5 ton) vehicles. In 2008 these will be increased to 43 and 21 mpg respectively. The fuel economy standards require the biggest improvements from the heaviest vehicles, which will have an impact on the composition of the fleet: in 2003 while 66% of cars sold met the 2005 standards, only 4% of SUV's and mini-vans met the standards.

157. Starting in the late 1990s, more than 80 Chinese cities placed restrictions on older small vehicles, usually those with two-stroke engines of less than 1.0 to 1.3 liters, which authorities viewed as slower, less safe, more polluting and less attractive for a city's image. Restrictions included limiting routes open to smaller cars, charging additional fees for license plates, and banning the use of small cars as taxis. However, due to concerns regarding China's fuel demands and rising prices, as well as the upgrading of the quality of these vehicles, NDRC lifted these restrictions in early 2006.

158. **Greenhouse gas emissions are closely correlated with use of fossil fuels.** China's transport system contributes about 7% of domestic CO<sub>2</sub> compared to about 30% in the USA. Cars accounted for less than 10% of those emissions in China but contributed around 55% of the North American transport emissions. Emissions from cars are forecast to increase due to the rapid motorization but even in 2020 they will be only some 10% of the total CO<sub>2</sub> emissions in China because of the long-term nature of motorization trends and changing travel patterns (USDOE, 2006).

159. China Railways has a program of electrification underway. While this may result in energy savings, there will be an environmental cost in the short-run. With some two-thirds of the electricity generated in China currently coming from coal-fired plants, China's electricity generation sector is producing large volumes of greenhouse gases and it is expected to be the largest emitter in the world by 2009. Electricity plants are major producers of sulfur dioxide emissions causing acid rain, which falls on over 30% of the country. Nevertheless, the future mix of fuels and technologies in this sector will undoubtedly affect the net impact of greenhouse gas emissions as a result of electrification.

160. **The health and amenity impact of transport emissions on urban air quality is substantial.**

Although the transport sector's contribution to overall emissions remains small (a comprehensive nation-wide study found that transportation contributed 10% to pollution damages, third behind power generation and cement production), projections of urban transportation growth and urban air emission sources suggest that motor vehicles, in particular cars, may become major sources of urban air pollution in the future. Motor vehicle emissions are already the main source of urban NO<sub>x</sub> and ozone pollution in many cities even although the evidence suggests they are relatively minor sources for the key pollutants of concern: particulates (particularly fine particulates) and sulfates.





161. There are two principal ways to address pollution from mobile sources. One is to reduce the emissions per vehicle by way of controlling/improving the quality of fuel and the quality of the vehicle technology. The other is to reduce the number of and length of trips made by motorized modes.

162. **Government at all levels has taken steps to address quality of fuel and vehicle technology.** Leaded gasoline was successfully phased out in 2000. China further adopted several important policies designed to improve vehicle efficiency and reduce vehicle emissions, including: (i) fuel economy standards for light-duty passenger vehicles; (ii) an aggressive schedule for tightening vehicle emissions standards, with a lag of only a few years behind European regulations<sup>18</sup>; (iii) introduction of a new passenger vehicle excise tax that levies higher taxes on larger engines, and; (iv) several hybrid vehicle standards and certification procedures, which together legalize hybrid vehicles for production and sale in China.

163. China's 2000 Clean Air Act requires motor vehicles to meet emission standards and prohibits manufacturing, sales or importing of vehicles exceeding the SEPA standards. Although enforcement is inconsistent and weak in some areas, the rapid growth of new passenger car registrations means that within a relatively short time the majority of vehicles on China's roads will meet the more recent emission standards. China is also making complementary investments in improved fuel quality to help ensure lower emissions—especially through the introduction of low-sulfur fuels.

164. An emerging challenge is the need to address the emissions from vehicles currently in use. The diesel vehicle fleet is particularly problematic in this regard, especially since the main pollutant from diesel, fine particulate matter (soot) is thought to be a cause of lung cancer. Diesel vehicles, which are often older and travel much longer distances than automobiles, dominate mobile-source emissions in most cities. In some cities, the conversion of buses to CNG or LPG can contribute towards a rapid reduction in some emissions and some cities are requiring the conversions. For example, Guangzhou has converted 85% of its bus and taxi fleet to LPG, with all vehicles scheduled for conversion by 2010.

165. With respect to reducing the number and length of trips made by motorized modes in the present and future, this is most effectively achieved by inducing a modal shift from private vehicles to public transport and non-motorized modes. The current status and key related priorities are discussed in detail in Chapter 3, dealing with the urban sector.

166. **China has begun investing in alternative fuels.** LPG and CNG are clean energy solutions, but supplies must be imported. China, with 13% of the world's coal deposits, began investing in coal-to-liquids technology (CTL) in 1999. Chinese car manufacturers plan to develop vehicles that run on methanol, a liquid derived from coal. The government's goal was to supply 5-10% of China's road transport energy demand from coal by 2020. In July 2007 the NDRC issued a circular requiring local governments to tighten control of new CTL projects before the national development program for the coal liquefaction industry is complete. The government will not approve coal liquefaction projects with an annual production capacity under three million tons. This was in response to the provinces and regions rushing into CTL plants—a total of 30 CTL projects were apparently under detailed planning or at the

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<sup>18</sup> New cars will be required to meet EURO IV standards by 2010, and commercial trucks will be required to meet EURO V standards by 2012.



stage of feasibility study in the country in addition to the three projects that had won approval from the NDRC<sup>19</sup>.

167. Biofuels are another alternative fuel option. Since first piloting a mixture of 10% ethanol and 90% gasoline (E10) in five cities in 2002, the program has been expanded to cover nine provinces. Anhui, Henan and Jilin provinces now allow only E10 to be sold at the pump. Some 2 million tons of ethanol were produced in 2005 from excess corn and wheat and the E10 blend is already 20% of China's total gasoline use. China's policy makers have stressed the expansion of biofuel production, placing higher priority on it than wind power among renewable energy options.

168. Although improved emission controls and cleaner fuels will lower emissions per vehicle-km, the number of vehicles will continue to grow and increase the total number of kilometers driven each year. Depending on economic growth rates the increase in travel demand is likely to outpace the per unit savings. The outcome could be improved by the introduction of hybrid vehicles which can potentially save 30-50% in energy consumption (excluding any difference in manufacturing and disposal). Toyota started building its Prius hybrid in China in 2005, and GM will be building hybrid vehicles in China by 2008. The high cost of the Prius has greatly limited sales.

169. The Ministry of Science and Technology (MoST) has been supporting major Chinese automakers to develop indigenous technologies. The effort has been focusing on buses more than cars. Six prototype hybrid-electric buses developed by Dongfeng Motor Corporation have been in service around Wuhan since 2002. Since 2002, MoST has also been supporting the demonstration of fuel cell urban buses in Beijing and Shanghai together with the Global Environment Facility and United Nations Development Program. This demonstration program is intended to reach maximum exposure during the 2008 Summer Olympics in Beijing and the 2010 World Expo in Shanghai. It is not clear when and if these technologies will be commercialized.

## 9.2 Issues

170. **Urbanization implies private traffic demand management and public transport solutions.** As described in Para. 36, China's urbanization rate is about 1.4% annually. Even assuming a 1% growth rate over the next 20 years, China's urban population would increase by some 300 million. This will lead to an increase in energy consumption, motorization and pollution which can only be partially mitigated through government policies. It is essential that urban expansion be coordinated with transport plans, so that public and non-motorized transport can play a major role. The focus needs to be on moving people, not vehicles, so development should where possible be concentrated in public transport corridors.

171. Fuel taxes would help improve energy efficiency as well as making road financing more financially sustainable. The central government controls the price of fuel. In May 2006, a gallon of gasoline was retailing for \$2.05 in Beijing and \$1.94 in Shanghai, as compared with an average price \$2.91 in the USA, \$6.28 in London and

<sup>19</sup> For further details, see the Xinhua news report of 7 July 2007 "China reins in fast growth of coal-to-liquid fuel projects". Available for download from various locations including: <http://english.eastday.com/eastday/englishedition/business/userobject1ai2215168.html>



\$6.90 in Oslo. One reason for the low price of fuel compared with other countries is the absence of fuel tax. Low fuel prices contribute to increased travel demand and remove the incentive for manufacturers to produce more fuel-efficient vehicles.

172. China has adopted stricter fuel economy standards. While China's recently adopted fuel economy standards are stricter than the USA and Canada, the fleet fuel economy for new light duty vehicles in China will still be behind the EU (37.2 mpg) and Japan (46.3 mpg) in the next ten years. Models developed by Chinese automakers themselves still consume 10-30% more energy than those based on international technologies. One analyst estimated that the adoption of higher standards for fuel efficiency would potentially reduce future oil demand by 40 million tons in 2020: some 10% of China's estimated fuel demand.

173. **Alternative Fuels are not a panacea.** The central government originally intended to pursue CTL to supply up to 10% of China's fuel from coal by 2020 and contribute towards energy independence. However, as mentioned earlier, the CTL efforts are currently being restrained. Similarly, ethanol production from grains (such as corn) has been effectively abandoned considering the marginal energy improvement (20-40% higher than the energy required producing it) and, more importantly, the need for China to use its limited cultivatable land to feed its population. To reach a Brazilian level of 25% ethanol blending would require a volume of corn nearly double China's total current production, taking up some 21% of China's arable land. Instead, the focus will be on expanding cultivation of more economical plants on marginal lands, or by scientific research into using "waste" residues such as cellulose to produce ethanol

174. **Clean diesel Engines would help improve vehicle fuel efficiency and reduce emissions per km.** Almost all cars sold in China run on gasoline. However, in Europe, about 50% of cars sold use advanced diesel engines, which consume 35-40% less fuel/km than gasoline engines. With diesel trucks estimated to be some 20% less efficient than comparable models in developed countries, there is scope for major savings in fuel as well as emission reductions through the introduction of modern diesel technologies. China's government has yet to decide whether or not to introduce fiscal incentives such as differentiated fuel or vehicle taxes to allow the market to select the most efficient technology. This decision with respect to diesel will depend in part on the higher quality fuel requirements over the current technologies. Europe is also moving to reduce the sulfur content in diesel. Ultra-low sulfur diesel allows the use of catalytic converters on diesel engines that radically reduce total emissions.

175. **Introduction of hybrid cars could be encouraged by fiscal means.** Hybrid cars in China are currently so expensive that there is little demand. The high price has been partially attributed to the 10-25% tariff paid on imported parts and components especially the hi-tech batteries. Since few, if any, Chinese producers manufacture the key components for hybrid cars—due in part to the limited demand—car companies must source the parts internationally. A reduction in tariffs for these specialized technologies would make the vehicles more price competitive in the market.



## 10 Epilogue

176. **Transport infrastructure plays an important role in China's development.** It provides the foundation for the country's economic development and is pivotal in reducing poverty. It connects industry with markets and markets with people. It facilitates communications, and provides the poor with improved access to employment, education, and health facilities.

177. **In recent years China has seen an unprecedented transformation of its transport sector.** It has created one of the world's most comprehensive expressway networks. It has significantly increased the capacity of its railway network. Ports and inland waterways have also seen major investments. There have been major improvements in airports. At the same time, there have been changes to policies across all sectors to attract private sector investment and to help China be competitive.

178. Despite remarkable progress in new infrastructure development and existing infrastructure improvements, China's transport sector still faces many challenges. Addressing these issues, summarized below and discussed in detail in the preceding chapters, is critical to ensuring that China's transport sector provides adequate support for the country's continued economic growth.

179. **China will have a continuing need to expand infrastructure capacity and quality.** Increasing demand for passenger and freight movements will call for continued upgrading of the infrastructure as is reflected in current long-term plans. Road infrastructure upgrades, particularly the expansion of the expressway network, needs to be accompanied by more targeted investment in maintenance of existing infrastructure and construction of local roads to improve access. Significant capacity upgrades are required for railways, which currently are operating close to capacity on many key routes. Airport and related infrastructure, as well as the provision of modern warehouse facilities and logistics facilities, are needed to meet air, port, and general logistic demands.

180. Despite major investments in every sector of transport, there are still gaps in the interconnectivity between modes, particularly in the inland infrastructure, which lags behind the coastal region. This deficiency creates impediments for the efficiency of certain transport sectors, particularly air and ports, where connections are most critical.

181. **There will be a need to increase focus on managing the system in the coming years.** As China's system matures, the focus will shift away from the construction of new infrastructure to infrastructure management. This includes issues such as road safety, congestion, air quality, public transport, and urban expansion.

182. **Financing and affordability.** Financing future transport infrastructure investments and maintaining existing infrastructure is a challenge for China. For example, the projected investment funding needs for railways to meet forecast demands exceed the foreseeable resources. China's first generation of expressways, soon in need of maintenance, as well as other highways will need considerable investments for rehabilitation works. Cost recovery for airports, waterway investment and maintenance, on the other hand, is one of the highest in the world.



183. Finding more sustainable financing sources for investments in transport is essential. For road transport, toll revenue is an important source of finance, but relatively high tolls reduce user affordability and contribute to truck overloading and diversion of through-traffic to less appropriate routes. Tolls also increase logistics costs. While expressway tolls at affordable levels are a positive element of expressway investment cost recovery, an efficient and sustainable mode of base-load financing for the road sector as a whole is needed. A taxation of fuel, currently very limited in China, would not only provide a more sustainable financing source, but would also promote fuel conservation.

**184. Institutional reforms have been widespread with much still to be done.**

In order to improve efficiency, reduce costs, and invite the transparent participation of the private sector, further institutional reforms are necessary in most of the transport sectors in China. The bureaucratic processes and lack of consistent national regulations often result in organizational inefficiencies. For example, in waterways, there is no effective institutional framework to aid in maximizing the navigational capacity. In railways, regional train operating priorities can impede the emergence of new inter-regional national business lines such as container services. Double examination of containers is often necessary at ports due to unclear revenue allocation between custom houses and the inability to carry container cargoes in bond. Air space is hindered by tight military controls even as considerable congestion in the skies increases. Cross-jurisdictional coordination including the interface between urban and inter-urban highways is lacking. Logistics are affected by unofficial border tolls. Finally, in urban transport, difficulties in cooperation between different entities, and an inappropriate policy environment have hindered effective response actions to rapid motorization.

**185. Private sector participation in transport has been found to be beneficial internationally and offers further benefits to China.**

Given the high financing demands for transport infrastructure, participation of the private sector is critical. However, for ports, air, and rail transport, further institutional regulatory reforms are needed in order to attract domestic and international private investment. In railways the monolithic institutional and industrial structure is likely to discourage new sources of investment and is unlikely to encourage a more customer-responsive industry structure or commercial innovation in operations. For ports, the current dominance of SOEs results in a lack of effective competition, necessary to make ports more globally competitive and attractive for private sector participation. The private sector is involved in a number of expressway projects; however, the arrangements have not always been done in a transparent manner or in a way which always maximizes the benefit to the province.

**186. The environmental impact of transport is becoming increasingly important in public policy.**

Increased motorized transport, longer distances traveled, and expansion of transport infrastructure, comes at a cost to the environment. The growth of China's vehicle fleet and the expansion of the air transport sector are rapidly increasing the contribution of China's transport sector to green house gas emissions. Air quality has become a serious issue in many Chinese cities and causes negative impacts on people's health; it also affects agricultural productivity in rural areas. Enforcement of emissions regulations is inconsistently applied and often weak.

187. Environmental impacts on natural habitats also result from infrastructure works. In waterways especially, impacts can be particularly large, and mistakes often irreversible.



188. **Safety impact is also an increasing concern.** Increased road traffic and speeds has led to high traffic accident rates. A lack of separation between fast and slow speed traffic contributes to China having one of the highest rates of road traffic deaths in the world. There are also safety concerns in the ports sector, where deaths by accidents at work are commonplace. In contrast, China has a good record of safety in the air sector.

189. **Increased energy security for transport uses is important.** There is concern with regard to securing sustainable energy sources for China's transport sector in the future. The problem can be addressed not only by lowering the energy consumption and emissions from vehicles with fuel and engine technologies, but also by reducing the number and length of the most polluting motorized trips. The latter strategy of energy efficient travel behavior will only be achieved by promoting public transport and non-motorized modes and ensuring viable alternatives to private vehicle use, even for those with access to an automobile.

190. **Improved multi-modal transport strategies and plans would be beneficial.** As part of its planning strategy, China is looking to find a balance between: (i) the desire for greater personal mobility, health and environmental protection; (ii) financing investment through user fees while keeping transport modes affordable; (iii) reforming institutional arrangements to facilitate coordination and the incorporation of the private sector with an aim at increasing operational and management efficiencies; (iv) expanding new infrastructure while maintaining the existing; and (iv) upgrading networks for improved efficiency while still investing in improved access for the poor.

191. In order to better deal with rising issues related to increased motorization and congestion, urban growth, and capacity constraints, a more focused planning strategy, both on a national and a local level, is desirable. Cities that plan their growth in tandem with transport strategy, public transport systems and facilities for non-motorized transport will attain more efficient and livable cities in the future. Public participation in planning processes would make it more likely that transport infrastructure and services will be planned and designed for all users.

192. Rigorous investment project selection procedures can lead to higher economic and social returns. The five year planning process has created a predictable and stable platform for physical improvements to the transport system, but many projects are not fully appraised before they are included in the plan and there is reluctance to modify the plan when the results become known. Use of project appraisal techniques, feasibility studies and public consultation at an earlier stage will help avoid creating premature commitment to schemes.

193. **Looking forward to 2008.** It is anticipated that 2008 will bring many changes to transport goals and priorities in China, as well as at the Bank. Some of the activities that may shift transport programs and policies include the following:

- ❑ **2008 Olympics in Beijing:** increase in development of urban transport in Beijing.
- ❑ **Fuel Economy Standards:** implementation of weight-based fuel economy standards (second phase).
- ❑ **GM to manufacture hybrid vehicles in China:** shift in vehicle production.





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