



Sustainable Drivers?

**Progress and Barriers to Sustainable
Transportation Planning in Beijing**



Joshua Paglia

**Natural Resource Management,
Governance and Globalisation
Master's Thesis 2007:4**

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Master's Thesis
2007:4

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Natural Resource Management, Governance and Globalisation

a transdisciplinary programme held by the Centre for Transdisciplinary Environmental Research, CTM, at Stockholm University. The one-year programme consists of four courses and the writing of a Master's thesis on a subject related to at least one of the courses.

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Abstract

The city of Beijing has the stated policy goal of transforming into a ‘sustainable development city.’ However, rapid increases in private car use in Beijing over the past two decades has increased fossil fuel consumption, local air pollution, and greenhouse gas emissions by Beijing transit; and has led to congested inefficient transportation systems.

Beijing has taken many positive steps to improve the quality of their transportation systems. However, the cities inability to accommodate the rising motor vehicle population has limited its overall ability to improve traffic conditions. Beijing could improve conditions by creating policies to limit car populations entering the city. Such policy is supported by Beijing transport and land use planners but is being blocked by the central government who seek to use the automobile as catalyst of the national economy.

This presents a policy paradox between urban sustainability goals and the national automobile policy. This paradox is created by a conflict of scales of governance, where national policy is managing transportation planning at the city level, leading to mismanagement at the local level. Current attempts to accommodate the rising automobile populations could jeopardize Beijing’s ability to create sustainable urban infrastructure for the future. This essay concludes decision making at the national level must weigh all costs and benefits of rapid motorization more comprehensively in order to better meet the stated national economic policy objective to ‘harmonize economic development and environmental sustainability.’

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List of Abbreviations and Acronyms

BRT- Bus Rapid Transport

CO- Carbon Monoxide

CO₂- Carbon Dioxide

FDI- Foreign Direct Investment

GDP- Gross Domestic Product

GHG- Green House Gases

IGES- Institute for Global Environmental Strategies

Km/hr- Kilometers traveled per hour

Sq. Km- Square Kilometers

P/h- Per Hectare

PM- Suspended Particle Matter

SO₂- Sulfur Dioxide

TOD- Transit Oriented Development

WTO- World Trade Organization

1. INTRODUCTION

Rapid urbanization and population growth in the developing world is bringing increasing demand for scarcer resources and new sources of large scale emissions of pollutants. In 1950, the global urban population was 750 million. By next year half the global population, over 3.2 billion people, will live in urban areas (State of the World Report 2007). As Lester Brown puts it, humanity has become an 'urban species' (Brown, 2001) and the sustainability of our now 'urban species' will be decided largely by how we construct and use our cities.

Transportation planning in fast developing countries will play a crucial role in building capacity for sustainable development. By 2050, double the current amount of global urban infrastructure is required to meet the needs of the increasing urban populations (ibid). The shape of this growth will be heavily influenced by the number and use of private cars in cities.

Transportation consumes 20% of global energy at present, and at current trends would increase 10 fold over the next hundred years to account for 40% of total energy consumption in 2100 (Riley, 1996). Automobiles account for 70% of this energy consumption in developed world, and by 2025, automobiles from the developing world will emit 16.6 million tons of carbon dioxide; over 400% the amount from the developed world (ibid).

The World Business Council for Sustainable Development sees motorization as a defining challenge to developing countries: "The major challenge in the developing world is to avoid being choked--literally and figuratively--by the rapid growth in the number of privately owned motorized personal-transportation vehicles" (Sperling & Clausen, 2002: p. 62)

This is because private motor vehicles are located overwhelmingly in urban centers because of their concentration of wealth and infrastructure (Barter et al. 2003). The rate

at which the fleets of private autos are increasing is outpacing the speed that most local governments can construct roads, especially in older cities with dense populations and urban roads built before the automobile (ibid).

Bangkok in the mid-1990's, for example, reached an urban transport crisis; where the cities 2 million combined automobiles and motorcycles average traffic speed downtown dropped to 8km/hr, and peak hour speed crawled along at 3km/hr (TDRI Quarterly Review, June 1994). In 1995, traffic problems cost the city an estimated \$2.9 billion in wasted labor, pollution, and fuel costs (Auto World, April 1998).

Though generally seen as a private object used for personal mobility, public policy managing the automobile is tightly linked to natural resource management, public health, social equity, and the global environment.

Nowhere is this more apparent than in Beijing, the capitol city of the world's largest developing economy. The swift expansion in automobile use over the past 15 years, and the explosion in use in the 21st century have created fear among many that the city may not be able to cope with the congestion, pollution and gridlock created in their wake.

In 2004, the Beijing Planning Authority issued their plan to create a sustainable developed city by 2050 (People's Daily, Nov. 26. 2004). That same year the national government issued its second national automobile industry plan placing it as a pillar industry for economic growth.

This essay will argue that the increase in the numbers and use of automobiles is outpacing improvements in transit infrastructure and lessening the benefit of technological advances in fuel efficient and cleaner transport. Moreover, the exclusive focus of the automobile industry as economic policy is compromising the capacity of Beijing to create energy efficient transit systems, and is limiting Beijing's ability to solve its congestion problems. This planning could be improved by closely following sustainable transportation development principles.

2. RESEARCH METHOD & STRUCTURE

The following chapter will describe how the research was formulated and designed. It will lay out the problem motivating the research, the objectives of the study, and how they are addressed by the case study. Section 2.4 will state each aim, the research question(s) used to investigate this objective; and how each aim and question is used in the research.

2.1 Problem Definition

Past experience links rapid motorization in large developing cities to urban development problems (Clausen & Sperling, 2002; Barter et al. 2003). Strategies for sustainable and efficient transport systems overwhelmingly support controlling the use of and limiting growth of automobiles during the early phases of motorization. However, such solutions are often not applied in developing cities experiencing serious urban problems resulting from motorization.

2.2 Case Study Selection

The case study was chosen to investigate how and why sustainable transport planning are, or are not, implemented in rapidly motorizing cities. Beijing was chosen as the area of study because is the capitol of the world's fastest growing automobile market and has experienced extremely high increases in automobile use over the past two decades. Further, the cities commitment to 'sustainability' in urban planning documents makes the results more relevant for future application.

2.3 Field Study

This study involved three weeks of field research in Beijing. The research included informal interviews and discussions with researchers, taxi drivers, environmental activists, and urban planners in Beijing. These interviews were used to help me better understand local opinions on environmental, economic and traffic conditions.

Three one hour semi-structured interviews were conducted with three members of government in Beijing. Two officials were leaders in the transportation department in

Beijing and one official worked for Beijing municipal government. Their reflections on the current conditions, challenges and policy alternatives, and the planning process in Beijing were used to evaluate the progress, opportunities, and barriers to sustainable transportation planning in Beijing. The interviewees were offered anonymity before the interviews and all three asked their names and job titles to remain anonymous in any publication.

Therefore, I chose the aliases ‘Long,’ ‘Ling,’ and ‘Yi’ to refer to the three interviewees. ‘Long’ and ‘Ling’ are high ranking officials from different divisions in the transportation department. Each has over 20 years experience working inside the Beijing transportation department. ‘Yi,’ the official from the Beijing municipal government, has worked for the city of Beijing over the past decade; and is an insider to decision making in Beijing municipality.

The interviews were conducted in Chinese, and direct quotes are my translation. Theoretical material was based primarily on academic essays, texts and journal publications. Quantitative material used to provide background information on Beijing and motorization in China was taken from secondary sources such as institutional publications, specialized journal articles, newspaper articles, and government reports.

2.4 Research Aims and Report Structure

The research was structured around three aims. Below, each aim will be stated along with the specific research questions used to structure the research.

- 1) Analyze the effect of rapid motorization and transit system development on local and national sustainability goals
 - *What effect has rapid motorization had on transit system development and local and national sustainability goals?*

The city of Beijing has the stated policy goal of transforming into a ‘sustainable development city’ and the development of Beijing as a sustainable city can be viewed as

part of China's national ambition is for 'harmonious economic development' and 'environmental sustainability' as is stated in its 2006-2011 economic plan. Connections to ecological economics and resilience theory are applied as a framework to define 'harmonious economic development' with 'environmental sustainability.'

The focus of this research is on the effect of rapid motorization and transit system development on these sustainability goals. This essay uses for its definition of 'urban sustainability' as urban systems and planning policies that promote "the integrated goals of improving social, economic, environmental welfare" (Litman & Burwell 2006, p 333)

Using these terms for urban sustainability, past and current transportation policy are critiqued. Analysis of the means to improve the sustainability and efficiency of transportation systems in Beijing uses the following criteria to assess how to best improve maximize benefit and minimize cost of transportation systems:

Mobility is considered the primary benefit of transportation systems and should be maximized. The primary measurements for environmental, social, and economic costs of transportation systems that should be minimized are: local air pollution, greenhouse gases, energy consumption, road accidents leading to injury or death, and road congestion.

There are further social and psychological factors that are important to understanding the motorization process and the relationship between the individual, the society, and the automobile. The automobile has great symbolic importance, as a representation of wealth, success, freedom, etc, which further drives individual desire for and attachment to personal motor vehicles. Wolfgang Sachs even describes the relationship between individuals and private motor vehicles as a 'love affair,' (Sachs, 1992) which needless to say makes management of transportation systems an emotional as well as practical process. These issues, however, are out of the scope of this research, as their effect on policy and welfare are difficult to measure and evaluate. However, further studies to investigate how these aspects of the motorization process influence sustainable transport planning, with emphasis on the relationship between individual and the automobile in

Beijing and China, would be useful to enhance understanding of how sustainable transportation planning could be better applied.

2) Assess progress and barriers to sustainable transit planning in Beijing

- *Has progress has been made to improve transportation system sustainability in Beijing?*
- *What barriers exist to prevent sustainable transportation planning in Beijing?*

The case study of Beijing details the history of urban problems associated with rising car ownership in Beijing. It reviews the impact of past policy, and compares present planning to show progress made and barriers blocking improved transit planning. Progress is defined where new planning policies closely match recommendations from sustainable transit planning theory. Specifically, measures made to improve the benefits and reduce costs of transportation systems are characterized as ‘progress’, while components limiting the ability to make further improvements, or actions to lower benefit or increase costs of transportation systems are considered ‘barriers’. Qualitative data gained from interviews with government officials is applied to access barriers, detail how they affect the urban transportation systems, and explain why these barriers exist.

3) Recommend means for improvements in planning policy and process

- *How could transportation planning be improved in Beijing?*
- *How could transportation planning be improved to better meet local and national sustainability goals?*
- *How could barriers to sustainability be overcome?*

Significant research has been done on motorization in urban transportation planning theory. This essay reviews past research findings on the impacts of automobile use on urban development and the most successful planning strategies for improving transportation efficiency that could be applied in Beijing. Section 6, discusses the opportunities, challenges, and changes necessary to better apply sustainability to planning in Beijing and China.

3. THEORETICAL FRAMEWORK

This chapter will provide the theoretical foundations used to analyze the case study. It will define how sustainability concepts will be applied in the essay, summarize the costs and benefits of motorization from a sustainability perspective, and review strategies for transportation planning that can be applied to improve sustainability.

3.1 Sustainable Transport Planning and Ecological Economics

Sustainable transit planning can be defined using general principles for development.

Definitions include:

- Planning that promotes the integrated goals of improving social, economic, environmental welfare (Litman & Burrell 2006, p 334).
- Development that integrates economic, resource, and environmental concerns, and can meet the current need without compromising the ability of future generations to meet their needs (Liu et al., 1999).

The concepts of ‘ecological resilience’ and ‘ecological economics’ provide guidelines for placing and managing economic development in an ecological context (Daly 1996, Jansson et al. 1994, Walker & Salt, 2006), which will be used to apply specific meaning to reference of ‘harmonious economic development’ with ‘environmental sustainability’ made in China’s current economic plan for 2006-2011 (China.org.cn, Nov. 9 2005).

Human welfare is dependent on resources and services created by ecosystems (Millennium Ecosystem Assessment, 2005). Ecological economics is grounded on the premise that the planets ‘carrying capacity’ for economic growth is not infinite (Arrow et al. 1996). Ecological systems produce the capital, in the form of natural resources and ecological services, which provide the base for the human economy (Jansson et al. 1994). Consumption that exceeds the rate of production of ecosystems leads to a depletion of total capital and is if that basic capital is exhausted, than economic activity resulting from that capital can not be sustained (ibid).

The ability of ecosystems to provide resources and services is not static, and if ecological conditions are disrupted, changes in the ecosystem can lead to rapid loss of the ability to

produce natural capital or valued services (Walker & Salt, 2006). As human systems are dependent on resources and services coming from ecosystems, and human activity and management both influences and is influenced by ecological systems, they comprise social-ecological systems (Folke, 2006). The ‘resilience’ of social-ecological systems, their ability to withstand disturbance without losing essential and desired functions, is the key attribute to their sustained ability to improve human welfare (ibid).

Since the ‘tipping points’ that cause changes can not be predicted with certainty and occur suddenly (Walker & Salt 2006), the ‘precautionary principle’ advises development activities consider any potential risks they pose closely and best predict what consequences they place on ecosystems before proceeding (Dovers & Handmer 1995). Adaptability of management to respond to disturbances is considered as a means to increase social-ecological resilience (Folke et al. 2005)

Transportation planning can play a key role in sustainability (Litman & Burwell, 2006) and creating ‘cities of resilience’ (Picket et al. 2004). For example, fossil fuel dependence can erode the social-ecological resilience of urban settlements. Fossil fuels are a non-renewable resource, and transportation systems that are most dependent on them will face the greatest loss when they become scarcer. If fossil fuels become exhausted, systems that can not adapt may lose essential functions of mobility, and could lead to an economic crash (Kunstler, 2005). Therefore, systems less dependant on fossil fuels, with more efficient and diverse forms of transit, and more aware of the ecological ramifications of their development, can be considered more sustainable (Litman & Burwell, 2006).

Considering this balance between economy and ecology, sustainable transport planning follows a conservation ethic for urban development (Litman, T. & Burwell, 2006). A conservation ethic shifts the goal and definition of development. Traditional economic models have a ‘growth ethic,’ where GDP growth is the tool for improving human welfare; this can also be called a ‘consumption ethic’ (ibid, p. 334). A conservation ethic

aims to structure economic development to maximize resource efficiency and minimize negative environmental and social impacts while improving human welfare (ibid).

3.2 Costs and Benefits of Motorization

In China, high levels of annual economic growth have facilitated rapid motorization, which both incurs costs and provides benefits (Schipper & Ng 2005). Benefits of motorization include increased individual mobility, enabling citizens to travel greater distances at lower financial and time costs (Green 1995), which improved accessibility for commercial activity promoting economic growth (Schipper & Ng, 2005). Travel time, convenience, and cost are the primary drivers that determine individual transportation choice for urban commuters (Wachs, 1990). Automobile travel generally is the fastest and most convenient form of travel (Riley, 1996; Glaser & Kahn, 2004). However, costs to the individual per automobile trip include fuel, parking, and toll consumption costs but often does not account for external costs of automobile use (Keeler & Small. 1974) including:

- CO₂ emission stress global climate system (MacKenzie, et al 1992),
- air pollutants on human health (Krupnick et al. 1997),
- congestion costs to other road users (Keeler & Small. 1974)
- accidents and traffic injuries (Fuller et al. 1983).

These all lead to negative impacts social, environmental, and economic welfare. Major impacts on health resulting from air pollution include respiratory illness, infection, asthma, and decreased lung capacity (IGES Report, Japan 2004, p. 53). Damages caused by CO₂ emissions accounted for 2.5% of GDP in 1999 (The World Bank Report, 2001, p. 180).

Traffic congestion decreases mobility of all road transport, thus reducing the primary benefit of transportation. Congestion is reached when individual drivers using the road decrease the mobility of other drivers on the road more than they increase their own mobility, leading to a decline in total utility of the road.

Moreover, congestion, traffic accidents, and air pollution can each have dangerous positive feedback loops. High accident rates increase congestion and lowers traffic

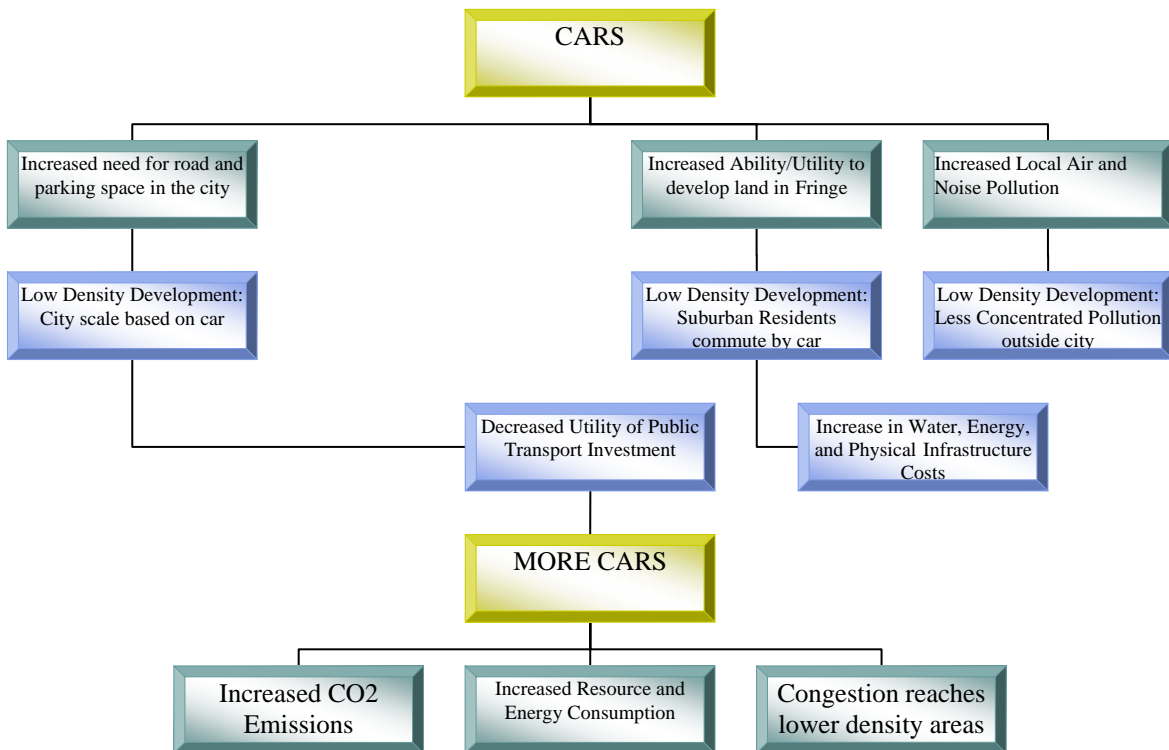
speed, while vehicles traveling at lower speed emit greater levels of local pollution (Deng, 2006).

3.3 Threats to Sustainable Transit Development: Automobile Dependency

The greatest threat to sustainability in transit systems is ‘automobile dependence’ (Gan, 2006). Increased car use leads to congestion and air pollution concentrated in the cities, where populations are densest. In densely populated areas, large private vehicle populations can congest the road, slow traffic down for both public and private transport (Midley, 1994). Cities often respond by expanding roads and parking inside the city core, (ibid) expanding the size and reducing the density of the city. In low density land-use, distances between residences and commercial destinations are increased; and with lower concentrations of populations public transport becomes a less cost-effective. Declining public transit can lead to further ‘automobile dependence’, which in turn pushes further low density development in a process called ‘urban sprawl’ (ibid). (See figure 1)

(Figure 1: The Costs of Sprawl)

(source: author)



Infrastructure costs increase as developed land expands, parking and roads take large amounts of urban space. The larger road, water, electricity, and sewage networks required by lower density development increases energy consumption levels and tax costs (Brown 2001).

While there are means to reduce automobile use (explained in section 3.4), automobile dependency arising from sprawled development patterns is difficult to reverse (Helling, A. 1997). If transportation planning is carried out in accordance so that all the costs of automobile use were included the price, then individual preference for automobile dependant urban forms could likely change (Litman, T. & Burrell, D. 2006).

3.4 Sustainable Planning Strategies

Maximizing mobility, while minimizing air pollution, CO₂ emissions, and traffic accidents are then essential to sustainable transportation planning. Reducing automobile use, increasing fuel efficiency of motor vehicles, and reducing travel demand can contribute to all these goals. In order to maximize benefit from all transportation forms, the price of automobile use to the individual must be increased to accurately reflect its true cost by taxing the external costs it poses (Litman 2001). This can be achieved through integrated taxes on those external costs: congestion taxes, fuel taxes, pollution taxes, parking taxes, carbon taxes, and road taxes can all be applied.

Table 1: Sustainable Transport Strategies (source: author)

POLICY GOAL	POLICY MEANS
Reduce total travel demand	transit oriented development
Improve Transport Efficiency	Prioritize public transport: including bus, subway, electric train, and Bus Rapid Transport
Improved energy efficiency, reduce air pollution/GHG	fuel quality regulations Improved Car Technology: light weight cars, smaller cars, hybrids technology, Alternative energy development: biofuels, fuel cell vehicles
Reduce congestion, excessive automobile use	congestion taxes parking fees fuel taxes pollution taxes

Public transit should be prioritized early in the development process (Sperling & Clausen, 2002) as mitigating environmental and social costs of automobile use is easier before motorization takes hold in a city (Barter et al. 2003).

Transit Oriented Development (TOD), which coordinates land use and transport planning by building high density residential areas around transportation nodes, improves the use and efficiency of public transport, and reduces the demand for automobile use (Newman, & Kenworthy, 1998)

Singapore provides a good example of how integrated sustainable transit development policy can be successfully implemented. From 1971, Singapore has used controls to limit car ownership and use; has invested in top level public transportation systems, and applied strict land use laws with dense residential areas, including 86% of the population living in high rise buildings (Fwa, 2004). Car population growth is held to 3% with a quota system and combined with multiple taxes for owning using and maintaining automobiles. As a result, traffic flow remains smooth even during traditional rush hours (ibid).

4. CASE STUDY: BEIJING

The case study background analyses the first research question:

- *What effect has rapid motorization had on transit system development and local and national sustainability goals?*

The following chapter provides background on the case study area and the causes of rapid motorization in China; and then reviews the impact of this motorization on local sustainable transit indicators discussed in section 3.2: congestion, safety, GHG emissions, and air pollution levels.

4.1. Background Information on Beijing

The municipality of Beijing is 16,000 sq. km with a population of 14 million inhabitants. 8.5 million residents live in the city proper, which is approximately 1000 sq. km (Guo, 2005).

Compared to other Chinese mega cities the overall population density of Beijing (150p/h) in its urban core in comparison to other Chinese mega cities of Shanghai 280 p/h, Tianjin 230 p/h, and Guangzhou 360 p/h is relatively low (China Economic Net, Mar. 3 2006). However, issues with the cities basic structure: monocentricity, central location of the old city, low road density, and concentric ring road design, leaves it with relatively poor capacity to accommodate large automobile populations (National Research Council of The National Academies, 2003).

The cities mono-centric and 5 concentric ring roads (the inner most ring road is called the 2nd ring road) forces too many cars to drive on the same arteries and in densely populated areas (ibid). Further, much of the central city inside and around the 2nd ring road is comprised of the historic center, which has many narrow roads built before the automobile.

This is one reason the inner city has limited ability to expand the roads and parking areas to accommodate the automobiles (ibid). The city intends to expand road density to 20% by 2010, while hoping to preserve 42% of the historic center (Guo, 2005) but the increasing pressure from motor vehicles is placing stress on preservation efforts (ibid).

4.2 National Automobile Policy

The automobile industry has been heavily subsidized by the government (Gan, 2003). During the 1980's and 1990's, before China joined the WTO, government controlled the motor vehicle market and regional small manufacturers were protected by tariffs (Holweg et al. 2005). Operation scales were small and inefficient and had used old technology (ibid). Poor technology of domestic motor vehicle producers led to heavily polluting motor vehicle fleets as protectionist policy placing quotas and high tariffs on foreign cars, gave local vehicles makers a 20% profit margin, providing no incentive to improve their emissions efficiency (Holweg et al, 2005; Gan, 2003). As a result, automobiles sold in the 1980's and 1990's had very poor emission and fuel efficiency (ibid). In 1999 average

fuel consumption per vehicle in China was nearly triple the 1989 levels of Japan, leading to severe air pollution despite smaller vehicle fleets (Hu and Zhang, 2003).

The 1994 National Auto Policy made the automobile industry a pillar of the national economy by pursuing 4 aims:

1. shift to large scale producer groups
2. improve component industry
3. improve product development capacity
4. encourage private automobile ownership

State investment increased from \$2.03 billion in (1986–1990) to \$7.17 billion (1991–1995) periods respectively (Gan, 2003, Zhang, 1998). From 1995–2000, state investment 80% were invested in 13 major state-owned companies who consolidated operation and controlled 90% of the automotive market (ibid). Productivity increased rapidly.

Starting in 1998's the state encouraged private car ownership to stimulate growth of the automobile industry by providing low interest loans and leasing programs to facilitate new car purchases (Holweg, et al. 2005). The intense increases in car production have led to lower car prices, which coupled with rising incomes of the urban middle-class; have caused the domestic market for automobiles to grow (ibid). After joining the WTO, production increased even faster, tariffs on foreign cars were phased out, prices on automobiles have decreased, and GDP per capita has increased. This, coupled with promotion of car ownership, led to an explosion of car sales after 2000 (ibid).

Total automobile sales increased 15% per annum 1990-2002. In 2002-2003 annual growth surpassed 37%, with passenger vehicle sales increasing 55% and 85% (ibid). In 2003 passenger car sales increased by another 50% (ibid).

Active loans to stimulate automobile purchase were ended in 2004, but Chinese consumers demand for private cars did not change. In 2004, had the highest 'aspiration' to become new car owners in the world at 60% (ACNielsen, 2005). Production continues to still outpace sales which further decreases automobile price; increasing vehicles production from 2-8 million produced in 2000-2006, almost double 2006 sales of 5.5 million cars (Gan 2003; Holweg et al. 2005; China Business, Oct. 12, 2006).

In 2004, the national government passed the 2004 National Automobile Policy, which changed its strategies to:

1. harmonious development of auto industries
2. industrial structural adjustment
3. self reliant product and brand
4. support independent R &D
5. support light duty energy efficient vehicles (Holweg et al. 2005)

The new goals are to improve the Chinese brands, improve quality for export, have successful brands in both its domestic and international markets, and now its approach is a market one in accordance with world trade laws (ibid). As will be discussed throughout this essay these policies have had large repercussions on the motorization process in Beijing. China is now the third largest producer and market for automobiles in the world behind the US and Japan (ibid). In 2003, investment in the automobile industry currently accounted for 1.5 % of GDP, and employs 1.6 million workers in related industries (ibid).

4.3 Rapid Motorization in Beijing

Total automobile fleets were 15,000 in 1980. In 1997, the reached its first million automobiles, by 2002 it the population doubled to 2,000,000 (Schipper & Ng, 2006), including over 1,000,000 private cars. The giant boom in automobile ownership continues, the current motor vehicle population is currently at 3 million, and is projected to reach 3.8 million in 2010 (Xinhua news Net 1.23.07).

The proportion of private cars used for commuting increased from 23.2 percent in 2000 to 29.8 percent in 2005, while the percentage of commuters using public transport rose relatively slowly from 26.5 to 29.8 percent (Beijing Municipal Transportation Commission).

4.4 Congestion & Transport Inefficiency

Poor public transit and heavy road congestion has led to inefficient public and private transit in Beijing (National Academies Press, 2003) in a study taken Beijing Institute for Urban Design, Beijing's transportation system efficiency ranked last of the 287 cities surveyed (BIUD).

Currently, 50% of total trips in the city are made within the 3rd ring road (see figure 2, page 15), including a 160% increase in private motor vehicle trips in the past 8 years (Guo, 2005). With such a large share of vehicle trips in a compact and densely populated area, traffic conditions are worsened. Annual traffic jams in Beijing were reported to reach 16,789 on 2002 (People's Daily, Nov. 23, 2003). Traffic on the 2nd, 3rd, and 4th ring roads are congested for approximately 10 hours on weekdays from, 6:30-11:00 and 15:00-20:00 (ibid).

There were 5,808 road accidents and 1,373 deaths due to road traffic in Beijing in 2006 (Xinhua news Net, 1.23.07). Increased danger has led to sharp declines in biking from 60% of commuter going by bike in 1998, to as low as 20% in 2002 (Cycling Association of China; Beijing Daily, 12.23.2003).

4.5 Local Air Pollution and GHG Emissions

Absolute and relative levels of air pollution emissions from motor vehicles in Beijing increased throughout the 1990's (IGES 2004). The transportation sector accounted for 77% of CO, 78% of HC, and 40% of NO_x emissions (Schipper & Ng 2006, p.52), and 32% of PM emissions (Clean Air Initiative for Asian Cities, 2006). Different means to measure the economic value of these costs to human health can lead to varied estimates (Deng, 2006), but in Beijing, the total costs to health from road transport air pollution in 2000 was estimated to account for at lowest 0,7% and as high as 3,26% of GDP (ibid).

Air quality in Beijing has improved 2000-2004; concentrations of PM, NO_x, and CO have decreased marginally (Clean Air Initiative for Asian Cities, 2006). As is detail in section Y, air quality management has improved significantly; however, pollutions levels are still rated as 'serious' [PM, NO₂, SO₂ levels over double EU or WHO standards] (ibid, p 89-92). Recent trends, still show most pollutants are decreasing (see table 2).

Table 2: Air Quality in Beijing

Year	SO ₂ (mg/m ³)	CO ₂ (mg/m ³)	CO (mg/m ³)	PM ₁₀ (mg/m ³)	Proportion of days that air quality reaches Grade II of National Standards (%)
1994	0.083	n.a	n.a	n.a	n.a
1995	0.061	n.a	n.a	n.a	n.a
1996	0.058	n.a	n.a	n.a	n.a
1997	n.a	n.a	n.a	n.a	n.a
1998	0.012	0.074	3.3		15.4 (55.8 _a)
1999	0.080	0.077	2.9	0.180	n.a. (75 _a)
2000	0.071	0.071	2.7	0.162	48.4
2001	0.064	0.071	2.6	0.165	50.7
2002	0.067	0.076	2.5	0.166	55.6
2003	0.061	0.072	2.4	0.141	61.4
2004	0.055	0.071	2.2	0.149	62.5

Source: Beijing Environmental Status Report (1994–2004) (Taken from Deng, 2006)

CO₂ emissions from the transport sector in Beijing increased by 11% annually, and comprise 6% of total emissions in Beijing 1999 (IGES Japan report, 2004, pp 52-53). Transportation now accounts for 33% of total oil consumption in China, up from 16% in 1980 (ibid).

5. EMPIRICAL FINDINGS

Chapter five investigates the second research aim: identifying progress and barriers to sustainable transit planning in Beijing. It answers the following research questions:

- 1) *Has progress has been made to improve transportation system sustainability in Beijing?*
- 2) *What barriers exist to prevent sustainable transportation planning in Beijing?*

Recent planning policy is reviewed and compared to sustainable transit planning recommendations to evaluate progress. Qualitative data from interviews is applied to identify limits and barriers to this progress and explain why these barriers exist.

5.1 Progress in Sustainable Transportation Planning in Beijing

Lack of experience, expertise, and necessary funding commonly leads to poor transit planning in the developing world (Sperling & Clausen, 2002). In Beijing, poor planning over the past planning included: encouraging the ownership of private cars; inadequate emission controls, insufficient investment in public transit, supply side measures (road expansion) as primary to deal with congestion (Hu & Zhang, 2003; p 11)

These deficiencies in transportation planning has left Beijing with a transportation system that could be characterised as having high congestion and pollution levels (National Academies Press, 2003), and inefficient public and private transportation (Beijing Institute of Urban Design, 2006).

Still, progress has been made in reducing air pollution, improving public transit, and smarter land use planning.

5.1.1 Improving Air Pollution Management

In the 1990's, lack of technological knowledge amongst Chinese auto manufactures placed fuel inefficient and heavily polluting cars on the road (Hu and Zhang 2003). As can be seen in table 3 on the following page, management of air pollution resulting from vehicle emissions in Beijing has improved steadily since the mid 1990's.

Table 3: List of major policies targeting vehicle emissions in Beijing

Year	Key policies
1995	Implementing new emission standards for light vehicles
1996	New vehicles that do not reach the emission standards are not allowed to be sold
1997	Phasing out leaded petrol
1998	Scrapping 38,000 vehicles
	Implementing 18 urgent policies targeting coal-burning, vehicle emissions, and dust
1999	From Jan 1st, implementing new emission standards for light vehicles that are equivalent to European standards in the early 1990s
	Installing vacuum time delay valve for vehicles that were registered before 1995
	Modifying 120,000 vehicles that were registered after 1995
	Scrapping more than 30,000 vehicles
	1st and 2nd stage air pollution control
2000	Applying new standards for heavy vehicles, diesel vehicles, agricultural vehicles and motorcycles
	Converting 26,000 taxis and buses into dual-fuel vehicles
	3 rd to 5th stage air pollution control
2001	Implementing environmental protection labeling system
	Vehicles without environmental protection label are not allowed to be on the road
2002	Implementing 2 nd stage emission standards for light vehicles on August 1 st
2003	New vehicles that have not reached the 2nd stage emission standards are not allowed to be sold and registered in Beijing
2004	Implementing 2 nd stage emission standards for heavy motor vehicles and motorcycles

Source: [Beijing Environment Protection Bureau, 1995–2005](#). (Taken from Deng, 2006)

Current policy surrounding automobiles focuses on increasing fuel efficiency and emission standards. In 2003, all new automobiles produced must meet Euro I standards for efficiency and emissions, and older pollution vehicles are being removed from the road (China Daily, Nov. 18, 2004) and new policies promote the purchase compact cars, although large sedans are currently are selling at the highest rate (China Daily, June 5,

2006). Moreover, large investments made in road infrastructure, traffic coordination, and social marketing all aim to improve driver behaviour and conditions.

5.1.2 Increasing Public Transit

Another positive development is new large scale investments in public transit. In 2007, the municipal government projects to spend \$622 million to develop public transport and \$1.4 billion to improve public transit infrastructure (ibid). By 2010 \$12.6 billion is budgeted for public transit investment. The largest investment will be in increasing subway and light rail networks to 273 km in 2010 and 568 km in 2015; by which time they intend for subway use to account for 29% of total trips (China Daily, Jan. 2, 2007). In 2008, buses will increase from (18,000 now) to 21,000, and BRT networks of 360 km. To further encourage commuters, this year the city has also reduced bus fares by 60%, with the hope to raise public transport from 30% to 40% by 2010 (ibid).

5.1.3 Smarter Land Use Planning

The ministry of land and resources in 2006 has banned land allotment for development of new villas or detached homes (Savills Real Estate Research, Jan. 17, 2007) as part of a concentrated effort to prevent sprawling style development and cool the real estate market. Public housing apartments in the outer towns is now a government priority, with 10,000,000 sq. meters of housing planned by 2010 (Xin Hua News Feb. 27, 2007), and population volume and density have increased in most of Beijing's suburbs (China Economic Net, Mar. 3 2006). Increased subway network are being planned to connect these areas to the city core through public transit (ibid). 'Park and Ride' networks, with large parking facilities placed around transit hubs at the edge of the urban core, are being planned to relieve congestion inside the city centre.

Overall, as shown in table 4, the large investments in public transportation, the start-up of alternative energy development, strict policies mandating increased fuel efficiency and reduced emissions for new automobiles reflect a new understanding of the urgent need to take steps to address the cities transportation and environmental problems.

Table 4: SUSTAINABLE CHOICES IN BEIJING URBAN PLANNING

Sustainable Policy Option	Planning Policy in Beijing
Reduced use of the automobile through: congestion taxes (in large cities) parking fees, park and ride, fuel taxes, etc	2002: Congestion/License Tax considered: no date for implementation ¹ 2007: fuel price increase ²
Reduced dependence on the automobile through: heavy investment in public transport including bus, subway, electric train, and BRT	2007: \$622 million to develop public transport \$1.4 billion to public transit infrastructure ³ 2008: BRT networks to 360 2010: \$12.6 billion public transit investment ⁴ 2010-2015: Subway Expansion 273 -568 km ⁵
Improved energy efficiency of all vehicles through regulations and laws	Promotion of Compact Cars ⁶ Fuel Efficiency Improvements: Euro I, II, III Standards 1999, 2003, 2005 ⁷
Increased use and development of alternative energy sources, such as biofuels, hydrogen powered vehicles, etc.	2.5% ethanol national gasoline for 2005 Renewable Energy Act 2005: 10% National Energy From Biofuels by 2020 Natural gas/Fuel cell cars and buses
Improved transit efficiency-access w/ TOD (source: author)	Park and Ride Systems at subway areas

5.2 Barriers to Sustainable Transit Planning

Despite positive steps on many of these policies, their effectiveness in improving congestion and travel efficiency are limited by the increase in vehicles on the road. Over the past 15 years the volume of vehicles on the road has increased faster than new road can constructed and fuel efficiency can be improved; therefore congestion, fuel consumption, and CO2 emissions from transport continue to increase (Schipper & Ng, 2005). Though planning has improved, solutions still lag behind the problems and policies are not being applied quickly enough to address the situation.

¹ People’s Daily Nov. 23, 03

² Xinhua Newsnet Jan. 23, 2007

³ ibid

⁴ ibid

⁵ Ibid, footnote 2

⁶ China Daily, June 5, 2006

⁷ ibid

The result has been an inefficient transit system, and traffic problems that are becoming increasingly difficult to solve. In a study taken by BIUD (Beijing Institute of Urban Design) in 2006, Beijing's traffic system ranked last of all 287 Chinese cities surveyed (Xinhua Newsnet Jan, 23, 2007).

5.2.1 Road Block: Policy Paradoxes and Conflicting Interests

There remains a clear policy paradox between the two goals of reduced energy consumption, increased public transit efficiency and the policy of promoting car ownership. As the city is unable to change the physical layout of Beijing's core that aggravates the cities traffic problem; mainly the central location of the old city and the ring road design, its traffic problems only become more challenging as the amount of motorists rise.

The rising car populations have placed greater responsibilities on underdeveloped institutions to manage and enforce the rules and regulations of automobile use (Long, interview). However, at present, the nation and city's institutional infrastructure lacks the maturity to effectively enforce its laws (ibid). Illegal parking, entrance of the cars into bike lanes, ignoring of traffic signs and lights by bikers, pedestrians and cars, all are considered by traffic officials to be systemic problems that are still unsolvable (ibid).

These problems have existed in the past but as congestion increases the competition for space heightens and the situation becomes more severe. As cars enter bike lanes they slow down bike traffic, and bikes frequently ride on the sidewalk, leaving no room for pedestrians. All parties often ignore traffic signals, leading to accidents and injuries (ibid). When traffic signals and laws are ignored traffic flow becomes less coordinated, making it slower and more dangerous. As a result, the transportation department wants to lower biking populations, as they are considered to be dangerous and slow traffic (interview, ling).

Indeed, this behaviour becomes a vicious cycle. Illegal behaviour begins as a reaction to poor traffic conditions (ibid). As citizens have no viable alternatives to illegal behaviour,

traffic officers consider their ability to punish violations as compromised. For example, available parking in the inner city is currently only enough for less than 10% of the demand; therefore people park illegally. However, until it is possible to provide any legal parking alternatives, they are unable to prevent people from parking illegally, even though illegal parking worsens traffic conditions (ibid).

However, when those who ignore traffic laws go unpunished, other members on the road compensate by ignoring the traffic regulations as well. An environment where infractions have become so regular, not following traffic signals and simply moving when you think you can, have become the traffic norm (Long, interview; Ling, interview). Currently, education is a top priority to shift the cultural values towards traffic laws (interview, Ling).

As the present administration is unable to enforce basic traffic laws effectively, it will require tremendous improvement of the municipal authorities to efficiently enforce new laws and fees to limit the increasing number of cars. As the city continues to wait to limit the amount and use of cars, the congestion problem only becomes more difficult to solve.

5.2.2 Scale Mismatch in Transportation Management: National Governance, Urban Consequences

The Beijing municipal authorities do not lack knowledge on the complex web of issues surrounding the transportation and urban design strategies. They do lack, however, the political authority to contradict, even indirectly, the national governments agenda to promote the automobile.

Transport experts recommended Beijing limit the sales of automobiles in Beijing by auctioning license plates in a similar manner to Shanghai (Ling, interview; Long, interview). Shanghai auctions out license plates, currently allowing 6,000 new cars into the city each month (China Daily Online, Sep. 7, 2006)⁸; Beijing for comparison, on average has 1000 new cars entering the city each day.

As a result, Shanghai has half the car population of Beijing, and half the levels of car use (16% of total trips in Shanghai, 32% in Beijing (Guo, 2005); despite having higher population and GDP per capita figures (ibid). As will be taken up in the discussion, limiting ownership is not a singular solution, but would help the city *begin* to solve its congestion problems.

Policy to limit car sales and ownership in Beijing, however, does not receive support from the National government (Long, interview; Yi, interview). As motorization has been made part of the national economic strategy, and attempts to limit it in the nation's capitol would present a conflict of interests.

With automobile production and sales so vital to the nation's economic plan (see section 3.2), the presence of the central government in Beijing makes it virtually impossible for Beijing leader to limit car ownership without the consent of the top party leaders. Yi assessed the situation,

“In Shanghai only 5 men had to agree that limiting cars was a good policy. In Beijing the system is much more complicated; those same 5 men have 95 men above them (at a national level). I think Hu Jintao would have to personally want to change directions for Beijing to do like Shanghai. (Yi, interview)”

Moreover, it is only because Shanghai has historical precedent in limiting car ownership, dating back before the first 1994 automobile policy, that it has the authority to continue this limitation (ibid). Government officials stressed that it is extremely unlikely that any other city in China will gain the approval to limit automobile growth in their region without the support of the national government (Long, interview; Yi, interview).

Ling also stated it is more difficult to limit car use when public transit is insufficient, because individuals must have viable alternatives to meet their transport demand (Ling, interview). This presents a circular problem; as it would be easier now to improve and increase public transit if congestion was less severe.

There is great hope that current investments in the subway will make immediate impact (Ling interview; Long, interview), and that after the completion of all metro lines by

2015, subway travel will account for 30% of total trips, more than triple the current rate (Guo, 2005).

6. DISCUSSION

The previous chapter documented progress made in transportation planning in Beijing, but noted a failure to limit the rapid increase of new cars as a powerful barrier to sustainable transportation planning.

The following chapter discusses the implications of these findings and addresses the final aim of the study: Recommending means for improvements in planning policy and process. It does so by answering the following research questions:

- *How could transportation planning be improved in Beijing?*
- *How could barriers to sustainability be overcome?*
- *How could transportation planning be improved to better meet local and national sustainability goals?*

Section 5.1 responds to the first research question by making specific recommendations to further improve the transportation planning in Beijing, and discusses challenges Beijing may face in implementing policy. Sections 5.2 and 5.3 address the second research question, by further analyzing the political and perceptual origins of barriers to sustainability. It then applies theoretical material discussed in chapter 3 as potential means for solving problems. Section 6.4 discusses the final research question, highlighting the need for a sense of urgency to better integrate sustainability in China's current development process.

6.1 Recommendations for Beijing: Be Bold!

The single policy of limiting the amount of new cars would not in itself solve the problems with congestion, air pollution, and GHG emissions, or ensure improved sustainability of Beijing's transit system.

Bold policy during periods of rapid growth, rather than incremental policies after growth has stabilized better establishes positive long term trends in development (Yusef & Nabeshiima 2006). Early prioritization of public transit early in the development process over private motor vehicles is most effective (Sperling & Clausen, 2002). Generally, it becomes more difficult to adapt to the externalities of automobile use when the motorization rates are low (Schipper & Ng, 2005), and mitigating environmental and

social costs of automobile use is easier before motorization reaches high levels in a city (Barter et al. 2003).

Motorization has already reached high levels in Beijing, and therefore, improving conditions for the future are going to be more difficult. More than any single new policy, Beijing needs to take bold actions to solve its congestion problems. In Bogotá, for example, drastic measures were taken to reduce automobile use: parking fees doubled, gasoline taxes were increased 20 percent, barriers were built on sidewalks to stop illegal parking, occasional 'car-free days' were promoted, and private cars were restricted in turns (by license plate numbers) from use during peak and evening hours (Sperling & Clausen, 2002: p. 68). After four years, conditions improved for public transit and pedestrians, however, the percentage of trips made by private cars and taxis only decreased 2%; from 19.7 percent to 17.5 percent (ibid). Thus, only bold measures can reverse negative trends of motorization; while dramatic reduction in automobile use can be exceedingly difficult to achieve.

In Beijing, the first and most important step is to enforce existing laws and follow through with planned policies (ibid). Illegal traffic behaviour, starting with illegal entrance of cars into the bike lanes, and illegal parking on sidewalks increases traffic accidents and slows traffic speed; and laws must be enforced to prevent this. This illegal behaviour effectively discourages biking which instead should be an encouraged form of transit, as it provides mobility at virtually no environmental or social costs (Liu et al, 2003). Biking can be promoted by creating 'bike and ride' with large protected parking areas for bicycles at public transit stops (ibid).

It is vital that the planned public transportation systems as constructed as rapidly as planned and they continue to expand bus routes and BRT networks. As mentioned by Ling, (ling, interview; page 25) acceptable alternative forms of transportation must be available to meet travel demand if automobile use is to be reduced.

As automobile use needs to be reduced in order to improve congestion, especially in the city core (National Research Council of The National Academies, 2003), multiple taxes should be used to increase the cost of car use dramatically.

Dynamic road taxes, which tax cars an amount corresponding to the time of day and congestion level of the roads they use, can reduce congestion and provide environmental benefit. In Stockholm, for example, rush hour traffic was reduced 22%, and CO2 emissions from cars 14% during the trial period in 2006 (High Deal Newsletter, Nov. 28, 2006). Further market means to increase the cost of automobile use that can be applied: fuel taxes, emission taxes, parking taxes, carbon taxes, etc. In fact, the city is already planning to introduce these multiple taxes. The revenue from these taxes should be used to further improve public transit.

Figure 2: Plans for Integrated Taxes on Automobile Use in Beijing



SOURCE: BEIJING PLANNING EXHIBITION

(The Beijing Planning Exhibition Shows off its plan for increasing the costs of automobile use in the city. The Driver shouts 'Its truly not worth it!' and the signs from left to right bottom to top say repair fees insurance, parking fees, fuel tax, road taxes, etc. However, does this increase or decrease social equity?)

When the city had a motor vehicle population of 2 million in 2002, it had severe congestion problems (National Research Council of The National Academies, 2003). By 2010, that population will have doubled million. This means there will be more drivers that need that the demand for that road space will increase, which will raise the cost needed to dissuade drivers.

Though these taxes improve overall social equity and welfare by accounting for the social and environmental costs of automobile use (Litman 2004), they may be opposed on the grounds of social inequity. Congestion taxes especially, are intended to make individuals unable to afford to drive private vehicles, in order to change their behaviour. In effect, by making driving more costly, it becomes more exclusively available to the wealthy.

Fear of social discontent from middle class car owners has previously been an obstacle to implementing taxes on car use (Peoples Daily Online, Nov. 23, 2003); now the percentage of the population who owns a car, or aspires to own a car, and will be affected by these taxes continues to grow. Again, this population will only continue to increase, so it is better to apply the taxes as soon as possible. It is better to dissuade prospective car owners from purchasing a car now, then to have them buy an automobile first and be prevented from driving it later.

Another potential complication in applying the taxes to limit car use is the large population of ‘company vehicles’ and ‘government vehicles’ in Beijing, where individual drivers do not pay for the costs of using their cars themselves (Interview, Yi). These drivers may be less likely to be dissuaded from high cost of travel and will be more difficult to control through market means (ibid).

6.2 Resolving Scale Mismatches

Beyond controlling car use, the city will be left with no choice but to accommodate the increasing car population as best they can by increasing amount of road area, decentralizing population, increasing parking quantities exponentially, and decreasing the stress on the city core by creating more polycentric development. To do this, massive resources are being put into Beijing in order to minimize the negative effects of Beijing’s growing car population.

However, it is still not enough to deal with the congestion, parking, and pollutions problems. In fact, during capitol functions (like welcoming foreign delegations, or the upcoming Olympic Games) the communist party prevents government employees from using their cars in order to hide the city heavy traffic problems. This way the capitol city

can function without compromising its national agenda of expanding the automobile industry as part of its economic growth strategy.

Though policy to limit the amount of new cars would not by itself fix Beijing's chronic congestion problems, it would at least help make the problem less challenging to solve. The national government's promotion of automobile sales and individuals' desire for private transport is superseding urban management in Beijing. This has led to a mismatch of scales in Beijing's governance. A Cumming et al. state that scales mismatches can lead to mismanagement when:

- 1) The proper level of management lacks power to apply solutions at the scale required
- 2) The managing institution lacks understanding of the nature of the problem (Cumming et al, 2006, p 13).

The first condition is certainly the case in Beijing urban transit management. City officials have to deal with the consequences of rapid motorization, yet they do not have the authority to dictate limits on the amount of new cars entering the city. The second condition is also likely true in the case of Beijing as well. National automobile policy is pushed by national government officials as economic policy. These decision makers are focused on national level economic growth goals and not their effects on urban planning.

The problem is compounded by the states role as owner in the automobile industry which is likely the most important source of conflict and a barrier in this issue. Further, while cities have been receiving professional consultation on sustainable urban planning and urban transit strategies (interview Ling, interview Long), it is unlikely that national government officials have received the same consultation for the obvious reason that they are not involved in urban planning.

Since they lack expertise in urban transit planning, the central government must allow cities to have the authority dictate their infrastructure policies rationally according to local conditions. In Beijing, this includes allowing restrictions of the amount of new cars allowed to enter the road. Still, because the national government has involved itself in urban planning decisions through the promotion of the automobile industry, attempts

from the outside to change the course of the urban problems resulting from motorization should be directed to the central government.

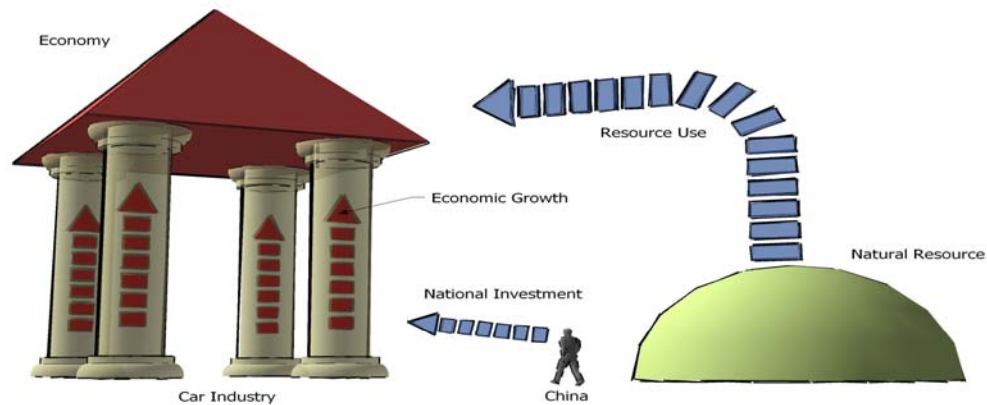
To do this, urban transit planning must be discussed in the context of China's national development process. Decision makers at the national level would need to be convinced that the costs of rapid motorization are greater than benefits it provides in terms of GDP growth. To achieve this, their perspective on the relationship between the automobile and sustainable development must be changed.

6.3 Shifting Perspectives

One of the major challenges presented by motorization is that while the automobile is a private good its use impacts the public sphere. Automobiles are produced and sold by private companies, driven by individuals, but take public space and emit pollutants to the local and global environment. While private interests and individuals benefit, many external costs of automobile use are not paid by users (Helling, 1997).

As the automobile is a central component of urban infrastructure and resource management policy its impact on these areas must be weighed accurately in order to create efficient policy. Unfortunately, as shown in the diagram below, the automobile is being used primarily as a tool for economic growth, where the current hopes are that GDP growth can outpace rising energy demands (Schipper & Ng 2004). As seen in the figure below, this follows a classical economic model, and assumes a straight forward relationship between natural resource use and economic growth.

Figure 3: Current Perception of the Relationship between Resources, Car Industry, and the Economy



Natural Resources are used to invest in the economy. China, places its economy onto the pillars of the car industry which securely hold and push the Economy higher. As the economy grows, more resources can be purchased. (source: author)

While the automobile industry has expanded rapidly as a result (Gan 2003, Holweg et al. 2005), the city of Beijing’s ability to create convenient and energy efficiency transportation systems has been compromised.

In order to impact the national government’s perspective on the automobile, it would require a fundamental shift in their perspective of development and the environment. The national government is aware of the current contradictions and problems facing China development process:

Problems such as the rural-urban gap, polarization of rich and poor, waste of resources, environmental deterioration, administrative corruption and low efficiency have amassed over years...The formulation of the 11th Five-Year Plan signals a complete transformation of China's social and economic development mode... It will, for the first time, incorporate the idea that economic growth does not equal economic development, economic development does not necessarily result in society's development and that growth is not the goal, but the means of development... [and] build a society that is energy-efficient, environment-friendly, wholly coordinated and sustainable (China.org.cn, Nov. 9, 2006)

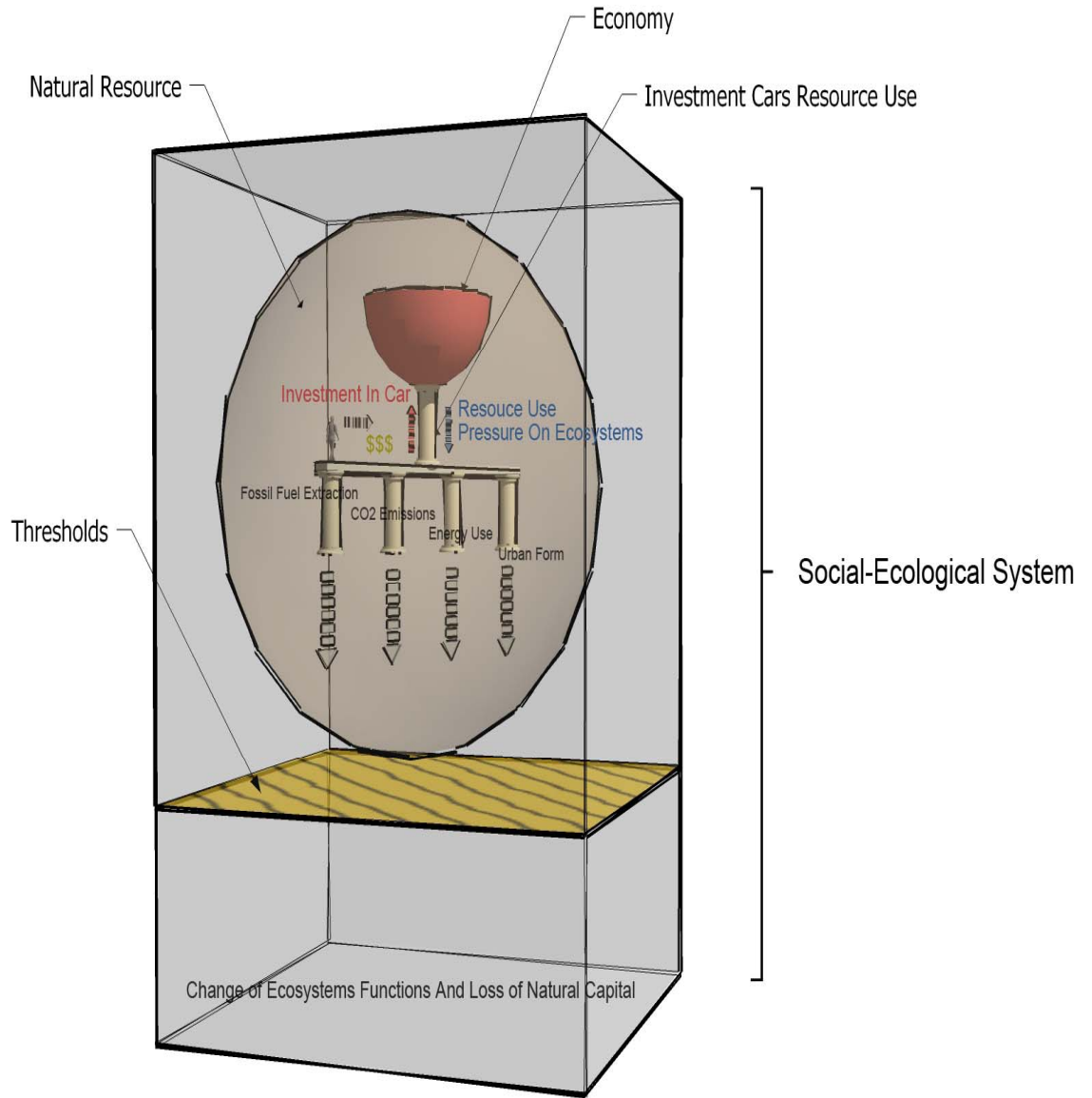
The paragraph above from China’s 11th 5 year plan 2006-2011, succinctly describes ‘complete transformation of China’s social and economic development mode’ that the

'paradigm shift' from a 'growth ethic' to a 'conservation ethic;' considered fundamental to sustainable planning (Litman & Burwell 2006).

However, as noted by Yi, one major problem for 'sustainable development' objectives is that officials at all levels will prioritize short term economic growth goals over any long term development considerations. Government leaders are generally in power for 10 years, and still equate economic growth most closely with success. Yi surmised it is very difficult for politicians to sacrifice present economic goals for the sake of the long term development in China (Yi, interview). Further, the continued promotion of rapid motorization through the automobile industry goes directly against this desired transformation social-economic development.

To effectively enable this transformation a conceptual ecological economic model is needed (Jansson 1994, Daly 1996). This model can be applied to view how the external social and environmental costs of current motorization patterns in China's development process pose risks that undermine its long term sustainability. Figure 6 illustrates that by shifting to an ecological economic perspective of economic development, where the a sustainable human economy exists within the limits of ecological system ability to produce resources and services for human consumption (ibid), the economic growth stimulated by the automobile industry is placing greater pressure on, and thereby reducing the resilience of the greater social-ecological system in China.

Figure 4: Eco-centric Reality



(Note: The Box is the National or Global Ecosystems)

(source: author)

Natural Resources [the sphere] exist and are produced by global ecosystems [the box]. The economy [the hemisphere] exists with the limits of available natural resources to consume. China [the man] is pushing up the economy by putting its (money) resources into the pillar [the automobile industry]. However, the automobile is held up by more resource needs below, [the four pillars] which are placing stress on the greater social-ecological system. As the lower pillars continue to be pushed down towards the threshold of the systems capacity to accommodate automobile growth, the resilience of the entire system is degraded. If these pillars continue through to be pushed past the threshold, the natural resource sphere might start spilling and sinking down, or if the foundation cracks, it may fall through.

When looking at the diagram above, it is important to remember that the exact location of these thresholds and the triggers that will cross them in social ecological systems involve uncertainty (Walker & Salt, 2006). The future availability and cost of fuel, the potential impact of increased CO₂ in the atmosphere and possible consequences of climate change could all potentially threaten sustainability of Chinese cities. More fossil fuel dependant economies are less resilient to shocks in the oil price or the potential scarcities in future fuel supplies. Here the precautionary principle should be applied to motorization policy, where the potential long term consequences of the current rapid increase of automobiles on urban areas are unknown, but potentially severe (Dovers & Handmer, 1995).

China's development faces great challenges and solutions will not be simple. This does not mean it can not become a motorized nation, however, it does show that it is imperative for China to make efficient urban planning and resource decisions.

In fact, it is probably too late to reverse motorization trends in the fastest growing Chinese cities, such as Beijing (Schipper & Ng 2005), but at a national level China is still early in the motorization phase and choices made now can direct what the impact the result of this process will be on its development process.

Future potential solutions in the form of alternative fuels and car technology can not be counted on. Fuel cell/hydrogen engines and biofuels are very unlikely to make a large impact in China in near future (Holweg, et al. 2005, Liu, 2007). To utilize fuel cell technology, new vehicles and fuel loading infrastructure is needed making, and is not likely to become common in China soon (Holweg et al. 2005).

Bio-fuels, which have low carbon emission, and are compatible with current automobiles and fuel station equipment (Hunt et al. 2006). However, they also can require large quantities of productive land, water, and energy resources to convert crops into fuel, which also have damaging environmental effects (ibid). China's pursuit of bio-fuels is contained to non-traditional farmland because of their limited supply of water and agricultural land (Liu, 2007). Currently, their biggest bio-fuel growth area is in the

mountainous region of Sichuan, is threatening the resilience of the larger ecosystem there (ibid), which may lead to a loss of ecosystem services.

Integrating numerous steps to improve the energy efficiency of reduce the use of automobile is the most practical way to ensure transit sustainability. The most important applications of technology is increasing fuel efficiency, fuel quality, making lighter weight smaller vehicles, and hybrid technology (Schipper & Ng, 2005). These measures can be implemented immediately and can reduce future oil demand and energy consumption from the transit sector by as much as 40% (ibid).

6.4 Policy Windows for Sustainability: Finding Urgency

During my interviews with policy officials, and repeatedly during conversation with Chinese peers, when I asked why limiting automobile growth in Beijing or even nationally would not be possible, I was commonly reminded that China is a developing nation with poverty problems, and the automobile is a major part GDP growth, which will indirectly help the plight of the poor (interviews Yi, Ling, Long).

There are numerous ways to discuss and challenge this contention which have been covered in this essay ranging from: evidence of negative effects of automobile use on economic growth (Helling, 1997), social costs of motorization disproportionately affecting the poor (Gan, 2003), or even economic drivers to limiting car ownership in Singapore (Fwa, 2001).

However, more important than the accuracy of this statement, is the worldview the argument suggests. The argument is that as a developing country, China can not afford to sacrifice opportunity for GDP growth from the automobile. This view, and the corresponding policy, implies there is a greater urgency for immediate economic growth than sustainable development in China.

It is easy to understand the logic and sentiment behind this claim as well. The United States, Germany, Japan, and Korea have all developed their economies in part with a

strong automobile industry and taken advantage of their large domestic markets and currently have less severe poverty than China does.

However, if ‘harmonious economic development’ with ‘environmental sustainability’ is the path China intends to follow, then the urgency lies in making those decisions while they can still be effectively applied. The window of opportunity to make lasting sustainable urban choices is during the period where the majority of the infrastructure is created, not after. To open window of opportunities, recognition of the problem, knowledge of solutions, and a proper political climate must convene at the same time (Kingdon, 1995). The attention given to sustainability concerns at the municipal and national level suggests that problem recognition and a conducive political climate exist. However, in order to establish a sustainable trajectory for transportation development; the need to address these concerns will need to be perceived as urgent as the sustainable solutions can be most effectively applied in the early phases of development. Each license plate issued in Beijing is an infrastructure decision that the city will have to build around, and its ability to manage the external costs it suffers as a result is becoming progressively weakened, and solutions to its traffic problems become increasingly more challenging.

7. CONCLUSION

Transportation planning in Beijing is improving, as is evidenced by improved public transportation system, stricter regulations on automobile emissions and fuel standards. Further positive signs include intentions in the near future to improve traffic flow through market oriented means of reducing private car use. However, the increase in the numbers and use of automobiles in Beijing is outpacing improvements in transit infrastructure and lessening the benefit of technological advances in fuel efficient and cleaner transport. This process of motorization is not unique to Beijing, in fact it is quite typical in developing countries. Extreme congestion and pollution commonly arise when rapid increases in private car use overwhelm local capacities to handle new automobiles (Sperling & Clausen, 2002).

The exclusive focus of the automobile industry as a tool for economic growth at the national level have prevented the city of Beijing from controlling the amount of new private vehicles entering the city to more manageable levels. This is limiting Beijing's ability to establish energy efficient transit systems for its future development, and is jeopardizing the cities ability to alleviate its congestion problems. Despite national policy goals to prioritise sustainable development, this national interference with urban management of the automobile in Beijing is compromising the cities efforts to achieve its sustainability goals.

7.1 Learning for the future

Beijing's congestion problems resulting from rapid motorization should provide a lesson for other cities in China. Motorization has brought the benefits of increased GDP growth and improved mobility (Schipper & Ng, 2005). However, unless appropriate transportation policies are already in place and well integrated with urban planning (see section 2.3), then rapid increases in private motor vehicle populations will worsen traffic conditions and have high external costs (Hu & Zhang, 2003). In this case, rapid motorization can have the opposite effect on cities; it causes immobility and hinders economic development (ibid, Helling, 1997). Indeed, it is argued that the mobility concerns for the near future and the threat of transit systems collapsing as the result of the congestion that should be the most convincing driver for China to reconsider its how it will approach the motorization process (Schipper & Ng, 2004). This is the reason that transportation planners in cities facing chronic congestion like Beijing, would push for greater control of this motorization process. It is also clear in the example of Beijing, that the city would have been better off if it had acted earlier in the motorization process. This is necessary to both reduce high external costs during the adjustment period where the city infrastructure can not handle the increase in automobile use and to create foundations for more efficient and less automobile dependant transportation systems in the future.

The automobile will be an important part of China's development process, but cities must manage automobile growth and use carefully if the benefits of rising motorization are

going to outweigh the costs. Cities must have the authority to manage at the appropriate level, and the foresight to apply sustainable transit systems based on efficient public transport, transit oriented development and fuel efficient cars early in the development process to best ensure efficient and sustainable transportation systems.

Further, China's massive population, rapid urbanization and lack of available land for development, all make any shift into an 'automobile society' certainly problematic. Further considerations such as the decreasing global supply of fossil fuels, the need to reduce carbon emissions, are more reason why it is necessary for China to act early to ensure that this process does follow sustainability goals sought at the national level.

7.2 Challenges and Choices for Sustainable Development in China

This essay has focused on the automobile in terms of its economic, social, and environmental impact on cities. Using these three pillars it has attempted to put perspective on the motorization process in terms of cost and benefit derived from automobile use, to recommend a more optimal approach to integrate better transport planning with sustainable development.

Increasing ability to purchase automobiles by Chinese consumers is cited as the primary driver for motorization. This driver explains the conditions of *how* the society could motorize so rapidly, however, it does not explain *why individuals choose* to purchase automobiles. The automobile is more than a tool for mobility; it is a symbol of wealth, modernity, freedom, and a way of life. This makes the relationship between individuals and societies to the automobile as much emotional as practical. So and so describes this relationship for many as 'love affair' between the individual and their car. As explained in section 2.2, this love for the automobile can cause human settlements to change the way they construct their habitats and daily patterns.

In China, its history of poverty only increases individual desire to reap the benefits and make expressions of new found wealth through the automobile. Despite problems with congestion and air pollution, automobile shows are increasing in popularity.

But the state can not display the same emotional attachment to the automobile that individuals do, because China does not have the capacity to accommodate the increasing demands an ‘automobile society’ will place on its development.

Both physically and metaphorically, China is nearly out of land for development. Since 1996, China’s arable land has been reduced from 130 to 122 million acres, while 120 million acres is considered base minimum to meet national food security (China Economic Review, Dec. 30 2006), while the nation’s cities continue to expand. In 2002, China had already exceeded its national bio-capacity by over 200%, and the figure is rising exponentially (Flavin & Gardner, 2006).

Finally, if China had the same vehicle to person ratio as the United States, it would require more oil, 80 million barrels a day, than the world produces at this time (Brown, 2001). These statistics symbolizes the stark reality that China, and the developing world, simply do not have the same options in their development process as currently industrialized countries did.

There is no shortage of information on issues concerning China’s development process, not in China and not in the world. Researchers around the world are closely observing China (and India), as it is common knowledge their development decisions will have global repercussions. We all are keenly interested that China understands at least what its options are not. That is why it is promising to hear of China’s ambitions to create ‘A society that is energy-efficient, environment-friendly, wholly coordinated and sustainable.’

To do that however, the first step needed is to understand that creating a sustainable society is not simple. Especially considering China’s development conditions it will be especially difficult. However, it seems current Chinese behavior is still perceiving these problems an interesting puzzle to solve during its economic development. Consider the quote below from the Beijing Daily in 2003,

“By 2010, the city will basically solve the problems of transportation, water resources and ecological environment, build a public transportation system and management system, and modernize facilities of water, electricity, gas, heat supplies and communication” (Beijing Daily, April 23, 2003)

The ecological environment is not a problem that can simply be ‘solved.’ It certainly can not be solved by China, by 2010, the country with the largest ecological environment economic contradictions in the history of human civilization.

This may be simply an optimistic newspaper report; however, the process is being repeated at a national level. In 2010, the world’s first sustainable city, Dongtan, will be built in China. In Dongtan they will likely, at the local level, perhaps better than anywhere else in the world “basically solve the problems of transportation, water resources and ecological environment.” However, sustainability can not be engineered like laboratory projects, and growing urban populations will not all be able to move into newly built cities.

Despite skeptics, China’s commitments to sustainability are not simply green wash. However, its commitments to sustainability may be compromised by misinterpretation of how it must be approached. By definition, sustainability can never be fully achieved. Instead, it is an ongoing process for human development. Making smart decisions about managing automobiles and urban transportation systems will be a much more important part of the process of improving sustainable development conditions than attempts to build our way out of them.

Perhaps, the automobile industry is already too big a part of China’s development process for rapid motorization to be reversed at this point. Still, this process can and must be managed better. Indeed, to accept the notion that ‘economic growth does not equal and can impede development’, the automobile is a perfect example of the types of challenges that lie before China and the choices that will be necessary to meet its national sustainability goals.

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Appendix 1: Full Size City Map of Beijing

