FISCAL POLICIES FOR SUSTAINABLE TRANSPORTATION:

INTERNATIONAL BEST PRACTICES

A Report Prepared for

The Energy Foundation
and
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by

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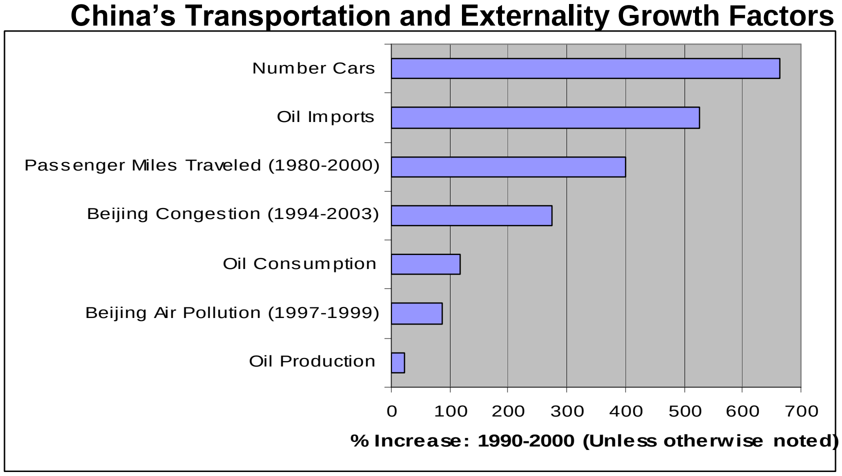
EXECUTIVE SUMMARY

Now is the time to start along the path toward sound fiscal transportation policy adoption. Automobile use in China is headed upward at an accelerated rate. Greater numbers of cars means more traffic, fuel consumption, oil imports, air pollution, traffic congestion, carbon dioxide emissions, accidents, and a host of other problems. While the growth in personal mobility is very good for the economy, it bodes less well for public health, energy security, and the environment.

One of government's most important roles is to deliver public goods. Clean air, energy security, livable cities, and public safety must be protected in order to have a thriving market economy. Individual citizens cannot manage these problems alone. Policymakers must align consumer prices with social marginal costs for optimal economic balance.

When external impacts are not addressed, economic growth ultimately suffers. China's vehicle growth trends must be strategically managed by fiscal and regulatory policies to minimize the detrimental impacts of increased auto use. In 2003, there were 4.5 million new cars sold, many of which do not meet current EU and US emissions standards. As the number of cars has increased in China, transportation externalities have followed suit. (Figure S-1).

Figure S-1
China's Transportation and Externality Growth Factors



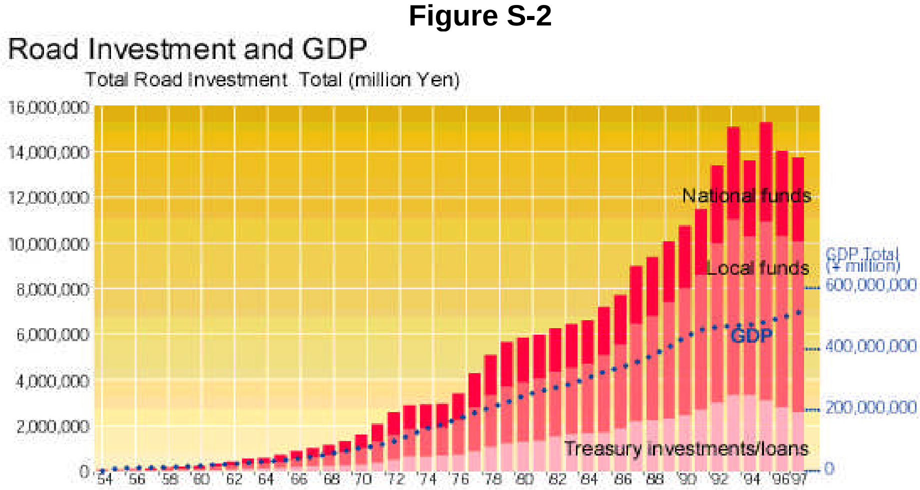
Sources: EIA 2004a, EIA 2004b, Chinese Academy of Engineering and US National Research Council, 2003, Zhong-Ren Peng, 2004.

Mounting transportation externality concerns are not unique to China. When cars dominate the transportation sector, their externalities become problematic. In the EU, externalities are projected to cost over 5 percent of GDP (1998 figures) and in the US the figure is higher – over 8 percent (1991 figures). As a result, the EU and US have implemented and are continuing to develop regulatory and fiscal policies to address air pollution and oil consumption concerns.

Addressing traffic congestion is a more complex undertaking. The initial response by many countries has been to simply build more roads. Road building is extremely costly, consuming tremendous public resources. Increasing road supply alone tends to increase travel and traffic problems. If complementary pricing and multi-modal investment strategies do not accompany expanded road infrastructure, congestion will just tend to grow, spreading farther out.

There are numerous examples around the world where policymakers now realize that road building does not bring commensurate economic benefits and results in irreversible environmental damages. In Japan, for example, the government has funneled huge sums of money into the road sector to stimulate the economy in order to bring Japan out of a long recession. However, economic growth has been negligible as a result of new roads which have added to a dangerously-large national debt. Since the end of World War II to the present, Japanese road investment has grown nearly four times faster than the economy (GDP). Road building is not obviously fueling Japan's economy and it is creating destructive environmental loads that are counterproductive to a healthy economy and strong workforce. (Figure S-2).

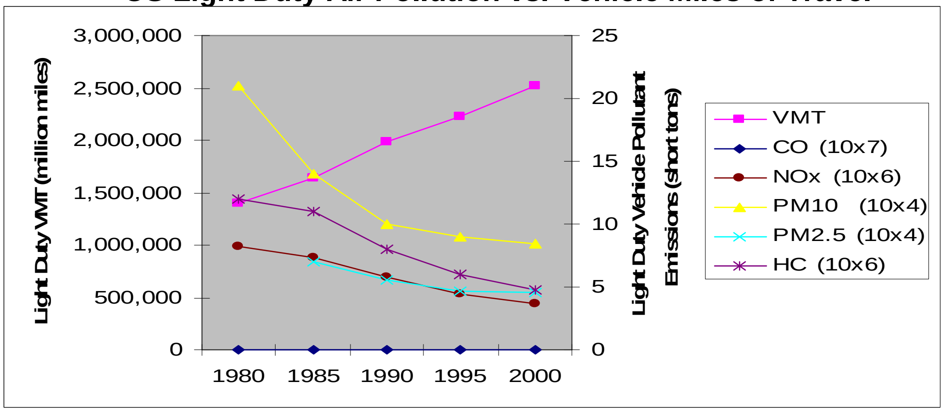
Figure S-2



Source: Japanese Ministry of Land, Infrastructure, and Transport, 2000.

When prices (for cars, gasoline, driving, parking) vary based on use, and ideally when all transportation prices reflect social marginal costs, externalities are minimized. The US has not yet converted its transportation pricing structure to align with these social costs. Today most US vehicle costs (72 percent) are fixed – they are paid in a lump sum whether a vehicle is used or not. This has lead to unfettered growth in vehicle use. Despite this continued growth in light-duty vehicle travel over the past two decades, the US has reduced air pollution. (Figure S-3). Policymakers have achieved these environmental gains with a wide array of regulatory and fiscal vehicle emissions policies, including tailpipe standards, incentives for cleaner cars, dirty vehicle scrappage incentives, and allowances for policy innovations in states like California.

Figure S-3
US Light Duty Air Pollution vs. Vehicle Miles of Travel



Source: Davis, S., 2004.

Regulatory policies complement fiscal policies and their role cannot be discounted. A comprehensive package of regulatory standards and fiscal policies can lead to a more sustainable transportation sector. Regulations safeguard public welfare, conserve and protect natural resources, and prevent the injurious actions. Fiscal policies generate necessary revenues to cover investment costs. As importantly, fiscal policies can create mechanisms to capture the negative externalities of transportation use, thereby sending the proper signals to users. Standards and fiscal policies should be packaged together; they are complementary strategies.

The revenues generated from transportation externality charges afford investments in transit, cleaner fuel production facilities, expanded bus rapid transit systems, and research and development on alternative fuels and other transportation innovations. Moreover, the public agencies needed to design, implement, and evaluate sustainable transportation policies can be supported by transportation user fees.

No one fiscal policy can address the host of problems attributed to the transportation sector. There are numerous independent decision factors that must be influenced to make transportation more sustainable. These include: what vehicle to purchase; how to maintain the vehicle; how many miles to drive; where and when to drive; how much fuel is used; what type of fuel is used; what alternative mode to use (i.e., transit, bicycle, telecommute, etc.); and when to replace a vehicle with a newer, improved model.

There are seven different fiscal policy categories discussed in this report. These include:

- Fuel taxes and fees
- Vehicle taxes and fees
- New vehicle incentives
- Road fees
- Parking pricing
- Vehicle insurance fees

- Fleet vehicle incentives

Each of these fiscal transportation policies operates differently. These policies enhance one another and can be adopted together. Different policy designs strongly impact certain energy- and emission-related decisions but have weaker connections to other decisions. (Table S-1). For this reason, a comprehensive fiscal transportation policy package is the recommended approach.

Table S-1
Impacts of Fiscal Policies on Energy- and Environmental-Related Decisions

Fiscal Policy	Purchase New, Clean, Efficient Vehicle	Purchase Improved Used Vehicle	Vehicle Maintenance	Number of Miles Driven	Where & When Vehicle Driven	How Much Fuel Used	Fuel Type	User Alternative Mode	Replace Vehicle
Differential Fuel Taxes	3	3	3	1		1	1	2	2
New Vehicle Incentives	1					2	1		3
Annual, Externality-Based Vehicle Fees	2	2	2	1		1	1	2	1
PAYD Insurance		3	1	1		1		2	
Parking Pricing				2	1	2		1	
Road Pricing				1	1	3		2	
Fleet Vehicle Incentives	1		3	3		2	2		2

Key: 1 = Strong effect; 2 = Some effect; 3 = indirect or weak effect.

The best fiscal transportation policy practices involve common elements. Prices are set to vary with externality levels – such as fuel consumption and air pollutant emissions. Most are recurring so that users pay repeatedly (i.e., daily) rather than just one-time, fixed charges. Policies target both transportation demand (motorists) and transportation supply (vehicle manufacturers, roads, parking, transit) simultaneously. These policies are applied universally throughout the transportation sector so that certain fuels and vehicles are not exempted or subsidized due to special, powerful, private interests.

Pay-as-you-go transportation systems instituted through fiscal policies are likely to have equity impacts. Fee exemptions, free transit privileges, fuel vouchers, and other targeted forms of compensation need to be incorporated into these policies to minimize their regressive effects on low-income groups. For example, combining affordable transportation alternatives such as public transit with user fees aimed at inefficient, polluting, single-passenger cars allows citizens to choose better mobility options given their budget.

Comprehensive policymaking is necessary to align prices so that policies do not counteract one another. Transportation decisions are made by local, state, and national policymakers, often at the same time. "Big picture" policies (such as vehicle incentives, fuel taxes, and carbon taxes) are national while city officials make numerous local transportation decisions (such as parking pricing, road pricing, and transit investments). Lack of coordination can be counterproductive and wasteful. The opportunity costs of disorganized, piecemeal policymaking can be significant. The EU and US have experienced problems caused by contradictory policies at the local, state, and national government levels. A nation the size of China will surely face such policy challenges. A coordinated approach will require strategic management.

The EU is now engaged in a formal process of comprehensive fiscal policy reform in the transportation sector. In 1998, the European Commission set out the case for a phased transition to marginal social cost pricing. To that end, policymakers initiated both a continuing program of research and a structured process of dialogue with officials and experts from the EU member states. Five years later, the Transport Ministers of 43 European countries have endorsed the recommendation of the European Conference of Ministers of Transport (ECMT) to reform their transport taxes with the long-term aim of marginal social cost pricing and to refrain from adopting tax changes in the reverse direction.

A simultaneous top-down and bottom-up policymaking approach is necessary in this complex, dynamic sector. The bottom-up component entails developing individual fiscal policies based on sound principles – aligning prices with marginal social costs (establishing variable prices for fuels, vehicles, and roads that are related to energy consumption, pollution, congestion, and other socially harmful impacts). Guidelines and examples are documented in this report. International best practices are summarized in Table S-2. Policies are separated into levels (I, II, III) indicating the degree of simplicity, practicality, and ease of implementation associated with each policy design (Level I being the easiest). In most cases, the different policies can be packaged together. If it can be achieved, a Level III policy design will be even more effective in achieving energy and environmental goals. Level III policies should ultimately be adopted, even if they are not feasible at present.

A top-down fiscal transportation policymaking effort is equally as important as designing individual policies. This entails examining fiscal policies as a comprehensive package. Unfortunately this component often gets less attention than individual policy development. Any individual fiscal policy is only <u>one</u> part of the total set of prices faced by users. However, consumers react to overall transportation prices. The key issue here is: Does the *overall policy package* move the full set of relevant prices toward a more optimal outcome? The EU is developing guidelines for comprehensive fiscal transportation reform. Such a comprehensive approach is critical to China's overall transportation policy success.

There is extensive experience countries around the globe have been gaining with fiscal transportation. Valuable information and technical assistance are available. The lessons learned about fiscal transportation policymaking, which are summarized below, underscores the promise of this approach as long as strategies are carefully designed and comprehensively implemented.

Table S-2
International Best Practices: Fiscal Policies for Sustainable Transportation

CATEGORY	LEVEL I	LEVEL II	LEVEL III
FUEL TAX	**Gasoline/Diesel Tax** Poland	**Carbon Tax** Sweden	**Environmentally-Based Fuel Fees** N/A
VEHICLE TAX	**Annual Vehicle Attribute-Based Taxes and Fees** EU	**Tax and Fee Reductions or Exemptions for New Clean, Fuel-Efficient Cars** Japan, Germany, Denmark	**Annual, Externality-Based CO_2 and Smog Fees** UK, Denmark
NEW VEHICLE INCENTIVE	**Clean Car Rebates** Japan, US	**Gas Guzzler Tax** US	**Vehicle Feebates** Austria
ROAD FEES	**Road Pricing/HOT Lanes** US (California)	**Congestion Pricing** UK (London)	**Fully-Externality-Based Road Pricing** Singapore
USER FEES	**Parking Fees** US (California)	**In-Lieu Fees for Parking** South Africa, Iceland, Canada, Germany	**Parking Demand Management** US
VEHICLE INSURANCE	**Fines for Lack of Mandatory Insurance** UK, US	**Insurance-Specific Auto Tax** France	**Pay-As-You-Drive and Pay-At-The-Pump Insurance** US, UK
FLEET VEHICLE INCENTIVES	**Cost-Effective, Clean, Fuel-Efficient Public Fleets** Canada	**Incentives to Promote Clean, Efficient Company Cars** UK	**Incentives for Environmentally-Based Vehicle Leases** N/A

Develop a Comprehensive Transportation Policy Package

Fiscal policies and regulatory policies are equally important components of a sound, comprehensive transportation strategy for China, and any nation. These approaches build on each other's strengths and should be packaged together to reach desired goals.

Comprehensively plan and evaluate fiscal policies to advance fuel-efficient and clean transportation goals for China. Consider policies both individually and as part of an overall package. The EU, US, and other international experts have sophisticated analytical tools available to forecast comprehensive impacts.

Align Transportation Prices with Marginal Social Costs

Over the long term, all prices should align with marginal social costs. One of the government's primary objectives should be to adopt policies that achieve this goal. Paying directly, up front for transportation externalities will cost less over time than paying indirectly over a long time.

In addition to ultimately getting the prices right, it is important in the short term to minimize incorrect pricing signals. Avoid counterproductive measures and subsidies that move prices away from the alignment of prices with marginal social costs.

Design Fiscal Policies for Maximum Effectiveness

Take calculated policy risks. Just because the more complex Level III fiscal policies are not currently implemented does not mean that these policy designs should not be adopted. The inability of governments to adopt the most effective fiscal policy design is more a matter of politics and entrenched special interests than lack of technical merit in achieving desired energy and environmental goals.

Fiscal policy measures, are dynamic. It is difficult to get the prices right upon initial policy adoption. Policymakers must be prepared to delegate administrative authority to experts who evaluate and revise the adopted fiscal strategies so that they achieve their stated goals over time.

Spend Fiscal Policy Revenues Wisely

Environmentally-motivated taxes are visible instruments. They can be subject to public pressure. And their high visibility makes them easy to attack. Accounting for their revenues in public budgets can make these policies more durable.

Use fiscal policies to maintain diversity in the transportation and energy sectors. A sustainable passenger transportation system serves and encourages bicycles, pedestrians, public transit, telecommuting, and clean, fuel-efficient automobiles. Moreover, a transportation system that is entirely dependent on oil is not stable. Do not devote the bulk of all revenues to building roads and refining gasoline. If petroleum-fueled automobiles predominate over all other modes, the system will tend to break down and the economy and livability will ultimately suffer.

Minimize Subsidizing Cars and Heavy Trucks

It is not enough to invest in transit and other auto alternatives or fund alternative fuel research. If cars and oil are subsidized and motorists do not pay appropriate user fees, a sound multi-modal transportation system will not result.

Heavy trucks, although they are not the focus of this report, also have significant external impacts – even greater than those of cars. Fiscal policies for freight transport will be necessary to align heavy truck prices with marginal social costs.

Address Equity Issues Directly

Mobility should be a right for all, not a privilege for those who are wealthy. As income disparity widens, transportation policies and investments should be developed and managed to benefit all citizens. Avoid fiscal policies that are detrimental to low-income groups unless ample compensation can be permanently designed into the policy. The more equitable transportation policies are, the more stable and effective they will prove to be over time.

Use A Coordinated Full Fuel-Cycle Approach

Financial incentives should be placed on full fuel-cycle costs whenever possible. Consistent "wellhead to wheel" environmental and energy policy signals on transportation fuels and vehicles is crucial.

Fuel consumption, carbon dioxide, and air pollution emission objectives should be combined wherever possible. Basing fiscal policies to all of these externalities simultaneously will help avoid unnecessary trade-offs between these important, related goals.

Anticipate Unintended Consequences of Fiscal Policies

Reduce policy gaming by predicting in advance the unintended consequences of any given policy design. Ask the question repeatedly: How will a stakeholder take advantage of a given policy in order to individually maximize benefits or minimize costs?

Extreme caution should be exercised in exempting any industry or product from financial incentives. (For example, China can avoid the runaway problem in the US with light-duty trucks given their historic exemption from gas-guzzler taxes and relaxed CAFE standards.) Exemptions can bring about excessive gaming.

Avoid National Pre-Emption of Local and Regional Transportation Policies

Reward policy innovations, do not hinder them. Facilitate technological breakthroughs by avoiding national pre-emption of energy and environmental policies. (In the US, states like California have tried to address many of the nation's vehicle fuel economy issues, but the federal government has legally challenged these state policies. (The California Air Resources Board recently adopted a CO_2 standard, but there is concern that the federal government will pre-empt this policy.)

Approach These Issues Believing That You Know Enough to Act

Where benefits greatly exceed costs, back up fiscal transportation policies with ample documentation on their costs and benefits. (US and EU environmental agencies have extensive experience with these cost-benefit analyses.)

Where cost-benefit calculations do not provide clear guidance, acknowledge the limits of estimation models. Do not fuel endless arguments over the exact amount of external costs. Adopt the statement, "we know enough" to act, even though the precise value of a certain external costs is impossible to ascertain. (A research project on transport in the Alps, undertaken on behalf of the European

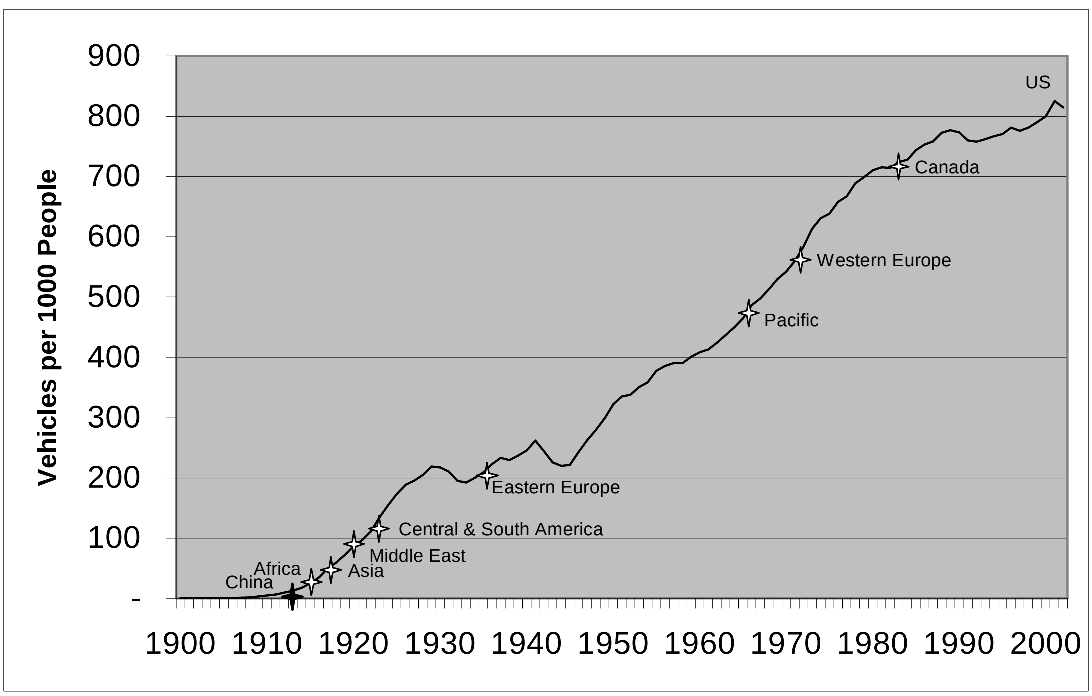
Commission along with a group called Alp-Net developed this approach and is using it successfully.)

With careful planning, effective implementation, and strategic management, China has the opportunity to expand its economy while still managing the problems associated with a rapidly growing transportation sector. Expediting fiscal transportation policymaking is important. Once cars prevail over all other transportation modes, the problems become much more severe and difficult to address. There is a significant cost to doing nothing. This is a critical moment for China and us all.

I. BACKGROUND– THE STATE OF TRANSPORTATION IN CHINA

Mobility is the hallmark of a modern, thriving economy, making transportation a vital contributor to job creation, business investment, and economic growth. But nothing comes without a cost, and transportation is no exception. The problems associated with cars and trucks are especially pronounced: traffic congestion, petroleum dependency, air pollution, ecosystem damage, climate change, and a host of other challenges. Several decades ago, only advanced Western economies had to worry about these problems. There were too few personal vehicles in developing nations like China for government officials to be concerned about their social impact. But this is no longer the case. China is experiencing rapid economic growth, and its transportation sector is expanding at an accelerating pace. The Chinese passenger car market grew tenfold between 1990 and 2000.[1] Demand has increased especially rapidly since 2002, when local automakers launched a price following China's entry into the World Trade Organization.[2] While the number of vehicles per capita in China remains much lower than in the United States, the trend is clearly upward (Figure 1).

Figure 1
Vehicles per Thousand People:
US (Over Time) Compared to Other Countries (in 2002)



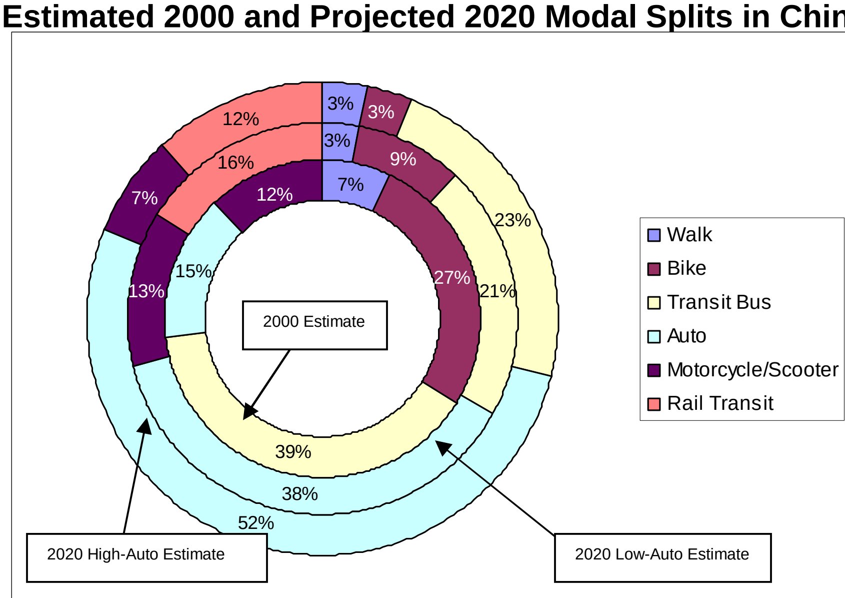
Source: Davis, S., 2004.

Loss of Alternative Transportation Modes

The growth of personal cars will have significant impacts on Chinese travel habits. As people move farther apart increasing their distances traveled daily, bus and car modes will replace walking and bicycling. These modal shifts profoundly reshape cities and alter quality of life as witnessed worldwide. Mexico City and Sao Paulo, for example, where cars provide 20 percent of all trips, are almost paralyzed by car traffic.[3]

An estimated 27 percent of the Chinese public used bicycles and 7 percent walked, based on the number of trips taken in 2000.[4] Use of these modes is projected to shrink in the next two decades. (Figure 2). Non-motorized travel has already fallen substantially over the past couple of decades. The use of bicycles has dropped by an estimated 16 percentage points while pedestrian travel has declined by about 9 percentage points in China's cities between approximately 1985 and 2000.[5] These modal shifts will have major environmental, public health, energy, and equity impacts.

Figure 2
Estimated 2000 and Projected 2020 Modal Splits in China

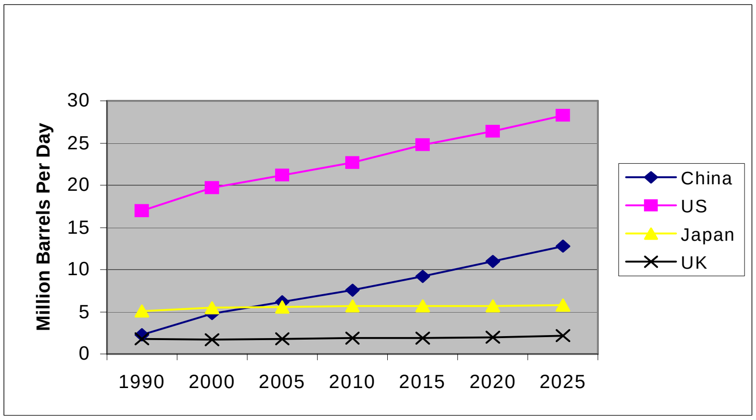


Source: Chinese Academy of Engineering and US National Research Council, 2003.
Note: These estimates and projections are most likely based on relative share of the numbers of trips, not distance traveled.

Growing Oil Dependence

As the world's most populous country, China is now the second largest energy consumer after the United States. In 2003, China surpassed Japan to become the world's second-largest petroleum consumer, with total demand of 5.6 million barrels per day (BPD). (Figure 3). China's oil demand is projected to reach 12.8 million BPD by 2025, with net imports of 9.4 million BPD. Over the next two decades, China's oil imports are expected to grow from 36 percent to 73 percent. Chinese oil demand has become a very significant factor in world oil markets, accounting for nearly one-half of world oil demand growth over the past four years.[6]

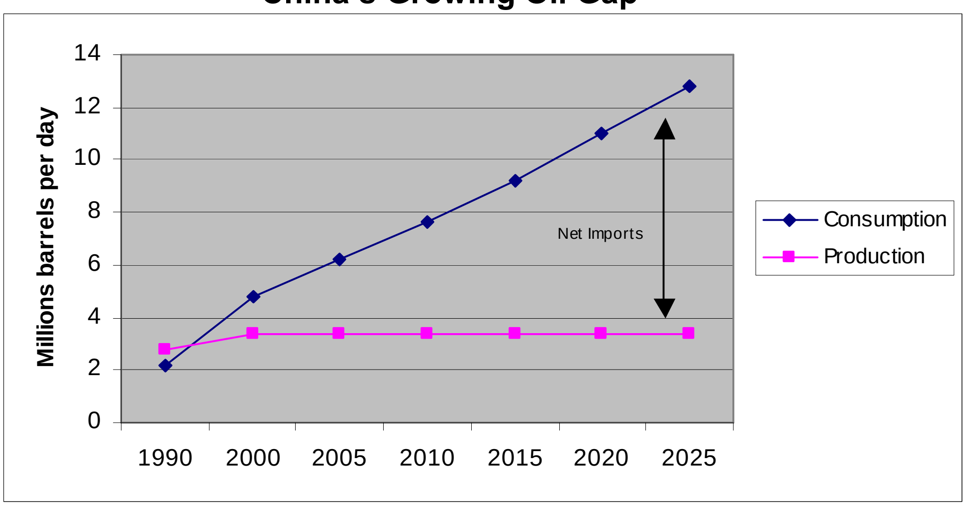
Figure 3
Historic and Projected Oil Consumption



Source: EIA, 2004a, Table A4.

China, like the US, does not possess enough domestic oil to fuel itself. China's transportation system will never be self-sufficient as long as it runs on oil. As a net importer for the past 10 years, China has been mainly focused on meeting domestic oil demand. (Figure 4). Today, half of China's imported oil comes from the Middle East, with Saudi Arabia alone accounting for 17 percent.[7] Without sound fiscal policies to increase China's transportation energy efficiency and utilization of non-petroleum fuels, reliance on unstable international oil supplies will only mount.

Figure 4
China's Growing Oil Gap

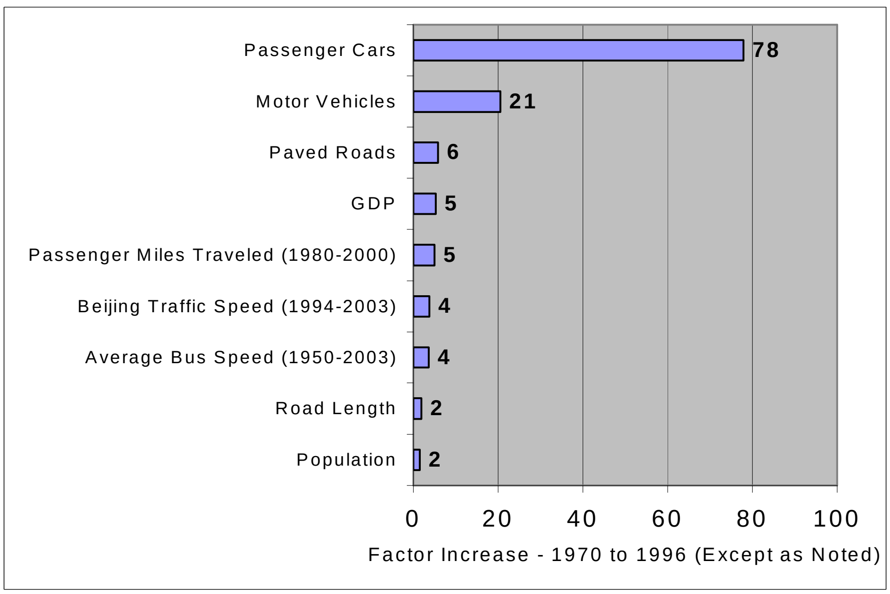


Source: EIA, 2004a.

Increasing Urban Traffic Congestion

Energy consumption and oil imports are major issues facing China's transportation system, but they are not the only concerns. Personal mobility in China has soared in the past two decades, with passenger miles traveled increasing fivefold.[8] However, the road system is failing to keep pace with China's growth in cars and their use. While the kilometers of paved roads in China increased by a factor of 6 between 1970 and 1996, the number of passenger cars increased by over 75 times.[9] (Figure 5). As a result, major cities are already experiencing traffic gridlock. The average speed of buses in major cities has dropped by a factor of 4 over the past five decades. In Beijing, the average traffic speed has fallen from 45 kilometers per hour (km/hr) in 1994 to 12 km/hr in 2003, with some arterial roads creeping along at only 7 km/hr.[10]

Figure 5
China's Transportation and Economic Growth Factors



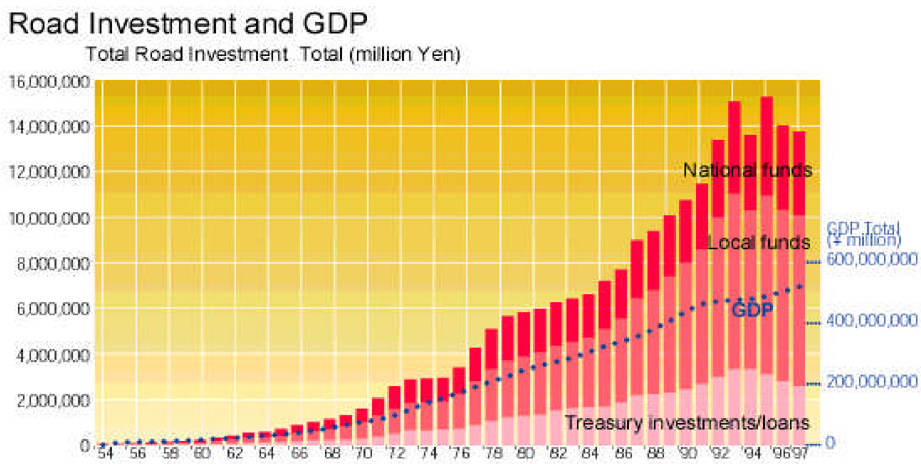
Sources: Populations, road length, GDP, paved roads, motor vehicles, passenger vehicles - Chinese Academy of Engineering and US National Academy of Sciences, 2003; Passenger miles traveled – International Energy Agency, Energy Outlook 2004a; and Average bus speed, Beijing Traffic speed – Zhong-Reng Peng, 2004.

Solving congestion by simply building more roads does not work. More roads induces more travel. More travel means more congestion, energy consumption, oil imports, air pollution, and on. Without fiscal policies that price roads and parking, improve vehicle fuel efficiency and reduce emissions, and generally apply pay-as-you-go strategies, China's transportation problems will spiral out of control.

There are numerous examples around the world where policymakers now realize that road building does not necessarily bring economic benefits and even results in irreversible environmental damages. In Japan, for example, public investment in roads is being thoroughly re-examined. The government has funneled huge sums of money into the road sector to stimulate the economy, hoping to lift Japan out of a long recession.

Economic growth has been negligible as a result and there is now a dangerously-large national debt. Since the end of World War II, Japanese road investment has grown by a factor of 221 while GNP has only grown by a factor of 59. (Figure 6).[11] Road building is not obviously fueling Japan's economy. But it is creating destructive environmental loads that are counterproductive to a healthy economy and strong workforce.

Figure 6
Road Investment and GDP in Japan



Source: Japanese Ministry of Land, Infrastructure, and Transport, 2000.

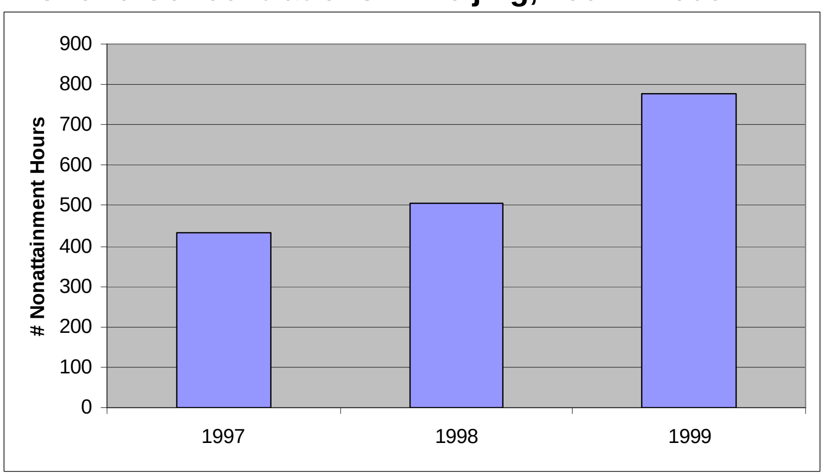
In the UK, policymakers are warning against assuming that road building will bring jobs and that catering to cars is the key to economic success.[12] Not a single study has provided conclusive evidence that economic benefits have resulted from simply building roads. Business viability, profitability and private investment decisions are not proving to be significantly dependent on road building. There is greater evidence, on the other hand, that road investments can be detrimental to the economy. A "two-way-road" effect has been borne out in the UK, whereby public funding of new roads that make it easier to drive "to" a new place also make it easier to travel further away. In North Wales, for example, expensive road improvements have greatly increased truck travel as freight is now transported at much greater distances than before. This growth in truck travel comes at an economic cost. The UK has found the relationship between transportation and the economy to be complex. The country is focusing on totally restructuring their transportation policies and investments to bring about long-term economic benefits.

In the US, despite enormous sums of money spent building the world's most extensive road system complete with sophisticated signals and controls, has witnessed increasing congestion, oil imports, air pollution, and traffic accidents. Such unfettered growth in vehicles (cars and trucks) and the miles they are driven is invited by road building. When roads replace public transportation, bicycling, and walking, it becomes difficult to solve transportation problems. Major US cities have been harmed economically as roads lead jobs and people farther and farther out to less developed suburban and rural areas.

Increasing Urban Air Pollution

China's rapidly growing vehicle fleet has resulted in a significant increase in urban air pollution. Data indicate that standards for ozone have been exceeded in several metropolitan areas during the last decade, with a clear upward trend in Beijing.[13] (Figure 7). Efforts have been made to improve air quality in Beijing and other Chinese cities. But reducing pollution from stationary sources has been the primary focus of these air quality improvements. As the number of vehicles grows significantly, mobile source (vehicle) air pollution will overwhelm any improvements in air quality from stationary source controls. Chinese vehicle emission standards allow cars to discharge almost twice as much carbon monoxide and three times as much hydrocarbons and nitrogen oxides as do the US emission standards. Mobile source air pollution will be a fast-growing concern for cities like Beijing in the future.

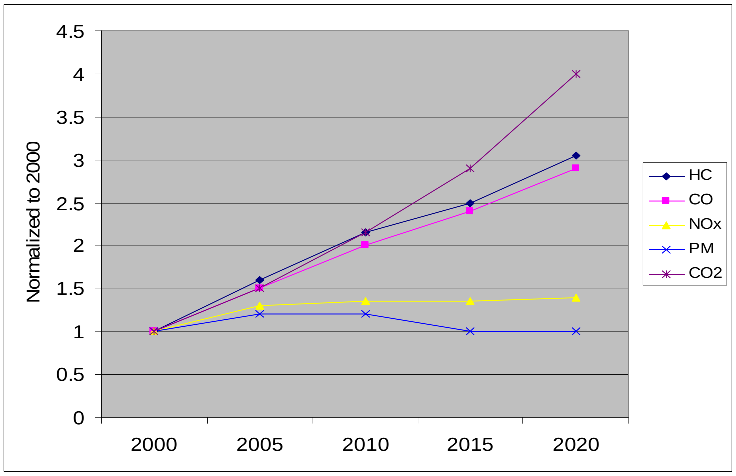
Figure 7
Ozone Concentrations in Beijing, 1997 – 1999



Sources: Chinese Academy of Engineering and US National Academy of Sciences, 2003 and He Kebin, Tsinghua University, Beijing.
Note: "Nonattainment hours means time that the respective air quality standard was exceeded in Beijing, which occurred on the indicated number of nonattainment days.

Air pollution has been estimated to cost China roughly 5 percent of GDP annually.[14] Heightened morbidity and mortality results from unchecked air pollution. Using medium-growth scenarios, motor vehicle pollutant emissions in China are projected to increase or stay at currently high levels. (Figure 8). Adopting the more stringent EU emission standards is an important next step. Without meaningful regulatory standards (and financial incentives), public health, the environment, and the economy could be severely strained. And certainly the quality of people's lives will deteriorate significantly.

Figure 8
Motor Vehicle Emissions in China, 2000-2020



Source: Chinese Academy of Engineering and US National Academy of Sciences, 2003; calculations by Michael P. Walsh.

Roadmap for this Report

While China is just beginning to manage the tradeoffs associated with increased personal mobility, other nations have been working on solutions for some time. The EU, Japan, Canada, and the US have all developed public policies to mitigate the negative side effects of personal vehicle use and promote a more sustainable transportation sector. China can take use these international best practices – to hopefully avoid other nations' transportation mistakes. A critical challenge is to design an appropriate set of fiscal policies for the transportation sector. Fiscal policies generate revenue to cover investment costs. As importantly, fiscal policies can create mechanisms to capture the negative externalities of transportation use, thereby sending the proper signals to users.

The first section of the report explains the role of sound fiscal transportation policies. The next section identifies specific policy options, explains how they work, and documents best international practices in each area. The report also discusses four common policy pitfalls to avoid. The conclusion of the report offers some broader lessons.

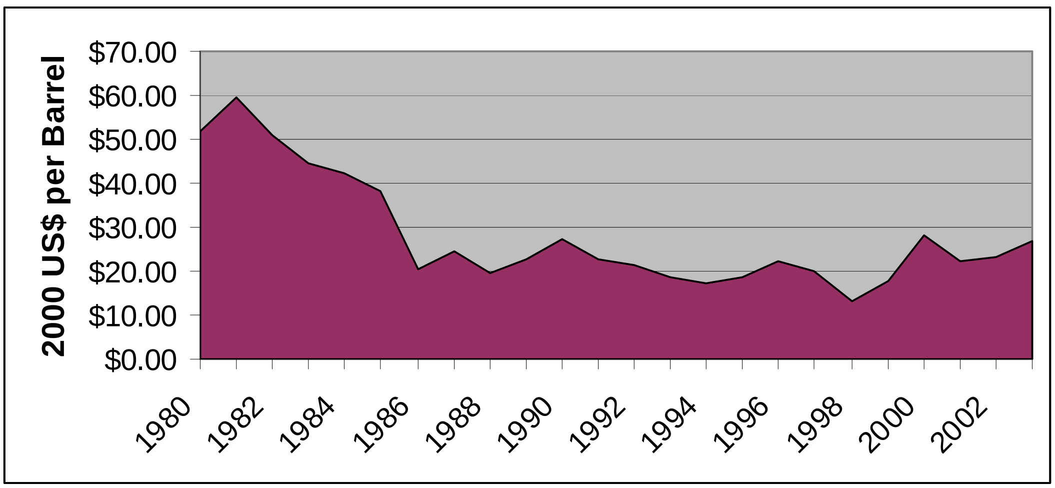
The policies in this report are not a panacea nor can they be copied without modification. With comprehensive planning and effective implementation, however, China has the opportunity to continue its economic expansion while still managing the problems associated with a rapidly expanding transportation sector. It is vital for China to design and implement a sound package of regulatory and fiscal policies before cars prevail over all other transportation modes and problems become too severe to address.

II. THE ROLE OF FISCAL POLICIES

Everyone likes a "free ride" – it is human nature. But what happens when millions, or billions, of people do not pay as they go? The results can be reek havoc with a country's economic growth, resource demands, public welfare, livability, and environment.

When fuel, roads, emissions, and cars are not assigned appropriate user fees, severe problems of congestion, pollution, and oil security set in. When the market signals that energy prices are low, falling, or erratic, a clear message is not sent to consumers, businesses, and manufacturers to conserve resources or invest sufficient amounts in energy-efficient technologies. (Figure 9). Left to cartel control in OPEC's hands, and absent sound policy intervention, world oil resources are unlikely to be efficiently priced and allocated.

Figure 9
World Oil Prices, 1980 - 2003



Source: EIA, 2004c.

Sound fiscal transportation policies offer enhanced mobility and economic growth while protecting the environment, saving energy, and managing congestion. These win-win programs come in the form of financial incentives, user fees, and recurring charges that are based on negative impacts. Such fiscal policies can achieve two important ends – managing demand AND generating revenues for wise investments in efficient transportation supply. Such programs have been put into practice around the globe. Carbon taxes in Sweden, congestion pricing in London, vehicle *feebates* in Austria, and clean vehicle incentives in Japan are just a few examples discussed in this report.

Fiscal transportation policies go hand-in-hand with transportation standards and regulations. Developing a comprehensive package of fiscal and regulatory transportation policies is the best way to assure desired energy and environmental outcomes.

Despite their benefits, the most promising fiscal policies have not yet been widely adopted. At their most basic level, there are widespread examples of these policies, detailed in this report. Optimal fiscal policy designs, however, have historically been thwarted by special interests. Nevertheless, policymakers and public interest groups have been tirelessly developing and advocating sound fiscal transportation policies. The potential benefits of this approach are so great that it is believed by most experts that they will ultimately prevail and succeed. The question is: who will lead the way? If China were first to adopt a comprehensive package of coordinated fiscal and regulatory transportation policies, the world may follow their lead.

Correcting Market Failures

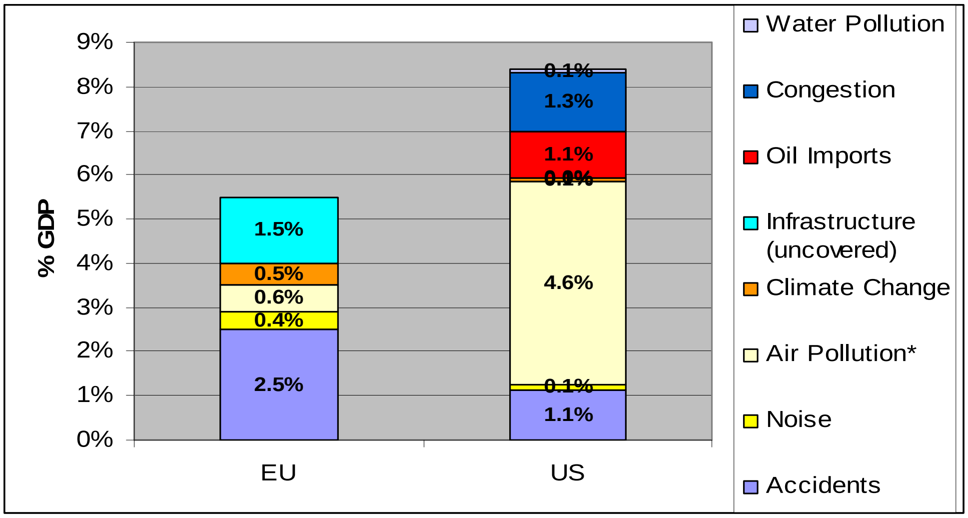
In theory, perfect markets allocate resources efficiently and equitably, producing an optimal outcome. This optimal outcome represents the alignment of prices and marginal social costs in all markets.

Many obstacles disrupt the perfect alignment of prices and costs leading to imperfect markets. First and foremost, prices are rarely set at marginal social costs and full external prices are typically not incorporated. Moreover, there is not always perfect competition (monopoly and oligopoly power exists). Perfect information is not always available for consumers. Even when there is a lot of information, most consumers are incapable of evaluating full social costs. Consumers are not sovereign; their demand preferences do not completely influence supplies of goods and services in the market. Such lags create disequilibria between demand and supply. Future generations are seldom considered, greatly discounting the preferences of those not currently born. Given these barriers, *perfect* markets really only exist in theory. So when markets inevitably “fail”, they do so in relation to an ideal that, in practice, cannot be achieved.

Despite its theoretical underpinnings, the optimal market outcome ought to be a long-term objective. Moreover, it should also be a benchmark by which to measure current distortions and assess partial steps taken to correct these distortions.[15] In transportation markets, this requires taxation and user fees to raise prices up to marginal costs (correcting for high external costs) and subsidies or rebates to lower prices down to marginal costs (to cover high fixed costs of desired products). It requires better information for rational public decisionmaking. And it requires competition and increased consumer sovereignty.

When policymakers ignore market failures, costly problems mount. Studies have concluded that the sum of external costs associated with transportation is a significant portion of GDP.[16] (Figure 10). In other words, the price to a nation’s economy of policy inaction is high. The failure to fully account for external social costs in the pricing structure in the United States has resulted in a 16 to 45 percent increase in externalities over the past decade. (Figure 11).

Figure 10
Average Estimates of Total External Costs of Transportation, % GDP

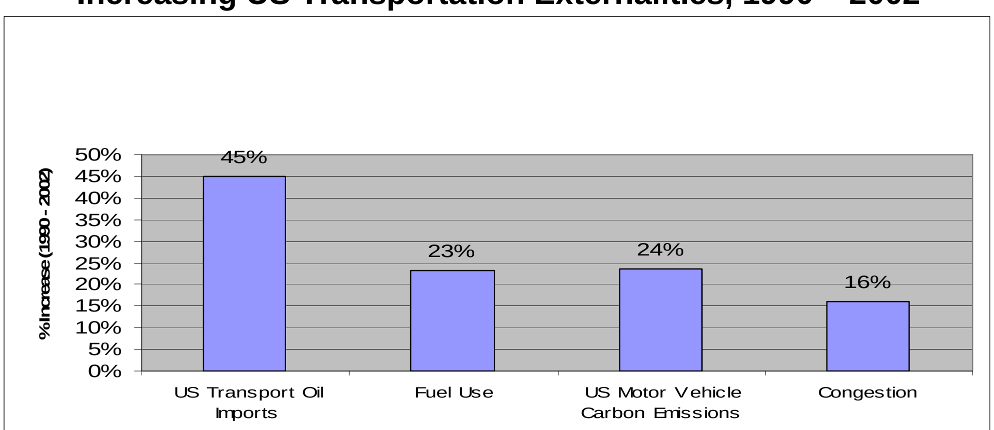


Sources: EU-IEA, 2000; US-Delucchi, M., 2003 and Davis, 2004.

Notes: EU-1998 data with only local air pollution values and missing data for oil imports, congestion, and water pollution; US-1991 data with total air pollution values and missing data for infrastructure.

Air pollution is one of the most pronounced externalities from conventional petroleum vehicles. Today, an estimated 125 million Americans breathe polluted air despite the tremendous sums of money invested.[17] While total pollutant emissions have been reduced, overall exposure has increased as the population grew in areas that do not meet US air quality standards. Between 1990 and 2002, an estimated 21 percent more Americans were exposed to unhealthy air quality. The urban areas of Los Angeles, New York, Chicago, Boston, Philadelphia, Houston, Dallas, and Phoenix are some of the dirtiest in the US.[18]

Figure 11
Increasing US Transportation Externalities, 1990 – 2002

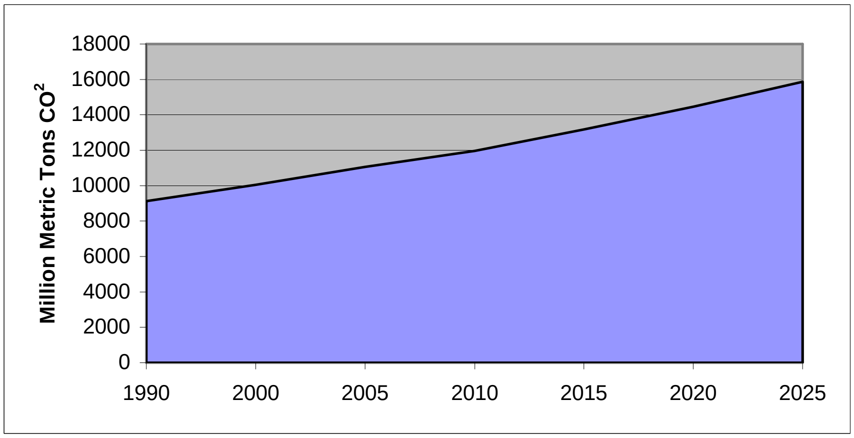


Sources: Oil Imports (mbpd): Davis, 2004, Table 1.7; Fuel Use (million gallons): Davis, 2004, Tables 4.1 and 4.2; US Motor Vehicle Carbon Emissions (million metric tons carbon): IEA, 2002a, Table 9; Congestion (% Peak Period Urban Highway Travel): TRB, 2002.

Designing policies that take our children and grandchildren into account help make transportation more sustainable. Resource depletion and irreversible impacts create significant problems for future generations. Climate change is one example of such an intergenerational problem caused by the market's failure to take future citizens into account. As a result, carbon emissions have been rising dramatically and are expected to continue to mount because the market is not internalizing their full social costs. (Figure 12).

Figure 12

Historic and Forecasted Growth in World CO_2 Emissions from Oil Use



Source: EIA, 2004a, Table A4.

There are several policy mechanisms that correct market failures. These are not mutually exclusive. One solution typically involves regulation. Establishing limits for performance and behavior is often necessary for guaranteeing certain outcomes, such as vehicle fuel efficiency and tailpipe emissions. Regulations can be very effective when their limits are set at appropriate levels. Because markets are inherently imperfect, there will always be a role for regulations to minimize those outcomes that must simply be avoided.

Another set of tools – fiscal policies – complement regulations in dealing with market failures. Specifically, fiscal policies can be packaged together to better align prices and marginal social costs. The wrong prices definitely lead to inefficient outcomes. So fiscal policies are a key part of the solution. Such policies include, taxes, fees, subsidies, rebates, exemptions from taxes and charges, and other financial strategies.

Public policies must be examined comprehensively. Any individual fiscal or regulatory policy is only one part of the total set of prices faced by users. Consumers react to the full set of relevant transportation prices and their relationships to each other. Thus, any particular fiscal measure (Level I, II, or III) discussed in this report can only be judged in relation to whether or not an *overall policy package* moves the full set of relevant prices toward a more optimal outcome. Any single or small number of policies, no matter how effective, cannot fix all problems. The EU is now engaged in a formal process of comprehensive fiscal transportation reform to correct for years of "piecemeal" policymaking.[19] China and other countries should follow the EU's lead adopting a comprehensive policymaking approach.

Generating Revenues

Fiscal policies help fix transportation problems. Taxing activities that have harmful side effects (such as air pollution, congestion, increased oil imports) is tightly tied to funding the solution. In other words, charging externalities and using these revenues to fund minimizing them goes hand-in-hand. This approach – known as "polluter pays" – is an important government responsibility that policymakers are uniquely capable of implementing.

The public acceptability of fiscal policy instruments is strongly linked to how the revenues are used. EU research suggests that revenues should visibly improve the situation.[20] When their revenues are invested in public transportation, clean fuels, successful research, and other popular programs, fiscal policies are more durable. The public supports externality taxes and user fees when they perceive that they do not go into a governmental "black hole".

The revenues generated by fiscal policies are instrumental in accomplishing several to crucial goals. Some examples of constructive uses include:

(1) Building and continually upgrading infrastructure, such as new public transit systems and cleaner fuel production facilities;

(2) Expanding and upgrading bus rapid transit systems that are already in Chinese cities;

(3) Promoting research, development, and demonstration (RD&D) to advance energy-efficient technologies, such as cleaner fuels and cleaner vehicles;

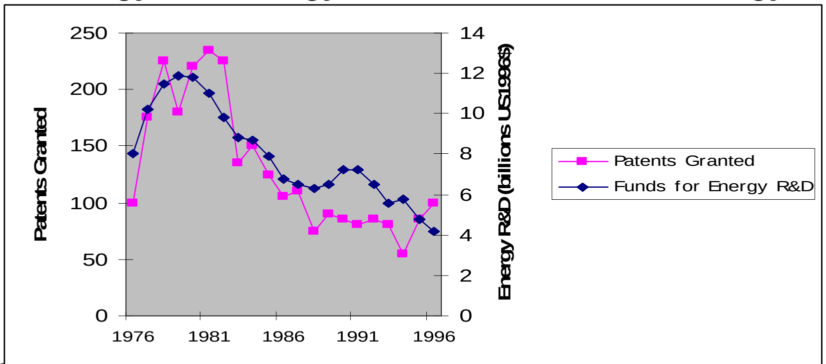
(4) Supporting administrative agencies who will develop and implement policies that promote cleaner and more fuel-efficient vehicles and transportation systems;

(5) Providing revenues for targeted performance-based incentive programs, such as rebates and tax exemptions; and

(6) Raising general revenues for other governmental programs that may be related indirectly to transportation, energy, and the environment.

Each of these program components is important to creating a sustainable transportation system. Without public funds a government cannot pay for public goods, such as transit and roads. Long-term RD&D – investments with long payback times – are unlikely to be conducted using private money. US energy technology patents track total US energy public- and private sector R&D. (Figure 13). The amount of funding devoted to energy R&D in the US is declining – representing only 0.25 percent of US R&D in 1995.[21] Fiscal policy revenues provide funds for these endeavors.

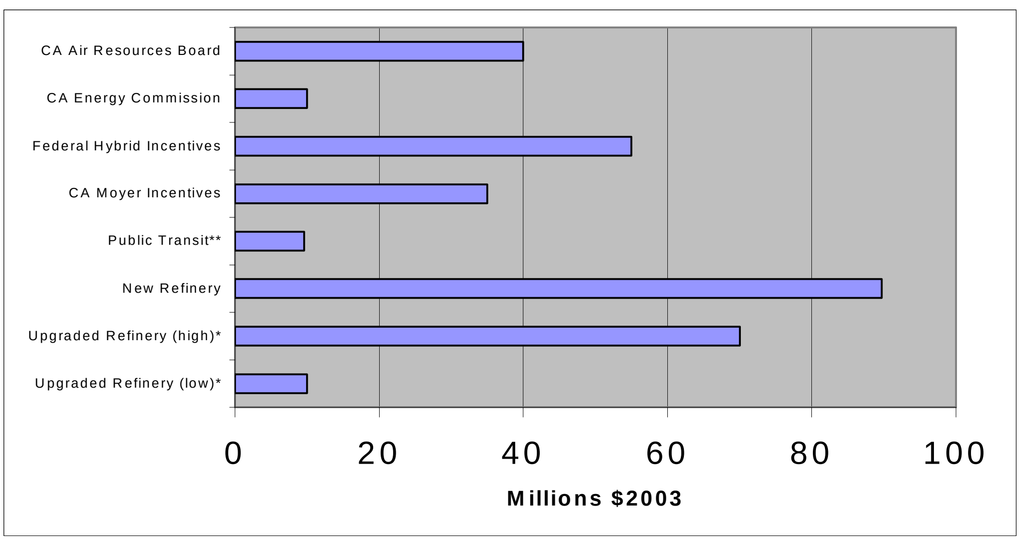
Figure 13
US Energy Technology Patents and Total US Energy R&D



Source: Margolis, R. and Kammen, D, 2001.

Fiscal transportation policies can help finance refinery upgrades needed to improve fuel quality in China. The better the fuel quality, the more effective vehicle pollution controls operate and the less pollution generated by the refining process itself. Such policies can also provide a portion of the necessary funds for the backbone of China's transport network – its railway system. Similarly these funds can offset the cost of the growing number of clean buses in China. (Figure 14). There are also numerous incentive policies, discussed later in this report, that are candidates for funding.

Figure 14
Examples of Energy and Environmental Transportation Program Costs (US$ 2003)



Sources: CEC and CARB: Estimates using, State of California, 2005;Refinery Upgrades: Hydrocarbons Technology, 2005 [Panipat Oil Refinery in India (low sulfur diesel production) and Bahrain (BAPCO) Refinery Upgrade (extra low sulfur diesel production)]; Federal Hybrid Incentives: US DOE, 2004; Public Transit: EIA, 2004a; Carl Moyer Incentives: Government Innovators Network, 2004.
Note: * $million/metric ton crude per year; ** $million/mile

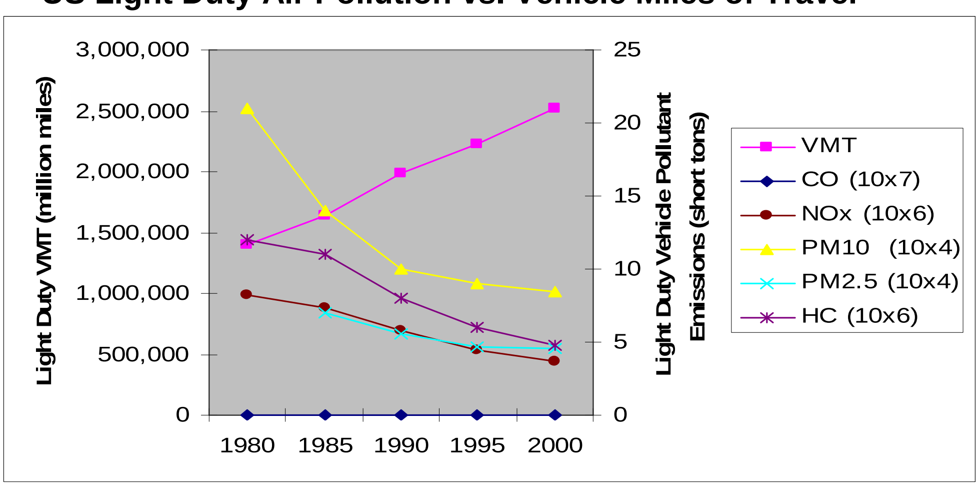
Revenue stability can pose political challenges for externality taxes. Finance ministers and budget officials do not want their income streams to fluctuate. The more successful the policy, the greater the externality is reduced and the lower the tax revenues. This is certainly the case for any single externality tax. However, waste and pollution are a fact of life. Physical laws dictate that matter cannot be destroyed. So as new products and processes are developed, new waste streams will result. For example, diesel fuel exhaust has changed over time. Old methods of controlling particulate exhaust have just created new problems from smaller (more noxious) particles. In order to keep revenue streams constant, fiscal policies have to be dynamic, as the precise nature of transportation externalities change.

Producing Economic and Public Benefits

Beyond correcting market failures and generating needed revenues, fiscal transportation policies produce economic and social benefits in their own right. Getting market prices right (by including externalities) can lead to more jobs, increased incomes, higher industry profits, and increased vehicle sales. Any given fiscal policy will generate individual benefits depending on its specific design. The bottom line, however, is that a clean, energy-efficient economy is more productive than a polluted, energy-inefficient one. As hosts of the 2008 Summer Olympics, Beijing has much to gain economically and socially by implementing sound fiscal transportation policies.

In addition to the economy, the public and the environment also benefit. When coupled with emission standards, fiscal transportation measures have reduced environmental damage, even as motor vehicle use has risen in the US (Figure 15). CAFE standards and gas-guzzler taxes, for example, have helped keep vehicle fuel consumption level as gasoline prices have fallen over the past few decades. These policies indirectly reduce healthcare costs, reduce morbidity and mortality, increase crop production, reduce energy imports, and minimize costs for securing oil imports.

Figure 15
US Light Duty Air Pollution vs. Vehicle Miles of Travel

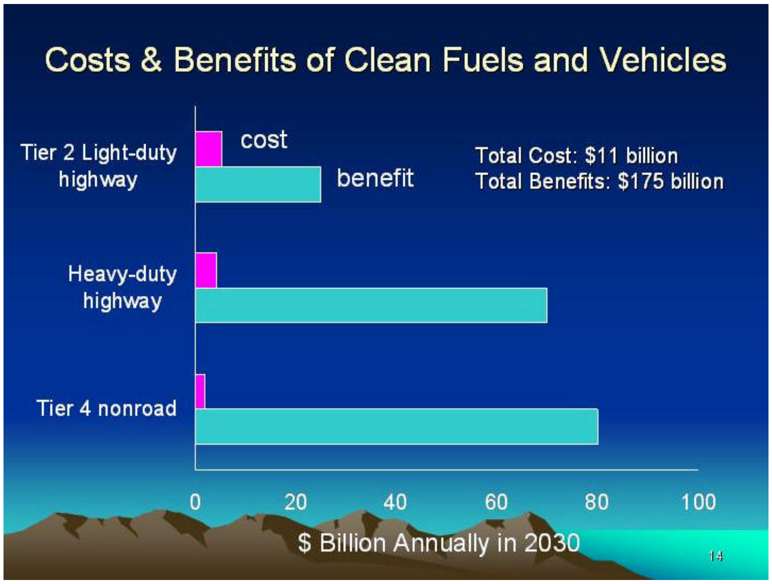


Source: Davis, S., 2004.

A few examples of such public health cost savings illustrate the value of these policies. Reducing the sulfur in transportation fuels and improving vehicle emission controls would save a portion of the estimated $13 billion (110 billion Yuan) caused by acid rain in China.[22] Fiscal measures that lower ozone levels caused by vehicles' nitrogen oxides and hydrocarbon emissions could save lives, reduce cardiovascular and respiratory diseases, and decrease a host of other health problems caused by smog exposure. Unnecessary deaths could be avoided; ozone concentration increases of 10 units are associated with a significant increase in deaths – 1.5 percent a day.[23] Policies that lower particulates would be especially beneficial to the health of fetuses, infants, children, and pregnant women. Taken together, fiscal policies that reduce energy and environmental damages from vehicles have overwhelming indirect benefits that cannot be overlooked.

It is widely recognized that emissions from cars and trucks increase morbidity and mortality. Such public health concerns are an important consideration for policymakers. It has long been known that motor vehicles that burn fossil fuels result in widespread disease and premature deaths. For many years, the US Environmental Protection Agency has studied the costs and benefits of controlling vehicle emissions. Benefits outweigh costs by a margin of over 10 to 1, providing political support for ongoing efforts to develop even cleaner fuels and vehicles in the United States. (Figure 16).

Figure 16



Source: Michael Walsh, 2005.

Adopting fiscal policies will help line up prices with full social costs. This will promote more sustainable transportation practices in China. And a more sustainable transportation sector means a stronger economy and a healthier public.

III. The Theory Behind Selecting the Right Fiscal Policy Tools for Comprehensive Adoption

There are three primary ways to craft policy to bring about change – use a carrot (incentive), a stick (disincentive), or a command (regulation). These approaches can be used simultaneously. In fact, critical objectives – such as energy conservation and pollution abatement – require a combination of tools in order to be successful. For example, motor vehicle performance standards are the best way to guarantee a baseline for energy efficiency and emissions. But these strategies are not likely to spur ongoing innovations in vehicle technology. Instead they require that individual vehicles be above a floor. Financial incentives (or disincentives) move the market beyond these minimums, rewarding (or penalizing) manufacturers and consumers for the production and use of clean energy-efficient vehicle technologies.

Choosing who a fiscal policy applies to is important. There is a big difference between taxing vehicles themselves and taxing their use. Vehicle taxes influence the decisions manufacturers and consumers make regarding what vehicles to manufacture and purchase. Taxes and fees on all vehicles in use (such as fuel taxes and annual charges) tend to influence how vehicles are used. These taxes should be implemented together for maximum affect.

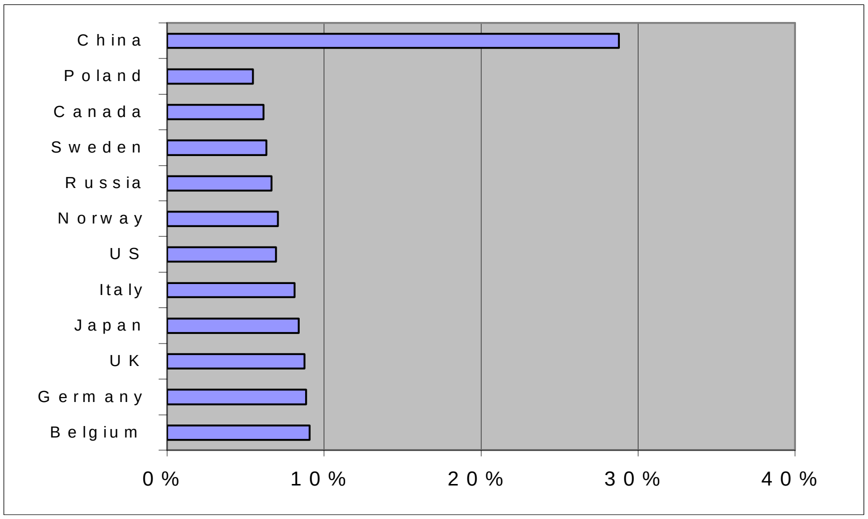
Fiscal policies, especially taxes and fees, can be regressive in that they impact those with low incomes more than wealthier individuals. Care should be taken in designing any fiscal policy to minimize, and if possible avoid, adverse equity impacts. The goal should be to reduce transportation externalities while increasing overall social welfare. Charges should be means tested. When low-income individuals pay reduce fees, are exempt from taxes, and/or compensated in other ways, fiscal policies can be applied fairly. Using revenues to build transit serving lower-income areas is one example of equity compensation. Many creative ways exist to minimize equity impacts from a pay-as-you-go system.

The wide array of incentives, disincentives, taxes, and fees is presented in this section. This is geared toward policy analysts and the discussion is more theoretical – explaining how fiscal policies work and offering different design options. Section V presents detailed examples of international best practices in place with real-world experience and what we can learn from fiscal policies in use around the globe.

New Vehicle Financial Incentives and Disincentives

In most countries, new vehicles only represent about 7 percent of all vehicles on the road. However in China, the world's fastest growing auto market, this figure may currently be closer to 29 percent.[24] (Figure 17). So while fiscal policies focused on new vehicles are a small, but important, part of the solution in the US, EU, and Canada, they are a large and crucial part of the solution in China.

Figure 17
Portion of New Vehicles On-Road in Various Nations, 2000



Sources: Davis, 2004; Automotive Engineering Online, 2005; National Geographic News, 2004.
Note: Figures for new vehicles represent those vehicles sold in the calendar year 2000, not model year.

Regardless of where you live, purchasing a new car presents an enormous financial decision. Even in China where "affordable" domestic car models sell for $4,000 – 7,000 (US $), this accounts for 110 percent of the Chinese per capita income. Britons spend 88 percent of their per capita income on an average new car, the Japanese spend 66 percent, and in the US it is 57 percent.[25] Even a used, three-year old Russian-made car costs about 60 percent of the average Russian salary.[26]

The high cost of new cars makes buyers very price sensitive. Information about the vehicle's energy efficiency or emissions can be applied all over the car, but without financial backing, such informative labels can get lost in the hype and high expense of car-buying**.**

American researchers have found that a new car's fuel efficiency is less important to the average consumer than even its appearance.[27] Certainly a majority of buyers consider the vehicle's power and performance to be much more important than its environmental characteristics. While vehicle fuel economy survey rankings are up 15 percentage points from a year ago, and have surpassed higher horsepower for the first time, energy efficiency still ranks only 23, tied with the number of cup-holders in a vehicle.[28] In Japan, the fuel economy situation is in greater flux. There, vehicle styling and instrumentation still get high marks. But the sluggish Japanese economy has consumer preference shifting to lower-priced, higher fuel-efficiency vehicles.[29] Chinese consumer preferences are, at present, similar to the Japanese.[30] However, desires tend to change as people become wealthier as witnessed in the US market that once preferred small, Japanese cars thirty years ago and now desires big, expensive, fully-loaded American sport utility vehicles and super-sized light-duty trucks.

Despite its importance, surprisingly little is known about how consumers estimate the value of improved fuel economy (and probably pollutant emissions) and how this information is factored into car-buying decisions.[31] Preliminary investigations indicate that consumers may not find it worth the effort to fully investigate the costs and benefits of higher fuel economy.[32] This lack of relevant information leads to market failure. Thus, public information and media reporting about vehicle fuel efficiency and its links to economic, energy, and environmental benefits should be touted to the Chinese public.

A car can run for 15 years or more. Given the long lifetimes of motor vehicles, it is critical that cleaner and more fuel-efficient cars be manufactured, sold, and bought by the public, sooner rather than later. Then as the vehicle fleet ages, improved vehicles become the norm.

An array of financial incentives and disincentives have been developed and, in some cases, tested for motor vehicles. Financial incentives reward consumers for buying products with better energy and environmental performance. Financial disincentives penalize consumers who ignore a product's societal impacts. Direct, up-front costs enhance government's ability to convey technical information to consumers. Incentive policies help consumers make better choices, usually within a pre-determined range of models under consideration. Over time, manufacturers respond to these policies. A wider selection of improved vehicles qualifying for financial incentives are made and sold.

Fiscal incentives work best when based on energy and environmental performance rather than specific technologies or fuels. Caution should be exercised in picking technology "winners" and "losers". Government agencies need to be strategic in the event that they offer incentives to specific technologies. The goal should not be to simply gain market share for a given technology. A more sophisticated agenda – creating competition between different fuels and vehicles, promoting technological breakthroughs in vehicle components, spurring marketing of new technologies – is needed. Deft policymaking can bring about change indirectly without getting fixated on the "best" technology. California's push for methanol in the 1980s, while not entirely productive, is thought by many to have pushed the development of reformulated gasoline. Likewise, California's focus on electric vehicles, while few are on the road today, spurred the development of more popular, cleaner hybrid-electric vehicles. Similar skill should be exercised in advancing hydrogen fuels and vehicles so as to motivate preferred energy and environmental outcomes from the use of this energy source.

Fees, rebates, "feebates", tax credits and fee exemptions are different types of fiscal policies that can be assigned to new motor vehicles. These tools attempt to "pull" the market toward an energy or environmental goal rather than "push" the market as regulations do. Policymakers can use fees alone, rebates alone, or combine fees with rebates creating "feebates". These tools are only are only effective when set at meaningful levels. Adopting high enough fees and/or rebates that affect consumer and manufacturer behavior is vital to their success.

Rebates (Plus Fee Exemptions and Tax Reductions)

Rebate policies offer cash back or a credit to those who buy better-performing vehicles. These policies can apply to consumers, businesses, and/or manufacturers. Exemptions from motor vehicle fees are another way to offer vehicle rewards (such as in China with a 30 percent consumption tax exemption for automakers meeting EURO III emission standards[33]). A third mechanism is tax reductions. Lower taxes can also be used to reward those who purchase better vehicles.

Rebates require sufficient funds for their financing. Therefore, the design of these policies is crucial. If rebates are set too high and too few funds are set aside, these programs quickly become insolvent. This is an ongoing risk with rebate programs. The Netherlands, for example, offered fee exemptions for efficient vehicles. Because Denmark's registration fees are so high, the public responded strongly. The program's huge success was its downfall; just three months after initiation, the program folded due to lack of public funds.[34]

Japan has large rebates for hybrid-electric vehicles. In addition to a 2.7 percent low-emission vehicle reduction in sales tax, an additional 2.2 percent tax break is offered to hybrids.[35] A 2005 hybrid Toyota Prius costing approximately 2257500 Yen in Japan can save its buyer at least 110620 Yen in taxes. Such large rebates are making hybrids more attractive to car buyers in Japan.

Fees (and Vehicle Taxes)

Fees are the mirror image of rebates. This policy discourages bad outcomes but does not encourage good results. Targeted fees impose costs only on poorly-performing vehicles. Fees result in the net collection of new funds, as do taxes. The level of fees determines their effectiveness. When fees are set low, they serve primarily as revenue-raising schemes. However, when set high, fees can also alter behavior. Consumer decisions change to avoid fees and taxes. Fees can be placed on consumers and/or manufacturers. Some form of fees or taxes is necessary to generate revenue for sustainable transportation programs. The more closely linked the fee is to the externality, the more effective it will be in reducing the externality. Setting fees or taxes too high can bring about opposition. While more effective, high fees will require means testing to reduce their equity impacts on low-income individuals. Complex equity issues will need to be addressed if this strategy is adopted.

Vehicle fees range widely by country. Singapore is at the high end of the spectrum. There, the owner of a new subcompact Toyota Corolla has to pay an estimated S$57,000 in fees – nearly 3 times the cost of the car itself.[36] These high fees have a direct impact on demand. At the low end, US states like South Dakota charge only an estimated US$450 for vehicle fees on a $13,780 Toyota Corolla – about 3 percent of the purchase price. Such low fees do nothing to influence vehicle ownership.

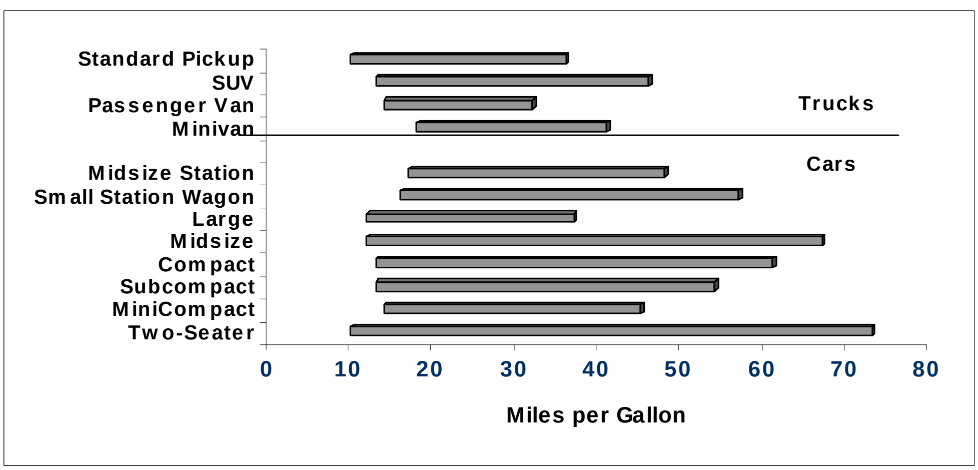
Feebate (Fees plus Rebates)

The policy of combining fees and rebates (termed "feebates") is designed to encourage the manufacture and purchase of cleaner and/or more fuel-efficient vehicles. Feebates contain two common components – "fees" (costs imposed discouraging use of inferior goods) and "rebates" (rewards subsidizing purchase of better products). This policy design adheres to the "polluter pays" principle. Consumers are free to purchase any vehicle, but they receive a rebate or pay a surcharge if their selection is above or below average in terms of its externalities.

Feebates work best when there is a large selection of vehicles to choose from. This is certainly the case regarding vehicle fuel efficiency.[37] (Figure 18). Similar ranges exist in the EU.[38] If a greater number of "best-in-class" vehicles were purchased, overall fuel economy would increase dramatically. One aim of feebates is to shift consumer purchase decisions on the margin throughout the market. The other, probably more important, response is when manufacturers accelerate their adoption of fuel-efficient technologies.[39]

Feebates such as those studied by Oak Ridge National Laboratory that set fees and rebates high enough are projected to have a meaningful impact on new auto emissions and fuel economy. A 60 mpg hybrid car would receive a US$1,460 rebate while a 12 mpg SUV would pay a $5,200 fee.[40] Existing feebate programs in place have been less effective because they tend to set rebates too low, such as in Ontario, Canada with a flat $100 rebate or Austria whose rebates currently are set too high (78.5 mpg) to apply to any vehicles for sale.

Figure 18
Ranges of Best and Worst US Fuel Economy in Each New Vehicle Class



Source: US Environmental Protection Agency and US Department of Energy, Fuel Economy Guide, 2005.

A key advantage of feebates is that they provide an on-going incentive to increase fuel economy as new technologies are developed.[41] Other vehicle fuel economy policies, including gas taxes, gas-guzzler taxes, and CAFE standards may not be as effective as feebates at increasing vehicle energy efficiency because they are less dynamic tools. Consumers tend to under-value fuel savings, but accurately reckon vehicle prices in their purchase decisions. Moreover, manufacturers tend to accurately weigh the costs and benefits of increasing miles per gallon (MPG) so as to avoid fees and capture rebates.[42] These behavioral patterns play to the strength of vehicle feebate policies.

Feebates can be tied to any one or more externality, including fuel economy, emissions, miles traveled, safety, or others. A rate for each externality needs to be set. The simplest types of feebate systems are those that set a constant dollar rate per unit of externality (i.e., $ per gallon of fuel consumed or $ per gram of pollution emitted). If vehicles travel approximately the same number of miles per year, constant rates lead manufacturers to equate the marginal cost of saving a gallon of gasoline (or gram of pollution) across all vehicle types. [43]

A "pivot" point needs to be selected to divide vehicles charged fees from those receiving rebates. This point can and should change over time as vehicles improve in response to feebates. A single pivot point can be used for all vehicles or vehicles can be divided into classes (e.g., passenger cars and light trucks) and different pivot points can be assigned to each class. Depending on where the pivot point is set, this policy can be designed to either generate revenues or be revenue neutral. Revenue-neutral designs are self-financing (self-funding), so that the revenues collected from imposed fees cover the costs of rebates and do not require general government revenues for program implementation. This self-funding characteristic is an inherent benefit for feebates since they may not be viewed as a "tax."

Charges on All Vehicles

Purchase incentives and disincentives are useful for bringing cleaner, more fuel-efficient vehicles to the market, but these policies target new vehicles. Total energy consumption and pollution depend not only on whether vehicles employ cleaner and more fuel-efficient technologies, but also on how much cars are driven, when they are driven, where they are driven, how much fuel they use, what type of fuel they use, how well they are maintained, whether cleaner alternative-transportation modes are used, and when vehicles are scrapped.

Fiscal policies that apply to all vehicles help address these components and are an important part of the overall solution. These strategies employ several different types of user-related charges. These include: user fees, liability-based taxes, externality charges, benefit-based taxes, and regulatory fees.[44]

General-Revenue Taxation

Sales, income, value-added (VAT), and other such taxes that fund general government revenues are prevalent in any country's economy. These fiscal instruments do not represent "pay-as-you-go" systems as user fees do. They do not yield direct benefits those who pay as beneficiary-based taxes do. Liabilities and externalities are not captured through their charge. Regulations are not enforced through their incidence. Basically, these fiscal policies are not capable of achieving societal goals other than indirectly, through strategic expenditures of revenues. Examples in the transportation sector of these fiscal tools are vehicle sales taxes and vehicle VATs. The best application of these taxes is when they are based on social goals and made to resemble liability-based taxes or externality charges, discussed below.

User Fees

User fees are payments made by consumers or businesses for goods or services provided by the government., consumed voluntarily, and not generally shared by other members of society. These "pay-as-you-go" systems are common throughout the economy. They are similar in kind (but not necessarily in amount) to payments made in ordinary business transactions. Given the large number of vehicles in use, use, these fees tend to be lucrative and are used to fund specific programs or agencies.

The problem with user fees is that these charges usually are not set at the marginal social cost. When designed as fixed fees, as with most tolls vehicle fees, and parking charges, these policies do much more to raise revenues than affect consumption. Thus, the effectiveness of user fees is dependent on their specific policy design whereby these policies both target externalities and generate revenues. When user fees do not take externalities into account, large indirect costs mount in the transportation sector. Alternatively, strategic user fees can achieve private and social goals simultaneously.

Transportation-related user fees include, highway and bridge tolls, vehicle leases, insurance premiums, parking pricing, and road pricing. Road pricing and tolls require motorists to pay directly for driving on a particular roadway. Paying a fixed rate per mile (or, even less effective, a flat toll regardless of distance driven) does little to alter driver behavior and merely amasses revenues. Toll roads have a long history in funding bridge and highway construction. Such tolls, while not technically user fees, are more fee-for-service, with revenues dedicated to roadway project costs. Privately-financed roads often use tolls to recoup their investments and these fees are structured to maximize revenues. Cordon, or area, tolls are another form of road pricing. Motorists who drive in a particular area, usually a city center, must pay a toll. Some cordon tolls only apply during peak hours and simply require vehicles to display a pass for passage into the area.

Parking pricing applies to those who use parking facilities. Similar to road tolls, this policy is often used to generate revenues or recover facility construction and operation costs. But creative parking policies can reduce vehicle traffic (and energy consumption), especially in highly-congested urban areas. Often parking is provided free or charge or subsidized. Implementing parking pricing represents a significant change from current practices. Unpriced parking is not really free, however, consumers ultimately pay for parking costs through higher taxes, higher retail prices, and reduced wages and benefits. Parking pricing can take many forms. These include:

- Imposing a parking tax
- Eliminating or reducing tax exemption of parking subsidies
- Eliminating early bird/all-day discounts, or replace with peak-period surcharges
- Replacing free parking with transportation allowances coupled with the introduction of parking rates
- Offering the value of the subsidized parking space back as a cash credit to persons who agree to drive (take transit, walk, bike) – termed "Cash-Out"
- Offering discounted parking for high-occupancy vehicles

- Levying an entry surcharge on single-occupancy vehicles (SOV), particularly during peak periods
- Imposing charges at major traffic generators, such as malls and activity centers, hospitals, universities, and entertainment sites
- Levying a parking tax on public or private parking operators
- Restricting off-site parking in residential areas and/or installing meters or increasing metered rates
- Reducing parking supply or raising parking costs at residential locations

Systems where employers offer travel allowances, or financial payments to workers for commuting and then charge the full cost for parking provide a financial incentive to travel to work by any other means than driving alone. This creative use of user fees is called "Parking Cash-Out".

Another creative fiscal policy is charging for auto insurance at the gas pump. This insurance arrangement works better than simply regulating insurance coverage. It eliminates uninsured motorists and increases the price of gasoline with commensurate reductions in fuel consumption.

Beneficiary-Based Taxes

Taxes on benefits are charges levied on bases correlated in varying degrees with the use of a publicly provided good or service. Benefit taxes may be proxies for user fees and are usually dedicated to governmental funds. Many transportation and energy conservation charges are benefit taxes. Often they are excise taxes. These taxes are considered user charges when government laws create a relationship between the collection of a tax on a product and the provision of a good or service.

Beneficiary-based taxes differ from fees, not only in the structure of the charge, but also in the degree of connection between the payers of the charge and the benefits or services that are financed with the proceeds. Taxes are more likely than fees to be levied at uniform rates with less regard for differences in cost when using the transportation system.

Fuel taxes and truck weight-based taxes are examples of beneficiary-based taxes. Fuel taxes, as they are currently configured, do not spur the use of fuel-efficient vehicle technologies or change vehicle purchase decisions.[45] Instead, they do more to raise general government revenue. And the higher the rate, as in the EU, the more funds they generate and the greater their connection to vehicle fuel efficiency. These fiscal policies are not sophisticated, rather they are a blunt tool that generates revenues. Externality-based charges for fuel can be designed to complement these taxes so that social and private benefit result.

Liability-Based Taxes

Another group of taxes are dedicated to covering liabilities. These charges are levied for the purpose of abating hazards or compensating for damage. Where possible, the government collects damages from responsible parties. At times, taxes on products and actions that might have some connection with the cause of damages serve as proxies for recovering damages from responsible parties.

The use of taxes to finance liabilities illustrates the trend toward using dedicated taxes to pay for environmental and other damage imposed. These policies are related to externality charges. They represent an attempt to include within the final prices of certain goods the costs imposed on society of producing or consuming them. Carbon taxes are one example of this policy. Ordinary taxes, such as vehicle sales taxes and value-added taxes, can be converted to these externality charges by changing their basis to mitigate a social damage.

Regulatory Fees

Regulatory fees are charges based on the government's power to regulate particular businesses or activities. In general, these charges are for functions that are traditionally performed by government rather than the private sector. Regulatory fees include charges for vehicle licenses, registrations, circulation taxes, and vehicle emissions inspections. Such charges should be, but are not always, undertaken in order to make sure that transportation activities avert environmental or other damage to public health and safety.

These charges can be used to directly support government standards, such as emissions and fuel economy standards. Flat regulatory fees that do not vary with consumption do nothing to reduce externalities. But when vehicle licensing, registration, circulation, and emissions fees are directly linked to energy and environmental factors, they provide incentives for meeting standards. Environmentally-based fuel fees are another creative application of these fees. This policy charges fuel producers for "upstream" fuel production emissions.

Vehicle registration fees based on carbon, smog, and miles driven and mileage-based emission fees are examples of strategic regulatory fees. The advent of on-board information technologies facilitates the implementation of these user fees. Today's computers that run cars can store this information for daily, monthly, or annual charges. The more frequently such charges are assessed, the greater the impact user fees will have on behavior.

Externality Charges and Fees

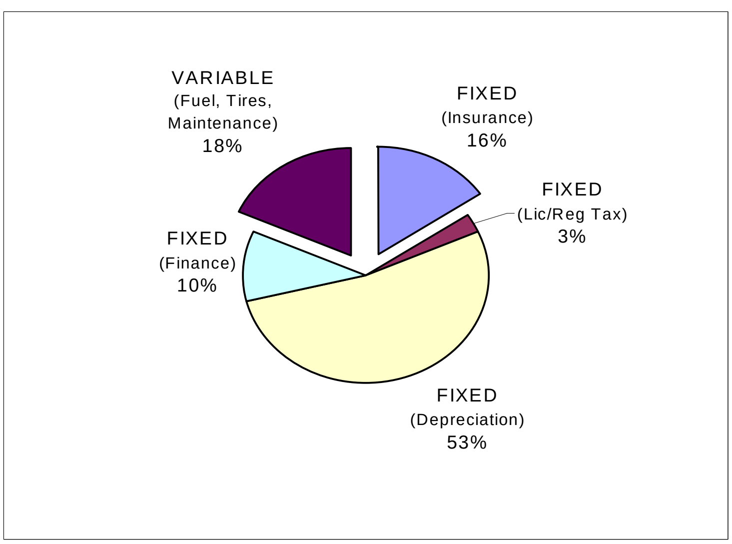
Externality charges are user fees that enable the government to levy fees that in some way reflect external costs. The rationale for doing this is that efficient pricing of goods and services should include both direct costs and the costs to society. External costs may result from both investment (i.e., building roads) and consumer activities (i.e., driving). Externality fees raise prices and reduce the output of polluting goods and thereby lessen pollution. To discourage travel in hours of peak activity, charges for parking and using roads could include the external costs of congestion. Similarly, to mitigate climate change, charges for gas guzzling vehicles could include the external costs of carbon dioxide emission.

The right to levy externality charges stems from the ability of government to protect the health and safety of its citizens. In exercising its powers, the government may set limits on property rights. How the government chooses to do so will determine who gets the charges or rents. If the government asserts that it wholly "owns" the environment (or roads), then the charges would go to the public sector. This allows the government to use revenues for expanding public transit, equity compensation, providing energy-efficiency rebates, funding R&D, and several other sound public investments. However, if the government gives the private sector property rights (such as parking facilities and insurance agencies), it may grant permits up to specified levels to sell "pollution", "congestion", or "uninsured motorist" rights. In-lieu parking and pay-as-you-drive insurance are examples of an externality fee arranged between government and the private sector.

Liability-based taxes and regulatory fees can resemble externality charges. If these fiscal tools are reasonable proxies for the external costs of producing or consuming certain goods, they increase economic efficiency. Assessing the cost of potential damage to third parties can be a difficult undertaking. The less direct the link between a fee or a tax and the activity that it finances, the less likely that the charge will contribute to economic efficiency (although the charge may bring about a reasonable trade-off with other goals, such as administrative ease).

Regardless of the exact type of fiscal policies selected, it is crucial that transportation charges vary (based on externalities) rather than be fixed. The failure of fixed costs is borne out in many countries where it costs much more to own a car than to drive it. In the US, for example, fixed costs currently account for 72 percent of total vehicle costs.[46] (Figure 19). Such a pricing system encourages inefficient vehicle usage.

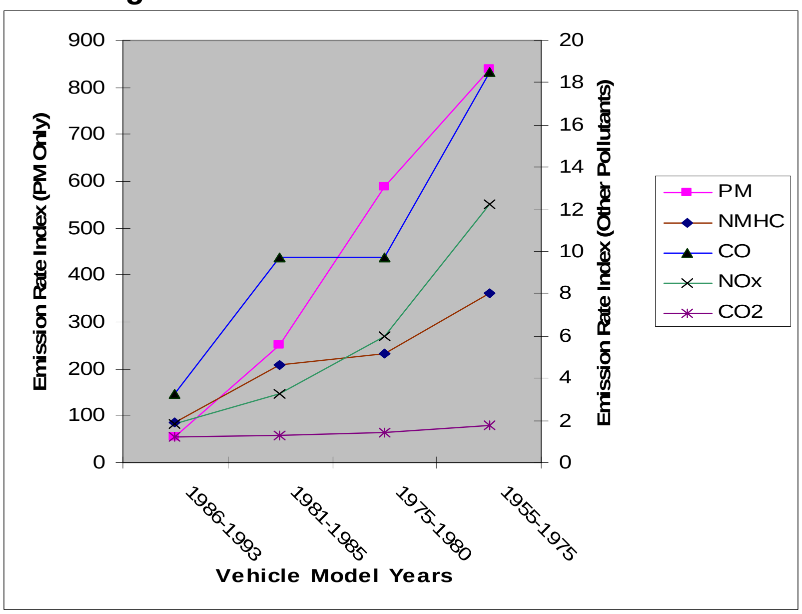
Figure 19
Fixed vs. Variable Vehicle Costs*, US 2003



Source: AAA, Your Driving Costs, 2003 Edition, www.aaa.com
* Total 2003 vehicle ownership cost = $6,194/10,000 miles.

Fiscal policies aimed at all vehicles on the road and how they are used should be part of any comprehensive policy package. An estimated 92 percent of vehicles on the road in any given year are old, not new in the US and many EU countries.[47] However, these policies can be complicated. There can be large differences between older and newer vehicle externalities. Old Japanese, US, and EU vehicles tend to be exported to other countries, pushing vehicle ages even higher around the world than in America and Europe. The older the vehicle, the dirtier (and more gas-guzzling) it tends to be.[48] (Figure 20). However, this is not necessarily the case. New vehicles with malfunctioning controls, poor maintenance, driven under harsh conditions, or those tampered with can perform worse than older vehicles. Vehicle maintenance plays a role in how energy efficient and polluting vehicles are in use. Regular oil changes, tune-ups, prevention of tampering with emission controls, replacing tires with higher fuel-efficiency performance, maintaining tire pressure, and other operational actions help keep cars from becoming gas guzzlers and gross polluters. Therefore, transportation policies that promote vehicle maintenance, prevent tampering, require ongoing emission control verification, and encourage vehicle turn over can be effective at reducing externalities.

Figure 20
Vehicle Age vs. Pollutant Emissions and Fuel Economy



Source: California Air Resources Board, 1998, "Characterization of Particulate Emissions from Gasoline-Fueled Vehicles," September, 98-VE-RT85-006-FR.

When charges are based on real-time, in-use amounts of the miles driven, pollution emitted, and carbon produced or energy used, drivers have better information and can act more rationally. The more they drive, pollute, and guzzle oil, the more they pay. The less they drive, pollute and consume fuel, the more they save. Such fiscal policy structures can be designed to be more economically efficient and fair than existing pricing practices. Converting fixed costs to full pay-as-you-go arrangements gives motorists a new opportunity to save money.

As with all fiscal policies, “lifelines” can be established for low-income motorists. Sound fiscal policies should not be abandoned due to equity concerns. Compensation is always an option to hold harmless certain less-fortunate groups. More importantly, funds raised by user fees can be used to fund transit and other auto-alternatives, providing more options for travel.

US researchers have modeled the potential magnitude of reductions to travel, energy consumption, and pollution due to various vehicle, fuel, and road charges.[49] The ranges of these results are summarized in Table 1.

Table 1
Potential Magnitude of Impacts of Road Pricing Policies, Estimated Decreases from 1991 US Mobile Source Baseline (%)

Policy	Rate	VMT	Trips	Time	CO_2	HC	CO	NO_x
Regionwide Congestion Pricing		0.6 - 2.6	0.5 - 2.5	1.8 - 7.6	1.8 - 7.7	1.5 - 6.2	1.6 - 6.3	0.7 - 2.9
VMT Fee	US$0.02 per mile	4.6 - 5.6	4.4 - 5.4	4.8 - 5.7	4.8 - 5.7	4.5 - 5.5	4.4 - 5.6	4.3 - 5.4
Regionwide Parking Charges	US$1 per day	0.8 - 1.1	1.0 - 1.2	1.0 - 1.2	1.1 - 1.2	0.9 - 1.2	0.9 - 1.2	0.8 - 1.0
	US$3 per day	2.3 - 2.9	2.6 - 3.1	2.5 - 3.0	2.6 - 3.0	2.5 - 3.1	2.6 - 3.1	2.4 - 2.8
Mileage & Emission-Based Registration Fees	US$40-400 per year*	0.2 - 0.3	0.1 - 0.2	0.2 - 0.3	3.4 - 4.4	7.4 - 9.5	7.5 - 9.6	6.6 - 8.5
	US$10-$1,000 annually**	2.9 - 3.6	2.7 - 3.3	2.7 - 3.5	6.3 - 7.9	15.8 - 19.3	15.6 - 19.4	13. 1- 17.3
Gasoline Tax Increase	Double Rate US$0.50/gal	2.3 - 2.8	2.1 - 2.7	2.4 - 2.8	5.8 - 7.4	2.2 - 2.7	2.1 - 2.7	2.1 - 2.5
	Quadruple Rate US$2/gal	8.1 - 9.6	7.6 - 9.2	8.4 - 9.7	24.3 - 27.3	7.8 - 9.5	7.6 - 9.4	7.8 - 9.2

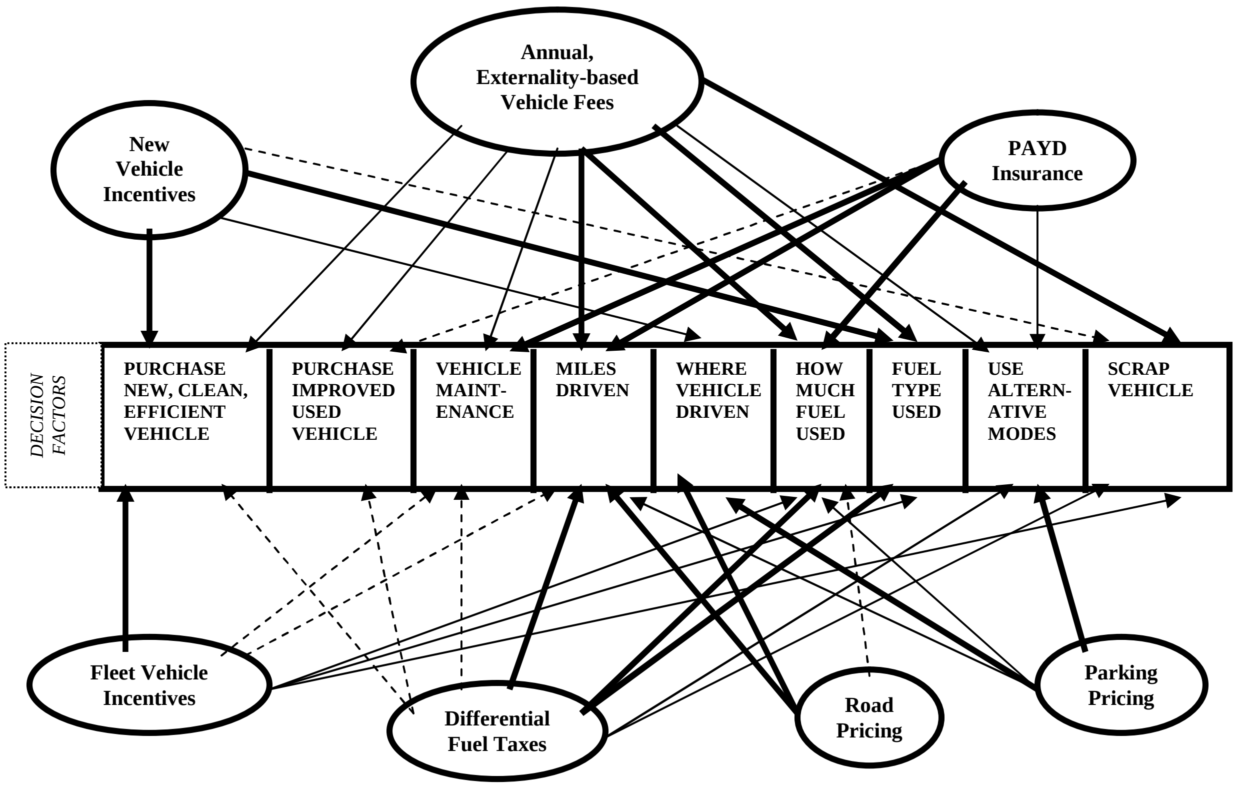
Source: US EPA, 1998.

Notes: * Based on average, modeled mileage and emissions.
** Based on actual odometer readings and in-use tailpipe emissions.

The rule of thumb for all fiscal policies is to assign charges, taxes, and fees as close as possible to the incidence of the externality. Charges differing in time, space, and relation to important vehicle characteristics hold the most promise for a sustainable transportation future.[50] Motorists should pay-as-they-go according to externality-based, recurring charges rather than flat, one-time, general-revenue taxes. Figure 21 traces the incidence of the various fiscal policies discussed in this report and their impacts on energy and emission-related decisions.

Figure 21

The Impacts of Fiscal Policies on Energy- and Emissions-Related Decisionmaking Factors



Note: Dark lines indicate significant impacts; regular lines indicate some impacts; and dotted lines indicate indirect or weak impacts.

Toward Comprehensive Fiscal Transportation Policy Adoption

Designing sound fiscal transportation policies individually can be counterproductive taken as a whole. If any given policy is part of an overall policy package that sends the wrong price signals, the policy will not have the desired effect. For example, if modest congestion charges are accompanied by significant reductions in subsidies for public transportation, the net effect could lead in the wrong direction toward greater car use. To avoid this trap, policymakers should always design individual policies and consider them comprehensively. Choosing the best feasible overall package of fiscal transportation policies is preferable to adopting any individual policy.

Europe is now engaged in a formal process of comprehensive fiscal policy reform in the transportation sector.[51] Such guidance will prove invaluable for considering the best *package* of individual policy measures discussed in this report.

In 1998, the European Commission set out the case for a phased transition to marginal social cost pricing.[52] To that end, they initiated both a continuing program of research and a structured process of dialogue with officials and experts from the EU member states. Five years later, the Transport Ministers of 43 European countries endorsed the recommendation of the European Conference of Ministers of Transport (ECMT) to reform their transport taxes with the long-term aim of marginal social cost pricing and to refrain from adopting tax changes in the reverse direction.[53] As a result, last year the UK Government announced its decision to commence preparation for a national road pricing scheme.[54] Britain's Prime Minister endorsed this multi-pronged approach that entails: (1) taxing transportation using marginal social cost pricing; (2) sustaining transportation investment over the long term; (3) improving transportation management; and (4) planning ahead.[55]

These overarching policy commitments are of immense value in guiding transportation policymaking. Such protections will be necessary to combat the dismantling of fiscal policies over time. As an example, the European Commission, at the behest of its Competition Directorate, recently proposed legislation to "harmonize" and in effect lower the weighted-average level of fuel tax across the EU without first putting in place alternative instruments. The adverse result could have been to reduce the relative price of road use. However, the established comprehensive policy commitments discussed above helped persuade the member states to defeat this proposal which would have increased car use, causing a detrimental "reverse modal shift."

This comprehensive European dialogue has also been instrumental in spreading best practice at a national level. The most important example here is the deployment of differentiated distance charging for lorries (heavy trucks) – initiated by Switzerland in 2001 and now being adopted by several EU member states, including Austria (January 2004), Germany (January 2005) and the UK (by 2007-08). The Swiss scheme has already generated significant efficiency gains in the road freight sector. The same level of tonnage is now being carried by fewer vehicle kilometers and newer, cleaner, better-managed vehicles – that is to say, the same level of output is being delivered at less cost in consumption of road space and the effects of that consumption. While this example focuses on freight not passenger mobility, it is nevertheless relevant and noteworthy.

A commitment for comprehensive fiscal policymaking – even if it is a decade or more away – provides the right context, and the political, financial, and technical support, for preparing for a sustainable transportation future. These landmark decisions in the EU will be very useful for emerging transportation systems and policies in countries, like China, facing enormous change.

IV. Avoiding Fiscal Policy Measures and Practices That Will Not Solve Problems

Adopting sound, comprehensive fiscal policies can set in motion a more economically-efficient system, especially in the transportation sector with its multitude of stakeholders. No doubt these policies and their designs can be complex. But they can be well worth the effort. There are a few general rules to keep in mind to help get the job done right.

Tax "Bads" Not "Goods"

Working, earning a living, and accumulating wealth are very good things for any economy. So why tax these activities knowing that imposing a tax reduces their demand. Instead, tax things you want less of. Taxing "bads" (like energy, pollution, and resource use) and not "goods" (such as human labor and capital) has been shown to yield immense ecological and economic benefits. Problems are compounded further by subsidizing the wrong activities. Subsidy policies in almost all industrialized countries now favor precisely those fuels that are depletable, have a high carbon content, and generate excess pollution. Removing subsidies, however, is only one side of the coin. It is of vital importance that prices are set to reflect the marginal social costs. Reversing subsidies and rationalizing pricing through ecological tax reform is recognized throughout the world as one of the main pillars of sound transportation, energy, and environmental policy. Developing countries actually may have an advantage over developed ones as they are just beginning to put these fiscal policies in place and can choose to learn from others' mistakes. Care should be taken to design flexibility into programs that tax "bads". Then as revenue streams diminish over time due to policy success, an expanding definition of pollution and waste comes into play. New, unforeseen externalities are certain to replace prior concerns in the effort to continue taxing "bads."

Use Flat, One-Time, Non-Externality-based Fees Judiciously

If non-recurring taxes and fees are to be used, make them count. Levels will need to be especially high. Or make them even more effective by combining with rebates (as in feebate designs). Policy design matters a lot when there is a single incidence in order to make the program effective. Whenever possible, design charges to be recurring and based on actual damages and actual measurements. Use technology to assist in ongoing readings of data on pollution, energy consumption, stop-and-go driving, congestion, and other relevant transportation factors. The more frequently user fees are paid, the greater their effectiveness.

Couple Revenue Generation with Reduced Externalities and Sound Investment Strategies

Historically taxes have been used with one goal in mind – generating revenues to run government and provide public goods (such as roads). After decades of this policy, it has become clear that raising funds is not a sufficient goal. Especially when revenues are spent on activities with high externalities, a bad cycle is set in motion. Generating revenues by taxing "bads" not "goods" and reinvesting these revenues into incentives and research, development, and demonstrations of continued reductions in transportation externalities is crucial to solving these problems.

Do Not Waste Political Capital on Flat Fees

Differentiate the level of harm caused wherever possible. Policies such as VAT, fixed vehicle registration fees, sales tax, and fixed parking fees will raise revenue, but they are not up to the task of targeted externality reductions. Base taxes, fees, and rebates so that they go beyond regulatory goals and spur innovation. If opposition is encountered, choose to adopt a few well-designed fiscal transportation policies rather than numerous ill-designed programs. Case studies of the EU show that these countries are working hard to transform many of their flat taxes to variable, externality-based fees. But there are so many different poorly-designed policies in place, it will take a while to rationalize the EU's entire fiscal transportation policy system.

Do Not Ignore Unintended Consequences

Fiscal transportation policies should be analyzed not only econometrically, but also politically. These strategies are subject to gaming by industry and consumers. If there is a way to beat the system, interested parties who stand to lose or gain financially will find a way. Apply fees and taxes with few or no exemptions. Design intelligent compensation for low-income individuals. Avoid unintended consequences of freight transport. While this report deals with passenger transportation, freight modes – especially trucks that share infrastructure with motorists – should not be ignored. When developing fiscal policies, ask the question: How would I cheat (i.e., avoid paying, get a subsidy) if I wanted to?

Do Not Consider Policies in Isolation from One Another

Adopting fiscal policies in a piecemeal fashion – one-by-one – can be counterproductive. Any particular tax, fee, or subsidy is only one (or a part of one) of the set of prices faced by the user. Since the impact of any one price depends on the full set of relevant prices in the market, it is of vital importance that fiscal policies are analyzed comprehensively.

Do Not Consider the Problems Solved Following Successful Policy Implementation

Markets are dynamic. As prices change, supply and demand follow suit. A policy can be effective following its adoption and over time become less effective. Therefore fiscal policies must be re-evaluated in the years following their implementation. Periodic analysis should be designed into policies so that they can be refined over time.

V. Recommended Policies and Best International Practices

The designs of fiscal tax policies vary widely. Many of these strategies work well when packaged together. Adopting and optimally-designed policy should be the goal, but it is not always feasible. Good policies are often better than the policy of doing nothing. Examples of fiscal transportation policies around the globe are presented below.

These fiscal transportation policy designs are separated by their levels of complexity and ease of implementation. Level I is the simplest policy design and is generally the most feasible to implement; Level II is more sophisticated in design but may be less easy to adopt; and Level III entails the most complex policy design and could be the most difficult to implement. Level III policies are more effective and efficient than those policies with simpler designs at lower levels.

Each of these policies can be designed to stand alone. But their optimal implementation is as a package. Even if only Level I policies are politically feasible, policymaking should proceed with the best coordinate package of these basic policies. Given political will and public acceptance, Level I policies can be coupled with Levels II and III policy designs over time. Failure to adopt any policy ("do nothing") is, in effect, a policy decision. Transportation externalities will continue to do damage unless a sound package of the policies discussed below is implemented.

Fuel Taxes and Fees

LEVEL I: Gasoline and Diesel Taxes (Poland)

Most nations tax transportation fuels, but levels vary widely. There are two important dimensions of fuel taxation – the mean level of the tax and the difference in taxation between various fuels. (Table 2). Indexing gas taxes to the wealth of a country (Gas Tax Indexed to GDP) helps explain why car ownership and use is lower in a certain countries, such as Eastern Europe. In other countries like the US, however, where this ratio is very low, fuel taxes do little to influence fuel consumption or car ownership.[56]

Overall, the EU, by international standards, has relatively high taxes on fuels. Northern European countries tend to have higher fuel taxes than southern EU states. Poland, for example, has a fuel tax that is similar to other EU states. However, Poland's fuel tax is very high relative its GDP. Denmark and Switzerland, on the other hand, impose relatively low fuel taxes compared to their wealth. The lower the total vehicle user fees –fuel and other in-use vehicle taxes – the more vehicles are driven. This is witnessed by the Danes who own few cars (due to high ownership fees) but drive their cars more than their EU neighbors.[57]

Table 2
Fuel Taxes in Selected Countries, 2001

Country	Gasoline Tax (US$ per liter)	Diesel Tax (US$ per liter)	Gasoline Tax Indexed to GDP
Poland	$0.41	$0.30	204
Hungary	$0.48	$0.44	100
Greece	$0.36	$0.31	31
UK	$0.73	$0.77	30
France	$0.70	$0.48	29
Netherlands	$0.71	$0.44	29
Finland	$0.69	$0.41	28
Spain	$0.43	$0.32	28
Belgium	$0.60	$0.37	25
Sweden	$0.68	$0.50	25
Germany	$0.48	$0.32	19
Denmark	$0.46	$0.31	14
Switzerland	$0.50	$0.41	14
US	$0.10	$0.12	3

Sources: Orfeuil, J., 2001, and UK Department for Transport, 2002.
Note: Multiply fuel tax by 3.785 to convert to US$ per gallon; divide by 0.92 to convert US$ to Euro€.

Fuel prices relate to the quantity of fuel used over time. Studies have sown consistent results in terms of long-run elasticity.[58] (Table 3). Short-term elasticities are much lower. This may explain why volatile fuel prices in the US (where fuel taxes are very low) have relatively little impacts on demand factors.

Table 3
Estimates of Long-Term Elasticities of Fuel Demand to Fuel Price

Effect of Fuel Tax On	Median Elasticity Estimate
Vehicle Fleet	-0.1
Mean Fuel Intensity	-0.4
Annual Distance Driven per Car	-0.2
Fuel Demand	-0.7
Travel Demand	-0.3

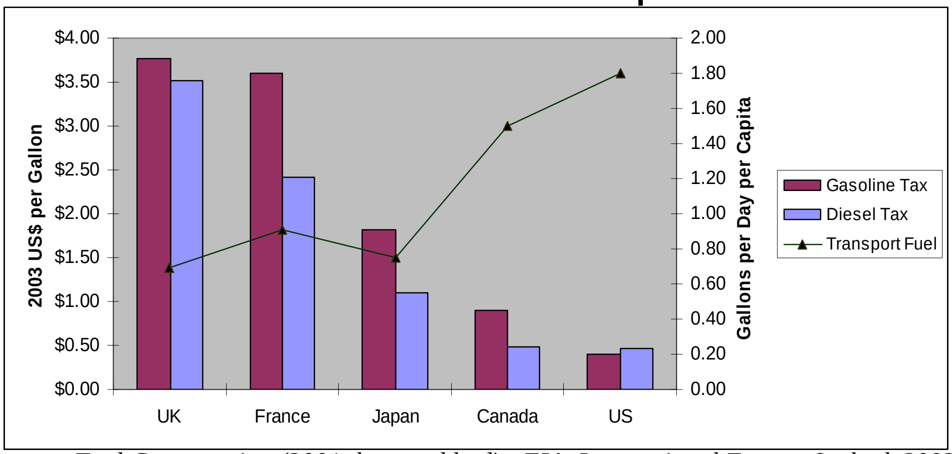
Source: Johansson and Schipper, 1997.

Taxes on diesel in the EU can be as much as 40 percent less than on gasoline. (See Table 2). This fuel price spread has several policy implications. Principally, when motorists switch to cheaper fuels, they tend to buy less fuel-efficient vehicles and/or drive more.[59] In France, for example, the annual mileage of a diesel car is 19,700 km compared to only 11,400 km for gasoline cars.[60] These "rebound effects" from cheaper diesel diminish on-road vehicle fuel efficiency gains. Thus, the EU diesel fleet (in use) is only 15 percent less fuel intensive than the gasoline fleet despite the fact that diesel engines could technically achieve at least twice that amount.[61] Additionally, the carbon intensity of EU vehicles is no lower for diesel than for gasoline.

Fuel policies that tax diesel lower than gasoline do not necessarily consider full externalities. Diesel fuel currently has higher air pollutants – particulates, nitrogen oxides, and air toxics – than other transportation fuels, including gasoline. Respiratory ailments, cardiovascular disease, asthma aggravation, chronic bronchitis, decreased lung function, and increased lung cancer incidence have all be traced to diesel exhaust emissions.[62] In 1998, California designated diesel particulate matter as a toxic air contaminant. Subsequent studies have found that diesel emissions are responsible for over 70 percent of the estimated cancer incidence from urban air toxics in Los Angeles, California.[63] The US Environmental Protection Agency has concluded that "diesel exhaust is likely to be carcinogenic to humans by inhalation at any exposure level."[64] Given its public health impacts, extreme caution should be taken in developing policies that promote widespread use of diesel, as currently formulated, over other fuels.

In terms of their mean level, fuel taxes tend to influence overall fuel consumption when they are set high enough. (Figure 22). But when set too low (as in the US), fuel taxes have a small demand response and do more to generate revenues. These receipts generally go into general government accounts. While their high visibility can make fuel taxes politically unpopular, their tremendous revenue generating capability makes them an attractive fiscal policy nonetheless. While fuel taxes are better than no fiscal fuel policy at all, they are not based on externalities and therefore do little to reduce environmental problems in the transportation sector.

Figure 22
Fuel Tax vs. Fuel Consumption



Sources: Fuel Consumption (2001 thousand bpd) - EIA, International Energy Outlook 2002; Fuel taxes (2003 $) – Davis, S., 2004, Tables 10.1 and 10.2; Population (2003) – US Census Bureau, 2004.

LEVEL II: Carbon Taxes (Sweden)

Apart from pure hydrogen fuel (obtained from water with energy from the sun or other renewable source), carbon is a part of every other transportation energy source.[65] All the carbon in fossil fuels transforms into carbon dioxide (and trace amounts of carbon monoxide) when combusted. A carbon tax assigns a charge for the carbon dioxide emissions associated with each fuel.

Specifically, a carbon tax is an established monetary rate for a unit (ton) of carbon generated by the production of each good in the economy. The tax placed on the amount of carbon is achieved through calculating the carbon intensity of each good. This tax affects all parts of the economy, and it can be coupled with tax reductions on labor or income. So overall taxation need not increase. Carbon taxes offer a broader scope for emissions reductions and are thought to result in a more *permanent* incentive to reduce emissions than gasoline, diesel, or other energy taxes.[66]

It is inconsequential whether these taxes are levied on carbon or carbon dioxide intensity. Carbon and carbon dioxide emissions are directly proportional (molecular weights of 12 to 44, respectively), so equivalent taxes can be easily computed. There is a fixed carbon content inherent in the exhaust of each fuel. (Table 4). There are also carbon emissions associated with upstream production of each fuel. These are important, but unless measured directly, must be approximated for different producers.

Table 4
Carbon Content from Combusting Transportation Fuels*

Fuel	Carbon Content Metric Tons Carbon per billion BTU
Coal	25.61
Crude Oil	20.24
Gasoline	19.33
Diesel	19.95
Natural Gas	14.47
LPG	16.99
Hydrogen	0

Sources: Energy Information Administration, 1997; and IEA, 1994.

*Varies with exact fuel composition and weight and includes vehicle exhaust emissions only.

In 1991, a carbon tax was introduced in Sweden.[67] This tax was designed to complement rather than replace the existing energy tax system, which was simultaneously reduced by 50 percent. But Sweden's carbon tax was developed with too many exemptions. The industrial sectors pay no energy tax and only 50 percent of the general carbon tax, while electricity production sector pays neither energy nor carbon taxes.

As of 1997, Sweden's carbon taxes were increased to 0.365 SEK/kg CO_2 (approximately US$150 per ton carbon). The carbon tax that passed through to gasoline was relatively small compared to the energy tax on fossil fuels which is high – $0.42 vs. $1.60 per gallon (US 1999$).[68] This tax reduction is a general problem for carbon taxes on transportation fuels. Sweden's carbon tax rate is so low that it apparently has not affect consumers' demand behavior for gasoline or diesel fuels.

The most obvious effect of the carbon tax has been an increased use of biomass in the Swedish heating system. Biofuels currently contribute about half of the energy supply to the Swedish district heating systems. Increased demand for biomass has spurred technological developments and price reduction in that sector.

The impact of carbon taxes on the energy and resource efficiency in Swedish industry, including transportation fuels, has been limited. This is because: (1) overall tax level for industry users of fossil fuels was reduced (the carbon tax on industry is only 50 percent of the general level); (2) the non-exempt industries have been slow to upgrade the energy efficiency of their existing plants because their low energy costs represent only a small fraction of their total costs; and (3) only a small percentage of the industrial energy supplies are generated by fossil fuels (e.g., the most energy intensive sector, pulp and paper, mainly uses biomass and electricity instead of fossil fuels).

As designed, the Swedish carbon tax does not truly tax carbon emissions.[69] While most fuels containing carbon were taxed, this tax did not reflect the actual level of carbon emitted from fuels. For example, low emission diesel fuel and high-emission diesel fuel were both taxed at the same level despite causing different levels of environmental damage. Distinguishing differences is necessary to maximize the gains. Additionally, Sweden adopted a differential tax based on the sulfur content; this probably spurred the rapid switch to ultra-low sulfur diesel fuel.[70]

Despite its design flaws, an evaluation of Sweden's carbon tax concluded that this policy has helped to reduce emissions of carbon dioxide in line with Swedish Environmental Protection Agency policy. Specifically, SEPA estimated that the carbon tax would remove 20 – 25 percent more carbon emissions than the old tax regime by 2000.[71] Since its imposition, between 1987 and 1994, carbon emissions decreased between 6 – 8 million metric tons, a 13 percent decrease in emission levels. Since these results coincided with the lower industry energy tax rate, it can be hypothesized that emission levels would be lowered even more with consistent carbon taxation across sectors.[72]

There are important considerations for an efficient carbon tax that the Swedish program does not take into account. The entire fuel process needs to be taken into account, not just the last step – the amount of fuel used by consumers. Total carbon emissions attributed to any fuel has several components, including exploration and production ("upstream") as well as fuel transportation and vehicle combustion ("downstream").

Full-fuel cycle emissions are vitally important because "clean" fuels can be made from "dirty" sources. This is especially clear in the case of clean-burning hydrogen fuel, whether it is made from either coal or water/renewable energy. Thus hydrogen can have vastly different fuel-cycle environmental impacts.

Creating loopholes (carbon tax reductions or waivers on certain goods) sends inconsistent signals to the marketplace. Sweeping policies, such as carbon taxes, can fail when they accommodate special interests. In order for carbon taxes to be effective they must be applied broadly and at significant levels to encourage technological innovation rather than just slightly change prices.

Internationally-coordinated carbon tax systems may be difficult to construct. The average price per ton of carbon equivalent (based on current fuel tax rates) differs from country to country.[73] (Table 5). Uniform carbon taxes would require EU states to, in effect, change their fuel tax rates. This could be politically and economically infeasible.

Table 5
Effective Fuel Tax Rates Expressed in Terms of CO_2 in Selected Countries
($1997 Purchasing Power Parity)*

Country	Unleaded Gasoline ($PPP/ton CO_2)	Diesel ($PPP/ton CO_2)
Denmark	164	95
Finland	232	113
France	245	129
Germany	205	109
Netherlands	242	117
Norway	216	140
Sweden	189	103
UK	261	224
Japan	133	43
US	42	40

Source: Regional Environmental Center for Central and Eastern Europe, 1998.

* PPP (purchasing power parity) sources: OECD Main Economic Indicators, July 1998, Paris.

The carbon rate (per-kilometer basis) would have to be set extremely high to affect drivers' behavior . However, carbon reduction may not be a high enough priority in China at present for this policy to be both politically feasible and highly effective. Nevertheless, the simultaneous adoption of a low carbon tax and a higher fuel tax (discussed above) would be complementary. Moreover, a mechanism would then be put in place so that China can deal effectively with climate change in the future. Such a tax could also help minimize carbon emissions from other sectors.

Empirical studies evaluating the environmental effectiveness of carbon taxes are rather limited to date. There are several methodological complexities in doing such evaluations. Those studies on the impact of carbon taxes and reduced carbon dioxide emissions on the Chinese economy have found that a carbon tax will have much more moderate impacts on the whole economy than on individual sectors.[74] Outputs of coal fields, oil refineries, and the coke industry are projected to decline the most, while sectors using few energy sources, such as apparels, foods, and alternative energy production, increase their outputs slightly.

LEVEL III: Environmentally-Based Fuel Fees (n/a)

Stationary sources of air pollution, including oil refineries and fuel processing plants, are controlled in the US by a complex series of local, state, and federal regulations. These rules have been developing for over 25 years. Obtaining environmental permits for these facilities often stirs up controversy, especially between the energy industry, public citizens who live nearby, and the government who wants to encourage economic activity but needs to protect public welfare. The permitting process for such stationary sources can take years.[75] Before they are constructed, fuel facilities require extensive environmental permitting. This entails detailed designing, performing emissions estimation models, inventorying emissions, employing best available control technologies, determining permit requirements, conducting public hearings, deciding whether and under what limits the facility should be built. Replicating this system, while extremely beneficial, could take years.

While regulatory fees should definitely not replace important regulatory policies for permitting fuel facilities, they might have a role to play in setting overall fuel prices. Fees could be set based on total fuel emissions (exploration, processing/production, and transmission). Companies could be charged for the amount of pollution (including carbon and air toxics) that their fuel processes emit. These fees would presumably be passed on from companies to consumers. The more competition there is between fuel companies, the cleaner their fuel processes would be resulting in lower fees.

Data exists for emissions and control costs for most fuel processes. Determining surcharges, while controversial, is at least technically feasible. Extensive research is underway regarding such a system of full accounting for fuels. The GREET model (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) is one such resource, although toxic air contaminants are not currently included and would have to be added.[76]

Historically, transportation-related pollution has been managed more at the vehicle tailpipe. Fuel-cycle environmental impacts from fuels themselves have not garnered much policy attention. US regulations in the 1990s, however, required producers to reformulate gasoline to make fuel cleaner burning. Unfortunately this change in formula increased certain air toxic emissions, and slightly increased carbon emissions. And while work is underway to make cleaner diesel fuel worldwide, more is being uncovered about the high toxicity of diesel fuel exhaust emissions.

This fiscal policy proposal deals with the entire fuel cycle – from wellhead to wheel. The current system of transportation sector charges and regulations has failed in part because the oil industry and automobile industry have not worked together to tackle related fuel-vehicle problems. Creating financial incentives for both stakeholders simultaneously – fuel producers and vehicle manufacturers – would be a real breakthrough in this large, inter-related, complex sector.

Currently no country has adopted such a full fuel-cycle externality-based fuel pricing policy. Sweden and Denmark pioneered differential taxes for cleaner fuels. And Germany and Hong Kong have used taxes to encourage low sulfur diesel fuels. This policy design takes these countries' approaches a step further. To be sure this policy is broad and sophisticated. Environmentally-based fuel fees complement both fuel and carbon taxes. If packaged together, all three of the fuel taxes and fees presented in this section could create policy parity for alternative fuels and innovative vehicle technologies, spurring the cleanest and most fuel-efficient options to enter the market.

Vehicle Taxes and Fees

LEVEL I: Annual Vehicle Attribute-Based Taxes and Fees (EU, Japan, Singapore)

There are many different forms of vehicle taxation and their levels vary widely by country. One-time taxes and fees are assessed on almost all new vehicles purchased. This fiscal tool includes, sales taxes, value added taxes (VAT), ownership fees, registration taxes, and other excise taxes. These charges can be fixed (charging a standard percentage of the vehicle price) or vary with vehicle attributes (engine size, cylinder capacity, emissions, or energy consumption).

Denmark, Japan and Singapore are examples of countries with high vehicle ownership taxes. Denmark has extremely high ownership taxes.[77] Danes tend to buy fewer cars per household. Yet they drive as much as other EU citizens.[78]

Car-related tax revenues in Japan account for about ten percent of total tax revenues in the country, funded by nine automobile related taxes.[79] A five percent acquisition tax on the base price of the new vehicle, a new car sales tax of five percent, annual vehicle property taxes ranging up to US$900 based on engine size, and an annual weight tax (12,600 yen per ton) are some of the new vehicle fees levied in Japan.[80] The car-related taxation system in Japan is coming under increasing scrutiny as the goals of transport policy are changing. More emphasis is being placed on achieving reductions in environmental loads as well as more efficient and equitable transportation (as in the EU). Funneling huge sums of money into the road sector to stimulate the economy have not worked. Structural transportation reforms are gaining considerable attention.

In Singapore, a Vehicle Quota System has been in effect since 1990. A certificate is required to own a car. In 2003, the certification fee for a Toyota Corolla was S$30,500, along with a fixed registration fee of S$140 and an additional registration fee of 130 percent of the market value. Thus, a S$20,000 Corolla could end up with a final price tag of S$77,000. As a result of these high fixed vehicle fees, the car population ratio in Singapore is significantly lower than in most other nations.[81]

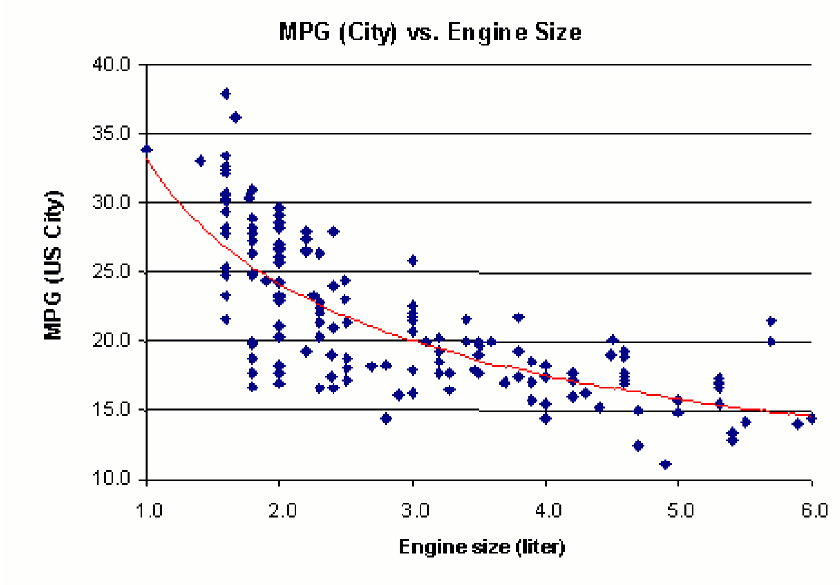
High ownership charges can be very regressive. Preventing low-income individuals from owning vehicles has significant equity impacts. Lowering upfront fixed vehicle ownership costs and raising variable vehicle fees, makes it affordable for more citizens to have personal transportation. Vehicle user fees then help prioritize usage; the greater the mobility need (i.e., medical attention), the more likely a vehicle will be available for use. The less important the need (i.e., recreation), the less likely the vehicle will be driven.

High fixed vehicle purchase taxes also inhibit vehicle manufacturers in the EU and other countries from using fuel saving technologies on new cars because the additional cost is tripled by the taxation system. This is an unintended consequence of ownership taxes and another reason why these fees should be replaced with annual vehicle taxes.

Annual vehicle taxes and fees are then an essential part of any fiscal transportation policy package. These annual charges are assessed in different ways (annual registration taxes and charges, circulation taxes, or certification fees). Again, these charges can be fixed or vary based on a number of vehicle attributes, including retail value, vehicle fiscal horsepower, engine size, vehicle weight, vehicle air emissions, fuel consumption, or carbon dioxide emissions.

Engine-size based vehicle taxes and engine power (HP)-based taxes are two relatively common policy designs that have been tested in the EU and other countries. These vehicle policies are indirectly related to energy consumption and carbon dioxide emissions.[82] There is generally a positive correlation between engine size and fuel economy. However, this relationship does not describe all models as witnessed by some degree of vertical spread in the data of Mexico's vehicle fleet.[83] (Figure 23). With power-indexed vehicle taxes, the more powerful the engine, the greater its fuel consumption and the higher its tax. Since more powerful vehicle models with larger engines tend to be more expensive, this tax is progressive (less equity impacts).

Figure 23



Source: Feng An, February 11, 2005.

EU policymakers are recommending that one-time registration taxes are reduced in favor of uniform annual circulation taxes (ACT). An overview of the current, uncoordinated system of annual circulation taxes is presented below. (Table 6). The UK has converted its annual circulation tax from an engine capacity basis to a carbon dioxide basis. This preferable measure (discussed below – Level III) will have a more direct effect on fuel consumption than the former policy design.

Denmark has already made several changes along these lines to its vehicle taxation system. Danish policymakers adopted a slightly lower first-time registration fee for new, fuel-efficient cars to compensate for their higher cost. Annual registration taxes were shifted toward fuel consumption measures and away from car weight ("Green Owner" fee), electric vehicles were exempt from annual registration fees, and a new car tax was shifted more toward fuel consumption and away from vehicle price.[84] Some of these policies are discussed below.

Table 6
Circulation Tax on EU Cars

	Basis for circulation tax	Approximate range, annually (National currency)	Approximate range, annually (EUR)
Belgium	Tax base is Fiscal HP (cm^3), Small supplementary tax for diesel cars	BEF 2,284 (HP = 4) to BEF58,462 (HP = 20)	EUR 57 (HP = 4) to EUR 1,449 (HP = 20)
Germany	Tax base is cm^3 Differentiated petrol/diesel		
Denmark	Tax based on fuel consumption; Differentiated petrol/diesel Increase 2% annually (in fixed prices)	DKK 460 (>20 km/l) to DKK16,920 (« 4.5 km/l)	EUR 62 (>20 km/l) to EUR2,272 « 4.5 km/l)
Spain	Tax base is Fiscal HP (cm^3)	ESP 2,100 (D-8 HP) to ESP 18,635 (> 20 HP)	EUR 13 (D-8 HP) to EUR 112 (> 20 HP)
Greece	Tax base is Fiscal HP (cm^3)	GDR 25,000 « 9 FHP) to GRD 130,000 (> 17 FHP)	EUR 73 « 9 FHP) to EUR 382 (> 17 FHP)
France	Tax base is Fiscal HP Rates vary with county		
Italy	Tax base is kW (linear relationship)	ITL 55,000 (11 kW) to ITL 1,580,000 (316 kW)	EUR 28 (11 kW) to EUR 806 (316 kW)
Ireland	Tax base is cm^3	IEP 98 (« 1,000 cm^3) to IEP849 (> 3,000 cm^3)	EUR 124 « 1 ,000 cm^3) to EUR 1,078 (> 3,000 cm^3)
Luxembourg	Tax base is cm^3	LUX 1510 (« 1000 cm^3) to LUX 13,600 (8000 cm^3)	EUR 37(« 1000 cm^3) to EUR 337 (8000 cm^3)
Netherlands	Tax base is Weight Differentiated for petrol/diesel Varies between districts	E.g., 1,100 kg: NLG 848 (petrol) and NLG 1,676 (diesel)	E.g. 1,100 kg: EUR 385 (petrol) and EUR 761 (diesel)
Austria	Tax base is kW (12 x (kW – 24] x 0,55 EUR)	Min. EUR 66 (+ approx. EUR 73 road toll)	Min. EUR 66 (+ approx. EUR 73 road toll)
Portugal	Tax base is cm^3 Differentiated petrol/diesel	PTE 2,700 « 1 ,000 cm^3) to PTE 59,700 (> 3,500 cm^3)	EUR 14 « 1,000 cm^3) to EUR 298 (> 3,500 cm^3)
Finland	Tax base is total (max) weight for diesel cars, flat rate for petrol cars	FIM 700 E.g. 1,100 kg: FIM 1,650	EUR 118 E.g. 1,100 kg: EUR 277
Sweden	Tax base is weight Differentiated petrol/diesel	E.g. 1,000 kg: SEK 734 (petrol) and SEK 2814 (diesel)	E.g. 1,000 kg: EUR 78 (petrol} and EU R 299 (diesel)
UK (Until 3/01)	Tax base is cm^3	GBP 100 « 1.1 liter) and GBP 155 (> 1.1 liter)	EUR 159 « 1.1 liter) and EUR 246 (> 1.1 liter)
UK (After 3/01)	Tax base is CO_2	GBP 100 (« 150 g CO_2) and increases gradually up to GBP 155 (> 185 g CO_2) for petrol cars. The tax is approx. GBP 10 higher for diesels.	EUR 159 (« 150 g CO_2) and increases gradually up to EUR 246 (> 185 g CO_2) for Petrol. The tax is approx. GBP 15 higher for diesels.

Source: An, Feng, 2004.

LEVEL II: Tax/Fee Reductions or Exemptions for New Clean and Efficient Cars (Japan, Denmark, Germany)

Externality-based taxes are replacing flat taxes in many EU countries. In Denmark, a tax reduction was introduced in 2000 for new, highly-efficient cars. A 16.7 percent tax reduction applies to gasoline cars between 2.5 and

4 liters per 100 km (60 – 95 mpg). A 67 percent tax reduction applies to gasoline cars lower than 2.5 L/100 km (over 95 mpg) and to diesel cars under 2.2 L/100 km (over 105 mpg).[85] Perhaps future vehicles will attain these high efficiency levels and qualify for tax reductions.

Denmark exhibited a large new vehicle fuel efficiency improvement between 1975 and 1999. As seen below, this country has also adopted annual, liability-based fees for carbon dioxide. These policies, together with the fact that Danes drive relatively small vehicles, are at least partly responsible for increased new car fuel economy – an estimated 30 percent improvement over this time period.[86]

In Germany, an exemption in the circulation tax is granted to cars that meet advanced emission standards or are very fuel efficient. These fee reductions can be as high as €2200, if the vehicle is both clean and fuel efficient. (Table 7).

Table 7
Circulation Tax Exemptions for Clean, Fuel-Efficient Cars, Germany, 2000 DEM

Criteria	Levels	Gasoline Car	Diesel Car
Emissions			
	Euro 3 (registered before 1/1/00)	250	500
	Euro 4	600	1200
Fuel Consumption			
	Less than 120 g CO_2 per km	500	500
	Less than 90 g CO_2 per km	1000	1000

Source: An, Feng, 2004..

Note: In 2008, the lower (120 g) CO_2 tax exemption is no longer in effect.

In Japan, the vehicle acquisition tax has been reduced for clean, alternative fuel vehicles. A tax reduction ranging from 25 to 75 percent is offered for vehicles that meet certain emission targets. (Table 8). The number of low-emission vehicles in Japan significantly increased from 2000 to 2001 due to this tax reduction.[87]

Table 8
Clean Vehicle Tax Reductions

Emissions (% Reduction 2000 Standards)	**Tax Reduction**
-75%	50%
-50%	25%
-25%	13%

Source: Hirota, K. and Minato, K., 2003.

LEVEL III: Annual, Externality Charges for Carbon Dioxide and Smog (UK and Denmark)

The EU passenger car market is fragmented into fifteen national markets; this promotes divergent policies on car taxation. The introduction of the Euro has started to bring greater price and tax transparency. The Commission of the European Communities believes that better, coordinated fiscal vehicle policies will both improve EU market functions, benefit EU consumers, and contribute to the achievement of climate change commitments.[88] Hence, the Commission has recommended to the European Parliament that all EU countries tax their passenger cars similarly. Some countries have already followed the Commission's recommendation by basing their vehicle fees to CO_2 emissions. Others will likely follow.

While most EU states have not made this transition to energy-based vehicle taxation, Denmark and the UK are leading the way on fuel economy (CO_2). As of 1997, Denmark has replaced its fixed annual vehicle ownership tax with a variable vehicle tax based on fuel efficiency. This policy, known as the "Green Owner" fee, has a rate of €200 for a gasoline car with a specific consumption of 6.5 L/100 km (36 mpg), and the rate increases by €100 for every additional liter per 100 km. An average 8.5 L/100 km (27.7 mpg) car would be assessed €400. Relative to the old system, vehicles under 7 L/100 km (33.5 mpg) pay less than they used to before this variable fee was adopted, while vehicles over 7 L/100 km pay more than they used to.[89]

Likewise, in March 2001, the UK converted its annual circulation tax base from engine size to a carbon dioxide basis. Vehicles with CO_2 emissions under 150 grams per km pay approximately €150 and this tax increases gradually up to €246 for vehicles over 185 grams CO_2. This tax is €15 higher for diesel vehicles.[90]

Vehicle taxes can also be based on other air pollutants. In the US and other countries, vehicles are probed annually for actual tailpipe emissions. The results of these smog tests could be used to determine the vehicle's annual registration or pollution fee. As vehicles become increasingly electronic –

with the development of on-board diagnostics and computerization – it is possible for emission rates to be measured and stored while driving. Basing fees on actual pollutant measurements is both more realistic and could be designed to financially penalize motorists who tamper with their vehicle emission systems.

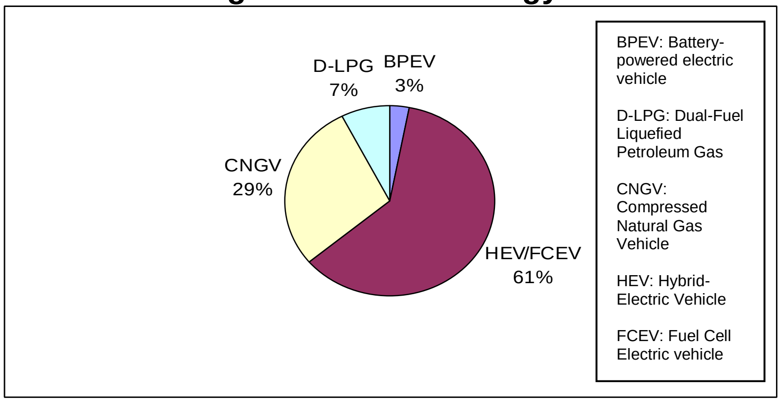
New Vehicle Incentive Programs

LEVEL I: Rebates (Japan and US – Carl Moyer Program)

Rebates can be used to promote clean, fuel-efficient, and/or alternative-fuel vehicles. Japan and California have adopted two different approaches.

Japan implemented targets for clean-energy vehicle sales nearly three decades ago. In 2001, the Ministry of International Trade and Industry (MITI) expanded its 1997 plan to include battery-powered electric (BPEV), hybrid-electric (HEV), fuel-cell (FCEV), compressed natural gas (CNGV), and liquefied petroleum gas (D-LPG) vehicles. Goals were set for 2010. (Figure 24). Under the Kyoto Protocol, Japan's new carbon dioxide reduction goal for 2008-2012 requires the inclusion of hybrid-electric vehicles.[91]

Figure 24
Current 2010 Targets for Clean-Energy Vehicles in Japan



Source: JEVA, 2002.

These goals are backed by financial incentives as well as R&D funding. From 1978 to 1996, the Japanese Electric Vehicle Association (JEVA) conducted, while MITI funded, various alternative-fuel leasing and purchase incentive programs. In 1996, a BPEV Purchasing Incentive Program was introduced, replacing prior leasing and purchase incentives and offering new subsidies (50 percent of the extra incremental BPEV purchase price compared with a comparable conventional vehicle). Initially, from 1996 to

1997, only businesses and municipalities qualified for rebates. Total funding was JPY 380 million. In 1998, a new, expanded program – Clean-Energy Vehicle Introduction Program (CEV) – was introduced for CNG, methanol, and hybrid-electric vehicles. The CEV Program was budgeted at JPY 9 billion in 1998, and JPY 10 billion in each 1999 and 2000. Private citizens now qualify for subsidies if the vehicle being replaced is older and being used for commuting. A project promoting fuel cell vehicles was also conducted and was funded at just over JPY 4 billion from 2000 to 2002.

MITI's alternative-fuel vehicles policy approach has focused on market support for the introduction of new technology where commercialization is short-term, but initial vehicle investments are high. In 2000, as much as JPY 12 billion was spent on financial incentives for alternative-fuel vehicles. Since 1971, analysts estimate that the Japanese government has spent JPY 36.5 billion (2001 currency) for alternative-fuel powertrain incentives. Japanese government R&D support has been dwarfed by these incentives at a rate of almost 3 to 1.[92]

Japan's financial incentives (and R&D funding) has played a role in the estimated 26,000 BPEVs and 155,000 HEVs sold in the country between 1977 and 2001. And while it is not possible to determine exactly how much government support really facilitated the introduction of HEVs and BPEVs, it is claimed that the Japanese approach offers greater flexibility than regulation and technology-forcing mandates.[93]

California's the Carl Moyer Memorial Air Quality Standards Attainment Program funds the incremental cost of engines and equipment that are cleaner than standards require. In 2004, this program was expanded to include cars and light-duty trucks. Air pollutants, including oxides of nitrogen, hydrocarbons, and particulate matter, are the primary focus because they are necessary for meeting clean air commitments.

Up to US$140 million a year is available for Carl Moyer incentives.[94] Funding for these clean-vehicle and stationary source rebates come from general state revenues and, more recently, were supplemented by adjustments to vehicle tire fees and increases of motor vehicle registration fees (up to US$2 per vehicle).

Southern California alone, from 2002 to 2003, reduced over 750 tons of smog-forming NO_x emissions as a result of Carl Moyer Program funding for 453 new engines and vehicles.[95] Now that light-duty vehicles are included in the program, the on-road benefits of these incentives are expected to grow.

Statewide, the Carl Moyer Incentive Program has cleaned up an estimated 5,000 engines at a cost of US$1.00-$3.50 per pound of NO_x. In general, off-road projects have been more cost-effective than on-road applications.

Demand for funding has exceeded available funds each year the program has been in operation. District and industry partnerships have been critical to the program's success. It is projected that a $500 million Carl Moyer Program could reduce NO_x emissions by 50 tons per day, based on the program's existing cost effectiveness.[96]

Vehicle rebates like the Carl Moyer Program are an important component of an overall clean air plan, according to the California Air resources Board. They enjoy widespread public support and provide cost-effective emission reductions beyond what regulations require.

Vehicle rebates for specific vehicle fuels and technologies might be popular, but they may not be the most efficient policy. A more cost-effective use of funds would be to design rebates based on environmental and energy-efficiency performance. New, improved technologies may have the potential to deliver benefits, but they can easily be used to less good ends. Witness the declining fuel efficiencies of hybrid vehicles as power and performance is enhanced on these otherwise technologically-improved vehicles. For example, the new Ford Escape SUV Hybrid is being designed with "V6-like performance" and is therefore only projected to get 2 mpg (7 percent) more than the conventional four-cylinder gasoline model.[97] Yet hybrid technology is capable of far greater fuel economy enhancements. Policies designed to capture the real technological potential could do more to reduce energy consumption.

Recent analyses shows that vehicle fuel-efficiency rebates have projected fuel savings of 77 percent compared to the "no policy" case.[98] And feebates are projected to be over six-times more effective than rebate policies at saving fuel. (Table 9).

Table 9
Analyses of US Energy-Efficiency Rebate Impacts (2002 US$)

	No Policy	Efficiency Rebate ($500 per 0.01 GPM)	Feebate ($500 per 0.01 GPM)
Cars (mpg)	28.3	28.7	31.8
Light trucks (mpg)	21.8	22.4	26.0
Total (mpg)	25.0	25.5	28.9
Change in sales (%)	0	-0.5	0.2
Per vehicle fuel savings (gallons)	126	223	773
Total fuel savings ($)	$3.1	$5.5	$19.1
Societal value	$2.3	$4.1	$14.0
Manufacturers' revenue	$1.4	$1.7	$1.5

Source: Greene D.L., Patterson, P.D., Singh, M, Li, J., 2005, Tables 1A and 1B.

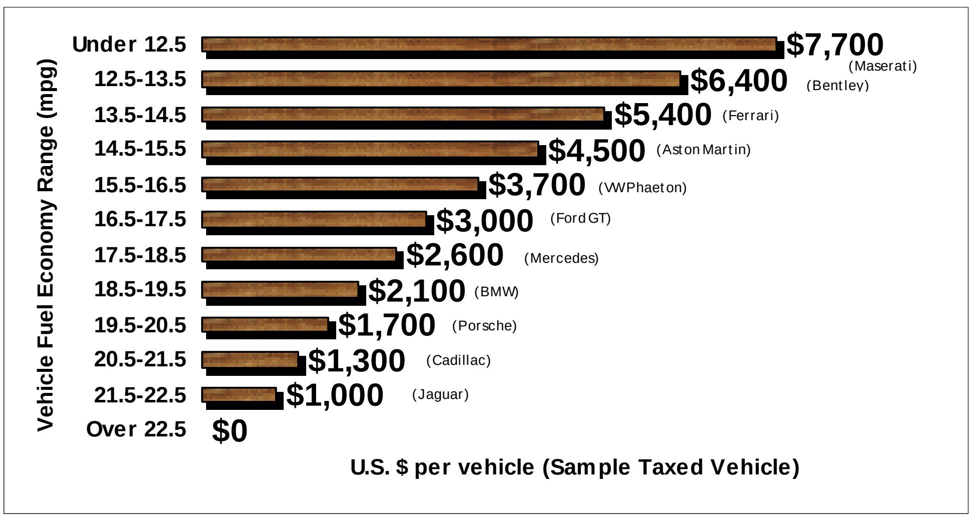
Note: All dollar figures in $US Billions

LEVEL II: Fees (US – Gas Guzzler Tax)

The US Gas-Guzzler Tax was implemented in 1980 and revised in 1991. This policy applies only to passenger cars getting less than 22.5 miles per gallon (MPG). Gas-guzzler taxes set at US levels can have a meaningful influence on lowest-performing vehicles. A strong incentive exists to get just above the minimum MPG level. The gas-guzzler tax has nearly eliminated the sale of cars less than 22.5 MPG target.[99] Today, the only cars with fuel economies below 22.5 mpg are high-priced, low sales volume, luxury and performance cars, such as Maserati, Farrari, Lamborghini, Porche, and Mercedes.[100] (Figure 25).

There is no comparable gas-guzzler tax for light trucks in the US. Given the wide gap between US car and truck fuel economies, it is surprising that an analysis of the impacts of a gas-guzzler tax on light trucks has not been conducted. Extending the US gas-guzzler tax to passenger trucks and sport-utility vehicles could achieve fuel efficiency gains in these popular, high consumption models.

Figure 25
US Gas-Guzzler Tax on New Cars, 1991-Present



Sources: US EPA and US DOE, 2005; and Davis, S., 2004.

Gas-guzzler tax receipts have varied widely since its implementation. (Table 10). After increasing the rate in 1991, revenues temporarily rose, but then decreased as manufacturers improved fuel economy on their worst vehicles to just above the gas-guzzler trigger. Over its 23 year history, the US government has collected approximately $1.8 billion from gas-guzzler taxes.[101]

Table 10
US Tax Receipts from Gas-Guzzler Tax
(Thousands 2002 US$)

Model Year	2002 Constant $
1980	1,616
1981	1.544
1982	3,207
1983	7,261
1984	15,272
1985	66,526
1986	66,526
1987	42,373
1988	31,051
1989	177,589
1990	159,066
1991	142,048
1992	156,389
1993	138,940
1994	77,811
1995	86,763
1996	60,311
1997	54,026
1998	52,646
1999	73,753
2000	73,966
2001	79,436
2002	79,700

Source: Davis, S., 2004.

When implementation is set a few years out from its adoption, manufacturers find cost-effective technologies to avoid the tax. As a consequence, vehicles cluster just above the pivot point MPG, because there is no incentive for vehicles above the pivot point to further increase their MPG. Analysis of gas-guzzler taxes has found that today's higher-level tax rates ($2,000 per 0.01 GPM) have essentially the same impacts as lower tax rates ($1,000 per 0.01 GPM).[102] (Table 11). An 11 percent increase in fuel economy is estimated from current gas-guzzler taxes.[103] The pivot point is probably more important to fuel-savings than further increasing an already-high tax rate. Therefore, extending gas-guzzler fees so that they cover vehicles with average fuel economy levels could increase the effectiveness of this policy.

Table 11
Analyses of Gas-Guzzler Tax Impacts (2002 US$ billions)

	No Policy	Gas-Guzzler Tax ($1,000 per 0.01 GPM)	Gas-Guzzler Tax ($2,000 per 0.01 GPM)
NRC Price Curve	Average	Average	Average
Pivot Points	N/A	Car and light truck	Car and light truck
Fuel Economy Calculation	3-year payback	3-year payback	3-year payback
Cars (mpg)	28.3	31.6	31.8
Light trucks (mpg)	21.8	25.1	25.1
Total (mpg)	25.0	28.3	28.4
Government Expenditures	$0	$0.2	$0.2
Change in sales (%)	0	-0.6	-0.6
Fuel Saved/vehicle (gallons)	126	684	694
Total fuel savings	$3.1	$16.9	$17.1
Societal value	$2.3	$12.4	$12.6
Manufacturers' revenue	$1.4	$1.1	$0.7

Source: Greene D.L., Patterson, P.D., Singh, M, Li, J., 2005, Tables 1A and 1B.

Note: All dollar figures in $US Billions

LEVEL III: Feebates (Austria)

To date, feebate systems have been widely considered but not widely adopted. Ontario, Canada, Austria, Denmark, and France have tried this policy but have been unable to implement a full-scale vehicle feebate program. The US federal and state governments have seriously considered feebates, but not implemented them.

Feebates were included in several US Senate energy bill proposals starting in 1991. The California legislature passed a comprehensive feebate system only to have it vetoed by the Governor in 1989 because it appeared too much like a tax. And the State of Maryland enacted a limited feebate policy that was later held up by the US government on federal pre-emption grounds (because the federal government has sole authority on fuel economy standards which feebates relate to).[104] The states of Massachusetts and Rhode Island are currently developing feebate policies for their climate change action plans.[105]

In 1990, Ontario, Canada introduced a feebate (Tax for Fuel Conservation). The additional variable tax applies (between $75 and $7,000) to vehicles with fuel consumption ratings above 6 liters per 100 km. A flat $100 rebate is given to purchasers of vehicles with fuel consumption ratings below this target.[106]

Fuel economy cost curves support the adoption of feebate policies. The IEA estimates that for as little as $US 600, new car fuel economy increases of 2 liters per 100 km are achievable in Denmark, Germany, and the US.[107]

Austria has implemented a feebate-type vehicle purchase tax that varies with fuel consumption. The feebate rate is linear, set at $0.02 of the vehicle market price. The specific feebate formula varies for gasoline and diesel cars. There is linear relationship of the feebate rate above or below 3 liters per 100 km (gasoline) and 2 liters per 100 km (diesel).[108] For example, a €20,000 gasoline car rated at 5 liters per kilometer (47 mpg) would pay a fee of €800 while a comparable priced gasoline car of 2.5 liter per kilometer (95 mpg) would receive a rebate of €200. The feebate is caped at 16 percent for gasoline vehicles whose specific consumption is 11 liters per 100 km (21.5 miles per gallon). The Austria feebate design is limited. Its progression is very low. Also, no new vehicle models qualify; the most fuel-efficient vehicle gets around 4 liters per 100 km (60 mpg) and none get under the established level of 3 liters per 100 km (78.5 miles per gallon).[109]

In reality this fiscal policy is more of a steep fee program with rebates only at the extremely high end of the spectrum. A €20,000, inefficient, 11 liter per 100 km vehicle would be assessed a €3,200 fee under the Austrian program.

Research has consistently shown that the rebate and fee components of feebate policies are equally important. Yet, few implemented programs have given them equal weight. The most recent comprehensive study of fuel-efficient vehicle feebate programs show that this policy can induce significant increases in fuel economy. Adding a $500 per 0.01 gallon per mile (GPM) feebate with two pivot points (one for cars and another for light trucks) has a projected average fuel efficiency increase of 12 percent (cars) and 19 percent (trucks).[110] Raising the feebate rate to $1,000 per 0.01 GPM is projected to increase light-duty fuel economy by 23 percent. (Table 12).

Table 12
Analyses of Feebate Benefits (2002 US$)

	No Policy	Feebate ($500 per 0.01 GPM)	Feebate ($1,000 per 0.01 GPM)
NRC Price Curve	Average	Average	Average
Pivot Points	N/A	Car and light truck	Car and light truck
Fuel Economy Calculation	3-year payback	3-year payback	3-year payback
Cars (mpg)	28.3	31.8	35.2
Light trucks (mpg)	21.8	26.0	29.2
Total (mpg)	25.0	28.9	32.3
Consumers' Surplus	$0.1	-$2.0	-$6.4
Government Expenditures	$0	$0.2	$0.6
Change in sales (%)	0	-0.5	-1.6
Fuel Saved/vehicle (gallons)	126	773	1,195
Total fuel savings	$3.1	$19.1	$29.2
Societal value	$2.3	$14.0	$21.4
Manufacturers' revenue	$1.4	$1.5	$0.4

Source: Greene D.L., Patterson, P.D., Singh, M, Li, J., 2005, Tables 1A and 1B.

Road Fees

LEVEL I: Road Pricing (Orange County, CA Toll Lanes)

Road pricing and tolls, while widespread, have never been put in place throughout the entire territory of a state or country. Tolls are generally limited to certain freeways and bridges. Some areas have used them more extensively than others, including parts of New York, Massachusetts, New Jersey, France, Italy, and Spain. But freeways are generally free of charge in most of the U.S., Netherlands, UK, and Germany, for example. Such fixed fee systems are generally revenue measures that are not energy or environmentally driven.

Toll roads whose fees correspond to the actual congestion levels are a more recent application of road pricing. In 1995, a private corporation in Orange County, California constructed an expressway with central charge lanes. The road, SR91, was the first of its kind in the United States. Charges are levied so that free-flow speed of a steady 65 miles per hour is maintained. The revenues up to a fixed level go to the company that built the road, any surplus goes to state revenues. Other private and public highways have followed SR91's example. One unique feature of SR91 is its "HOT", or high occupancy toll, lanes. HOT lanes are parallel to existing roads, and can only be used by buses, rideshare (high occupancy) vehicles, and by those driving alone who pay a special fee.

The precise energy and environmental benefits of HOT lanes are probably very small, if measurable at all.[111] On the one hand, HOT lanes reduce stop-and-go traffic, lowering emissions from vehicles traveling in congestion.

And building more HOT (or HOV) lanes that allow buses to travel in less congested conditions than cars can be beneficial in environment and energy terms. Using HOT lanes as a first step to introduce road (and congestion) pricing could lead to better fiscal transportation policymaking over time. On the other hand, using HOT lanes and toll roads to overbuild infrastructure will simply induce travel demand, thereby increasing emissions and energy consumption.

Caution should be exercised here. This policy can create more problems than it solves. Road pricing should be designed to reduce miles of travel, lower emissions per mile traveled, shift people from automobiles to public transit, and bring about other socially-targeted outcomes. Toll roads that exist mainly for revenue purposes do not have energy and environmental benefits and many compound these problems.

LEVEL II: Congestion Pricing (London)

Road pricing has been discussed for many years in London. Congestion has mounted – the average speed has fallen to below 3 miles per hour[112] – costing time and money. The general consensus took root that something had to be done. London-wide congestion pricing was discussed as part of a wider strategy, including public transport improvements, parking/loading enforcement, and traffic management. Without such public transport investments, this policy would not have meaningful energy and environmental benefits.

In 2003, a congestion charging zone was established in central London. The "boundary" of the zone is formed by the Inner Ring Road, on which there is no charge to drive. Vehicles are given a registration number and a flat daily charge of **£**5 applies between 7 a.m. and 6:30 p.m. While there is no volume discount (which is advisable), motorists can pay for weekly passes (**£**25), monthly passes (**£**110), or annual passes (**£**1,250). If payment is made after 10 p.m., the charge rises to **£**10. Payments can be made electronically or in person. Fixed cameras monitor the system using automatic license plate number recognition. If no record of payment is made by midnight an **£**80 penalty is charged to the registered vehicle owner. Persistent evaders are clamped or towed. There are exemptions for taxis, licensed minicabs, emergency service vehicles, blue/orange badge holders, and alternative-energy vehicles.

After six months in operation, the congestion charging is reported to have had beneficial effects on traffic conditions in central London. Traffic delays inside the zone have been reduced by 30 percent and travel times are down 14 percent. Just over half of the motorists who have responded to congestion pricing now use public transport; about one-quarter now drive around the perimeter of the zone, avoiding the charge, and the remainder have switched to other modes, such as taxis.[113]

Public transport is coping well with increased ridership. Overall, 60,000 fewer car trips are coming into the congestion pricing zone and only 4,000 people no longer are traveling to central London as a result of this policy.

A significant portion of the net revenues are being devoted to public transport. Improvements in bus reliability and journey speeds have resulted. Net annual revenues are less than the £130 million projected. This figure has been revised to £80-100 million a year.[114]

London is not the only city with some form of distance-based road charges. (Table 13). However this city is the only one preparing in the short-term future to extend local congestion charging beyond the center city. In the future, both London and its suburbs may adopt a larger, more differentiated, targeted road pricing strategy. The possibility exists to extend this throughout the UK.[115] Such a national road pricing scheme for 60 million people, and its extension to three other countries with a combined population of 200 million.

Table 13
Examples of Worldwide Differentiated Road Pricing

Country	Location /Name	Rate Description	Website
Denmark	Copenhagen	Trials with road pricing for cars based on satellite monitoring completed in 2003, no current intent to introduce full scale-system.	www.progress-project.org
Italy	Rome, Historic City Centre	Access control through fixed annual charge for entry during weekday daytime and Saturday afternoons. Automated electronic enforcement with road-side transponders and number plate recognition cameras.	www.interdev.oecd.org
	Genoa	Cordon charge to enter 2.5 km2 city centre, based on automatic number plate recognition technology.	www.progress-project.org
	Bologna, Milan, Sorrento	Cordon pricing experiments near ready for full scale application	www.transport-pricing.net
Norway	Trondheim	Road-side transponder based cordon charge; Toll Ring around city	www.progress.project.org www.aksess.no/vegvesenet
	Bergen Toll	Cordon charge around city	
Singapore	Electronic Road Pricing	Multiple peak-period pricing rates, based on road-side transponders monitoring actual traffic	www.lta.gov.sg
Sweden	Gothenburg	Trials with road pricing for cars based on satellite monitoring. No full scale system planned at present.	www.progress-project.org
UK	London	Congestion-based charges in city center based on number plate recognition	www.tfl.gov.uk
US	SR91, CA	Variable toll road with charges based on free-flow traffic plus HOT lanes (where buses and carpools travel free and single-occupant vehicles can pay	www.91expresslanes.com
	I-10, TX	HOT lane with toll during the peak	www.quickride.org
	US-290, TX	HOT lane with toll during the peak	
	I-15, CA	HOT lane with variable toll rate	www.argo.sandag.org/fastrak

Source: Perkins, S., 2004.

Although it is not the focus of this report, it is important to stress here the application of road and congestion pricing policy to trucks (lorries). There are many examples worldwide of the increasing implementation of distance charging for trucks. This is equitable since trucks have greater externalities per mile traveled than do cars. Truck transport should be expressly included in a comprehensive transportation fiscal policy package.

LEVEL III: Full Externality-Based Road Pricing (Singapore)

In 1975, Singapore implemented an area-based road pricing system. This was the first in the world designed primarily to regulate traffic. In 1998, the system was fully automated through the use of pre-paid smart cards. The goal of this policy was initially only congestion relief, recent policy modifications include reducing environmental externalities. The primary basis for the road charge is proportional to a target-speed that gives improved traffic flow. If the average speed drops the fees increase and vice versa. The fees are revised every third month and specified on electronic billboards at every gate.

From 2001, the charges have integrated environmental and energy measures. Electric vehicles pay a 20 percent lower road fee and hybrid vehicles pay a 10 percent lower fee.[116]

Overall Singapore's road charge varies for different places, types of vehicles, and hours of travel. The highest fee is €1.50 per gate at peak time. Revenues, estimated at €40 – 50 million per year, go to general revenues and are not distinguished from other state revenues.[117] (Earmarking these proceeds to clean, alternative-fuel transit would yield additional environmental benefits.)

The reduction in traffic levels has been significant. The effects of the old area license system show a 75 percent reduction in inbound journeys in the morning rush hour. The change over to the more finely-tuned electronic system in 1998 resulted in another 16 percent fall in morning rush-hour traffic, and a 15 percent fall in overall traffic. While only 5 percent of drivers switched to other modes or abandoned their daily journey to the zone, the main effect was to discourage multiple trips crossing the entry points to the zone during the same day.[118] Such "trip chaining" reduces energy and environmental impacts.

Beyond the clean-car exemption in Singapore's road pricing, an environmentally/energy-based road pricing policy has not been fully implemented anywhere. It has, however, been considered, studied, and modeled. Such an integrated approach makes sense because the rates for each externality – air pollutants, carbon dioxide, and congestion – can be set according to an areas' relative concerns. Design and use of vehicles becomes much more rational under such a comprehensive externality-based system.

Models have found that emission and congestion reduction benefits could be large. In the San Francisco Bay Area, for example, a policy of charging vehicles based on actual emissions measured while the vehicle is operating (real-time measurements) would reduce fuel consumption by 6.6 percent, traffic delays by 2.5 percent, and emissions by 17.7 percent.[119]

Parking Pricing

LEVEL I: Parking Fee (Pasadena, California)

Free or discounted vehicle parking creates a strong incentive for vehicle use for all types of travel, both work and non-work. In the US, nine out of 10 workers in urban areas park for free or at below-market prices.[120] Moreover, employer-paid parking is treated as a tax-exempt fringe benefit by federal and state tax laws. This encourages workers to commute alone by car, costing the US economy at least $65 billion in wasted time and fuel.[121]

There are an estimated two off-street and 1-2 on-street parking spaces per vehicle in the US, with total annualized value of US$1,500 or greater per vehicle. This averages US$0.12 per vehicle miles, about equal to average vehicle operating costs.[122] These significant costs need to be underscored, especially for large Chinese cities that already have parking problems.[123]

Establishing parking fees appears to be rational and straightforward. One of the issues complicating the implementation of parking fees is that, in many countries, parking is controlled by municipal governments. These local authorities typically restrict implementation of parking surcharges. Instead they usually impose minimum parking space requirements on developers, fostering a system of subsidized parking. Fortunately, the more congested the urban area, take Manhattan for example, the more likely high parking fees are levied without any issue. The problem resides more in smaller cities and suburban areas where parking may not be perceived as part of the problem.

Parking pricing was identified by Environment Canada as one of the most promising instruments to achieve CO_2 and air pollutant emission reductions.[124] Environment Canada gave parking pricing the highest rating for overall effectiveness for its ability to reduce emissions, reduce travel, minimize investment costs, improve the economy, and improve the social situation. In California cities, parking fees ranging from US$1.00-3.00 are projected to reduce fuel use from 1 to 3 percent.[125]

Downtown Pasadena, California is a case study of parking pricing.[126] The downtown had become run down in part due to fewer shoppers given the limited amount of parking available. Curb parking was restricted to two-hour duration, but many simply parked on-street and moved their vehicles several times each day. The city proposed parking pricing as a way to increase turnover and make parking available to customers. In light of opposition by merchants, city officials agreed to dedicate all of the parking revenues to downtown public improvements. A zone was established where revenues were invested.

Parking meters were viewed in a new way – for funding projects and services that benefited downtown businesses. These investments should have included transit investment, although this was not the case in Pasadena.

Pasadena's parking policy has resulted in extensive redevelopment of buildings, new businesses, and residential development. Local sales tax revenues have increased 800 percent, more than the other regional shopping districts with lower parking rates, and nearby malls that offer "free" customer parking. Charging market rate parking – prices that result in 85-90 percent peak-period utilization – with revenues dedicated to local transit improvements can be an effective way to support urban development while benefiting the environment.

Charging market prices for parking both reduces parking demand and raises revenues making the area safer, cleaner, and more livable. Revenues can be used to build and enhance public transit so that people have options other than driving and paying for parking.

If motorists are not charged for parking, we all pay. Developers pay by meeting minimum parking requirements. Residents pay through higher housing prices and rents. Consumers pay through higher prices for goods and services. Employers pay through higher office rents. Workers pay through lower cash wages. Property owners pay through lower land values. And all this because motorists park for free for 99 percent of all US trips.[127] This is likely the case in the EU and other countries.

LEVEL II: In-Lieu Fees for Parking (South Africa, Iceland, Canada, Germany, US, UK)

Minimum parking requirements are placed on most developers. This system subsidizes parking by increasing its supply and reducing its price. In many ways, parking construction requirements resemble regulatory fees – "mandated expenditures by private land developers, required as a price for their obtaining regulatory permits, in support of infrastructure and other public services."[128]

A better option is to allow developers to reduce parking demand rather than increase the parking supply. To this end, some cities offer developers the option of paying a regulatory fee in lieu of providing the required parking specified in building permits. This transfers the burden of parking from developers to local authorities who can establish parking pricing (see above). Policymakers can also adopt other parking strategies, such as free parking for clean, energy-efficient, and high-occupancy vehicles and devoting parking revenues to develop public transit systems.

Palo Alto, California, for example, allows developers to pay the city a fee of US$17,848 for each required parking space that is not built. The city then uses the revenue for priced public parking spaces to replace the free private parking spaces that developers would have provided. Several cities already provide versions of this successful policy. (Table 14). Fees vary widely – from US$2,000 – 27,500 per parking space not provided.[129] Cities set in-lieu parking fees either by calculating them individually for each project or by adopting a uniform fee.

Table 14
Examples of Cities with In-Lieu Parking Fees

Country	City	In-Lieu Parking Fee (US$ / space)	Parking Impact Fee – Office Space (US$/sq. foot)	Parking Impact Fee – Highest Use (US$/sq. foot)
US	Palo Alto, CA	17,484	71	71
	Beverly Hills, CA	20,180	59	448
	Walnut Creek, CA	16,373	55	55
	Forest Lake, IL	9,000	32	23
UK	Kingston upon Thames	20,800	48	160
	Sutton	13,360	36	114
	Harrow	14,352	33	
	Waltham Forest	2,000	2	9
Germany	Hamburg	20,705	32	64
Iceland	Reykjavik	13,000	28	28
Canada	Kitchener, Ontario	14,599	19	112
	Burnaby, B.C.	7,299	15	75
	Ottawa, Ontario	10,043	7	98
	Calgary, Alberta	9,781	7	101
South Africa	Port Elizabeth	1,846	4	34

Source: Shoup, D., 1999.

Crowded Chinese downtown areas are probably best served by not adopting minimum parking requirements. The physical limitation of parking spaces could be better used for commercial development and public transit infrastructure. In smaller cities, however, where parking requirements may be considered, in-lieu fees are a better option. In-lieu fees expose the high cost of parking requirements. In fact, minimum parking requirements subsidize cars and distort urban areas. In-lieu fees mitigate the damage caused by parking requirements. Where it has been implemented, this fiscal policy has helped to reduce congestion, air pollution, and energy consumption, especially when coupled with transit improvements.[130]

LEVEL III: Replacing Parking Supply With Programs that Reduce Parking Demand (US)

Parking is at the center of urban development. However confusion reigns with respect to parking and its pricing. Planners cannot agree on whether to require or restrict parking. Parking policy mistakes are easy to make. Rather than establishing minimum space requirements that increase parking supply, it would be more efficient to allow developers to reduce parking demand.

There are many ways this policy can take effect. One option is for employers to offer free transit passes to commuters and reduce the demand for parking at work.[131] In exchange, local policymakers would reduce parking requirements in lieu of an employer-based transit pass program. This is done in Santa Clara, California, where the transit agency offers employers an "Eco Pass" that allows all their employees to ride free on all local transit lines, including buses and light rail. The annual price per employee in Santa Clara varies by exact location and the number of employees, ranging from $10 per employee for the largest corporations with only bus transit access to $80 for small employers (1-99 employees) in downtown San Jose locations, with full transit accessibility.[132]

Other examples of reduced parking demand have taken place at universities. Contracts between educational institutions and local transit agencies allow student identification cards to serve as public transit passes. These transit pass programs reduce demand for parking on campus.[133] Likewise, some cities allow theaters and stadiums to offer free transit to all ticket holders instead of providing required parking spaces. The University of Washington, for example, contracts with Seattle Metro so that ticket holders can show their game tickets and ride on any metro transit service on the day of the game. The share of ticket holders arriving by transit has increased from 4.2 percent in 1984 (before implementation) to 20.6 percent in 1997.[134]

This policy also works for residential apartment buildings and hotels. In State College, Pennsylvania (a city with in-lieu fees), the transportation authority contracts with apartment developers and owners to give all residents transit passes for lines that serve the apartments. The passes are priced at $100 per apartment per year. Developers build bus shelters and bus pull-off lanes and owners advertise transit passes to tenants.[135] Moreover, hotels that offer free transit for guests could save money on constructing parking and attract a niche market of guest without cars. Reduced parking requirements could be exchanged for free hotel shuttles and tokens for public transit.

Some Chinese cities already have implemented similar mechanisms to encourage the use of transit – starting with subsidies for urban residents. These programs should be retained, and if possible, expanded. They increase transit ridership and keep the quality of service from deteriorating.

Beyond transit passes, there are other measures to reduce parking demand. Offering employees the option to cash out employer-paid parking has been found, in eight case studies, to reduce parking demand by an average 11 percent, at almost no added cost to employers.[136] Parking cash out offers commuters the option to take the cash equivalent of any parking subsidy offered. California law requires many employers to offer parking cash out if they subsidize commuter parking in spaces they rent from a third party. The option to "cash out" raises the effective price of commuter parking without charging for it. Commuters can continue to park free at work, but the cash option also financially rewards commuters who choose to carpool, ride public transit, walk, or bicycle to work.[137]

If successful, this policy could be extended to developers who wish provide *more* than the required number of parking spaces. This option benefits developers, property owners, employers, commuters, transit agencies, cities, and the environment. This strategic policy holds promise for China's cities.

Vehicle Insurance Fees

LEVEL I: Fines for Lack of Mandatory Insurance (UK and US)

In most countries, automobile insurance is required and for good reason. Uninsured motorists create large societal costs in terms of lost life, injuries, ongoing medical costs, property loss, and property damage. There are huge public benefits for maintaining insurance coverage for all motorists.

In the US, auto insurance limits and enforcement are dealt with by the individual states. There are compulsory insurance laws in 47 out of 50 states. Nevertheless, uninsured motorists still account for 4 to 34 percent of all drivers in those states and uninsured drivers are involved in more than 20 percent of fatal crashes.[138] Some states regulate minimum insurance coverage, while others do not require insurance at all. Such systems are rife with "free riders" who claim to have insurance, but they either do not or are underinsured.

Fines in the US for those not complying with mandatory insurance laws differ by state. For the first offense, the highest fine is US$1,000 in only two states (Missouri and Hawaii) while the lowest fine is a mere US$50.[139] Several states have no fine whatsoever. And most states impose fines around US$100, ten-times less than a typical annual insurance policy.

In the UK, motor insurance policies include minimum requirements, yet the government has neglected to put more serious deterrents in place. Fines of up to £5000 can be imposed for driving without insurance, but in reality the figure rarely exceeds more than £150 – far less than a typical annual insurance premium (which is high and expected to increase 10 percent this year alone).[140] In the UK, insurance companies pay out 15 – 20 percent more on claims than they collect in premiums.[141] As a result, major insurers have gone out of business. This situation does not adequately protect motorists and other innocent bystanders who are involved in accidents.

A policy of high fines for lack of mandatory insurance is necessary to reduce social costs imposed by uninsured drivers. With the prospect of many cars traveling China's roads in the future, it would be wise, at a minimum, to put such a system in place. There are indirect connections between insurance, energy, and the environment. Minimizing accidents (by encouraging motorists to drive more safely) reduces delays and aggressive driving both of which increase in-use fuel consumption and emissions.

LEVEL II: Insurance-Specific Automobile Taxes (France)

In France, an insurance-specific tax is levied on motorists. The tax is placed on insurance contracts, and the rate is applied to the net price of the contract. The tax depends on the price and type of the car and the accident rate of the car owner. There is no link to fuel consumption or environmental externalities, the actual level of vehicle use, or poor driving habits that may impact energy consumption. Currently the tax is lower for a small, inexpensive vehicle driven by a motorist with good driving records.

The rate of this tax is on the order of 450 Francs per vehicle (approximately US$90) in 1999.[142] Little could be found about the specifics of this car insurance-specific tax, but if implemented in conjunction with mandatory insurance with high fines for noncompliance, it may be more effective than the prevailing practice of regulating insurance without fiscal policy components.

LEVEL III: Pay-As-You-Drive and Pay-At-The-Pump Insurance (US and UK)

US driving costs are mostly fixed rather than set variably to pay-as-you-drive. Insurance alone accounts for 16 percent of these fixed costs.[143] This means that Americans pay for their cars whether they drive them or not.

This system does not induce rational vehicle use. Instead it makes economic sense to use cars in the US to the maximum extent possible.

Basing insurance premiums directly on how much a vehicle is driven, rather than fixing it at an annual rate, is more efficient. This can be done by charging the unit of exposure based on vehicle-mile, vehicle-kilometer, vehicle per minute or per unit of fuel consumption. Existing rating factors can be incorporated so high-risk motorists pay more per unit than lower-risk drivers.

Annual insurance claims increase with annual vehicle mileage, within existing price categories. For example, in the US, vehicles driven under 5,000 km per year have 0.04 crash-related claims per year, while vehicles driven 25,000-30,000 km per year are involved in over two-times (nearly 0.1) the number of claims annually.[144]

Pay-As-You-Drive (PAYD) Insurance can be implemented on either a mileage basis or a fuel consumption basis. A mileage system requires verified mileage data that can be collected through odometer readings or electronic devices that automatically send mileage data to insurers. When implemented through a fuel-based system, called " pay-at-the-pump" or PATP, an insurance surcharge is placed on gasoline and collected during refueling. This policy is especially beneficial in the US and other countries with low fuel taxes. PATP has the additional benefit of reducing gasoline demand. Pay-at-the-pump insurance also continually guarantees auto insurance for all drivers since all vehicles are refueled weekly.

Several PAYD insurance initiatives are currently under consideration in the US.[145] In 2003, the Oregon legislature passed a bill that provides a $100 tax credit per insurance policy to insurers who offer PAYD pricing. In 2001, the Texas legislature passed a bill giving insurance companies authority to offer PAYD insurance policies and supporters are endorsing this option with their insurance companies. The Washington State Department of Transportation conducted a market survey that found PAYD insurance would encourage commuters to shift to ridesharing and transit. As a result, the largest transit agency in the state is seeking to partner with an insurance company to offer PAYD insurance to its 150,000 customers. And the US Environmental Protection Agency is developing an initiative that rewards motorists for driving less by voluntarily converting vehicle insurance to mileage-based pricing.

Studies show that the average America driver pays US$0.06 per mile for insurance. If this charge were converted to a PAYD policy, travel demand is projected to be reduced by 10 percent.[146] At only US$0.02 per mile, fuel consumption and air pollution are each estimated at a 4 percent reduction.

In the UK, there are plans afoot to introduce a PAYD insurance policy.[147] There motorists are routinely upset by expensive car insurance bills over which they have little control. A global positioning (GPS) system will be used for monthly PAYD insurance. By the end of 2004, telematics (electronic data recording devices) will have been placed in the trunks of 5,000 cars, make itemized monthly bills possible. An 18-month pilot project will be tested by Norwich Union in the hopes of introducing a PAYD insurance system in two years time. Insurance premiums in the future could be calculated on how often, where, and when people drive their cars. This means that people who only use their car occasionally and on uncongested roads could pay lower premiums than those who exhibit higher-impact driving habits.

Although this policy has yet to be implemented, there has been a lot of interest in its use. It would help rationalize car use while making insurance coverage more universal and affordable. Insurance fees could be collected along with fuel taxes and distributed by the government to insurance companies. This could minimize conflicts between gasoline station operators and insurance companies. Increasing the application of variable vehicle pricing could help reduce travel, congestion, fuel use, and emissions.

Fleet Vehicle Incentives

LEVEL I: Cost-Effective Clean, Fuel-Efficient Public, Government-Vehicle Fleets (Canada)

Life-cycle costs should be considered in making vehicle purchase decisions. This is especially important if sales of fuel-efficient vehicles is to increase. While the public may not be adept at performing complicated discount rate calculations, governments should certainly be more capable. Determining cost savings over a vehicle's lifetime and comparing this to the increased upfront cost of a fuel-efficient model is prudent when public funds are being used for vehicle purchases. Cost-effective decisions can save the public millions of dollars in large governmental vehicle fleets.

Advancing policies that require cost-effectiveness considerations in vehicle purchase decisions is recommended. Moreover, these large acquisitions of fuel-efficient (and clean) vehicles can help on the margin to reduce prices of these improved vehicles.

Canada has been working since 1995 to green its government vehicle fleet. Objectives for government fleet vehicles are being coordinated by the Treasury Board, Natural Resources Canada, and Environment Canada. In the past, economic issues took precedence. Now environmental and fuel-efficiency goals are being fully considered. The Canadian government's fleet's best practices include: maximizing fuel efficiency and the use of alternative fuels, using low-sulfur diesel, purchasing vehicles with the smallest engines size to get the job done, reducing the number of vehicles for departmental use, performing emissions testing on all vehicles, recycling all used vehicle liquids, and conducting driver education to enhance energy savings.[148]

The federal government is the largest employer in Canada, composed of 29 federal departments. It has an on-road vehicle fleet of 23,000 vehicles, of which 32 percent are driven less than 20,000 km per year.[149] To date, Canada has made substantial reductions in greenhouse gas emissions by reducing energy use in fleet vehicles and other sectors through green procurement policies and other programs.

Other countries, such as the US, have extensive clean government fleet programs in effect. The direct link between government agencies and public policy objectives makes vehicle fleets a prime target for testing clean vehicles and fuels. Data from such public programs can also serve to refine clean car incentive policies as on-road operating characteristics are better understood.

CalStart and Clean Cities are knowledgeable resources on alternative fuels.[150] Clean Cities (in partnership with numerous OECD countries) is partnering, for example, with Bangladesh to increase the country's energy security and improve air quality. With the help of Clean Cities International (CCI), alternative fuel vehicles are being added to the fleet, including natural gas buses and refueling stations. Program goals include: 500 CNG buses and 25 CNG stations in Bangladesh's capital, Dhaka, by mid 2005.[151] Special care must be taken to insure that these CNG vehicles have low tailpipe emissions. CNG vehicles tend to have high NOx and aldehydes emissions if not carefully controlled. Also, methane (natural gas) is a potent greenhouse gas so upstream (gas processing) climate change emissions could increase.

LEVEL II: Incentives to Promote Clean Company Cars (UK)

Similar to government fleet vehicles, fiscal policies could be put in place to reward companies purchase clean, fuel-efficient company-owned cars. Company-owned cars represent a large portion of vehicles on the road in the UK, and overall in much of the EU (Table 15). Company cars have long been used as an incentive in recruiting and retaining staff. Over 80 percent of large organizations provide company cars, either for essential use or as a status reward.[152] An estimated 1.6 million company cars were driven in the UK in 2001.[153] British company cars account for an estimated 6 percent of all cars on the road.[154] The average annual mileage of a company car in Britian was 21,300 miles, compared with 8,100 miles for privately-owned cars.[155]

In 2002, the UK's company car tax regime was reformed to reduce carbon dioxide emissions. The goal of this reform was to change the way businesses think about car fleet policies and to change purchase decisions for company cars. The new company car tax provides financial incentives for employers and company car drivers who choose cars with lower CO_2 emissions. Moreover, business mileage discounts were omitted from the calculation of the company car tax, removing the incentive to travel more miles in company cars.

Table 15
Share of Company Cars by EU Country

Country	% of New Cars into Company Car Fleets
Belgium	25
Germany	42
Denmark	27
Spain	25
Greece	25
France	25
Italy	10
Ireland	7.5
Luxembourg	25
Netherlands	45
Austria	25
Portugal	25
Finland	36
Sweden	50
UK	35

Source: Feng An, 2004.

For gasoline and diesel company cars, the tax varies by CO_2 emissions, with a total tax of between 15 to 35 percent. The tax target is lowered each year as more fuel-efficient new cars enter the market. In 2005/6, cars emitting less than 140 grams carbon per kilometer pay the minimum 15 percent tax rate. For each additional 5 g/km CO_2 emissions, the tax rate is increased one percent, up to 35 percent. Diesel cars with over 240 g/km CO_2 pay the maximum charge of 35 percent. An additional penalty is placed on diesel cars not meeting Euro IV emission standards which incur a penalty charge of 3 percent.[156]

Company cars running on alternative fuels, such as electricity and LPG, qualify for additional discounts. Currently only 1 percent of UK company cars run on alternative fuels.[157]

This new fiscal policy is being closely monitored by the UK Treasury.[158] In 2003 alone, the reform saved approximately 0.2 million tons of carbon – 0.5 percent of total road transport emissions. Early indications suggest that the UK will meet its targeted long-run CO_2 reductions from this company car tax reform program of 0.5 to 1 million tons (20 percent) carbon per year. The policy has also reduced business car travel by an estimated 300-400 million miles in 2003. The overall number of company cars has also been reduced by 16 percent, down to 1.35 million.

LEVEL III: Incentives for Environmentally-Based Vehicle Leases (n/a)

Whether vehicles are leased by public agencies, companies, or individuals, it would be more efficient to introduce environmentally-based surcharges and rebates on vehicle leases. Vehicle lease decisions are price sensitive. Therefore, the higher cost of cleaner, advanced-technology, fuel-efficient vehicles can deter their selection. If these improved vehicles are leased, however, these costs can be spread out over their lifetimes making them more affordable upfront. Moreover, leased vehicles tend to be sold in the used car market after a 3-5 year lease. The benefits of cleaner, more fuel-efficient lease vehicles will trickle down to the entire vehicle market over time.

In California, the first electric vehicles introduced were leased rather than offered for sale. Since their cost was much higher than conventional gasoline-powered cars, this policy facilitated early adoption of this new, cleaner technology.

Leasing agents tend to be private companies. Therefore, financial incentives are needed to encourage businesses to lease clean, fuel-efficient vehicles. Some companies, such as Hitachi Capital, are already headed in this direction. This company is applying environmental criteria to its own supplier network to advise its clients on how to develop environmentally-sound fleet management practices.[159] Large companies, especially in the UK, are demanding that fleet leasing companies have well-developed environmental policies. Hitachi Capital sees the industry moving in an environmental direction and has partnered with the UK Environmental Agency to deliver new, innovative vehicles. Cutting-edge businesses should be rewarded for staying abreast of new developments, continually improving on innovative vehicle leasing arrangements.

VI. Conclusions and Lessons Learned

No single policy can solve the myriad of problems attributed to the transportation sector. A package of sound fiscal policies, accompanied by strong regulatory policies, is necessary to do the job. While individual policy designs are important, comprehensive consideration of overall policy package impacts is even more important. A simultaneous top-down and bottom-up policymaking approach is necessary in this complex, dynamic sector.

The bottom-up component entails developing fiscal policies based on sound principles – aligning prices with marginal social costs (establishing variable prices for fuels, vehicles, and roads that are related to energy consumption, pollution, congestion, and other socially harmful impacts). Guidelines and examples are documented in this report. International best practices are summarized in Table 16. Policies are separated into levels (I, II, III) indicating the degree of simplicity, practicality, and ease of implementation associated with each policy design (Level I being the easiest). In most cases, the different policy design are not mutually exclusive. If it can be achieved, Level III will be even more effective in achieving energy and environmental goals. Level III policies should ultimately be adopted, even if they are not feasible at present.

A top-down effort in fiscal transportation policymaking is equally as important as designing individual policies. This entails examining fiscal policies as a comprehensive package. Unfortunately this component often gets less attention than individual policy development. Any individual fiscal policy is only <u>one</u> part of the total set of prices faced by users. However, consumers react to overall transportation prices. The key issue here is: Does the *overall policy package* move the full set of relevant prices toward a more optimal outcome? The EU is in the process of developing guidelines for comprehensive fiscal transportation reform to correct for years of "piecemeal", inconsistent policymaking. Such a comprehensive approach is critical to China's success.

General lessons learned about fiscal transportation policies are summarized below. Intelligence has been gather over many years on these programs. There is valuable information and technical assistance available. China is not alone in crafting policies to meet transportation, energy, and environmental goals.

- Fiscal policies and regulatory policies are equally important components of a sound, comprehensive transportation strategy for China, and any nation. These approaches build on each other's strengths and should be packaged together to reach desired goals.

- Establish a sound fiscal transportation policy goal: Over the long term, all prices should align with marginal social costs. All levels of government should adopt policies that achieve this objective. Paying directly for transportation externalities will cost less over time than paying indirectly.

- Avoid counterproductive measures and subsidies that move prices away from the alignment of prices with marginal social costs.

- Comprehensively plan and evaluate fiscal policies to advance fuel-efficient and clean transportation goals for China. When developing individual policies, simultaneously put them into context as part of a policy package. Evaluation models exist for such comprehensive policy development. The US, EU, and other international experts are available for technical assistance.

- Take calculated policy risks. Just because a sophisticated Level III fiscal policy design is not being currently implemented does not mean that the policy should not be tried. The inability of governments to adopt the most effective fiscal policy design is more a matter of politics and entrenched special interests than lack of technical merit in achieving desired energy and environmental goals.

- Fiscal policy measures are dynamic. It is difficult to get the prices upon initial policy adoption. Policymakers must be prepared and delegate administrative authority to experts who evaluate and revise the implemented strategies so that they achieve their stated goals over time.

- Use fiscal policies to maintain diversity in the transportation sector. A sustainable passenger transportation system serves and encourages bicycles, pedestrians, public transit, telecommuting, and clean, fuel-efficient automobiles. If automobiles predominate over all other modes, the system will tend to break down.

- Address equity issues directly. Mobility should be a right for all, not a privilege for those who are wealthy. As income disparity widens, transportation policies and investments should benefit all citizens. Avoid fiscal policies that are detrimental to low-income groups unless compensation can be incorporated into the policy. The more fair transportation policies are, the more stable and effective they will prove to be over time.

- Financial incentives should be placed on full fuel-cycle costs, whenever possible. Consistent "wellhead to wheel" environmental and energy signals on transportation fuels and vehicles is crucial.

- Fuel consumption, carbon dioxide, and air pollution emission objectives should be combined wherever possible. Basing fiscal policies to all of these externalities simultaneously will help avoid unnecessary trade-offs between these important, related goals.

- Reduce policy gaming by analyzing the unintended consequences based on the exact policy design. Ask the question repeatedly: How will stakeholders cheat if they want to benefit financially?

- Extreme caution should be exercised in exempting any industry or product from financial incentives. (For example, China can avoid the runaway problem in the US with light-duty trucks given their historic exemption from gas-guzzler taxes and relaxed CAFE standards.) Exemptions can bring about excessive gaming.

- Reward policy innovations, do not hinder them. In order to facilitate the most innovative policy environment leading to technological breakthroughs, avoid national pre-emption of energy and environmental policies. (In the US, states like California could address many of this nation's vehicle fuel economy issues, but the federal government has legally prevented states from dealing with these important issues. The California Air Resources Board, with support from the state government has recently adopted a carbon dioxide standards. But there is concern that the federal government will challenge California's new CO_2 standard.)

- Environmentally-motivated taxes are visible instruments. They can be subject to public pressure. And their high visibility makes them easy to attack. Accounting for their revenues in public budgets can make these policies more durable.

- Where benefits greatly exceed costs, support fiscal transportation policies with ample documentation on their costs and benefits. (US and EU environmental agencies have a lot of experience with these analyses.)

- Where cost-benefit analysis does not provide clear guidance, acknowledge the limits to quantitative analysis. Endless arguments over exactly what the external costs are can ensue. Adopt the statement, "we know enough" to act, even though we may not know precisely the value of certain external costs. (A research project on transport in the Alps, undertaken on behalf of the European Commission and a group called Alp-Net developed this approach.)

The cost of doing nothing could be high. The cost of subsidizing harmful transportation activities could be even higher. No doubt these are difficult problems to solve. It is the role of government to deliver public goods. Public policymakers who deal with, rather than avoid, these complex transportation problems have the best chance of balancing public and private goals. Adopting a strategic, long-range view is the key. Accounting for marginal social costs is essential. Leading the way is the best approach.

TABLE 15
INTERNATIONAL BEST PRACTICES: FISCAL POLICIES FOR SUSTAINABLE TRANSPORTATION

CATEGORY	LEVEL I	LEVEL II	LEVEL III
FUEL TAX	**Gasoline/Diesel Tax** Poland	**Carbon Tax** Sweden	**Environmentally-Based Fuel Fees** N/A
VEHICLE TAX	**Annual Vehicle Attribute-Based Taxes and Fees** EU	**Tax and Fee Reductions or Exemptions for New Clean, Fuel-Efficient Cars** Japan, Germany, Denmark	**Annual, Externality-Based CO_2 and Smog Fees** UK, Denmark
NEW VEHICLE INCENTIVE	**Clean Car Rebates** Japan, US	**Gas Guzzler Tax** US	**Vehicle Feebates** Austria
ROAD FEES	**Road Pricing/HOT Lanes** US (California)	**Congestion Pricing** UK (London)	**Fully-Externality-Based Road Pricing** Singapore
USER FEES	**Parking Fees** US (California)	**In-Lieu Fees for Parking** South Africa, Iceland, Canada, Germany	**Parking Demand Management** US
VEHICLE INSURANCE	**Fines for Lack of Mandatory Insurance** UK, US	**Insurance-Specific Auto Tax** France	**Pay-As-You-Drive and Pay-At-The-Pump Insurance** UK, US
FLEET VEHICLE INCENTIVES	**Cost-Effective, Clean, Fuel-Efficient Public Fleets** Canada	**Incentives to Promote Clean, Efficient Company Cars** UK	**Incentives for Environmentally-Based Vehicle Leases** N/A

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