

Overcoming Barriers to Transportation Cost Internalization

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Abstract

Much progress has been made in accounting for the externality costs related to transportation decisions in recent years. However, major institutional and political barriers currently impede both public awareness of this information and the introduction of market-based pricing mechanisms that might begin to better internalize both marginal costs and social and environmental cost factors to inform decision making by both consumers and policy-makers. Focusing mostly on the U.S. experience, this paper explores these barriers and discusses strategies that might contribute to progress in both cost internalization and regulatory reform. Incremental progress can come through development of information, analysis, and decision support systems for transportation and long range planning, through appropriate applications of Intelligent Transportation Systems technologies such as electronic road and parking pricing, through development of performance and incentive based regulatory systems, and by perhaps by influencing advertising that shapes public attitudes towards motor vehicles.

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The Growing Impetus Towards Market- Based Transportation Reforms

1.1 Traditional Motor User Fees. Many types of motor vehicle user fees have also been developed and applied over the past century. These include gasoline taxes, motor vehicle sales taxes and registration fees, parking user fees and taxes, and tolls for road use or entry into central areas. European countries and Japan have long imposed high gasoline and motor vehicle taxes and vehicle registration fees to raise general revenues and to finance public transportation. Scarce parking and high parking charges in central areas, combined with high quality railway and bus systems, walkable streets, and in many cases interconnected bicycle networks, have combined with these other motorist user fees to shape patterns of transportation consumption. As a result, motor vehicle dependence and use has remained substantially lower than in the U.S., where such taxes and fees are quite low by world standards, despite comparable per capita incomes.

1.2 Central Area Pricing and Vehicle Registration Caps. Development of market-based transportation measures to manage traffic growth and congestion has progressed farthest in Singapore, beginning with central area pricing in the mid-1970s, followed by a cap on total motor vehicle registrations by vehicle class, with auctions determining market prices in the 1990s. Central area pricing has been moving forward in several European metropolitan areas, with systems fully in place in Oslo and Bergen, Norway.

1.3 Toll Financing. Growing traffic congestion and fiscal constraints facing governments in much of the

world are prompting increased reliance on private financing and development of new roads using toll revenues in countries as wide ranging as China, New Zealand, Spain, Thailand, Australia, and the United States. In Orange County, California, a private toll facility is about to open using congestion-pricing to ensure a continued high level of service in a congested corridor. A private toll road is being developed in Loudon County, Virginia. Congestion pricing pilot projects are being planned in more than half a dozen communities across the U.S. with support from the Federal Highway Administration. A growing number of initiatives for electronic tolling or congestion pricing are promising signs for progress in several European countries, Canada, and Australia.

1.4 Local Parking Pricing and Commuter Choice Programs. Some U.S. cities and towns have used parking management and pricing quite successfully as traffic management tools, including Boston (MA), San Francisco (CA), Ann Arbor (MI), reinforced by other measures. Aspen (CO) in late 1994 instituted a \$1/hour parking charge in the downtown which faced initial opposition, but now has both business and resident support, particularly since the town continues to upgrade free or low cost bus services. Boulder (CO) has had good success in reducing automobile use and encouraging public transportation, walking, and bicycling through its coordinated program of restructuring commuter subsidies, parking management, expanded bus service, development of a bicycle network and traffic calming strategies, and public education. Nearly 30,000 downtown Boulder employees now receive discounted transit passes (for many, in place of formerly free parking) from their employers and the use of cars for work trips by these employees has fallen by half from before the program, to 3.6 work trips per week by car (GO Boulder, February 1995). (1)

1.5 Changing How We Pay For Transportation. In the U.S., there has been growing consideration of pricing reforms that would untie existing subsidies to motor vehicle users from the use of the motor vehicle, for example, by giving individuals a commuter subsidy which they might use to purchase parking or public transportation, rather than offering a free parking space at their work place. However, changes in federal tax policy are needed to put such flexible employer commuter subsidy programs on an equal footing with the treatment of parking subsidies. Some progress towards reform has been made, but more action is needed. Other reforms under consideration would convert fixed costs of motor vehicle acquisition and operation into variable costs related to the amount of motor vehicle use, for example, by paying for a portion of car insurance at the gasoline pump or through a fee paid at time of car registration based on the distance the vehicle has been driven. This will require state legislation to reform insurance system regulations, and has been under consideration in half a dozen states, most notably in California.

1.6 Market-Based Regulatory Reform. There are also major initiatives underway in the U.S. to achieve environmental goals through more flexible, market-based regulatory systems rather than through more layers of rigid rules and mandates. To produce the maximum results at the lowest cost, regulatory processes need to be designed to seek the root of problems, to set strong and enforced performance standards related to the problems, and to use incentives to encourage innovation in attaining standards. Such systems offer promise of pollution reductions through new types of traffic management at costs potentially much lower than further expensive controls on tailpipes, power plants, and factories. The 1990 Clean Air Act Amendments provide a framework for pollution cap and trade systems. These strategies could be extended to congestion management systems.

Advances in information, communications, and control system technologies promise to play a key role in developing more self-managing regulatory systems. Giving people and firms better information, setting prices to reflect true costs, and strengthening community and environmental education and ethics can focus efforts on pollution prevention and congestion management, rather than pollution clean up and costly expansion of often inefficiently utilized systems and infrastructure. There is particular potential for these approaches in the private motor vehicle transportation sector, especially in the U.S., where hidden subsidies, tax structures, regulatory systems, and streetspace design and allocation policies have encouraged dependence on private motor vehicles.

1.7 Learning from Experience. The experience of other countries, however, leaves little doubt that transportation pricing reforms must be handled carefully. Efforts to establish widespread road user charges in 1989-90 in the Netherlands floundered and contributed to the downfall of the government. Congestion pricing proposals in London, England, and some other European cities have been stalled by political factors, although they continue to receive serious consideration. In a time of intense domestic partisan political conflict, pricing and tax reform initiatives can become easy prey to populist rhetoric, opportunistic misinformation campaigns, and special interest politics. However, growing problems of infrastructure financing, government deficits, trade imbalances,

traffic congestion, economic inequality, and environmental degradation have led many business, government, and environmental leaders to conclude that market-based transportation reforms are worth pursuing, producing sometimes quite non-traditional alliances both for and against specific proposals.

Hidden Subsidies and the Total Costs of Transportation

Particularly in the U.S., the total costs of transportation system development and operations have been hidden as "externality" costs, borne by all, not by the consumers or producers of mobility. The systems in place have made it rather expensive for individuals to purchase and insure a motor vehicle, while keeping marginal motor vehicle user costs very low. Federal, state, and local tax systems and zoning and design standards continue to favor motor vehicle ownership and use and low density automobile-dependent development patterns while discriminating against other means of transportation and dense, mixed-use, transit-oriented development. Together, these forces have promoted highly automobile-dependent metropolitan areas.

The economic and strategic consequences of these policies are large and increasingly unsustainable. It makes the U.S. economy vulnerable to energy supply disruption in a world of growing instability, with petroleum and motor vehicles often accounting for more than half of the large U.S. foreign trade imbalance, contributing to the long-term decline of the U.S. dollar. It spurs increased consumption of energy, travel, and land, promoting traffic growth, traffic congestion, demands for costly new transportation capacity, continued unhealthy levels of air pollution in many regions, and a rising rate of greenhouse gas emissions. Subsidies and non-internalized costs tilt consumer choice to more costly and less efficient patterns of behavior and suppress the development of many alternatives, whether these are other means of travel or other means of satisfying daily needs for access to goods, services, and communications. It increases inequality in access to opportunities and services between rich and poor, between those with full access to private motor vehicles and those unable to command such access at will, such as children, the disabled, and others who do not drive. This also has substantial implications for regional economic growth. Studies in both Montgomery County, Maryland, and Los Angeles, California in the 1980s showed that for every dollar spent by consumers on gasoline, some \$.85 left the local economy; for every dollar saved from gasoline expenditures, local economic activity was boosted by \$2.50-\$3.50, since that dollar went for general goods and services or into bus driver's wages and then into such general spending (Montgomery County, 1985). (2)

In the U.S. a major share of the costs of highway construction and maintenance continues to be paid for out of general tax revenues, mostly at the local government level. The large past investment in highway capacity by taxpayers imposes a stream of current and future costs which affect the provision of added capacity. The recent report by the U.S. Congressional Office of Technology Assessment (OTA) (3) provides a good accounting of these elements. OTA identifies \$76.5 billion in 1990 public spending on highway construction, maintenance and services covered by payments by motor vehicle users, along with hidden private sector expenditures related to motor vehicle use of \$150 to \$400 billion a year in 1990 for parking. OTA estimates that U.S. taxpayers provided \$33 to \$64 billion in subsidies for highway construction and motor vehicle infrastructure and services in 1990, after accounting for total costs and deducting payments by motorists. Non-monetary externality costs related to motor vehicle use are estimated at \$325-580 billion per year in 1990. According to OTA,

"Approximately 49 to 61 percent of the total monetary and nonmonetary costs of motor vehicle use, excluding the value of time, are efficiently priced [i.e. paid and recognized by motor vehicle users]" (p.109-110). Motor vehicle users paid openly for 53 to 69 percent of the social (public plus private) costs of motor vehicle use, both monetary and non-monetary, excluding the value of time...if subsidies were withdrawn, externalities 'internalized,' and hidden costs brought out into the open and directly charged to motor vehicle users, the perceived costs of motor vehicle use would increase substantially (by 14 to 89 percent, depending on whether nonmonetary costs and other factors are included), and people would drive less.

Fair markets based on good information are a well-recognized means to allocate and manage scarce resources, but these are distorted or absent in much of the transportation sector. At the end of the 20th century, it is not just good land that is becoming scarce, but also street-space, healthy air, clean water, tax dollars, silence, and livable communities. Many economists and environmental experts argue we can move towards greater sustainability by recognizing the total costs of our decisions in advance and, to the extent that it is possible and equitable, use prices

to inform consumers of the consequences of their choices. The politics surrounding such price reform can only be aided by development of fuller information about these costs and the implications of alternative longer-range policies and investment patterns.

Public Awareness of Transportation Costs and the Role of Advertising

Over the past several decades, there have been repeated efforts to identify environmental, health, and social costs, as well as hidden subsidies, related to motor vehicle use. The past several years has produced yet another wave of such studies in the U.S. and elsewhere (OTA, 1994; Komanoff & Ketcham, 1994; MacKenzie, 1993; Litman, 1994, others). (4) Progress has been slow, however, in actually changing transportation pricing systems to better reflect these costs and to manage rapidly growing demand for personal motorized transportation. Institutional and political resistance to even studying pricing reforms in specific corridors and regions remains high, especially in the U.S.

A major barrier that must be addressed is the low public awareness of large externality costs and hidden subsidies now shaping the quality of their lives and daily travel choices, or the lack thereof. Most Americans remain convinced that gasoline taxes pay for all the roads, although 40% of the costs of road construction and maintenance is derived from sources other than user fees -- largely from the very same property taxes that have inspired widespread tax revolts across the U.S. since the late 1970s. Few Americans are aware of how expensive it is to build and operate automobile parking for employers, commercial establishments, and residential developments, since these costs are bundled with other things -- hidden as untaxed employee compensation, in the cost of goods and services, and in residential rents. If these hidden subsidies were made explicit, it is clear that a significant portion of individuals would seek out alternatives to solo driving in return for the cash value of the current subsidy or buried cost (Shoup, 1992). (5) Clearly, many would welcome lower property or other taxes. A least some would appreciate more widespread options to the automobile, which would become more viable in a wider range of travel markets if motorist subsidies were eliminated. However, most Americans correctly perceive that they now have few viable choices but to use an automobile for most or all of their daily travel needs, since so many communities built in the past half-century have been designed solely for automobile access.

Where studies of hidden costs and subsidies related to the automobile have been undertaken, however, awareness of the findings has remained low among the public and key decision-makers. The news media have had a hard time finding a place for stories on the costs and implications of transportation policies and the hidden subsidies that encourage congestion and sprawl. Except when focused on a crisis, such as petroleum supply disruptions or air pollution alerts, the focus of transportation media coverage is largely on metro page daily traffic stories, spectacular crashes, and individual transportation and real estate projects. The U.S.\$5 billion spent annually by the automobile industry on advertisements to position its product in the minds of consumers, together with oil company ads and the huge market of suburban real estate development and advertising, together have a powerful, if subtle influence on the attitudes of nearly everyone in contemporary society. Few private media outlets are interested in antagonizing their largest sources of advertising revenues by focusing reporting on stories that might be unpopular with these clients. Reinforced by advertising and emergent social patterns, personal motor vehicles have become for many a vital means for expression of self, for projection of power, status, and sexual appeal, a private sanctuary and protected place, a secondary office and home, as well as key to their livelihood and access to goods and services.

Although companies such as Volvo, Dutch Shell, and Toyota have at times in western Europe and Japan engaged in public information and advertising activities to promote socially and environmentally more responsible consumption of travel -- encouraging for example the use of bicycles -- automobile and oil companies in the U.S. have generally avoided such themes, sticking more closely in promotions to images of power, freedom, and conquest of the road and the land. Common sense would suggest that the responsiveness of travel demand to changes in price may be strongly affected by the social psychology of motor vehicle consumption which is powerfully shaped by this deluge of advertising and media images, which permeate modern societies. If motor vehicle product advertising were redirected to promote socially responsible consumption of these goods it could have a profound effect on public acceptance and effectiveness of market-based transportation pricing reforms. Without such a reorientation, even well-funded marketing campaigns mounted by government and non-governmental organizations to educate the public about hidden subsidies, to promote use of alternative modes and

vehicles, and to promote a new ethic related to transportation will likely be drowned out in the flood of contrary messages from other sources.

Other Impediments to Reform

4.1 Special-Interest Politics. In this context, the politics of implementing transportation pricing and related reforms remain challenging. In the U.S., few political leaders at any level have been willing to promote transportation pricing reform. Proposals for modest energy taxation floated by the Clinton Administration went nowhere. Even a minuscule increase in the federal gasoline tax (which would have raised prices to consumers by about 5% to US\$0.30 per liter) in 1993 led to a partisan firestorm of protest, despite the previous year's campaign by independent Presidential candidate Ross Perot, which included in its platform a gasoline tax increase ten times larger to balance the federal budget. While the U.S. automobile industry opposes mandatory federal fuel economy standards for motor vehicles and professes its support instead for higher gasoline taxes to make fuel-efficient vehicles more attractive to consumers, automobile dealers, the oil industry, many rural and suburban business and real estate interests, and much of organized labor has been hostile to increased gasoline taxation, especially at the federal level. Many liberals and others on the political left are suspicious of market-based transportation reform strategies out of fear that they will harm the interests of low-income and working class individuals. Many conservatives and others on the political right fear that market-based transportation reforms will harm rural residents and businesses with higher costs. Some see these hidden subsidies as a middle-class entitlement.

4.2 Concerns Regarding Equity. Relatively little research has been done on the equity of either current or alternative transportation policies and pricing systems. However, as recent study in southern California demonstrates, "market-incentive policies are neither inherently equitable nor inherently inequitable. How they are designed and implemented will determine their impacts on income distribution, as well as on regional pollution, congestion, and inefficiency problems." (Cameron, 1994) (6) The gross and net benefits of the current transportation system go mostly to those who earn the most, and least to those with the lowest incomes, reflecting income inequality. This study shows that either a VMT fee (evaluated at \$0.05 per vehicle mile traveled) or a comparable congestion fee would produce a net gain in benefits for all income groups, mostly in reduced congestion delay, although either would lead to a greater reduction in car use by low income, rather than high income individuals. Equity could be increased by rebating some or all of the revenues from these fees back to individuals directly, by reducing transit fares and increasing transit services, by reducing other taxes, or by establishing lifeline pricing to charge those from low-income households a lower VMT fee. Congestion pricing was found to produce larger benefits than a VMT fee to both low and high income travelers, since high income travelers tend to be on the road during congested hours much more than low income travelers, although the VMT fee is more effective at reducing pollution.

4.3 A Focus on Revenue, Not System Management. At the state and local level in the U.S., progress in reforming transportation pricing has also been slow. The Bay Bridge congestion pricing pilot project in the San Francisco-Oakland region of California was until recently the most advanced project under this new federal pilot program. It is now on hold for at least two years because the principal state legislative sponsor of required legislation lost his seat in the November 1994 election. In many states, transportation pricing changes are deemed suitable for public discussion only when dedicated transportation revenues become grossly inadequate to meet political needs for system expansion and maintenance. The use of revenues derived from transportation-related taxes for non-transportation purposes, while commonplace in Europe and many other parts of the world, remains highly controversial in the U.S. Approximately two dozen states retain constitutional requirements that gasoline tax revenues shall be used solely for road construction and maintenance. Even if revenues are dedicated to transportation spending, many U.S. politicians view increased user fees on existing toll roads (which principally are found in the northeastern and mid-Atlantic states of the U.S.) as a form of tax increase and resist such action, generally preferring to find other ways to finance road development and maintenance.

4.4 Institutional Inertia and Campaign Finances. The most important organizations engaged in highway development and maintenance remain the State departments of transportation (DOTs). These continue to be dominated by engineers and highway development interests in most states and have shown only limited interest and capacity in developing effective travel demand management strategies, including pricing reform. Because state DOTs can often deliver to voting districts large construction contracts, expanded access, and sometimes

sharply rising land values on key parcels, these organizations remain favorites of many governors and legislators seeking to earn political support and campaign contributions from the development industry, labor, and citizens. Because they control a larger amount of funding than is disbursed by the federal government for transportation, most state DOTs been able to limit local governments from exercising much of the power granted to them in the ISTEA-mandated metropolitan planning process to develop alternative plans and projects, particularly if these might upset long-standing plans for system expansion.

Fragmented land use decision-making authority, with little or no accountability for regional impacts, further impedes consideration of the long-term costs of alternative development patterns and transportation policies and investments. The preparation of long range plans and major investment studies, required under recent U.S. federal legislation -- the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the 1990 Clean Air Act Amendments, provides an opportunity to better explicate such hidden costs and subsidies. However, this requires improvements in regional transportation models, new ways of accounting for local and state spending, and consideration of how alternative scenarios affect consumer and business expenditures on motor vehicles, gasoline, parking, and other elements, and the implications of this spending on the local economy. While ISTEA and CAA reforms lay a foundation for establishing greater accountability, these have only begun to take effect and face significant resistance. Attacks from traditional highway-oriented interests have stepped up since the November 1994 election. A number of very damaging anti-regulatory and anti-environmental bills have passed the U.S. House of Representatives and are in danger of becoming law. These could reinforce old subsidy and investment patterns and freeze in place rigid regulatory structures, stopping progress towards development of sensible market-based regulatory reforms while spurring a sharp rise in litigation.

Growing Business and Environmental Support for Reforms

Despite continuing caution or resistance from politicians and many interest groups, there have been signs of growing support for transportation pricing reform among business, environmental, and community leaders in the U.S. that promises to change the longer term prospects for progress. In California, several studies and initiatives by business and environmental groups, such as the Bay Area Forum, the Environmental Defense Fund, and the Union of Concerned Scientists have endorsed market-based transportation management strategies such as congestion pricing, fees based on the distance driven, and feebates to penalize gasoline-guzzlers and to reward high fuel economy car purchasers.

A number of national commissions, such as the Aspen Institute study headed by former General Motors Executive Vice President and Director, Elmer Johnston, have recently recommended adoption of road-use or congestion pricing, elimination of tax incentives that spur automobile use, increased fuel taxes, and other reforms to enhance the economic and environmental performance of transportation (Johnson, 1993). (7) The Transportation Research Board recently issued a report focused on congestion pricing, which is generally endorsed as a sound future strategy. Most recently, the Energy and Transportation Task Force of the President's Council for Sustainable Development, a body representing a broad cross-section of high level business, public sector, and non-governmental organization leaders appointed by President Clinton, in April 1995 recommended market-based regional congestion management strategies as a key reform element. In the new Republican-led Congress, it appears likely that the 40-year long restriction prohibiting imposition of tolls on roads constructed with federal funding will soon be dropped.

Alternative Comprehensive Transportation/Land Use Planning

Many regions of the U.S. are awakening to the potential for transportation pricing reform to help manage congestion, to reduce the need for costly new infrastructure, to raise revenue to pay for system maintenance and improved transportation services, and to meet environmental performance requirements with less cost to society. A growing number of regions are considering comprehensive transportation and land use alternatives, including market-based pricing reforms, as part of their long range planning process. These studies lay a foundation for political and government action by illuminating the opportunities and costs of alternative policies and business-as-usual.

6.1 Portland, Oregon. Many regions are now developing alternative long range plans that seek to reduce the growth in vehicle miles of travel (VMT). In Portland, Oregon, the LUTRAQ study ("Making the Land Use Transportation Air Quality Connection,") has put together a transit and pedestrian oriented development plan as an alternative to building a proposed Western Bypass around the city. This project began by recognizing that the computer transportation model for the region, even though it was better than most, lacked the ability to evaluate the effects on travel behavior of changes in pedestrian friendliness. The model was re-estimated with new factors, a land use scenario was developed with input from the community, and new demand management strategies were considered, all as a package. The LUTRAQ analysis showed that modest improvement in the quality of the pedestrian environment alone could reduce the Vehicle Miles of Travel in suburban zones by about 10%. Variation in building orientation at the zonal level was also found to account for changes of 10% or more in VMT per household. (8) The addition of parking charges of \$3/day at suburban work sites as a key element of pricing reform further boosted trip reduction. Nonetheless, the LUTRAQ model was unable to reflect potential improvement of bicycle friendliness, bicycle access to transit, or encouraging bicycle use, due to the lack of available local empirical data. Today, the Portland regional government (Metro) is moving forward to develop methods for incorporating these additional factors into their long range planning analyses and is working to develop a 2040 Plan that would reduce VMT per person by 20% from 1990 levels.

The lessons from LUTRAQ are that transit and pedestrian oriented urban design and infill development and the retrofit of pedestrian improvements to automobile-oriented suburbs can have significant effects on travel behavior sufficient to eliminate the need to build new ring freeways, particularly when reinforced by economic and pricing incentives, which included extension to suburban centers of policies that have been successful in keeping downtown Portland transit and pedestrian oriented -- a parking charge of \$3/day at work sites which pay for free transit passes for workers at these sites. Total vehicle trips per household in the Transit Oriented Developments (TODs) were 6.05 per day, compared to 7.09 outside the TODs under the LUTRAQ scenario and 7.7 with either the Bypass or No Action alternative. The LUTRAQ scenario reduced VMT in the study area by almost 14% compared with the Bypass alternative and reduced Vehicle Hours of Travel in the PM peak hour by almost 8%. Sensitivity testing showed that about 30% of the increase in non-automobile driver mode shares for all trips (and about 55% of the change for work trips) was accounted for by the economic incentive elements. Even greater effects on travel behavior can be expected when these measures are combined with bicycle improvements, stronger economic incentives, more effective parking management, introduction of neighborhood vehicles, and further shifts in land use policies to favor infill housing and commercial development. Portland, Oregon, is being joined by a growing number of other regions considering such alternatives.

6.2 San Francisco. The Metropolitan Transportation Commission in California has also considered alternative long range plan scenarios, including one developed by the Regional Alliance for Transit (RAFT), a local citizens group. The RAFT 2010 land use/transportation scenario would shift some housing growth from suburban areas to urban areas and introduce a \$3/day "parking cash-out" policy which would require every vehicle driver commuter in the Bay Area to pay an additional \$3/day above and beyond current parking costs. This scenario also assumed only one highway widening project would be added to the current Regional Transportation Plan (RTP) No-Project and that one major convert-a-lane HOV-3 would be put in place, along with rail and bus line and service expansions. Compared to the RTP No-Project alternative, the RAFT scenario was found to reduce average automobile ownership, average trip length, and the number of mechanized person-trips in the region by 3% each. The number of work vehicle driver trips was projected to drop by 8% -- sensitivity testing showed that half of this change was due to the parking cash-out element. The RAFT scenario led to 6% fewer regional VMT, 13% fewer vehicle hours of travel, 8% higher daily traffic speeds, and more than a 10% decrease in PM-10 emissions from motor vehicles, compared to the RTP No-Project alternative. Transit boardings were projected to increase by one-fourth over the RTP project or no-project alternative and to increase by one-half from 1990 levels. (9)

6.3 Montgomery County, Maryland. The Maryland-National Capital Park and Planning Commission has considered alternative transportation and land use scenarios, including comprehensive travel demand management strategies, using enhanced computer transportation models, as part of its Comprehensive Growth Policy Study. This effort found that by focusing growth near the stations and stops of an expanded transit system, making communities pedestrian and bicycle friendly, managing parking supply, and shifting commuter subsidies to favor alternatives to the automobile, this County of 800,000 people could handle twice as many jobs and households with only a modest rise in VMT over a 30-year period and acceptable levels of traffic congestion. On the other

hand, continued growth in the planned, automobile-oriented corridor development pattern would result in unacceptable levels of traffic congestion, even if growth were significantly restrained. **(10)** The study assumed parking charges of up to US\$12 a day in the urban core and the most dense suburban satellite cities, lower parking charges of \$3-6/day in outer activity centers, and \$2/day elsewhere, with equalization of employer commuter subsidies to produce a 50% drop in user-perceived public transportation fares from 1985 levels.

6.4 London, England. A study by the UK Department of Transport for the greater London region found that a combination of car restraint and improved public transport -- with a cordon charge like in Singapore or Oslo, reduced parking provision and light rail construction -- would likely reduce carbon dioxide emissions by 23% compared with the base case for 2000. This combined strategy was found to reduce traffic entering the central area of London and to increase peak period traffic speeds in the central area from 23 to 30 km/h. About 15% of this increase was accounted for by the effects of the light rail network and the remainder by the measures to restrain traffic. **(11)**

6.5 Copenhagen, Denmark. Some regions have made even larger changes of this sort real in the context of high gasoline and motor vehicle registration fees and taxes. In Copenhagen, Denmark, a city of 1.7 million people, road building was abandoned in the early 1970s, large numbers of bus priority lanes were introduced, and a comprehensive network of segregated cycle paths built. The result was a 10% fall in traffic since 1970 and an 80% increase in the use of bicycles since 1980, which are used year-round despite cold, snowy winters. About one-third of commuters now use cars, one-third public transport, and one-third bicycles, and bicycles are also a major means of access to the public transportation system. Cycling accidents have decreased slightly, despite the increase in mileage, because of the network of cycle paths, which in many cases were created by reallocating arterial street space from cars. **(12)**

The Need for Enhanced Regional Analysis Tools

Some regions have made progress in developing improved transportation analysis tools and evaluating more comprehensive alternative long range plans. However, many current regional transportation models do not explicitly represent even such elements as parking price at workplaces, nor are they capable of considering the equity impacts of alternative pricing strategies. If new and more policy-sensitive models are unavailable, substantial outside-the-model adjustments are thus needed to work with current tools while avoiding incorrect conclusions or skirting the evaluation altogether of important potential market-based pricing and other demand management or urban design oriented strategies. Improved analysis can be supported with more widespread use of stated preference (SP) surveys in combination with revealed preference (RP) surveys. Development of new activity and travel behavior models calibrated on combined SP/RP survey data and enhancement of current models with coefficients transferred from other regions using scaling factors (Hensher, 1994) offers promise for near-term improvement in evaluations of the likely effectiveness of different transportation management and pricing strategies. Microsimulation models of travel behavior and activities sensitive to pricing strategies can be developed on existing regional travel surveys (Cameron, 1991 & 1994). Where these are unavailable, microsample data from the U.S. Census and National Personal Transportation Survey can be used, despite the lack of a high level of geographic specificity, statistically imputing data where needed.

However, most operational regional transportation and travel behavior models are not set up to distinguish the effects of many different pricing strategies. Congestion pricing demands far better time-of-day of travel modeling than is now found in most regional evaluation tools. VMT-based automobile registration fees or pay-at-the-pump automobile insurance systems might be implemented as revenue neutral, but can have distinctly different behavioral effects depending on how they are implemented. A once-a-year payment based on distance driven will likely have quite different effects on travel behavior than an equivalent charge imposed at the gasoline pump or via a smart debit card that sits on a car's windshield. Similarly, few models are well structured to consider the effect of introduction of new forms of demand-responsive smart paratransit, or shared-ride taxis, that might be dispatched with new communications technologies in the context of new motor vehicle use charges. Work is also needed to make models sensitive to the potential effects of enhanced bicycle access to public transportation, with guarded bicycle parking garages at major stations, or small neighborhood vehicles that can get people to local shops or park-and-ride-lots on traffic calmed streets, which might find ready market acceptance if heavy, freeway-capable vehicles were to bear higher use charges related to their environmental and social costs. Indeed, there are

many dimensions to potential comprehensive transportation demand management and land use strategies that have not been touched by most alternative scenario analyses undertaken to date. Could these, together with advances in telecommunications, telework, and teleshopping, help regions avoid the forecast sharp growth in VMT in coming decades? Many believe so.

Applications of Intelligent Transportation Systems to Promote Market-Based Reform

Another avenue for progress in developing market-based transportation reforms and internalizing transportation costs is in the application of Intelligent Transportation Systems (ITS). These comprise a wide range of technologies, from computerized traffic signals that cities now commonly use, to information systems that help freight move more efficiently between truck, ship, and rail. ITS has tremendous potential to protect the environment while promoting efficient use of resources and advancing a healthy economy, but if misdirected, ITS could undermine these goals and waste scarce tax dollars.

ITS technologies are already reducing the costs and delays associated with toll collection on numerous highways in half a dozen U.S. states or more, in Canada, Europe, and elsewhere. They are helping to create an increasingly seamless and efficient intermodal integration of rail, truck, and water-based freight transportation, aiding efficient logistics, and boosting economic competitiveness while avoiding unnecessary air pollution. They can increase the schedule adherence and speed of buses in a growing number of U.S. cities and suburbs, making transit more efficient and attractive.

ITS could allow us to achieve pollution reductions through new types of traffic management at a lower cost than further expensive controls on tailpipes, power plants, and factories. ITS could help integrate demand management into transportation operations and planning, enabling the gradual introduction of user fees for roads and parking to minimize congestion. This could help us reduce costly subsidies that encourage over-dependence on the automobile and shift costs from taxpayers to users while boosting equity. It could help the marketplace create new smart public and private transportation services to better meet the fast-paced demands of life in the late 1990s with less pollution and energy use. Such approaches will lead to more jobs and a stronger economy for the same level of environmental compliance.

New models for cooperation between all levels of government, business, and community interests must be explored to assess and manage development of these new transformative technologies. In an era of constrained fiscal resources, the federal government should focus its involvement in ITS to roles it can uniquely fill, such as promoting timely development of industry standards and system architecture and promoting deployment strategies consistent with national policies to protect the environment, better manage traffic congestion, and ensure that state and local governments, business, and community interests are all effectively involved in shaping cost-effective, performance-oriented transportation system plans and programs.

Intelligent transportation technologies on roads, and in cars, trucks, and buses, are already being advanced by hundreds of companies and public agencies. The scale of potential public investments in ITS technologies makes it crucial that governments work cooperatively with others to develop data collection systems for performance measurement and policy-sensitive transportation and emission models to evaluate the likely effects of ITS and other strategies on travel behavior, motor vehicle use, and emissions. Resources should be dedicated to upgrading the capabilities of major metropolitan areas to evaluate ITS and other transportation management strategies so they can begin to consider these more effectively as part of their ongoing planning process over the next several years. This could be done through pilot projects, training, collaborative development of improved performance measurement, monitoring, and forecasting systems for travel behavior, transportation system performance, and emissions. Without such investment, ITS deployment is likely to be hindered by uncertainty and conflict over cost-effectiveness, equity, and environmental impacts. Improved evaluation is essential to smart ITS development.

There is need for greater public and local government involvement in ITS decision-making. Industry and state highway agency perspectives to date have dominated the program. Local governments, transit agencies, environmental agencies, community and environmental groups, highway safety interests, and consumers, have not

been as effectively brought into this process. This will require a commitment of resources to support stakeholder involvement and the early integration of ITS into the metropolitan planning process, which the federal ISTEA law has begun to make more effective and responsive to local needs. Communities and taxpayers will not be well served by a top-down pork barrel or corporate welfare approach to ITS. Public investment to deploy ITS technologies will be most cost-effective if these technologies face open competition with other types of transportation investments in a locally-responsive and fiscally-constrained transportation planning process, with objective evaluation of a range of alternative strategies against broad system performance benchmarks.

With its emphasis on information and advanced communications, ITS represents an unprecedented opportunity to enhance the performance of surface transportation systems and to promote flexible regulatory reform. It is only by playing to the unique strengths of ITS that we can fix the flaws that keep our current system from being "smart": missing links between different transportation modes, underuse of the most fuel-efficient and least polluting options already available, hidden subsidies and rigid regulatory systems that prevent us from finding least-cost strategies for pollution prevention, and failure to meet the access needs of many segments of our population. It would be a waste to devote scarce federal dollars to the task of merely automating selected aspects of the system instead of truly making it smarter.

Conclusions

It has taken decades to develop subsidized and highly motor vehicle dependent transportation and community systems in America and elsewhere. The automobile will remain a vital means of mobility for most travel for decades to come. Transportation pricing reforms will need to proceed cautiously and deliberately, beginning with pilot projects and innovation in individual communities and states, reform of tax and design codes, and development of more flexible, market-based, performance-oriented regulatory systems and incentive-based funding programs. Specific opportunities for early progress will most often exist where fiscal problems, system capacity deficiencies, or environmental problems create pressures for change and innovation. System reform will require longer term institutional restructuring and changes in marketing, advertising, and public education. The way public and institutional attitudes towards recycling have changed in America over the past two decades indicate that profound shifts in values towards consumption and daily choices can be made in a relatively modest span of time. Business, citizens, and the environment can all benefit from a similar transformation of our transportation and community systems.

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