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I. Abstract

Motor vehicle use in the United States creates considerable social harms, costing Americans hundreds of billions of dollars per year, which are not reflected in prices paid by drivers. This article presents a framework for developing roadway pricing measures specifically targeted to the major harms caused by vehicle use, that would collect over $300 billion annually. Five measures are presented: *congestion pricing, smog fees, weight-distance charges, gasoline taxes,* and *violator fines*. No single measure would be responsible for capturing more than one-third of the total revenue. Two additional measures would restructure key components of the costs to drive to make them more transparent to motorists:

cashing-out free parking, and *pay-at-the-pump insurance*. Phased adoption of these measures over the next several decades could help reduce single-occupant driving, reverse suburban sprawl, and make transportation in America less costly to individuals, society and the environment.

II. Preamble

Motor vehicles present America with a paradox. Not only do they play a central role in economic activity as the nation's primary source of transportation; but they are fundamental to the Americans' conception of mobility and personal autonomy. Cars and trucks have so profoundly shaped modern America that few of us can imagine life without the present level of vehicle use. At the same time, however, motor vehicles are a major source of *disbenefits*. Specifically, pollution, accidents and congestion from car and truck use strain household and civic budgets, harm people and communities and damage the natural environment.

The discipline of economics offers a two-step approach to such a paradox: first, estimate the extent of these motor vehicle costs; second, craft mechanisms to internalize these costs into the price of vehicle use, so that individual decisions on whether and how to drive fully reflect the cost of driving to society. This article is organized along those lines; it first summarizes the various social and environmental costs of car and truck use, and then outlines seven complementary means to make the price of driving better reflect its costs.

However, it should be said at the outset that America is far from any consensus about the merits of raising the price of driving in order to diminish the harms that driving creates. Indeed, despite widespread frustration over pollution, congestion, accidents and other consequences of motor vehicle use, there is no consensus about the costs and benefits of the nation's reliance on the automobile. The researchers and activists who have spotlighted this issue in recent years will need to redouble their efforts so that motor vehicle harms and potential remedies, including pricing, can be fully debated.

In addition, the social and political consequences of full-cost pricing of motor vehicle use need to be investigated far more fully. Impacts on the poor and other at-risk groups must be a major concern; this paper touches on them, but a far more thorough treatment is needed. The ultimate implications of full-cost pricing on the United States economy also require full discussion. Even if phased in over a long period of time, full-cost pricing will almost certainly lead to fewer miles driven by fewer cars on fewer roads. The potential consequences of such a change are vast. Opening up the American political system to explore the social and cultural dimensions of auto-dependence is an essential undertaking.

III. Introduction

Motor vehicles are America's primary means of transportation. They are fundamental to commerce, recreation and daily life. Almost nine-tenths of person-miles traveled and one-third of intercity freight movement in the United States are by cars and trucks.[1]

Yet operation of motor vehicles damages the environment and harms individuals and society. Combustion of motor fuels pollutes the air and accelerates global warming. Petroleum extraction damages human settlements and wildlife habitat. Transporting and refining crude oil into gasoline further pollutes air, land and water. Noise from vehicle traffic creates stress and disrupts daily life.

Roads increasingly are built larger, wider and faster, to a scale that overruns urban communities, trashes landscapes and destroys wilderness. Vehicle crashes kill 40,000 people a year in the United States and cause hundreds of thousands of serious injuries. Traffic congestion steals time and equanim-

1. Motor vehicles accounted for 88.2% of person miles in 1990 (excluding school bus travel); FEDERAL HIGHWAY ADMINISTRATION, OFFICE OF HIGHWAY MANAGEMENT, 1990 NATIONWIDE PERSONAL TRANSPORTATION STUDY, EARLY RESULTS, 24 tbl 6, Person Miles of Travel By Mode. Trucks accounted for 32.8% of United States intercity ton-miles in 1991 (excluding pipelines and coastwise shipping). ENO TRANSPORTATION FOUNDATION, INC., TRANSPORTATION IN AMERICA, 1992, 44 tbl., Intercity Ton-Miles By Mode. Including intracity freight movement raises trucks' modal share significantly.

ity from drivers, passengers and from non-motorists caught in gridlock.

The total cost of these harms is enormous. Recent studies estimate United States motor vehicle costs to society and the environment at upwards of several hundred billion dollars annually.[2] An extensive analysis by this author puts the cost at roughly $700 billion a year,[3] equal to one-eighth of total gross domestic product.[4] By comparison, United States electricity generation, the object of a concerted effort by environmental advocates to reduce ecological damage, generates annual harms estimated to cost only $120 billion.[5] Motorists themselves bear much of society's costs from driving, in terms of time lost in traffic, lives lost in road deaths, et cetera. Nevertheless, as discussed below, almost all vehicle harms qualify as externalities—costs borne by individuals and groups that do not participate in or benefit directly from the transaction that imposes the costs.[6]

Internalizing these costs could benefit society significantly. Charging drivers for the harms their driving imposes would create incentives for individuals to seek out alternative means of travel and to drive in ways that are less harmful socially. Government could invest the revenues from these charges in alternative modes, to make them at least as satisfactory as car and truck use. Choices would be expanded and

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2. JAMES J. MACKENZIE ET AL., THE GOING RATE: WHAT IT REALLY COSTS TO DRIVE, WORLD RESOURCES INSTITUTE (June 1992) (estimating the external costs of United States motor vehicle use at more than $300 billion a year). PETER MILLER & JOHN MOFFET, THE PRICE OF MOBILITY: UNCOVERING THE HIDDEN COSTS OF TRANSPORTATION, NATURAL RESOURCES DEFENSE COUNCIL (Oct. 1993) (estimating the external costs of United States passenger vehicle travel (excluding freight trucks) at between $380 and $660 billion a year).

3. Charles Komanoff & Brian Ketcham, Win-Win Transportation: A No-Losers Approach to Financing Transport in New York City and the Region (July 1992) (unpublished manuscript, on file with Komanoff Energy Associates).

4. United States Gross Domestic Product in 1990 was $4.897 trillion, in 1987 dollars. The GDP Deflator indicates a 12.9% increase in price levels during 1987-90, making the amount $5.53 trillion in 1990 dollars.

5. *See* RICHARD OTTINGER ET AL., ENVIRONMENTAL COSTS OF ELECTRICITY (1990). Externalities therein in 1989 dollars per kWh for each fuel (Coal 5.8¢, Oil 3.8¢, Nuclear 2.9¢, Gas 1.0¢, Hydro 0.1¢), multiplied by 1992 net generation, yields $115.7 billion; converting to 1990 dollars gives figure in text. *Id.*

6. *See infra* § V.

the total cost of transportation including externalities would be reduced. Equity and efficiency would both be served: equity, because the costs of harms would be shifted onto those benefiting from the activity; and efficiency, because travelers would be encouraged to select the most socially beneficial travel option for each trip.

This paper identifies seven policy instruments for internalizing harms from motor vehicle use. One of them—a tax on gasoline—is already in place, but revenues from it are currently applied to pay for road construction and maintenance, leaving nothing to defray the harms caused by gasoline's production and use.[7] Moreover, as this article will argue, gasoline taxes alone are a very poor means of internalizing the costs of driving. As will be seen, the harms from driving are so various, and their extents differ so widely depending on the nature and use of the vehicle, that only a broad array of targeted instruments can internalize costs effectively and fairly.

IV. Motor Vehicle Costs

Costs created by driving can be divided into three types: motorists' direct out-of-pocket costs for gas, depreciation and insurance; taxpayer costs to finance road building and maintenance; and social costs like time lost in traffic and lung damage from air pollution borne directly by drivers and indirectly by everyone else.[8] All three categories are large, and all appear to be growing.

A. Motorists' Direct Costs

Motor vehicle maintenance absorb huge amounts of money from its owner-operators. Passenger car owners spend a half-a-trillion dollars a year for gasoline, depreciation, insurance, parking and upkeep—an average of $3600

7. A small piece of federal gas tax revenue—just over $1 billion a year—is set aside for the Mass Transit Account (at the rate of 1.5¢/gallon) and the Leaking Underground Storage Tank Trust Fund (0.1¢/gallon).

8. This typology excludes motorists' non-monetized costs, such as time. Travel times for different commuting modes are treated in Apogee Research, Inc., CONSERVATION LAW FOUND., THE COST OF TRANSPORTATION (Jan. 1994).

annually per car.[9] Moreover, as destinations spread beyond the convenient reach of walking, bicycling or transit, families increasingly rely on two or even three cars, which strain household budgets. However, these costs are internal—motorists receive direct benefits for their expenditures on driving—and thus, are not the primary concern of this paper.[10]

B. Governmental Costs

Notwithstanding monies that motorists pay in gasoline taxes, tolls and parking tickets, the public sector collects considerably less money from drivers than it spends to build, maintain and control highways. In New York State, for example, public agencies at all levels of government spend roughly $7 billion annually on roads, while collecting only $4.5 billion in motorist user fees. This indicates that New York drivers are subsidized by taxpayers at a rate of $2 billion or more a year.[11] Similar analysis for the entire country indicates that taxpayers subsidize drivers at a rate of between $20 and $30 billion annually, in effect paying through income, property and sales taxes for government to build, maintain and control roads.[12]

C.. External Costs

External costs include human mortality and morbidity from air pollution and vehicle accidents, the psychological effects of car noise, time lost by traffic congestion, and land lost to highways. As noted, these costs are as high as $700 billion a year. A summary of the major costs follows.

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9. Frank A. Smith, *Transportation in America*, ENO TRANSP. FOUND., INC. at 40, 42, 63 (1992) (lists 1990 United States auto (passenger vehicle) costs at $523.5 billion for 143.5 million autos or $3,648 per vehicle per year. An additional $270.6 billion was spent in 1990 on 44.5 million trucks).

10. This is not to say that car owners have necessarily chosen freely to own cars and bear the associated costs. A host of interrelated factors, including relocation of jobs and stores to the suburbs, transit cutbacks, the perceived insecurity of walking or cycling, and social pressure increasingly make automobile use a necessity rather than a matter of consumer choice.

11. CORA ROELOFS & CHARLES KOMANOFF, SUBSIDIES FOR TRAFFIC: HOW TAXPAYER DOLLARS UNDERWRITE DRIVING IN NEW YORK STATE (Tri-State Transportation Campaign, ed. Mar. 1994).

12. *Id.*

V. Societal Costs of Roadway Transportation

Five categories dominate motor vehicle harms: accidents, congestion, air and noise pollution, lost land, and energy-related costs. Table 1 provides estimates of the societal cost of these harms and, for completeness, lists direct taxpayer subsidies to motor vehicle use, in four ways:

(i) total (for society as a whole);
(ii) amounts borne by drivers;
(iii) amounts borne by the public; and
(iv) costs that are ripe for user fees.

Following is a brief explanation of the estimates in Table 1.[13]

"HIDDEN" COSTS OF ROADWAY TRANSPORT IN THE UNITED STATES
(billions of 1990 dollars, per year)

Cost Category	Total	Borne by Drivers	Borne by Public	Ripe for User Fees
1. Accidents	$319	$270	$ 49	$ 49
2. Congestion	168	143	25	50
3. Air Pollution	66	3	63	66
4. Land	65	0	65	65
5. Energy-related	60	0	60	60
6. Noise	28	2	26	28
7. Tax Subsidy	20	0	20	20
Total	$726	$418	$308	$338

Source: Komanoff & Ketcham, *supra* note 3. *Accident* costs reflect 46,300 fatalities, including 7,400 to non-motorists (pedestrians and bicyclists), and 3,620,000 injuries of varying severity, including 204,000 to non-motorists; costs shown are net of insurance awards. *Congestion* externalities include lost time and amenity of pedestrians, cyclists and transit users. *Air pollution* reflects values of human lives lost, time and amenity lost to illness, and ecosystem damage. *See infra* note 16. *Land* reflects half of space occupied by roadways, on premise that roads' common carrier function requires only half of actual road space. *Energy-related costs* are for military forces to guarantee United States hegemony over foreign oil, and global warming costs from gasline's CO_2 emissions. *Noise* cost extrapolates from estimated effect of highway noise on property values; it also includes damage to non-roadway infrastructure caused by vibration from heavy trucks. *Not yet reflected* here are: costs of petroleum extraction, shipping, storage and refining; air pollution's degradation of visibility; vehicle manufacture and disposal; water pollution; and enabling of sprawl.

TABLE 1

13. *See generally,* MACKENZIE ET AL. *supra* note 2 (estimates from noted source, unless otherwise indicated).

A. Accidents

Vehicle crashes in the United States in 1990 caused losses with an estimated value of $346 billion, or $319 billion after netting $27 billion in insurance awards to victims.[14] Motorists (drivers and passengers) bore the brunt of the pain, suffering and lost life. Employers and taxpayers have financed most of the associated health insurance and workers' compensation, and also bore much of the cost of workplace disruption as well as vocational rehabilitation for incapacitated workers. Non-motorists also bore the loss of life and amenity to pedestrians and cyclists struck by motor vehicles, which accounted for 16% of United States crash fatalities and almost 6% of injuries in 1990.

Of the $319 billion in net costs associated with United States motor vehicle accidents in 1990, motorists bore $270 billion, and the public at large bore $49 billion. The $49 billion in public costs represents a subsidy of drivers by the general public; increasing the price of driving by that amount would internalize this subsidy.

B. Congestion

Stop-and-go driving costs Americans an estimated $168 billion a year. Most of this cost represents motorists' lost time as well as higher shipping costs; but as much as 15%, or $25 billion, falls on the public, in time lost by non-motorists (walkers, cyclists, bus passengers) and municipal vehicles. This $25 billion in congestion costs is an externality that drivers impose on the public. In another sense, however, all congestion costs are imposed by drivers on someone else, for example, other road users. All congestion costs should, thus, qualify as externalities, eligible for inclusion in the price of driving via congestion pricing. As we see below, however, it is not necessary to charge for all congestion costs in order to reduce traffic jams and create considerable societal benefits.[15]

14. Cora Roelofs & Charles Komanoff, Costs of Motor Vehicle Fatalities and Injuries in New York City and State (Dec. 1993) (unpublished manuscript, on file with Komanoff Energy Assosciates).

15. *See infra* § VI A.

C. Air and Noise Pollution

The annual cost in illness, lives cut short, crop loss and ecosystem damage from vehicular pollution is estimated at $66 billion.[16] Noise cost includes $22 billion in stress, sleep loss and impaired activity from direct vehicular noise (tires, engines, brakes, horns, sirens, etc.); and $6 billion in vibration damage to buildings and underground infrastructure such as water mains, propagated through the roadway surface, primarily from heavy trucks in older Northeastern cities where highways are in close proximity to old structures and conduits. Motorists probably bear around 5% of air and noise pollution costs; the other 95% is felt by the public (including car users when not driving).[17] Still, because even motorists are primarily affected by other vehicles' noise and fumes rather than their own, 100% of both categories qualify as externalities, eligible for user fees.

D. Land

Roads consume land and alter landscapes, both rural and urban. Early roads blended with the landscape; for the most part, they were amenities used by a wide variety of travelers. Today, roads are built on a vaster scale that intrudes on—some would say destroys—landscapes and communities, and have been appropriated by motor vehicles for their exclusive use.

Here, the land costs of motor vehicles are estimated as the tax revenues foregone on half of all land used by roads; the other 50% is assumed to provide a societal good as a common carrier for municipal vehicles and, to a limited extent, non-motorized travel. All such costs—an estimated $65 billion a year in lost production or revenue—are assigned to the public sector, since it represents a loss of resources that were previously held in common by the citizenry.

16. Cora Roelofs, Costs of Vehicular Air Pollution in the United States (1994) (unpublished manuscript, on file with Komanoff Energy Associates).

17. Emission control devices and less-polluting fuels already cost motorists approximately $50 billion a year. Telephone Interview with Brian Ketcham, Konheim & Ketcham (Feb. 1994).

E. Energy-Related Costs

Energy-related costs refer, first, to the prospective financial impacts of global climate change from carbon dioxide generated in gasoline combustion ($25 billion annually), and, second, to federal tax dollars expended on maintaining American military hegemony over oil exported to America to fulfill gasoline demand ($35 billion annually). As with land, 100% of these costs, which total $60 billion annually, are assigned to the public at large, and are considered eligible for user fees.

VI. Roadway User Fees[18]

At least seven different kinds of economic incentives are available to offset and internalize the public costs from motor vehicle harms enumerated here. Two mechanisms restructure expenditures on insurance and parking to enable motorists to save money by driving less. This section discusses five means to directly charge for harms that driving creates.

Some measures could be implemented immediately. Others would require technological development, public education and even modification of the roadway infrastructure. All of these proposals would need to be phased in so as to minimize economic dislocation and give drivers time to adapt. The phase-in might be stretched over several decades, to parallel the lead time to improve and create transit alternatives and mold land use to better fit the true costs of transport.

A. Congestion Pricing

Congestion pricing assesses vehicles for the congestion and the time losses they impose on other roadway users. In doing so, congestion pricing can dampen and flatten the demand to use roads, thereby reducing the aggregate loss of drivers' time and also defraying the need to expand road capacity. Ideally, congestion charges would vary widely among peak, shoulder (in-between) and off-peak conditions, corre-

18. CITIZENS ACTION PLAN (Tri-State Transportation Campaign, at Ch. 5 § C (New York, N.Y., Dec. 1993)).

sponding to each vehicle's responsibility in creating congestion. Commuters driving into or within city centers would pay premium prices, while travelers commuting from urban cores to suburban job locations would be charged considerably less, commensurate with their lower contribution to congestion. Motorists using uncongested rural roads would not pay congestion fees.

Airlines and utilities have used congestion or peak pricing for several decades to shift discretionary demand to off-peak periods. For example, most long-distance telephone service is priced only one-third as high on weekends as during business hours. Similarly, congestion pricing of roads would be expected to reduce peak usage of roadways via modal shifts to other forms of travel (e.g., train, bus, bicycle, ridesharing) or shifts in time of travel.

The microeconomic rationale is that although drivers endure their own lost time from congestion, they are not charged for the delay costs they create for others. The result, as noted by economist Anthony Downs, is that individual drivers continue to enter a roadway, even when the average total cost of their arrival on the roadway exceeds the average benefit of using it.[19] These delay costs can be enormous. By one estimate, a single automobile entering San Francisco's road system during peak hours can generate a total of one hour of additional delay for all other drivers combined.[20]

How much to charge under congestion pricing would depend on the extent to which drivers would respond to the higher price to drive. This would depend on the availability and attractiveness of alternative modes, the value placed on peak-period driving, and how much congestion society wishes to eliminate. As Downs and others have pointed out, the objective is not necessarily to eliminate all congestion, but to maximize the net benefits from society's economic resources, including not only time but capital invested in roads.[21] Thus,

19. ANTHONY DOWNS, BROOKINGS INSTITUTION, STUCK IN TRAFFIC—COPING WITH PEAK HOUR TRAFFIC CONGESTION 49 (1992).

20. *Market-Based Solutions to the Transportation Crisis: The Concept*, Bay Area Economic Forum, at 7 (San Francisco, CA, May 1990).

21. DOWNS, *supra* note 19, at 50.

the appropriate level of congestion pricing is probably far less than the $168 billion a year in congestion costs.

A comprehensive analysis of congestion covering the entire country was published by the World Resources Institute (WRI) in 1992.[22] The WRI analysis is based on estimated traffic congestion in 1989 on five types of roads in the federal aid system, ranging from interstates to arterials and collectors, which together account for slightly over half of all United States vehicle miles traveled. WRI modeled a system of congestion charges ranging as high as 21¢ per mile, but averaging 4-5¢ per all miles driven on these roads, and generating $44 billion in congestion charges. WRI estimated that this pricing regime would reduce vehicle miles traveled (VMT) by 6%, with an 11% reduction in VMT under most congested conditions.[23]

According to WRI, this regime would create the greatest net benefits, estimated at $4 billion per year. This is the value of time savings to motorists on these highways, netted by the costs of longer or rescheduled journeys for those who choose to avoid the congestion tolls. Adjusting roughly for higher traffic and price levels since 1989, WRI's $44 billion in national congestion charges equates to about $50 billion.

ESTIMATED CONGESTION TOLLS FOR ALL UNITED STATES HIGHWAYS

Based on World Resources Institute With 1989 Traffic and Price Levels

- Average per mile charges: 4-5¢
- Highest per mile charge: 21¢
- Estimated VMT reduction: 6%
- Est'd peak VMT reduction: 11%
- Total charges: $44 billion
- Benefits in time savings: $4 billion, (net of value of trips rerouted, rescheduled and foregone)

The WRI report also found that higher congestion charges could be justified by the reductions in *accidents* that could be expected from reduced traffic. Thus, a conservative total of $60 billion in congestion charges has been assumed

22. ROBERT REPETTO ET AL., WORLD RESOURCES INSTITUTE, GREEN FEES: HOW A TAX SHIFT CAN WORK FOR THE ENVIRONMENT AND THE ECONOMY, 44-45 (Nov. 1992).

23. *See* MACKENZIE ET AL. *supra* note 2.

here, of which $50 billion is allocable to congestion reduction and $10 billion to accident reduction.[24]

How much of the $60 billion in revenues should be invested in transportation improvements, and how much should be returned to the public in lower taxes and/or other public services, is a key question beyond the scope of this paper. A recent study in the United Kingdom found that public support for roadway pricing rose from 30% to 57%, under the assumption that revenues would be used to improve public transport, cycling and walking, and to reduce accidents, rather than being funneled into the general fund.[25] However, there is also a strong case for returning some congestion-pricing revenues to the general public, to offset the share of congestion costs that falls on the public at large.

Congestion pricing has been tried in only a handful of cities, all outside the United States.[26] Effective implementation will require a mechanism such as automatic vehicle identification that can charge vehicles for use of roads, without toll barriers and their attendant delays, frustration and fumes. Indeed, replacing existing toll systems with time-saving nonstop tolls could make congestion pricing and other user fees attractive to motorists. Minimizing traffic spillover onto parallel routes, particularly neighborhood streets where additional traffic would create danger and disruption, would be essential.[27]

A variant of congestion pricing could be implemented immediately, without any new electronic devices, to provide a market-based means for reducing congestion causing taxi cruising (driving in search of fares) in Manhattan and other high-congestion areas. A mileage surcharge would be added to all trips, to be passed along in the fare only during revenue trips; the surcharge would be absorbed by the driver (and the

24. *See* MACKENZIE ET AL. *supra* note 2.

25. Anthony D. May, *International Experiences with Congestion Pricing*, ITE J., 14, 19 n. 34 (Dec. 1993).

26. *See* articles by Anthony D. May, Andrew J. Lampe, Bert Arrillaga and A.P. Gopinath Menon in ITE J., special issue on congestion pricing, Dec. 1993.

27. Michele Herman et al., *Bicycle Blueprint: A Plan to Bring Bicycling Into the Mainstream in New York City*, TRANSP. ALTERNATIVES (Apr. 1993) at 45.

cabbie's company) for all cruising miles. Fees would be collected when taxis are routinely inspected for pollution and safety—every four months in New York City. A fee of 25¢ per mile could generate about $250 million annually for New York City. Customers would pay $150 million, since 60% of taxi miles are with passengers. Drivers would absorb $100 million, or about $25 per cab per day, creating a strong incentive to wait at designated cab stands rather than cruise for fares.

In addition, congestion pricing offers a potentially superior alternative to high-occupancy vehicle (HOV) lanes being constructed or proposed on dozens of American highways. Both seek to create incentives for ridesharing. HOV lanes attempt to accomplish ridesharing by offering carpoolers time savings through a relatively traffic-free place on the road. Congestion pricing attempts to encourage ridesharing by offering monetary savings, since with more passengers each pay less. Congestion pricing appears preferable from a theoretical standpoint, because it equalizes the charge paid per car, which is the agent causing the damage.[28] Moreover, HOV lanes are expensive to administer and police. In addition, HOV lanes have proven to be stalking horses for highway expansion. Finally, congestion pricing would allow flexible, real-time pricing varying with traffic levels over daily and weekly cycles and with long-term changes; HOV lanes are either in use or not, with no modulation.

B. Smog Fees

Smog fees would charge individual motorists for the harm caused by the emissions their vehicles dump into the environment. Each vehicle's emissions would be estimated as

28. A.P. Gopinath Menon et al., *Singapore's Road Pricing System: Its Past, Present and Future*, ITE J. 44, 47 (Dec. 1993). Hopefully, congestion pricing would put to rest recurring proposals to waive tolls for high-occupancy vehicles; such proposals ignore the fact that a four-person vehicle creates the same congestion as a one-person vehicle, and thus merits the same congestion charge—which the passengers may then split four ways. Singapore, site of the world's oldest congestion pricing program (since 1972), revoked its carpool exemption in 1989. *Id.*

the product of miles driven by the vehicle and per mile pollution emission rates. Mileage would be recorded from the odometer at the time of the emission and/or safety inspection. Emission rates would be obtained in periodic vehicle emission tests.[29] Dollar charges per each pound of vehicular pollution would also be estimated, according to each pollutant's damage to health, buildings, visibility, agriculture and the natural environment. This could vary for different locales, based on population density, ecosystem characteristics, and pollutant dispersion.

Smog fees would stand several decades of pollution regulation on their head. The original Clean Air Act and its periodic Amendments have all centered on compliance with standards. Specifically, it is legal to pollute so long as emission rates fall within mandated thresholds. Smog fees rest on the premises that pollution is harmful at virtually any level, and that polluters should compensate others for the damage they cause. Of late, these principles are being applied to corporate smokestacks and discharge pipes. Gaining acceptance to apply them to 150 million vehicle tailpipes will be difficult but not necessarily impossible.

A selling point of smog fees is their proportionality, which creates an element of fairness. Clearly, cars driven twice as far or emitting twice as much per mile *do* pollute more and, as a corollary, *should* pay more. Moreover, fees based on emissions could allow government to retire a battery of complex mandates, such as California's Low Emission Vehicle program, which specifies progressively lower emission rates for new cars[30]; the 1990 Clean Air Act Amendments' Clean Fuel Fleet Program, mandating emission limits for centrally-fueled vehicle fleets in high-pollution areas[31]; and the Amendments' Employer Trip Reduction program, which

29. Accordingly, smog fees are sometimes referred to as pollution-distance charges.

30. Clean Air Act (CAA) § 177, 42 U.S.C. § 7507 (West 1983 & Supp. 1994).

31. CAA § 246, 42 U.S.C. § 7586 (West Supp. 1994).

requires 20% reductions in automobile commuting at large workplaces in badly polluted metropolitan areas.[32]

Instead, each city or region would charge motorists for their vehicles' pollutants. This incentive should induce motorists to reduce emissions in various ways: by driving less; by trading up to less-polluting vehicles; among multiple-car owners, by shifting usage from higher-polluting to lower-polluting vehicles; and by improving maintenance of vehicle emission control systems.

Unfortunately, tests to accurately quantify vehicle emissions are relatively expensive. Because emissions vary depending on factors such as engine temperature and how recently the vehicle was serviced, an emissions fee could lead to frequent disagreements and claims for adjustments. However, an ingenious variant of emissions-based charges proposed by Professor William Vickrey could ease this problem by making the emission measurements voluntary.[33]

Each vehicle would be assigned a nominal pollution rating. Manufacturers' test ratings, certified by the federal Environmental Protection Agency, would be used for brand-new vehicles. As vehicles age, these rates would be adjusted to reflect degradation over time at a near worst-case rate, again based on test data for each vehicle make, model and year of manufacture. Motorists would pay according to this rating, which is analogous to the blue book valuations of car resale value, although the deterioration in per-mile emissions would need to be calibrated to both age and miles driven—not a simple matter.

However, motorists willing to invest in emission tune-ups could optionally base their pollution fee on emissions measured at licensed test centers. That is, motorists would be given an opportunity to beat the blue book rating by tun-

32. The Employer Trip Reduction program mandates 25% increases in per-vehicle occupancy, which are mathematically equivalent to 20% reductions in vehicle use. CAA § 182 (d)(1)(B), 42 U.S.C. § 7511a (d)(1)(B) (West Supp. 1994).

33. William Vickrey, *Making New York City Work* (May 5, 1992) (unpublished typescript, on file with Dep't of Economics at Columbia Univ.). To implement Vickrey's proposal, inspection and maintenance schemes might have to be modified to better reflect real-world driving cycles and actual emissions.

ing up their vehicle and having the emission rate measured after the tune up. Drivers would then have a strong incentive to put their emission control systems in good working order. If this system succeeded, smog fees could eventually become an alternative to mandated state inspection and maintenance (I&M) programs.

Per-pound levels of revenue for each pollutant would be based on estimated damage to human health and the environment. Nationwide revenues generated from smog fees should equal the total damage, less the small share of health costs that motorists bear by inhaling exhaust while they are driving so that motorists do not pay twice.

Vickrey's proposal, though attractive, does not solve all problems with smog fees. For one thing, emissions can range considerably per mile driven by a single car, varying not only with driver behavior and differences in gasoline quality, but also with trip distance. Since present-day catalytic converters are ineffective at cold engine temperatures, a series of short trips tend to be much more polluting than a single trip covering the same total distance. Safeguards would be needed to prevent tampering with emissions measurements and odometers, although eventually it should be possible to record both parameters automatically through real-time electronic monitoring. Because some pollutants are carried in the atmosphere over long distances, particularly ozone and nitrogen oxides, as acid rain, revenues from smog fees should be transferred from the point of generation to the point of harm, which is difficult to establish both scientifically and politically.

Even though smog fees are imperfect, they have strong advantages over current regulatory schemes to reduce vehicular emissions. Like congestion pricing, smog fees need not be implemented nationally, but could be put in place on a metropolitan or regional basis, particularly since they would be essentially revenue-neutral across the district where they apply. Moreover, given concern over pollution-related disease, if the public does perceive smog fees as reasonable and fair, it might be possible to implement them relatively quickly, with a shorter phase-in period than for some other

roadway user fees discussed here. A portion of the revenues generated by smog fees could be applied to improve transit and other alternatives to cars and trucks. Perhaps transit providers could borrow against anticipated smog fee revenues, allowing them to begin initiating service improvements so that alternative transportation is in place before or during the ramp-up to the full smog fees.[34] Global climate effects of carbon dioxide are discussed further below, as are equity considerations from smog fees.[35]

C. Weight-Distance Charges

Weight-distance, or ton-mile charges, would operate parallel to smog fees, or pollution-distance charges. Just as smog fees would be calculated as per-mile emissions times miles driven, weight-distance charges would reflect vehicle weight times miles driven. Weight-distance charges would capture, and thus offset, at least five distinct forms of societal harm from motor vehicles (parentheses denote annual United States costs deemed eligible for user fees):

1. Vibration Damage to (Non-Roadway) Infrastructure ($6 Billion)

Heavy vehicles shake buildings, water mains and other infrastructure in older urban centers. Because damage rises exponentially with weight—one heavy truck causes far more damage than a fleet of light vehicles with the same total weight—this cost might best be captured by user fees allocated only on vehicles exceeding a specified weight per axle. With that caveat, all $6 billion in infrastructure damage costs could be captured through weight-distance charges.

2. Noise and Intrusiveness ($22 Billion)

Weight times distance provides a reasonable approximation of vehicle noise and physical intrusiveness. The bigger

34. Letter from Charles Komanoff to Richard McClintock, Executive Director, The Colorado Public Interest Research Group (Feb. 7, 1994) (on file with Komanoff Energy Assoc.).

35. *See infra* § VI D.

the vehicle and the more it is driven, the more noise it generates through engine operation, gear-shifting, tire noise on pavement, etc., and the more other people on the road or in the community will hear it and have to adjust to its presence. Slightly more than half of this cost to the public, $12 billion annually, is reasonably estimated to be a direct function of vehicle weight and distance traveled. Other sources of vehicle noise such as horn-honking, burglar alarms, and some engine adjustment (e.g., by motorcyclists), are assumed to be a function of operator behavior and not vehicle weight; these damages, $10 billion per year, would be captured through fines and fees.[36]

3. Land ($65 Billion)

Vehicle demand for road space and, hence, land, is directly proportional to miles traveled and closely proportional to vehicle weight.[37] Weight times distance is thus an excellent proxy for vehicle use of land and the corresponding harms to society and the environment from that usage, suggesting that $60 billion in land costs should be captured through weight-distance charges. The remaining $5 billion is assumed to be attributable to vehicles parked on public land and streets; this could be offset through fees and fines.[38]

4. Accidents ($49 Billion)

A vehicle's annual weight times distance reflects its physical presence on the road, and thus serves as an indicator of its propensity to cause serious accidents. Actual corre-

36. Intriguing theoretical ideas abound for metering and charging for such harms without the direct regulatory intervention of fees and fines. One is a decibel charge for making motorists pay for the public annoyance of horn-honking; car and truck horns would be designed to require recharging via decibel-hour refill packs, costing so many dollars for so many seconds or minutes of honking at a given volume. Price would vary with population density where sold, to reflect the average number of people exposed to the noise. Since almost all horn use is venting of frustration, decibel charges need not discourage drivers from safety-related honking. An analogous scheme could be developed for recharging car burglar alarms.

37. The author has estimated that vehicle footprint—surface area—is approximately proportional to the 5/6 power of vehicle weight.

38. *See infra* § VI E.

spondence to actual accidents is admittedly rough, since driver behavior is not reflected, but there is at least a weak correlation nevertheless. Of $49 billion annually in externalities borne by non-motorists, one-fifth, or $10 billion, is assumed to relate directly to vehicle weight and mileage, independently of driver behavior.

5. Taxpayer Subsidies ($20 Billion)

As noted earlier, United States taxpayers pay $20 to $30 billion in general taxes, primarily at the local level, to make up for the shortfall of roadway user fees against governmental expenditures on roads.[39] These expenditures include repairs, much of which is necessitated by heavy vehicle loads,[40] new construction and associated maintenance. As a first approximation, the entire cost of $20 billion (the lower end of the range) is assigned to weight-distance charges, based on the connections between weight and distances, and the need to repair and build roads.[41]

Weight-distance charges would not be entirely new. Passenger vehicles (cars and light trucks) today pay lower annual registration fees than commercial vehicles (trucks), with fees generally varying by weight within classes.[42] Several states also levy weight-distance charges on trucks. However, the charges are often small—far below the variation in societal harm—and the mechanisms primitive. Weight-distance charges in New York State for forty-ton trucks are under 4¢ per mile, yet these heaviest trucks cause an estimated $2 of infrastructure damage alone per mile driven in the New York

39. *See supra* § IV B.

40. Heavy vehicles wear out pavement much faster than do light vehicles. The rule of thumb in highway engineering is that damage and stress to roadways is proportional to the 4th power of vehicle weight per axle.

41. From a theoretical standpoint, road work should be financed out of weight-distance charges, and gasoline taxes should be reallocated to defray damage directly associated with petroleum; *see infra* § VI D.

42. In Washington State, for example, weight-based differentials in annual registration fees vary by as much as $1,000. Jim Lazar, personal communication, Jan. 7, 1994.

area.[43] Moreover, truck weight-distance charges are generally estimated by an honor system, with truckers themselves filing the forms specifying weight hauled and miles driven.

What is needed is a more automatic system that will allow higher per-ton-mile rates to be levied fairly and accurately. One possible approach would use the automatic vehicle identification (AVI) technology envisioned for congestion charges.[44] AVI could also undergird a network of weight-in-motion stations to identify and weigh trucks while they are driven past a bank of sensors. This is not high-tech dreaming; alone among the fifty states, Oregon already measures truck weight at nearly seventy stations where trucks cross a weighing pad at speed. The next logical step is for Oregon, and other states, to bill trucks electronically using AVI technology. Passenger vehicles could be exempted initially, and would pay far lower amounts in any event due to their lesser weights.

The discussion in this section suggests that $108 billion a year could be raised nationwide through weight-distance charges to compensate the public for vehicle harms. The same estimation factors that were used to derive these estimates, largely matrices of per-mile costs for different vehicle types on different roadway types, would be applied locally and regionally to develop weight-distance charges appropriate to different land uses and population densities.

D. Gasoline Taxes

Taxes on motor fuels—gasoline and diesel fuel—are the prime means used by industrial countries to offset societal harms from driving. Taxes on motor fuel average $1.75 per gallon in Japan, $3.75 in Italy, and within that range in Germany, France and Britain. Gasoline taxes are far less in the United States, where combined federal and state levies average only 34¢ per gallon in the New York, New Jersey and

43. Komanoff & Ketcham, *supra* note 3 (1992 calculation by Brian Ketcham). New York State charge under 4¢ per mile, from New York State Department of Taxation and Finance, Form MT-903 (Combined Truck Mileage and Fuel Use Tax Return) (June 1990).

44. *See generally* § VI A.

Connecticut tri-state region, for example,[45] and these revenues are used almost wholly to pay for roads rather than to offset societal harms.[46] Still, they dwarf any other roadway use charges collected by government, except for bridge and road tolls in several heavily urbanized areas.

Raising taxes on motor fuel is attractive to policy-makers. The collection mechanism is already in place, and the system rewards fuel efficiency, a social good, since gasoline purchases decline with higher vehicle energy efficiency.[47] Gasoline taxes are an appropriate tool for offsetting the harms directly associated with vehicular use of petroleum. Those harms include refinery and groundwater pollution, the drilling's destruction of homeland and habitat, and American military expenditures to guarantee oil supplies. Gasoline taxes should also include a carbon tax component to capture driving's contribution to global warming, since vehicular CO_2 emissions are a direct function of the amount of gasoline burned.[48]

Conversely, gasoline consumption correlates weakly to other important categories of motor vehicle harms, such as congestion, air pollution and accidents. As suggested earlier, congestion pricing, smog fees, and weight-distance taxes capture these impacts more explicitly.[49] For example, a forty-ton tractor-trailer uses only three to four times the fuel of a one or two ton car while wreaking literally thousands of times as

45. In December 1993, the federal gasoline tax stood at 18.4¢; state taxes were 10.5¢ in New Jersey, 15.6¢ in New York, and 20.0¢ in Connecticut.

46. As noted earlier, motorist user fees—gas taxes, tickets, fees and fines—pay for some but not all road building and maintenance costs. For the entire United States, the gap, made up by general taxes, appears to be between $20 and $30 billion, even allowing for the exceptions.

47. Declining gasoline consumption due to higher automotive fuel efficiency helped swell the gap between governmental revenues from, and expenditures on, motor vehicle use in the early 1980's. *See* State of New York, Legislative Commission on the Modernization and Simplification of Tax Administration and the Tax Law, *Transportation Taxes in New York State*, May 17, 1983 (preliminary analysis, attributed to Prof. Kenneth Small, Princeton University).

48. Smog emissions depend far more on the design and condition of the emission control system.

49. *See supra* § VI A-C.

much damage to roadways.[50] Thus, weight-distance charges geared to axle weight appear to be a more precise means of offsetting vehicle damage to roadways, than are gasoline taxes.

Thus, gasoline taxes should be only one element in an array of roadway user fees, rather than the centerpiece as is often proposed. Perhaps policy-makers' frequent espousal of gasoline taxes to offset motor vehicle harms reflects a tendency to regard excessive auto and truck use as an energy problem centered on petroleum availability, rather than a transportation problem that affects society in a myriad of ways. Then again, the preference for a gasoline tax may reflect the pragmatic consideration that raising gasoline taxes requires neither technical nor institutional change.

Energy-related costs are shown in Table 1 to be $60 billion a year, comprising $35 billion for military forces to safeguard foreign oil, and $25 billion in global warming costs from motor fuel CO_2 emissions. These entire costs are borne by the general public through taxes and climate degradation. The figure does not include impacts from drilling, refining and other upstream parts of the petroleum fuel cycle—serious harms that urgently require study.

At the 1990 rate of gasoline usage in the United States, 7.2 million barrels per day, the $60 billion to be raised in gasoline taxes to offset petroleum's social and environmental harms is roughly 55¢ per gallon. This figure is in addition to the current average United States gasoline tax of 30-35¢ per gallon, since that revenue is already dedicated to pay part of government's cost to build and maintain roads. As Table 2 shows, even a 55¢ per gallon increase in gasoline taxes would account for only a modest percentage of the full set of revenue measures proposed here to offset roadway harms.

Gasoline taxes below the federal level may create boundary problems, as motorists chase after cheaper gasoline in the first untaxed county or state. This may limit the amount of gas taxes that can be assessed locally or regionally.

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50. *See supra* note 40.

E. Fees and Fines

The foregoing four mechanisms leave uncaptured roughly $44 billion in annual motor vehicle harms to the general public—$29 billion in accidents,[51] an estimated $10 billion in nuisance noise costs, such as horns or alarms, that cannot be captured from a generic formula such as weight-distance charges, and $5 billion in land occupied by parked vehicles.

All three sets of harms derive largely from driver behavior—imprudent driving putting other road users at risk, intentionally loud vehicle operation, and inappropriate parking. Fees and fines are a logical tool to offset and discourage such conduct. Fines would be levied for abusive horn honking, unnecessarily disruptive burglar alarms, illegal parking, and, especially, speeding and other aggressive driving behavior that endangers other road users. Fees for on-street parking should be increased to reflect space taken up by vehicles.

Averaged across America's 170 billion licensed drivers,[52] $44 billion a year in fines for illegal, harmful driving would work out to approximately $260 per driver per year. Although data are not readily available, this is probably 5-10 times what the average driver now pays for moving and parking violations.[53] Accordingly, fines of this magnitude would almost certainly stir up strong resistance, although a phase-in might help, as presumably it would with the other mechanisms discussed here.

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51. This is assuming that $10 billion in accident costs would be offset through congestion tolls, and an equal amount in weight-distance charges.

52. National Highway Traffic Safety Administration, *Traffic Safety Facts 1992*, tbl. 2, lists 167.0 million licensed drivers in 1990 and 171.5 million in 1992.

53. In New York City, motorists pay $372 million annually in parking and moving violations, or on the order of $200 per licensed driver. Source: $327 million in parking fines in FY 1991-92 and $45 million in moving violations in FY 1990-91, including surcharges, from Roelofs and Komanoff, *see supra* note 11; number of licensed drivers is assumed to be roughly 2 million. Anecdotal evidence suggests that annual per-driver fines in New York City are probably three to five times the national average.

F. Roadway User Fees—Summary

Table 2 summarizes the discussion to date. The rightmost column summarizes the estimated harms deemed ripe for user fees in Table 1. The columns preceding it divide these amounts into components that would be collected through the five roadway pricing mechanisms just discussed.

PROPOSED ROADWAY USER FEES - SUMMARY 1990 ANNUAL FIGURES FOR THE UNITED STATES, IN BILLIONS						
VEHICLE HARM	CONGESTION PRICING	SMOG FEES	WEIGHT-DISTANCE CHARGES	GAS TAXES	FEES AND FINES	TOTAL
Accidents	$10		$10		$29	$49
Congestion	$50					$50
Air Pollution		$66				$66
Land			$60		$5	$65
Energy				$60		$60
Noise			$18		$10	$28
Tax Subsidy			$20			$20
TOTAL	$60	$66	$108	$60	$44	$338
Share, Total	18%	20%	32%	18%	13%	100%
Most figures are derived in text. Percents do not add to 100 due to rounding. Total fees are roughly half of total motor vehicle harms (see text).						

TABLE 2

Revenues from the roadway user fees proposed here for the United States total $338 billion per year. The largest fee mechanism, weight-distance charges, account for less than a third of total revenue; the smallest mechanism is fees and fines, at 13%. In between are smog fees, (increased) gas taxes and congestion pricing, each of which constitutes 18-20% of the total.

Thus, congestion pricing, often touted as the centerpiece of roadway user fees, would account for only about one-fifth of the total.[54] Gasoline taxes too would be relegated to a somewhat secondary role; even counting the $35 billion now collected in gasoline taxes from United States motorists, total

54. The relatively small share of overall roadway user fees assigned to congestion pricing should be kept in mind by those who sometimes use the two terms interchangeably.

gas taxes with the program outlined here would be slightly less than weight-distance charges. The sleepers in this analysis are weight-distance charges and smog fees. Although most discussions of roadway pricing accord them little attention, together they would account for around half (52%) of total user fee revenues.

These share levels are highly theoretical and also are aggregated for the country as a whole. In practice, each city or region should choose its own revenue levels, reserving for itself decisions as to which vehicle harms are the most serious and, accordingly, which mechanisms should play the greatest roles.

The measures discussed here are not competing but complementary, even synergistic; they should be pursued simultaneously. If political or other considerations preclude adopting any one measure, the others should be correspondingly increased. As noted in this section, all of the measures should be phased in to allow institutions to expand transportation choices and to cushion the hardships that rapid price changes invariably create.

VII. Measures to Meter Different Parts of the Cost of Driving

The preceding section discussed five roadway pricing measures to be levied on the harms from driving—congestion pricing, smog fees, weight-distance charges, gasoline taxes, and fines. This section considers two different but related types of economic incentives which meter or unbundle motorist costs: cashing-out free parking and pay-at-the-pump insurance.

Measures to unbundle parking and insurance differ from roadway user fees. Rather than imposing new charges, they change the terms of payment through metering schemes that vary with the amount of driving. Unlike the roadway pricing measures above, unbundling is not a way to make motorists pay more, but a device to restructure motorist payments to make the costs of driving more transparent and equitable.

A. Cashing-Out Free Parking

United States motorists pay large sums to park at garages, lots and municipal meters.[55] But the vast majority of parking in America is provided at office parks, shopping centers and strip malls is free. Employers offer parking as a fringe benefit. Proprietors offer it as a courtesy.

Of course, firms make outlays to provide parking, to pay for land, construction and maintenance. They recover these costs by bundling parking as overhead in the price of goods. In effect, each $20 spent at the mall includes 25¢ to cover the share of rent that paid for the customer's parking space.

Provision of free parking is a strong inducement to travel by car, more powerful in many circumstances than if motorists were offered free gasoline.[56] Forced to choose between free parking and nothing, car-owners are more likely to take the parking and drive to work or shop—the fringe benefit becomes free commuting rather than free parking. In several instances in which workplace parking charges have been unbundled—paid for separately—driver-only traveling has declined by an average of 25-30%.[57] These drivers elect to avoid the parking fee and switch to carpooling, transit, walking or biking.

These considerations have given rise to proposals to charge employees for parking, and to return the revenues to all employees on an equal per capita basis. California law mandates cashing out in certain circumstances, and it is part of the Clinton Administration's Climate Change Action Plan.[58] Both initiatives apply only to employers; once they

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55. Perhaps surprisingly, no estimate is available of the annual value of parking transactions in the United States. The Eno Foundation's annual *Transportation in America*, which charts expenditures on United States ground transportation, bundles parking costs with auto repair, maintenance and rental.

56. Donald C. Shoup and Richard W. Willson, *Employer Paid Parking: The Problem and Proposed Solutions* Vol. 46, No. 2 TRANSP. Q. (ENO Transp. Found., Inc., Westport, Conn.) at 170.

57. *Id.* at tbl. 1.

58. Donald C. Shoup, U.S. DEP'T OF TRANSP., CASHING OUT EMPLOYER PAID PARKING 141 (Dec. 1992). In October 1993 President Clinton directed his Administration to prepare legislation giving workers the option of receiving the

have penetrated the workplace, they could be extended to shopping malls and other large establishments.

For example, consider an office park with 1,000 workers, 700 of whom drive and park for free (the remainder use transit, ride-share, walk, cycle, etc.). Under cashing out, each car would be charged the actual cost of providing its parking space (corresponding to land, maintenance, etc.), say $5 per day. Each day's parking revenue, $3,500 in this case, would be distributed per capita—a daily payment of $3.50 to every worker—drivers and non-drivers.

As a result, non-drivers come out $3.50 ahead; drivers are $1.50 behind ($3.50 less $5.00); the group as a whole breaks even. The $5 daily difference between driving and non-driving creates a strong incentive not to drive. As some drivers find other ways to get to work, the result will be less congested parking lots, roads, bridges, atmosphere, etc. Non-drivers, for their part, get a better deal than their present choice between a free parking space or nothing.

As the number of drivers declines, the parking area freed up could be sold or put to alternative use.[59] The charges and rebates would have to be adjusted over time, to ensure that the arrangement remains revenue-neutral. As the percentage of drivers goes down, the rebate would decline. Eventually a balance would be reached. Although managing the charges and rebates would cost money, electronic vehicle identification systems could hold down costs.

B. Pay-At-The-Pump Insurance

A proposal attracting attention in California and elsewhere would link automobile insurance with purchases of gasoline by including an insurance component in the gas price. Under pay-at-the-pump insurance, drivers would purchase sufficient premium with each refill of gasoline to

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cash value of employer-paid parking. President William Clinton, Earth Day Address (Apr. 22, 1993).

59. In many jurisdictions, zoning ordinances would need to be changed to enable office parks, shopping centers and other establishments to reduce parking capacity. Doing so would help establish a true opportunity cost for land now mandated for parking.

cover the actuarial risk associated with driving the distance that a typical car can travel on a gallon of gas. To reflect differences in actuarial risk between different drivers and different vehicles (e.g., urban vs. rural), high-risk vehicles would pay a surcharge at registration, fines for moving violations would be raised, and drivers in high-risk age groups might pay more for licenses.[60]

Proponents of pay-at-the-pump insurance make a convincing case for its potential to cut costs for drivers and society as a whole. Some insurance sales and underwriting costs would be eliminated, shopping and paying for insurance would be simplified, and all motorists would automatically carry insurance. Moreover, because the probability of being in an accident rises with miles driven, premiums would be aligned more closely with risk than under the present lump-sum system for purchasing insurance. Most importantly from the perspective of this paper, blending some of the cost of insurance into the price of gasoline would create a strong incentive to economize on driving, and thus reduce the attendant harms of congestion, pollution and traffic accidents.[61]

For example, consider a typical car with a $600 insurance premium, which is driven 12,000 miles a year. Assuming that the car averages 20 miles per gallon of gas, it requires 600 gallons of gas a year. Dividing the annual insurance premium by gallons of gas consumed, the car in effect absorbs $1 in insurance per gallon of gasoline.

Under pay-at-the-pump, insurance would be purchased with each gallon of gas. After a gradual phase-in, the level might be set at, say, 50¢ or 60¢ per gallon, constituting a big inducement to drive less. The monies would be collected by state government (along with the gas taxes it already collects) and divided among insurers in proportion to their cov-

60. Andrew Tobias, *Auto Insurance Alert* (Simon & Schuster 1993) is a popular treatment of this idea and the basis of the presentation in the text. *See also, To 'Fill 'Er Up' May Soon Mean With Premiums*, WALL ST. J., Nov. 8, 1993, at B1.

61. Motorists would also have great incentive to use more fuel-efficient cars, thus abating the various costs associated with petroleum extraction and processing. *See supra* § VI D.

erage. Insurers would be selected randomly through a state-run pool. Some premiums might still be paid in a lump-sum by drivers, but these would be reduced to reflect all drivers' purchases of insurance at the pump. Total insurance payments would not increase. In fact, they would drop because of savings in paperwork and elimination of uninsured motorists. Just the method of payment would change.

Border issues, including inequities for drivers from neighboring states and incentives to hunt for cheaper gas, may impede implementation of pay-at-the-pump insurance on a state or even a regional basis. Federal action may be preferable. As an alternative to pay-at-the-pump, auto insurance might be levied on the basis of vehicle miles traveled.

C. Another Mechanism: Drive Plus

Another mechanism intended to reduce the harmful impacts of driving is directed at car-owners' vehicle purchases. Under the Drive+ program, purchasers of new cars and trucks would be charged a fee or given a rebate based on whether the vehicle is more or less polluting and energy-efficient than the average new car.[62] Like cashing-out free parking and pay-at-the-pump insurance, Drive+ would be revenue-neutral. Specifically, the fees would cover the rebates and administrative costs. Drive+ might also be structured with incentives to retire or scrap the dirtiest vehicles already on the road.

Drive+ has been put forward by environmental groups who are primarily concerned with air pollution and other energy-related harms from motor vehicles, rather than with the less explicitly environmental harms of congestion, accidents and damage to community. Indeed, concerns have been raised that Drive+ might induce additional automobile purchases—and use—by making some vehicles less expensive to purchase. Moreover, it is not clear how Drive+ would

62. Drive+ is an acronym for Demand-based Reductions In Vehicle Emissions Plus Increased Fuel Economy. See Nathaniel Greene, *Getting the Sticker Price Right: Incentives for Cleaner, More Efficient Vehicles*, 12.1 PACE ENVTL. L. REV. (Fall 1994).

interact with existing cafe standards for fleet average fuel efficiency. Administering the fee/rebate program could generate considerable work for government, particularly if a component is included for accelerated scrappage. Drive+ could also compete with smog fees and gasoline taxes, which create direct incentives to drive less and curb emissions and fuel use by charging motorists for their vehicles' pollution and energy usage.

Nevertheless, Drive+ could be implemented today. No new technology or infrastructure is required, and political barriers are almost certainly lower than for increased gasoline taxes or even smog fees. Conceivably, a Drive+ program could be crafted as a transition step to full-fledged smog and other fees geared directly to the harms from driving.

VIII. Benefits from Roadway Pricing

This article proposes an unprecedented overhaul of the way motorists pay for driving, through charging for the harms caused by driving and unbundling a large share of insurance and parking costs. At issue are hundreds of billions of dollars in potential annual roadway user fees, and rearranging the way drivers pay $50-100 billion a year in insurance and parking. Combined, these payments constitute 5-10% of United States GDP. Even assuming the fees are phased in over many years, altering or creating new payment streams of this magnitude is an enormous enterprise.

It may help to bear in mind that the problems that these measures would address—congestion, pollution, car crashes, sprawl, urban disinvestment, and global military and climate disruption—are themselves enormous. Measures that can address them effectively by creating powerful economic incentives to reduce motor vehicle harms will spin off tremendous benefits.

Changing how motorists pay for parking and insurance, from a lump-sum to a metered approach, will save drivers large amounts of money by eliminating huge built-in costs. Congestion pricing will cut down on dispiriting traffic tie-ups. Smog fees will help clean the air. Weight-distance taxes will

help rail freight compete with heavy trucks. Gasoline taxes will shift motorists and auto manufacturers alike toward less inefficient vehicles, easing pressure to drill for oil in fragile areas and to feed military spending. Heavier fines for antisocial driving will make streets safer. In combination, the measures will work to reduce vehicle miles traveled and improve the economics of center-oriented development vis-a-vis continued suburban sprawl.

Moreover, the revenues raised through roadway user fees are not dollars thrown down the drain but monies that society can and must allocate to effect a range of transportation and other social benefits. Essentially all of the revenues from the user fees would be available to improve transit, redress the harms from driving, and tackle other social and economic problems in American society. A summary of principles follows, in lieu of a full discussion of revenue treatment:

Some revenue should be invested to improve alternatives such as transit, particularly in areas where alternatives to driving are poorly developed, and to create dedicated repair and maintenance funding to make auto use safer and more efficient.

To address inequities created by the increased cost, some revenue should be returned directly to the citizenry in tax savings, particularly by cutting sales and other regressive taxes.

Some revenue should be directed at repairing the damages associated with vehicle harms, i.e., by investing in communities blighted by expressways, providing health services for people with asthma or disabilities and other victims of pollution and crashes, soundproofing schools and other structures against highway noise, etc.

Revenue might also be allocated to fund vital social services.

IX. Equity and Other Concerns

The pricing measures discussed here would come at a price. Smog fees could hurt poor families that rely on old,

polluting automobiles. Congestion pricing in effect gives wealthier motorists more room on the highway by tolling road use beyond the means of other drivers. Weight-distance charges could add to the cost of goods movement. Unbundling free parking would create another service to pay for. These objections merit close attention and further study in some cases, although answers are available to some of them. Again, the present inefficiencies and inequities from rampant motor vehicle harms should be borne in mind.

A. Inequity for Poor People

America's motor vehicle dependence disproportionately harms poor people. Low-income groups are less likely to own and use automobiles. As a result, they receive fewer benefits from motor vehicles and, more than other income groups, are forced to rely on alternatives such as transit, cycling and walking that have grown more dangerous and difficult as more societal resources have been devoted to cars and expressways. Poor and low-income people are also more likely to be on the receiving end of motor vehicle harms. More than other groups, they are victims of pedestrian deaths (especially to children); are asthma sufferers vulnerable to air pollution and lacking access to health care; and live next to noisome highways.

Thus, poor and low-income groups stand to benefit from roadway pricing measures that reduce motor vehicle use and harms. Moreover, they would also benefit from social investment of user fee revenues in transit and other public services. In addition, because poor people do proportionately less suburb-to-downtown commuting, they would avoid the steepest congestion pricing fees.

At the same time, the poor have little or no cushion for absorbing roadway user fees, or higher living costs from any source. They are more likely to own and operate older and under-maintained vehicles that would be subject to heavy smog fees. Thus, while low-income people as a group might be made better off, roadway fees will certainly make some people within that group worse off, particularly those who

drive more than average.[63] Moreover, the idea of auctioning off public roadways to the highest bidders (i.e., wealthy drivers) is an anathema to many, notwithstanding the progressive uses to which public revenues from this auction could be put.

Research on these impacts is needed to precisely pinpoint the impact of roadway pricing on low-income groups as a whole and on vulnerable subgroups. Still, one measure that would clearly benefit low-income groups would be to allocate a significant share of roadway user revenues to reduce regressive taxes, i.e., to reduce income tax rates in lower brackets and cut sales taxes.

B. Inequity for Women

Only recently has transportation research begun to examine the particular circumstances of women. A recent study of Phoenix and Tucson, Arizona, found that at least as many women as men are solo drivers, and that women's commuting trips take longer, despite shorter commute distances, perhaps because of a greater number of linked trips involving daycare and eldercare.[64] Nationally, women work harder, earn less money, do more uncompensated work, have fewer employment options, and are more threatened by violence than men, as one commentator notes.[65]

These realities dictate that both roadway pricing and travel demand management policies such as Employer Trip Reduction programs include services to enable women to reduce solo and peak-period driving, without sacrificing time or

63. The rural poor who drive long distances in old, higher-polluting cars would be particularly vulnerable, although per-pound smog fees would be lower outside high-density metropolitan areas. Poor rural drivers would also be virtually unaffected by congestion pricing. Probably the most damaging roadway user fee for rural poor people is the gasoline tax, which accounts for a far smaller share of total user fees proposed in this paper than in most policy proposals.

64. SANDRA ROSENBLOOM & ELIZABETH BURNS, DRACHMAN INSTITUTE FOR LAND AND REGIONAL DEVELOPMENT STUDIES, DO ENVIRONMENTAL MEASURES AND TRAVEL REDUCTION PROGRAMS HURT WORKING WOMEN? (1993).

65. Cora Roelofs, *Review of Rosenbloom and Burns*, AUTO-FREE PRESS, Mar.-Apr. 1994, at 15.

personal safety. Such measures include flexible work schedules, worksite childcare, guaranteed ride home programs, and a spectrum of improvements to transit to make it safer, more convenient and affordable, and more accessible to children and seniors, many of which could be financed with revenue generated from roadway user fees.

C. Urban Areas

Not only congestion pricing, but weight-distance charges and smog fees, would make urban driving more expensive per mile.[66] This should not disadvantage cities, however, because much of the revenue could be levied, collected and respent locally. The dollars collected from congestion pricing, could be recycled directly as lower local taxes. In this way, taxes on harms (congestion) would displace taxes on goods (general economic activity).

Moreover, despite higher per-mile driving costs, city transportation and, even more important, access to goods, services and destinations need not become significantly more costly. Worldwide comparative studies by Newman and Kenworthy have documented that miles driven per capita fall precipitously as population density rises, because cars are less practical, destinations are closer, and alternatives (transit, walking, cycling) function better.[67] Thus, while diehard city motorists may protest roadway pricing, the likelihood is that the urban populace as a whole will benefit from the reduction in vehicle use and the newly found revenue.

For example, urban bus service, in a downward spiral almost everywhere due to congestion, among other factors, would tend to improve as traffic diminished. This would make congestion pricing more palatable. Moreover, as households and businesses reduce their expenditures on vehicles and petroleum, more income can go to local goods and services, thus helping recircuit local economies.

66. Charges for urban driving would be higher due to the fact that more people are exposed to pollution and other vehicle disamenities than with rural driving.

67. Peter Newman and Jeff Kenworthy, *Cities and Automobile Dependence: An International Sourcebook*, (Gower Technical, Brookfield, Vt. 1989).

D. Goods Movement

Trucks constitute 14% of United States vehicle miles traveled,[68] but they account for disproportionately more air pollution, infrastructure wear and tear and road congestion, especially on many local streets and urban expressways. Thus, the trucks' share of total roadway user fees would be considerably higher than 14%. While this raises the likelihood of higher costs for truck shipments, the revenues would concomitantly decrease the funds government must draw from general revenues to repair and maintain the highway and bridge network.

Moreover, user fees would lead truckers to reduce per-mile harms and would encourage shippers to find economies by switching to rail freight, consolidating loads, deploying smaller vehicles in congested areas, and using nearby suppliers. Analogous substitutions improved fuel efficiency in most sectors of industrial economies in the 1970's and 1980's.

E. User Fee Administration

Most roadway pricing measures would entail new or expanded administrative functions. An obvious expense would be the network of sensors on highways and major arterials to record vehicle movement in order to assess congestion and weight-distance charges. Smog fees would require mechanisms for estimation and payment. Increasing fines for violations would require additional police and adjudicatory personnel. Cashing out parking would add monetary exchanges to an activity that is now largely offered free. Even raising gasoline taxes could require efforts to prevent bootlegging. Indeed, strictures to guard against tampering and evasion of all roadway user fees would need to be developed and enforced. Finally, decisions on setting levels for these

68. Calculation by Brian Ketcham, from 1989 FHWA data apportioning national VMT among 13 vehicle classes—autos, motorcycles, buses and ten classes of trucks. Ketcham combines VMT for all truck classes (8.7%) and 30% of 2A4T (2-axle, 4-wheel trucks, 18.1%), yielding 14.1%. The figure is intended to exclude light trucks used for personal travel.

charges would require not only elaborate technical analysis, but vigorous public debate.

This is a tall order, as befits a program that would create or re-order revenue streams amounting to hundreds of billions of dollars yearly. However, the effort could be vastly aided by electronic and other information processing technology. Smart cards or other devices alluded to earlier would allow automatic metering and billing, not only of driving but of parking.[69]

Even more importantly, the pricing mechanisms proposed here could reduce or completely replace a myriad of existing or planned administrative structures for pricing vehicle use and controlling vehicle harms, such as:

(i) Toll Plazas (replaced by automatic vehicle identification, or AVI, under congestion pricing and weight-distance charges);

(ii) HOV lanes (replaced by congestion pricing);

(iii) Mandatory Inspection and Maintenance (I&M) programs (made optional under smog fees);

(iv) Employee Commute Option programs (made moot by smog fees, congestion pricing and cashing-out parking);

(v) Odd-even license plate days (mooted by smog and congestion fees);

(vi) Incentives or mandates for cleaner fuels (reformulated gasoline, ethanol, etc.) and alternative-fueled vehicles (electric, natural gas, solar, etc.) (superseded by smog fees);

(vii) Exhortations to leave the car at home during summer ozone alerts or holiday season gridlock alerts (replaced by pre-announced increases in smog and congestion fees, administered in real time to be commensurate with predicted pollution and congestion levels and the attendant social costs);

(viii) Bicycle parking and shower requirements (cyclists instead pay building managers or off-site providers for showers and safe bicycle storage, using their rebates and tax savings gained from cashing out free parking and the per capita

69. *See supra* § VI A.

"VMT dividend" of lower taxes enabled by roadway user revenues).

X. Conclusion

Thus, pricing mechanisms could help make roadway usage fairer and more efficient, without the need for potentially cumbersome regulations. Motorists will be able to continue making their own decisions about when, where and how to drive, while taking responsibility to offset the costs to society from their vehicle use. Non-motorists will receive windfalls, their entitlement for harms they avoid imposing on society, with which they can pay to improve their non-motorized travel, or to improve other aspects of their lives.[70]

The last example above, concerning bicycling, is intentionally provocative. The author, a bicycle commuter and activist for cyclists' rights, has long advocated for bicycle facilities such as indoor commuter parking.[71] Under the current system that lavishes motorists with subsidies, special facilities for cyclists are a modest and appropriate step toward a level playing field. However, as vehicle users are charged increasingly for consuming public resources, such special treatment would ultimately be neither needed nor warranted. Assuming, say, $400 billion a year in roadway user fees plus parking cash-outs, and assuming for simplicity that all such revenues were rebated to the adult citizenry pro rata, non-drivers would gain almost $2,000 a year each. This is far more than enough to finance each cyclist's parking and washup facilities.

Pricing roadway travel will not solve all problems of transportation. To continue with the cycling example, bike riders still need safe access to roadway facilities. In fact, social provision of a travel infrastructure will become more, not less important, as public revenues available for transportation grow and non-automotive transport options become more

70. Entitlements for miles not driven parallel the concept of negawatts—utility payments for conserved electricity—pioneered by Amory Lovins in the electricity sector.

71. *See* Herman et al., *supra* note 27, at 97.

highly valued for avoiding societal harms. Equally essential as pricing-based incentives will be non-monetary changes in transport policy—zoning modifications to permit higher densities and reduced parking; improved facilities for non-motorized vehicles; better intercity rail and bus service; easier availability of neighborhood car rentals and utility vehicle co-ops; transit-pedestrian oriented residential development, and so forth.

Still, movement toward full-cost pricing of roadway travel is the *sine qua non* of solving America's transportation problems. Even radically improved transit, cycling and walking will never compete effectively with cars,[72] unless subsidies for driving are slashed, parking and insurance costs are metered, and car and truck travel is made to pay its own way.

This analysis is intended as a first step toward careful consideration of a comprehensive program of roadway pricing. Although the figures here are at the national level, most of the measures outlined here could be implemented locally—as they should, reflecting local damages from vehicle use and local needs.[73] Let the debate multiply; the harms from over-dependence on motor vehicles are massive, and our society and environment cannot wait for cures.

72. U.S. General Accounting Office, *Reducing Vehicle Emissions With Transportation Control Measures*, Aug. 1993, concluded that traditional measures such as transit and ridesharing were unlikely to reduce vehicle emissions by more than several percent in most metropolitan areas, whereas market-based measures had far greater potential.

73. For a rough sketch of a possible local initiative on roadway pricing, see Komanoff, letter to Richard McClintock, *supra* note 34.