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Pay-As-You-Drive Vehicle Insurance in British Columbia

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EXECUTIVE SUMMARY

Insurance is one of the largest motor vehicle expenses, costing about $1,200 annually for a typical British Columbia automobile. This report shows that insurance pricing can affect how vehicles are used, and evaluates the impacts and benefits of alternative price structures. Most insurance policies, including those sold by the Insurance Corporation of British Columbia (ICBC), are a fixed cost with respect to vehicle use; moderate reductions in vehicle travel generally provide little or no premium savings. An alternative price structure, called *Pay-As-You-Drive* (PAYD), changes insurance into a variable cost, so motorists save money when they reduce their mileage. As a result, they tend to drive less.

Various studies using a variety of research methods indicate that a vehicle's chance of having a crash tends to increase with its annual vehicle mileage, so PAYD tends to increase actuarial accuracy, that is, insurance premiums more accurately reflect vehicles' claim costs. Mileage is just one of several factors that affect crash rates so it would be inappropriate to use mileage *instead* of existing rating factors, for example, by charging all motorists the same per-kilometre fee. However actuarial accuracy increases if mileage is incorporated with existing rating factors. PAYD does not simply shift costs from one group to another: premium reductions reflect, in part, the claim cost savings that result when motorists reduce their vehicle travel and therefore crashes. As a result, it need not reduce insurance company profitability.

Under most proposals PAYD would be a user option, so motorists could choose the price structure that best meets their needs and preferences. As a result, only motorists who expect to save money would choose this option.

In addition to consumer savings, PAYD pricing tends to reduce energy consumption, carbon and other pollution emissions, and traffic congestion. It increases insurance affordability by allowing motorists a new opportunity to save money, and it is progressive with respect to income since lower-income motorists tend to drive less than average. It can help achieve ICBC policy objectives including traffic safety, social equity, consumer affordability, emission reductions, and infrastructure cost savings.

There are many possible ways to implement PAYD, some that offer greater impacts and benefits than others. Total benefits tend to increase as more vehicle travel has PAYD pricing, and as the incentive to reduce mileage increases. A relatively simple approach, called *basic PAYD*, prorates existing premiums by the average annual mileage of each rate class, so a $600 premium becomes 3¢ per kilometre, and a $1,800 premium becomes 9¢ per kilometre. Mileage can be verified with odometer readings at the start and end of the policy term recorded by motorists using digital cameras, by insurance brokers or by service stations. Because this approach is relatively simple and inexpensive to implement, it is likely to have the largest travel reduction impacts and therefore the largest total benefits. *Instrumented PAYD*, in which electronic instruments are installed in each participating vehicle, allows pricing to vary by time and location, which can further increase actuarial accuracy, but this approach has high implementation costs and raises privacy concerns, and so is likely to have smaller impacts and benefits.

PAYD insurance is not currently available in British Columbia but has been implemented elsewhere, including in the United States, Europe and Australia.

There is some uncertainty concerning the magnitude of some PAYD impacts. It is impossible to predict with precision the risk profile of motorists who would choose optional PAYD, the amount and type of mileage they would reduce, and the claim cost savings that would result.

A pilot project based on the following recommendations would resolve these issues while minimizing risks to ICBC:

- Offer fully-prorated *basic PAYD* applied to all categories of coverage (all existing premiums prorated by average annual mileage), with a 2,000 kilometre annual minimum purchase requirement. Other pricing options (such as *instrumented PAYD*) can also be offered for comparison.
- Base mileage on odometer readings verified by digital photos or brokers and service stations.
- During the pilot program, collect mileage data from participating vehicle for at least one month prior to applying PAYD pricing, to provide baseline data.
- Provide effective marketing to promote PAYD insurance to appropriate candidates.

1. INTRODUCTION

Pay-As-You-Drive (PAYD, also called *distance-based, usage-based* and *per-kilometre*) vehicle insurance bases premiums directly on the amount a vehicle is driven during the policy term. This changes insurance from a fixed cost into a variable cost with respect to vehicle travel, giving motorists an additional incentive to reduce annual mileage.[1]

Various experts and organizations support PAYD insurance as a way to increase efficiency and equity, and help achieve policy objectives including increased traffic safety, consumer affordability, energy conservation, and pollution reduction.[2] Some jurisdictions have implemented policy reforms to encourage PAYD pricing,[3] and transport agencies are funding PAYD pilot projects.[4] Several insurance companies now offer PAYD pricing, as described later in this report.

This white paper provides an overview of PAYD issues. It describes PAYD insurance, evaluates potential benefits and costs in British Columbia, describes examples of current implementation, and provides specific recommendations for maximizing PAYD benefits.

2. HOW PAYD WORKS

Conventional vehicle insurance is considered a fixed cost with respect to vehicle use.[5] Although rate structures often include factors that broadly reflect vehicle travel, such as type of driving, commuting distance, or estimated annual kilometres, motorists do not generally save on premiums from marginal vehicle travel reductions. PAYD incorporates the number of kilometres driven during the policy term directly into the rate structure, in addition to other factors such as driver history, risk categorization, vehicle type, and territory. This converts insurance into a variable cost, so motorists save on insurance whenever they reduce mileage.

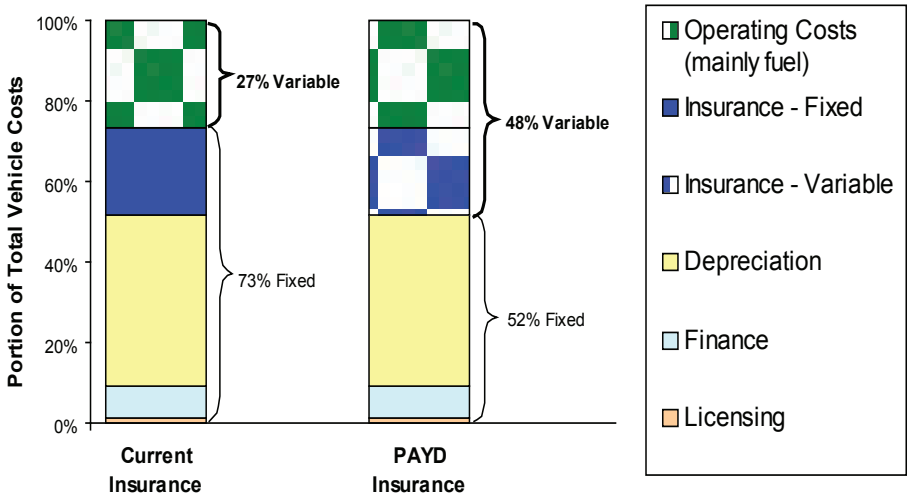

Figure 1: Vehicle Costs with Current and PAYD Insurance[6]

Pay-As-You-Drive pricing changes insurance from a fixed cost into a variable cost. Using Canadian Automobile Association cost estimates for a typical automobile with $1,850 annual insurance premiums, PAYD increases the portion of variable vehicle costs from 27% to 48%, nearly doubling the variable cost of driving while significantly reducing fixed costs.

There are several possible ways to implement PAYD pricing. Key policy design features are discussed below.

Universal or Consumer Option

PAYD could be universal (all polices have PAYD pricing), but under most proposals PAYD would be a user option so motorists could choose the price structure that best meets their needs and preferences, in much the same way as consumers can choose from different rate structures for telephone (per minute or unlimited minutes) or even restaurant meals (all-you-can-eat or al-a-carte). As a result, only motorists who expect to save money would choose this option.

How Mileage is Incorporated into Rates

A simple way to incorporate mileage, called *basic PAYD*, is to prorate existing premiums by average annual mileage for each rate class.[7] For example, if a rate class averages 20,000 annual kilometres, a $600 annual premium becomes 3¢ per vehicle-km ($600/20,000) and a $2,000 annual premium becomes 10¢ per km ($2,000/20,000). Since premiums currently average about $1,200 per vehicle-year and average about 20,000 annual kilometres, *Basic PAYD* premiums would average about 6¢ per km overall.[8]

A variation is to offer discounts for mileage below certain levels, such as 10% savings for driving fewer than 16,000 annual kms and 20% savings for driving fewer than 10,000 kms. This has the advantage of capping premiums so motorists know the maximum they could be charged, and avoids the need to collect additional premiums at the end of the policy term, but provides no incentive to reduce mileage once vehicles reach the maximum discount level.

Per-kilometre crash rates tend to decline with increased annual mileage, so it may be appropriate to vary per-kilometre premiums over the mileage range, such as 8¢ per kilometre for the first 5,000 annual kilometres, 7¢ per kilometre for the second 5,000 kilometres, 6¢ per kilometre for the third 5,000 kilometres, and 5¢ per kilometre over 15,000 kilometres. However, some factors that cause crash rates to decline with annual mileage can be reflected in other rating factors, such as type of use, driver history and territory, and the motorists who would choose PAYD may have risk profiles that vary from overall averages.

Mileage data can be collected from odometer readings at the start and end of the policy term, verified by digital photos emailed to the company (this method is used by MileMeter, a private insurance company that offers PAYD policies in Texas) or by third parties such as insurance brokers and service stations.

Another approach, called *instrumented PAYD*, uses various technologies to track when and where a vehicle is driven, so premiums can vary by time and location. For example, premiums might be 3¢ per vehicle-kilometre for daytime-rural driving, and 10¢ per vehicle-kilometre for weekend-nighttime-urban driving. This gives motorists an extra incentive to avoid higher risk driving conditions. It also allows more frequent billing. However, it adds equipment and tracking costs (typically $50-150 per vehicle-year) and raises privacy concerns that tend to reduce consumer demand.

Scope of Coverage

PAYD may apply to some or all types of coverage. Actuarial data indicate that comprehensive (fire, theft and window damage) claims increase with annual vehicle travel, indicating that PAYD should apply to these coverages.[9] The more that coverages have PAYD pricing, the greater the incentive to reduce mileage, and therefore the greater the total consumer savings and benefits.

Mileage Band Size

Conventional vehicle insurance generally measures vehicle travel using large mileage bands thousands of kilometres in size. This may be appropriate if mileage is based on motorists' predictions of their expected future vehicle travel, and so can only provide vague estimates, but is unnecessary if mileage data is based on odometer readings which easily measure individual kilometres.

Minimal Annual Payments

PAYD pricing often has minimal annual payments to ensure that transaction costs (the costs of selling policies) are recovered. This can be done either by requiring a minimal annual purchase (such as 2,000 annual kilometres), or by making a portion of premiums fixed (for example, instead of 6¢ per kilometre, charge a $200 fixed fee plus 5¢ per vehicle-kilometre). A higher per-mile fee with a minimum purchase provides a greater incentive to reduce mileage and therefore provides greater benefits, than making a portion of premiums fixed.[10]

Billing Process

With *basic PAYD*, motorists generally prepay for the kilometres they expect to drive during the policy term and settle accounts when it ends. For example, motorists who prepaid $1,200 for 20,000 kilometres at 6¢ per km would receive a $300 credit if they only drove 15,000 kms, and owe $300 if they drove 25,000 kms, which must be paid to reregister the vehicle. Vehicles are insured for the duration of the policy term regardless of whether or not miles are prepaid, so a motorist who purchases only 10,000 kilometres would still be insured at 20,000 kilometres, but must pay for the outstanding miles before the vehicle can be reregistered or ownership transferred. Rates could be structured to encourage prepayment, for example a 10% premium on kilometres paid at the end of the policy term. *Instrumented PAYD* allows monthly or bi-monthly billing based on the amount that the vehicle was actually driven during that period.

3. THE ACTUARIAL JUSTIFICATION FOR PAYD

Studies using various methodologies and data sets indicate that, all else being equal (that is, for vehicles with otherwise similar risk profiles), increased vehicle travel increases crash rates and insurance claim costs.[11] As a result, PAYD pricing tends to increase actuarial accuracy (premiums more accurately reflect a vehicle's claim costs).

Other factors also affect crash rates, including driver age, travel conditions and geographic location, so it would be inappropriate to use mileage *instead* of other rating factors by charging all motorists the same per-kilometre premium. However, actuarial accuracy can increase significantly if mileage is incorporated in addition to other rating factors such as driver experience, type of use, and territory, so higher risk motorists pay more per vehicle-kilometre than lower-risk motorists.

This price structure gives higher risk motorists a greater incentive to reduce mileage, providing extra safety benefits. For example, a motorist with a lower risk profile, who currently pays $600 annual premiums would pay 3¢ per vehicle-kilometre with PAYD, and so would only be expected to reduce mileage by about 5%, while a motorist with a higher risk profile who currently pays $3,000 annual premiums would pay 15¢ per mile, and so would be expected to reduce mileage by about 25%. This should provide crash reductions that are proportionately larger than mileage reductions.

With existing knowledge it is not possible to predict exactly which motorists would select optional PAYD insurance, how much they would reduce their mileage, and how much these mileage reductions would reduce crash costs. Only with experience will it be possible to determine this group's actual claim costs and therefore the optimal PAYD price structure. A pilot project can help answer these questions.

Until recently, research on this issue was constrained by inadequate data. In most cases, insurance companies only had motorists' self-reported estimates of their future mileage, which are unreliable, or highly aggregate data on total vehicle travel and crashes in a region. However, several recent studies match individual vehicles' insurance claim records with mileage data collected during emission or safety inspections.[12] This provides more accurate information on the relationships between mileage, crashes and claim costs.

Figure 2 illustrates an example of this research. It indicates that crash-related claims (particularly culpable claims, in which the driver of that vehicle was considered at fault) tend to increase with annual mileage.

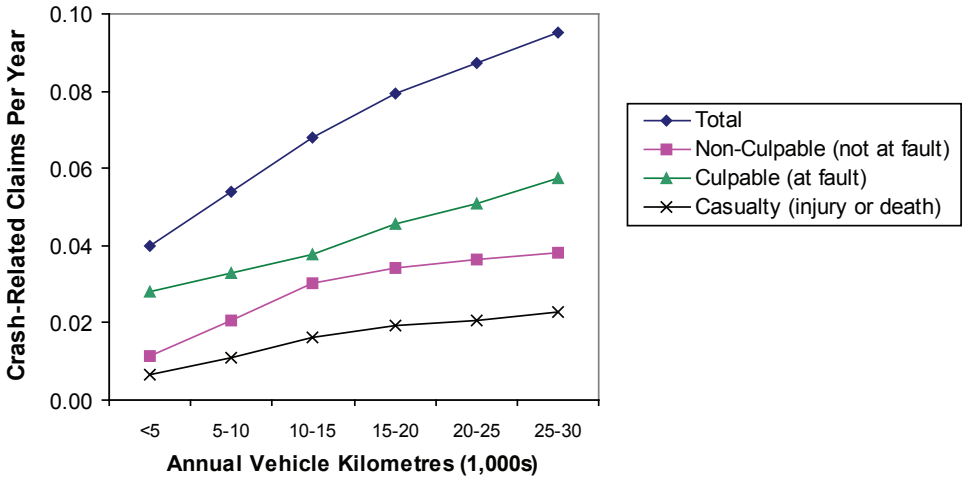

Figure 2: Crash Rates by Annual Vehicle Mileage[13]

Crashes per vehicle-year tend to increase with annual mileage.

Other factors that affect crash rates do not generally change with marginal reductions in mileage. For example, a motorist who drives 10% less in response to a price incentive does not usually become less skilled, more risk-taking, or drive a less-safe vehicle as a result. The safety effects of mileage reductions depend on the type of travel reduced. If motorists tend to reduce lower-risk kilometres (such as sober, daytime driving), a reduction in vehicle travel may provide relatively little reduction in crashes and claim costs. If motorists tend to reduce higher-risk kilometres (such as inebriated, nighttime driving), then vehicle travel reductions can provide relatively

large crash and claim cost reductions. If motorists reduce an average mix of travel (some lower and some higher risk kilometres), their chance of causing a crash should decline proportionately with mileage.

In addition to these *internal* safety benefits (reduced crash risk to the motorist that reduces mileage, and reduced claim costs to their insurer), mileage reductions provide *external* safety benefits (to other motorists, pedestrian and cyclists).[14] Since about 70% of crashes involve other road users, a 1% reduction in average-risk vehicle travel would theoretically reduce total crash costs by 1.7% (a 1.0% reduction in crash damages to the vehicle that reduces mileage and a 0.7% reduction in damages to other road users).[15] Evidence suggests that external safety benefits are actually somewhat smaller, perhaps because drivers tend to be more cautious as traffic densities increase, but most studies indicate that each 1.0% mileage reduction provides about 1.5% in total crash costs (a 1.0% reduction in crash damages to the vehicle that reduces mileage plus a 0.5% reduction in damages to other road users).[16]

In most jurisdictions, where most insurance companies only serve a small portion of the total market, each insurer would only capture a small portion of external savings that result from their PAYD policies. For example, if an insurance company with 10% market share changes to PAYD pricing, and its policy holders reduce their mileage 10% on average, total vehicle travel should decline 1%. That insurer should experience a 10% reduction in claim costs offset by a 10% reduction in revenues. The 1% reduction in total mileage should also provide an external safety benefit that reduces total crash costs by an additional 0.5%, as previously described, but those savings are shared by all insurance companies.[17] This dispersion of external benefits reduces the incentive for insurance companies to use PAYD pricing, since their competitors capture most of these benefits.

The situation is different in British Columbia. Because ICBC sells about 90% of total vehicle insurance in the province, it would capture most PAYD external savings. For example, if PAYD pricing caused provincial vehicle travel to decline 4%, ICBC should experience 4% in direct claim cost savings from the motorists who reduce mileage, plus nearly 2% external savings (savings to other motorists, including those who continue to have fixed insurance pricing), since reduced mileage reduces risk to all road users.

There are other reasons that insurance companies, including ICBC, lack a financial incentive to implement PAYD. Insurance companies only perceive the risks they must compensate, and a significant portion of crash costs are uncompensated. For example, there may be little compensation paid for the death of a retired person with no dependents, although society still places a large value on reducing their crash risk. The British Columbia Ministry of Transportation values a statistical life at about six million dollars,[18] more than five times the average traffic fatality insurance payout.[19] As a result, society typically places a higher value on avoiding casualty crashes than insurance companies would gain in direct savings from strategies such as PAYD pricing.[20] Since rural driving tends to have relatively high casualty rates, this difference between insurer's and society's valuation of mileage reductions is particularly large in rural areas.

In addition, PAYD provides other external benefits, such as reduced congestion, road and parking facility costs, consumer costs and pollution emissions, for which insurance companies receive no reward. As a result, rational insurers are unlikely to apply distance-based pricing as much as is optimal overall.

4. TRAVEL IMPACTS, BENEFITS AND COSTS OF PAYD PRICING

Travel Impacts

PAYD insurance gives motorists a new opportunity to save money when they reduce their mileage. As a result, motorists tend to drive fewer annual kilometres. Such travel reductions can be predicted based on responses to changes in other variable vehicle costs, such as fuel prices. For an average motorist who pays 10¢ per vehicle-kilometre for fuel, a 6¢ per kilometre insurance fee is equivalent to a 60% fuel price increase. Such a price change is expected to reduce participating vehicles' average mileage 5-15%.[21]

The following factors tend to affect these travel impacts:

Consumer Demand for PAYD Pricing

There is evidence of consumer demand for PAYD insurance.[22] Those consumers who choose optional PAYD are likely to be affected by factors such as its price structure, the ease and costs of participating, and how it is marketed. Although it is difficult to predict demand with precision, it is possible to make general estimates based on typical consumer responses to such products.

- Assuming that on average motorists would choose PAYD if they can expect to achieve at least 10% savings, *basic PAYD* should attract approximately half of all motorists, including those who currently drive less than 90% than their rate class average (typically, motorists who drive less than 18,000 annual kilometres), and those who currently drive their rate class average but would reduce their mileage at least 10% in response to PAYD pricing.[23] In practice, participation rates may be somewhat less due to motorists' uncertainty about their future mileage and general consumer reluctance to change. Since participants will be lower-mileage motorists, they will drive a smaller portion of total mileage. As a result, during the first five years, participation rates for optional PAYD policies are likely to be 20-40% of motorists who drive 10-30% of total vehicle travel. Participation rates should increase over time due to market dynamics described below, and could be raised with appropriate marketing and incentives, such as appropriate information and incentives to encourage suitable candidates to try PAYD.
- *Instrumented PAYD*, is likely to attract a smaller portion of motorists. Assuming that participants are required to pay $50-100 annually in additional fees, participation rates are likely to be 5-10% (consisting of motorists who drive significantly less than average and are undeterred by privacy concerns) of motorists who drive 2-4% of total vehicle mileage.

Long-Term Market Dynamics

Optional PAYD insurance will tend to attract lower-annual-mileage drivers, while higher-annual-mileage motorists will continue to choose flat-rate premiums. To the degree that lower-mileage motorists currently overpay their claim costs, flat-rate premiums will increase over time to reflect the true claim costs of higher-annual mileage vehicles. This will increase the annual mileage at which PAYD pricing is attractive to consumers, increasing the portion of motorists for whom PAYD will be financially attractive.

This shift should be gradual and predictable, with fixed-rate insurance premiums increasing a few percent annually. After a decade or two, the majority of the vehicle insurance market is likely to shift to PAYD pricing, leaving flat-rate insurance as a specialty product.

Fee Magnitude and Structure

The larger the per-kilometre premium, the greater the mileage reduction. *Basic PAYD* applied to all coverages results in per-kilometre premiums averaging about 6¢, with higher rates for drivers who are considered higher risk, purchase more comprehensive coverage, have more valuable vehicles, or live in areas with higher premiums. *Instrumented PAYD* premiums can vary by time and location, which provides extra incentive to reduce driving under higher risk conditions, such as during weekend nights, although this provides less incentive to reduce mileage at other times and locations.

Quality of Transport Options

Impacts are likely to increase as travel options improve, such as better walking and cycling conditions, improved public transit services, and more affordable housing in areas served by several modes of transportation. People sometimes assume that only urban motorists with high quality public transit can reduce mileage, but experience indicates that motorists in all geographic areas tend to reduce mileage in response to financial incentives: in urban areas they tend to shift to walking and public transit, in suburban areas they shift to bicycling, ridesharing, consolidating trips, closer destinations, and teleworking (telecommunications that substitute for physical travel).

Billing Frequency

Some people speculate that billing frequency affects travel impacts. In particular, they argue that *basic PAYD* will cause small mileage reductions due to the time lag between a reduction in mileage and insurance cost savings, which will average several months. However, experience with other products suggests that this effect is unlikely to be large. For example, there is little evidence that households that heat with oil and so pay once or twice annually, are less inclined to conserve energy (close windows and doors, insulate homes, upgrade furnaces) than those who heat with electricity or gas and so pay monthly or bi-monthly. Although the bills are less frequent, they are larger in size.

Marketing Practices

Like any optional consumer product, sales and impacts will depend on the effectiveness of marketing efforts. Mileage reductions may increase if PAYD is marketed with other efforts to encourage motorists to reduce vehicle travel, for example, by sending participants vehicle travel reductions tips and information on alternative modes.[24]

Benefits

Various PAYD benefits are described below.

Increased Actuarial Accuracy

As previously described, PAYD pricing tends to increase actuarial accuracy. To the degree this occurs, PAYD tends to increase economic efficiency and fairness. With current pricing, the claim cost savings that result from mileage reductions are retained as profits by insurers or returned to premium payers as a group. With PAYD pricing these savings are returned to the individuals who reduce mileage (Figure 3).

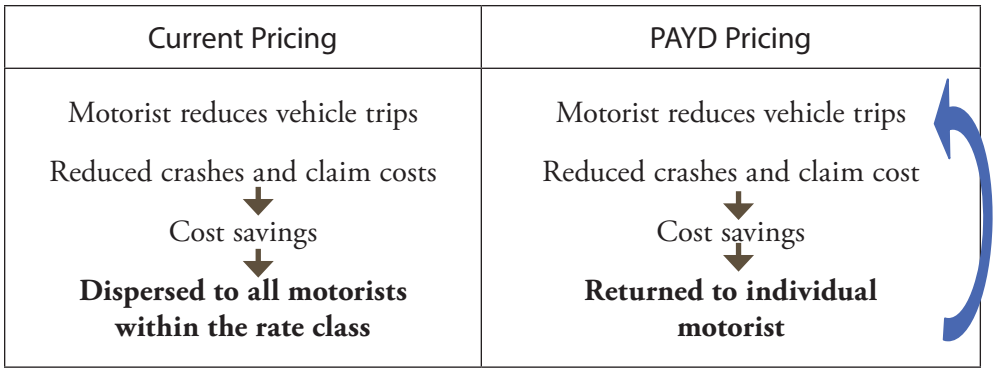

Figure 3: Efficient Pricing gives Consumers more Opportunities to Save

With current insurance pricing, crash cost savings from reduced driving are dispersed to all motorists in their rate class. PAYD pricing returns savings to individuals who drive less. This increases actuarial accuracy and provides a new financial incentive to reduce vehicle travel.

Although there is little doubt that incorporating mileage into existing rating factors increases actuarial accuracy, the exact magnitude of these impacts is uncertain, since we cannot predict with certainty the risk profiles of the motorists who would choose optional PAYD, nor the crash rates of the mileage that motorists would forego in response to this price incentive. A pilot project can answer these questions, allowing insurance companies to develop more actuarially accurate rates.

Consumer Savings and Benefits

PAYD pricing gives motorists a new opportunity to save money. Any vehicle-travel reduction provides net consumer benefits.[25] With *basic PAYD* an average motorist is expected to save about $120 annually.[26]

PAYD pricing redefines *insurance affordability*. With current pricing, insurance affordability means that even higher-risk, lower-income motorists can afford unlimited mileage coverage, which often requires cross-subsidies from lower-risk to higher-risk groups.[27] With PAYD pricing, insurance affordability means that motorists must limit their driving, and therefore their risk, to what they can afford. For example, a young male driver with multiple penalty points might have crash costs that average $6,000 annually. With current insurance pricing he is undercharged his full crash costs to make his premiums "affordable," and so only pays $3,000 annually, the additional $3,000 financed by overcharging lower-risk drivers relative to their claim costs. With PAYD pricing he pays 30¢ per kilometre and so must limit his driving to 10,000 annual vehicle kilometres to keep his premiums to $3,000. This cuts his mileage in half, and assuming that the reduced vehicle kilometres are of average risk, crash and claim costs are also cut in half, down to $3,000, which eliminates the need for cross-subsidies. He now has the opportunity to save even more money, if he further reduces his mileage and crash risk.

PAYD pricing also allows motorists to own a low-annual-mileage vehicle, such as a truck or van for occasional use, which would not be cost-effective with fixed insurance pricing. This should be particularly beneficial to some lower-income households that would like to have a vehicle available for occasional use, but cannot afford the hundreds or thousands of dollars of annual insurance costs.

PAYD pricing can be particularly useful to motorists with variable employment and incomes. For example, unemployed workers must currently pay high insurance premiums to keep a car available for essential trips, job searches and temporary work, despite declines in income, vehicle travel and associated crash risk. With PAYD pricing their premiums decline when their work and commuting activity declines.

Crashes and Casualty Reductions

PAYD can provide substantial crash and casualty reductions. Because most crashes involve multiple vehicles,[28] mileage reductions tend to provide proportionately larger reductions in total crash costs. Available information indicates that each 1% mileage reduction should provide about 1.5% reduction in total crash costs and casualties, and possibly more,[29] although only with experience will it be possible to determine the actual magnitude of these benefits. The magnitude of safety benefits will depend on the number and type of motorists who choose PAYD, the price structure used, the amount and types of vehicle travel reduced, and interactive effects (how much a reduction in mileage reduces total crash costs).

Energy Conservation and Pollution Emission Reductions

Reductions in mileage should provide approximately proportional energy savings and emission reductions. For example, if PAYD pricing reduces total vehicle travel by 10%, this should provide an approximately 10% energy savings and emission reductions. Additional energy savings and emission reduction may be achieved if PAYD allows households to afford a more optimal mix of vehicles, such as a fuel efficient vehicle for general use, and a van, SUV or light truck for special uses, rather than owning a single, less efficient vehicle sized for peak demands.[30] The U.S. Department of Transportation, *Transportation's Role in Reducing U.S. Greenhouse Gas Emissions*, a Report To Congress, ranks PAYD insurance as potentially one of the most cost effective emission reduction strategies.[31]

Reduced Traffic Congestion, Road and Parking Facility Costs

By reducing total vehicle travel and increasing the financial incentive to use alternative modes, PAYD can help reduce traffic and parking congestion, and therefore road and parking facility costs. It gives commuters additional incentive to use alternative modes such as ridesharing and public transit.[32]

PAYD Costs and Risks

Rate Structure Development Costs

Developing a new rate structure involves various analysis and repricing costs. *Basic PAYD* is relatively easy to design and implement since existing premiums are simply divided by estimated annual mileage for each rate class. *Instrumented PAYD* development would require more effort since price structures and their impacts are more difficult to quantify.

Increased Transaction Costs

PAYD pricing requires a system to collect vehicle travel data. With *basic PAYD* this can be as simple as having participating motorists email a digital photo of their odometer to ICBC. *Instrumented PAYD* has much higher transaction costs to install equipment in vehicles and process data.

Privacy Concerns

Basic PAYD has minimal privacy concerns since the data required (odometer readings) are already recorded at various times, such as during vehicle servicing. *Instrumented PAYD* does raise privacy concerns, although these can be addressed by controlling how data are collected, analyzed, and stored, as with other types of personal data.

Insurer Uncertainty and Risk

During initial PAYD pricing implementation, insurers face some uncertainly in determining optimal rates. Although there is little doubt that PAYD reduces vehicle travel, crashes and claim costs, the exact magnitude of these effects cannot be accurately predicted at this stage of analysis. It is possible premium revenue could decline more than claim costs, causing financial losses. This can be corrected by raising per-kilometre premiums as required to recover costs, for example, charging 6.6¢ per rather than 6.0¢ per vehicle-kilometre. Because of the many variables involved, optimal rates can only be determined empirically, through a pilot project.

Increased Vehicle Ownership

PAYD pricing may allow some households to increase their ownership of low-annual-kilometre vehicles. This may add some additional vehicle traffic which will offset some of the mileage reduction by existing vehicles, although it also provides consumer benefits, by allowing households, particularly those with low incomes, which cannot afford a vehicle due to high fixed-rate insurance.

Higher Future Premiums for Some Higher-Annual-Mileage Motorists

If PAYD is implemented as a consumer option, only lower-annual-mileage vehicle owners would choose it, so nobody will pay more in the short-run. However, to the degree that lower-annual-mileage motorists currently subsidize higher-annual-mileage motorists, flat-rate premiums will need to rise over time to cover their claim costs, as discussed previously. As a result, higher-annual-mileage motorists may end up paying more for insurance after a decade or two.

PAYD Equity Impacts

Horizontal Equity

Horizontal equity refers to the equal allocation of benefits and costs to people with similar abilities and needs. To the degree that PAYD increases actuarial accuracy, it also increases horizontal equity. Bordoff and Noel find that current insurance pricing results in substantial cross-subsidies from lower- to higher-annual-mileage motorists. Their analysis indicates that in the U.S., lower-annual-mileage motorists overpay an average of $318 annually compared with what is actuarially accurate.[33] PAYD pricing can correct this.

Vertical Equity

Vertical equity refers to impacts on physically and economically disadvantaged people. PAYD can increase vertical equity in the following ways:

- It allows households to own a vehicle that is currently unaffordable due to high insurance costs. Lower-income households are particularly likely to value this option.
- It is progressive with respect to income, since lower-income motorists tend to drive less than average (Figure 4) and tend to be price sensitive, and so are likely

to reduce their mileage to achieve financial savings. Lower-income households make up a dis-proportionately large fraction of low-mileage drivers within each risk class. Bordoff and Noel find that PAYD would provide savings to every income group making less than $52,500 (2001$US), and these savings represent a proportionately large share of lower-income household spending.[34]

- It gives motorists a new opportunity to save money, such as when they are unemployed, and so drive less and have reduced income, but still need a vehicle for occasional use.
- Disadvantaged people benefit from reductions in external costs, such as crash risk and pollution exposure to pedestrians and cyclists.

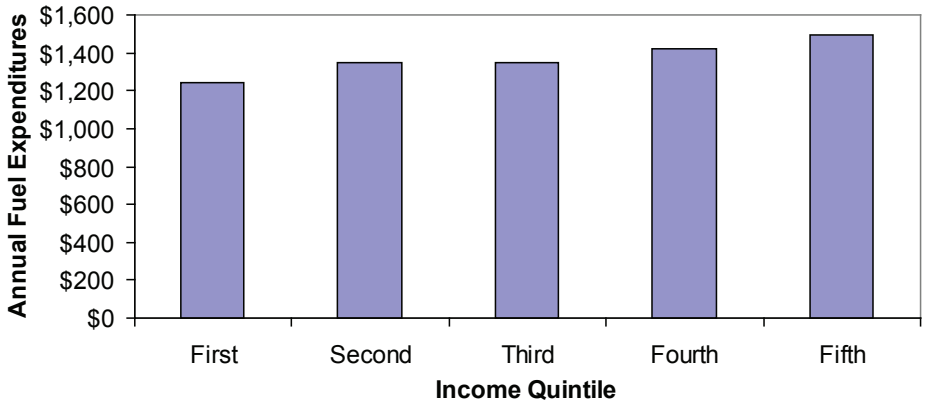

Figure 4: Fuel Expenditures per Vehicle by Income Class[35]

Fuel expenditures, and therefore annual mileage per vehicle,tend to increase with household income. This suggests that PAYD is progressive with respect to income.

Geographic Equity

Geographic equity refers to the distribution of costs and benefits between residents of different areas. Some people fear that PAYD would harm rural residents, because they tend to drive relatively high annual kilometres, but since territory is considered in setting rating factors, about half of all rural motorists (those who drive less than average among rural residents) would save money with PAYD, and those who drive more than average could stay with current insurance pricing. It can be particularly beneficial to rural residents because:

- It offers motorists a new opportunity to save money. Since incomes tend to be lower in rural areas, this should be highly valued by many rural residents.
- It tends to reduce overall crash and casualty rates, which are particularly high in rural areas.
- It allows households to own a more fuel efficient vehicle for most use, in addition to a larger truck or van that rural residents often require for occasional use.

5. TRAVEL IMPACT ANALYSIS

A spreadsheet model was used to compare the impacts of various PAYD price structures in British Columbia. This analysis considered three price structures:

1. *Universal basic PAYD* means that all insurance policies are prorated by annual mileage.
2. *Optional basic PAYD* means that consumers can choose *basic PAYD*. This would be chosen by 30% of motorists, who average 12,000 annual vehicle-kilometres.
3. *Optional instrumented PAYD* means that consumers can choose *instrumented PAYD*. This would be chosen by 5-10% of motorists, who average 5,000 annual vehicle-kilometres.

This analysis uses the following assumptions:

- Vehicles currently average 20,000 annual kilometres. *Optional basic PAYD*.
- Premiums average 6¢ per vehicle-kilometre if fully-prorated, or 4.8¢ per kilometre if 80% prorated (20% of premiums remain fixed).
- The long-run elasticity of vehicle travel with respect to fuel price is -0.2, meaning that a 10% price increase in vehicle operating costs reduces mileage by 2%.[36]

Table 1: PAYD Travel Impacts

	Universal *Basic PAYD*		Optional *Basic PAYD*		Optional *Instrumented PAYD*	
	Fully-Prorated	80% Prorated	Fully-Prorated	80% Prorated	Fully-Prorated	80% Prorated
Portion of vehicles participating	100%	100%	30%	30%	7.5%	7.5%
Avg. annual kms per participating vehicle	20,000	20,000	12,000	12,000	5,000	5,000
Average PAYD premium per km	$0.060	$0.048	$0.060	$0.048	$0.060	$0.048
Average fuel price per vehicle-km	$0.098	$0.098	$0.098	$0.098	$0.098	$0.098
Percent vehicle operating cost increase	61%	49%	61%	49%	61%	49%
Travel reduction per participating vehicle	11.5%	9.3%	11.5%	9.3%	11.5%	9.3%
Total percent vehicle travel reduction	11.5%	9.3%	2.1%	1.7%	0.22%	0.18%

This table indicates the travel impacts of various PAYD pricing options using the PAYD BC Spreadsheet. Fully-prorated means that total current premiums are converted to PAYD pricing. 80% prorated means that 80% of current premiums are converted to PAYD pricing.

This analysis indicates that *fully-prorated universal basic PAYD* is expected to reduce total personal automobile travel about 11.5%. *Fully-prorated optional basic PAYD* would reduce total personal automobile travel about 2.1%. *Fully-prorated optional instrumented PAYD* would reduce total personal automobile travel about 0.22%. Impacts decline somewhat if only a portion of premiums are prorated.

There is, of course, some uncertainty in this analysis since it is not possible to predict with precision which motorists would choose PAYD pricing and how much they would reduce their mileage. A pilot project would answer these questions.

6. PAYD EXAMPLES

Examples of currently-available PAYD insurance products are described below.[38] This information is the most current available at the time of publication.

MileMeter (www.milemeter.com)

MileMeter is a private insurance company which began selling PAYD insurance policies in Texas in 2008. Premiums are priced by the vehicle-mile, taking into account standard rating factors such as vehicle use and territory. Policies are sold over the Internet. Motorists submit a digital photo of their odometer for verification.

Aviva Insurance Autograph and Progressive Snapshot/MyRate

Aviva Insurance *Autograph* (www.autographinsurance.com) policies sold in Ontario since 2006, and Progressive Insurance *Snapshot/MyRate* (www.progressive.com/snapshot) policies sold in various U.S. states since 2005, provide discounts based on vehicle use, in addition to standard rating factors. Participants receive a small electronic device that they plug into their vehicle's On-Board Diagnostic port for six months, which records when, how and how much the vehicle is driven, and reports the results using wireless transmission. This information is used to calculate discounts the customer may receive when they renew their policy.

Real Insurance PAYD (www.payasyoudrive.com.au)

Real Insurance has offered PAYD policies in Australia since 2008. Motorists report their odometer reading at the beginning of the policy term and purchase kilometres of coverage. They can purchase additional kilometres any time. Any unused kilometres are either refunded if motorist cancels or does not renew (upon verification of vehicle odometers if requested by the company), or are carried over to the next policy. Odometer readings are verified if there is a claim and if kilometres exceed prepayment or there are signs of odometer fraud. This program was awarded Australia's Cheapest Car Insurance award by *Money Magazine*.

King County Mileage Based Automobile Insurance (http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/projects/not_involving_tolls/autousecostsvariable/wa_payd_seattle.htm)

King County and Unigard Insurance are implementing a *Mileage Based Auto Insurance* (MBAI) program that began recruiting pilot project participants in October 2010. The program will begin with 100 policies with a three-month test using telematics to track vehicle travel activity. If this test is successful, the project will expand to 5,000 policies within a year. The pilot will include various billing plans and mileage data collection methods.

7. RESPONSES TO COMMON CONCERNS

Insurance pricing already incorporates mileage.

Although ICBC incorporates mileage-related rate factors such as commute distance and territory, once a policy is purchased, motorists have little incentive to reduce mileage and little opportunity to save money on insurance.

Other rating factors have more effect on crashes than mileage.

Whether mileage is more or less important than other risk factors is irrelevant since PAYD pricing incorporates other rating factors. Abundant research shows within a rate class, annual crash rates increase with annual mileage.

It is unfair to suburban and rural motorists, who would pay more and lack public transit.

With optional PAYD, motorists would only choose it if they save. Since PAYD rates are based on average annual mileage for each rate class, suburban and rural motorists would save if they drive less than average in their area. Even without transit, suburban and rural motorists can reduce mileage by carpooling and consolidating trips. Rural and suburban motorists benefit from savings and accident reductions.

People need their cars too much to give them up.

PAYD pricing is not expected to cause people to give up cars. There is extensive evidence that operating costs affect vehicle travel. Moderate (5-12%) mileage reduction per affected vehicle can be expected from PAYD pricing.

Consumers will not accept this change.

Several private insurance companies profitably sell PAYD policies, indicating consumer demand. Support should increase as consumers and citizens learn more about its benefits.

Odometer fraud will be a major problem.

Although some odometer fraud may occur, it should be a minor problem overall, with fraud rates comparable to other common consumer transactions, and far lower than with current insurance pricing.[39] Odometers are increasingly tamper resistant, regular odometer auditing should discourage and identify most tampering, and the financial incentive for fraud is relatively low. Insurer's financial exposure would be minimal since odometer fraud voids coverage.

It would cause inconvenience to motorists and increase administrative costs to insurers.

Odometer data can be collected easily and inexpensively using digital photos or inspections by brokers and service stations.

It is an invasion of privacy.

Odometer readings are already collected during vehicle servicing, vehicle sales, and crash investigations; odometer auditing simply standardizes this practice. Odometer auditing does not identify when or where a vehicle has been driven, or other private information. Optional *instrumented PAYD* is no different than other commercial transactions that identify consumer location and behavior, such as telephone service and credit card purchases.

This type of pricing has never been used before.

Several insurance companies around the world now offer PAYD policies, and many use mileage data when rating fleets and commercial vehicles.

8. CONCLUSIONS AND RECOMMENDATIONS

PAYD pricing changes vehicle insurance from a fixed cost into a variable cost with respect to vehicle travel. This gives motorists additional savings when they reduce mileage. Mileage is just one of several factors that affect vehicle crash rates so it would be inappropriate to use mileage *instead* of existing rating factors, for example, by charging all motorists the same per-kilometre fee, but premiums become more actuarially accurate if mileage is incorporated with existing rating factors.

PAYD provides direct consumer savings and benefits, and by reducing vehicle travel it tends to reduce crashes, energy consumption, pollution emissions, and traffic congestion. It is also fairer since current insurance pricing means lower-mileage driver subsidise their higher-mileage counterparts. Potential benefits are substantial. PAYD does not simply shift costs from one group to another: premium reductions reflect the claim cost savings that result when motorists reduce vehicle travel and crash risk. As a result, it need not reduce insurance company profitability. PAYD can help achieve British Columbia and ICBC policy objectives including traffic safety, consumer affordability, social equity, emission reductions, and infrastructure cost savings. According to research by leading experts it is one of the most cost effective strategies available to reduce traffic accidents, energy consumption and pollution emissions. PAYD insurance is not currently available in BC but has been implemented elsewhere. Evidence from other jurisdictions indicates that there is consumer demand for these products, and they can be cost effective.

There are many possible ways to implement PAYD, some with greater impacts and benefits than others. Total benefits tend to increase as more vehicle travel has PAYD pricing, and as the incentive to reduce mileage increases.[40] *Fully-prorated basic PAYD* is likely to have the greatest impacts and therefore the largest total benefits. *Instrumented PAYD* allows pricing to vary by time and location, so rates are higher under higher risk conditions such as weekend nights, but it has high implementation costs and raises privacy concerns, and so would apply to a small portion of total vehicle travel, resulting in small total benefits.

There is some uncertainty concerning some of these impacts. It is impossible to predict with precision the risk profile of motorists who would choose optional PAYD, the amount and type of mileage they would reduce, and the claim cost savings that would result. A pilot project can answer such questions while minimizing risks to ICBC. The following recommendations are designed to maximize PAYD pilot-project benefits:

- Offer *fully-prorated basic PAYD* applied to all categories of coverage (all existing premiums prorated by average annual mileage), with a 2,000 kilometre annual minimum purchase requirement. Other pricing options (such as *instrumented PAYD*) can also be offered for comparison.
- Base mileage on odometer readings to be verified by digital photos or brokers and service stations.
- During the pilot program, collect mileage data from participating vehicle for at least two months prior to applying PAYD pricing, to provide baseline data.
- Provide effective marketing to promote PAYD insurance to appropriate candidates.

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ENDNOTES

1. The terms "vehicle travel" and "mileage" to refer to the number of kilometres driven during a time period, such as a policy term or year.
2. See Bordoff and Noel (2008); Ceres (2009); Greenberg (2009); NOW (2002); Parry (2005); USDOT (2010); Vickrey (1968).
3. CID (2008)
4. The US Federal Highway Administration sponsors several PAYD pilot projects. See FHWA (2010).
5. The Canadian Automobile Association's *Driving Costs* categorizes insurance as a fixed cost (CAA 2010).
6. CAA (2010). Based on a Cobalt LT 4-door sedan driven 18,000 annual kilometres. These cost values, intended to represent typical expenditures on a newish vehicle (first six years of operation), assume higher insurance and depreciation, and lower repair and maintenance costs than actual fleet averages.
7. This changes the *unit of exposure* from the vehicle-year to the vehicle-kilometre, or with some system the vehicle-minute. Brokers would quote rates, and motorists would think about insurance, using these units.
8. ICBC premiums, which represent about 90% of total British Colombia automobile insurance sales, currently average $1,100 annually, indicating that total insurance premiums average about $1,200.
9. Babiuk (2008); Litman (1997).
10. Although minimum annual purchase requirements eliminate the incentive to reduce mileage below that point, those below 3,000 annual kilometres should have little effect on vehicle travel, since few vehicles are driven less than that.
11. Babiuk (2008); Edlin (1999); Ferreira and Minike 2010; Litman (2001).
12. Ferreira and Minike 2010; Litman 1997; NCTCOG 2005
13. Litman (1997).
14. Edlin (1999); Litman (2001).
15. Vickrey (1968).
16. Edlin and Mandic (2006); Litman and Fitzroy (2005); Vickrey 1968.
17. These safety benefits exist regardless of which party is legally liable for crashes. A perfect driver who never violates traffic laws still reduces total crash costs by reducing mileage, since their vehicle is no longer exposed to risk caused by other drivers' errors.
18. The British Columbia Ministry of Transportation values a statistical life at about six million dollars (MoT 2007), more than five times the average traffic fatality insurance payout. The BC Ministry of Transportation currently values avoided fatal crashes at $6.1 million (MoT

2007). For more discussion on the differences between willingness-to-pay to avoid a death or disability, and crash casualty compensation rates see literature reviews in de Leur (2010), and "Safety and Health Impacts," Litman 2009.

19. See literature reviews in de Leur (2010), and "Safety and Health Impacts," Litman 2009.

20. The British Columbia Ministry of Transportation values a statistical life at about six million dollars (MoT 2007), more than five times the average traffic fatality insurance payout. For more discussion on the differences between willingness-to-pay to avoid a death or disability, and crash casualty compensation rates see literature reviews in de Leur (2010), and "Safety and Health Impacts," Litman 2009.

21. Various studies indicate that the elasticity of vehicle travel with respect to variable costs is -0.1 to -0.3, with relatively high values (-0.2 to -0.3, or even more) over the long run. Some people argue that *Basic PAYD* will have a low price elasticity due to infrequent billing; there will often be several months lag between a reduction in mileage and financial savings to motorists. On the other hand, PAYD may have a relatively high price elasticity because in addition to increasing variable costs, it reduces fixed costs and so reduces the incentive for motorists to increase vehicle use in order to "get their money's worth" from their vehicle expenditures. For discussion see Babiuk (2008); Edlin (1999); Litman (1997), Ferreira and Minike (2010).

22. Progressive Insurance (2010) indicates that more than 100,000 PAYD policies have been sold in North America, despite relatively high barriers including additional fees, effort and privacy concerns, and .

23. Analysis by Bordoff and Noel (2008) indicates that the distribution of mileage within rate classes is skewed (median mileage is less than average mileage), so the majority of motorists would save money with PAYD. They calculate that if universal PAYD were implemented in the U.S. with cross-subsidies from lower- to higher-annual-mileage vehicles eliminated, 63% of vehicles would have reduced insurance premiums, resulting in net savings averaging $496 for 63% of households and cost increases averaging $713 for 37% of households.

24. Direct marketing vehicle travel reduction campaigns, such as Vancouver's *TravelSmart Program* (www.tc.gc.ca/Programs/Environment/utsp/travelsmart.htm) typically reduce personal trips 5-15% if they lack financial incentives. PAYD insurance would likely increase these impacts by offering participants additional savings when they reduce their driving.

25. For example, with 6¢ per kilometre PAYD, any travel reduced consists of vehicle-kilometres that motorists consider worth less than this amount.

26. Bordoff and Noel (2008) estimate somewhat higher average savings from actuarially accurate PAYD due to the combined effects of reduced mileage and reduced cross-subsidies from low- to high-annual-mileage vehicles.

27. Bordoff and Noel 2008, p. 37; Ferreira and Minike 2010, p. 31-32.

28. According to the British Columbia, *Traffic Collision Statistics: Police-Attended Injury And Fatal Collisions* (www.icbc.com/road-safety/safety-research/traffic-coll-stats-2007.pdf) in 2007 police attended 43,507 crashes involving 74,567 vehicles, indicating that about 70% of serious crashes involved multiple vehicles.

29. The reason that even greater crash reductions are possible is because the research indicating that each 1.0% reduction in mileage provides a 1.5% reduction in total crash costs does not account for the higher incentive to reduce mileage that PAYD provides to higher risk drivers, nor the more targeted incentives to reduce higher-risk driving possible with *instrumented PAYD*.

30. PAYD should be easier to implement and provide more total benefits than another concept advocated by some rural residents – transferable license plates – which requires motorists to transfer plates between vehicles and provides no opportunity to save money by reducing mileage.

31. USDOT (2010).

32. People sometimes assume that *basic PAYD* can provide little congestion reduction benefits because it applies a flat fee. However, there is evidence that increased vehicle operating costs do reduce congestion. For example, a 28% increase in average fuel prices during the first half of 2008 contributed to a 3% reduction in congestion delays recorded in the 100 largest U.S. metropolitan areas and the nation's worst traffic bottlenecks (INRIX 2008).

33. Bordoff and Noel 2008, p. 37.

34. Bordoff and Noel 2008, p. 39.

35. BLS (2008), "Quintiles of Income Before Taxes: Average Annual Expenditures and characteristics," *Consumer Expenditure Survey*, U.S. Bureau of Labor Statistics (www.bls.gov); at www.bls.gov/cex/#tables.

36. For reviews of transport elasticity literature see Litman 2008; Pratt (1999-2007); and the Transport Elasticities Database Online (http://dynamic.dotars.gov.au/bte/tedb/index.cfm). Ferreira and Minikel (2010) use -0.15, which they describe as a conservative, lower-bound value.

37. PAYD BC Spreadsheet (www.vtpi.org/PAYD BC Calculator.xls)

38. For additional information see *Pay As You Drive Car Insurance Around The World* (www.payasyoudrive.com.au/howitworks/paydworld.aspx), and the "Pay As You Drive Insurance" chapter of the *Online TDM Encyclopedia* (www.vtpi.org/tdm/tdm79.htm).

39. ICBC currently uses motorists' unverified estimates of their commute distance. Many probably understate this value in order to reduce their premiums.

40. Total benefits including crash reductions, consumer savings, energy savings, emission reductions and congestion reductions. *Instrumented PAYD* may provide more crash reduction per policy, since it can provide incentives for motorists to reduce their highest risk vehicle travel, but because it is costly and raises privacy concerns, few of such policies are likely to be sold, so total impacts and benefits would be small.

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