

## 5.1 Vehicle Costs

*This chapter examines direct financial costs of vehicle use. These are divided into fixed costs, which are unaffected by mileage, and variable costs, which increase with mileage. This indicates the savings from transportation improvements that allow consumers to reduce their vehicle ownership and use.*

### Definitions

*Vehicle Costs* include various costs to own and use vehicles, and incremental equipment costs for telework. These indicate the savings that result when vehicle ownership and use are reduced.

These costs are divided into *fixed* (also called *ownership*) and *variable* (also called *operating, marginal* or *incremental*) costs, as indicated below. Variable costs increase with vehicle mileage, fixed costs do not.

#### Fixed Costs

- Vehicle purchase or lease
- Insurance
- Registration and vehicle taxes

#### Variable Costs

- Maintenance and repair
- Fuel, fuel taxes and oil
- Paid parking and tolls

Some costs that are considered fixed are actually partly variable. Depreciation is partly variable because increased mileage requires increased vehicle repairs and replacement, and reduces vehicle resale value. Used vehicle price guides ([www.edmunds.com](http://www.edmunds.com) and [www.kbb.com](http://www.kbb.com)) indicate that mileage-related depreciation typically averages 5-15¢ per mile, about as much as vehicle operating costs. Most leased vehicles have additional charges averaging about 10¢ per mile for mileage over a certain annual mileage (typically 15,000 miles). Increased driving also increases the risk of additional user costs from crashes, traffic and parking citations.

#### **Mileage-Based Depreciation Example** (by Art Ludwig, [www.oasisdesign.net](http://www.oasisdesign.net))

It is significantly more expensive to drive your car, and you save much more when you reduce your vehicle mileage, than indicated by the American Automobile Association's widely reproduced car cost estimates ([www.aaa-calif.com/members/corpinfo/costbrch.asp](http://www.aaa-calif.com/members/corpinfo/costbrch.asp)). These estimates treat depreciation as a fixed vehicle ownership cost, ignoring the higher rate of depreciation that occurs with increased vehicle use.

For example, according to Kelly Blue Book ([www.kbb.com](http://www.kbb.com)) a 2001 Honda Accord with 10,000 miles has an estimated resale value of \$21,175, while the same car with 20,000 miles has a value of \$19,350, indicating that mileage-based depreciation averages 18 cents per mile. This is greater than the entire vehicle operating costs estimated by the AAA. If the condition also drops (which is likely to occur with greater use), per-mile depreciation is even greater. In the case of the 2001 Honda, if the condition drops one increment, from *excellent* to *good*, the vehicle's value declines to \$18,230, representing mileage-based depreciation averaging 29 cents per mile, about three times the estimated vehicle operating costs. Thus, the true cost of operating this vehicle is two to three times greater than what an owner would conclude from the AAA's published estimates.

Driving a vehicle also has an opportunity cost, because it is unavailable for other users. Even a small reduction in per-household vehicle ownership can provide significant savings. For example, if improved transit service allows 10% of riders to avoid purchasing an extra household car, the savings average \$200-400 annually per user (assuming \$2,000 to \$4,000 in annual ownership costs per vehicle), and 4-8¢ per mile of transit travel (assuming an average of 20 miles of transit travel a day, 250 days per year).

Table 5.1-1 summarizes different types of variable costs. Motorists and transportation modelers often assume that driving costs about 10¢ per vehicle mile, considering just direct vehicle operating costs, but these additional mileage-related costs average another 10-15¢ per mile. As a result, strategies that allow motorists to reduce their mileage provide about twice the financial savings than is usually recognized.

**Table 5.1-1 Potential Cost Savings From Reduced Driving<sup>1</sup>**

Category	Description	Typical Values
Vehicle Operating Costs	Fuel, oil and tire wear.	12¢ per vehicle-mile.
Long-Term Mileage-Related Costs	Mileage-related depreciation, mileage lease fees, user costs from crashes and tickets.	10¢ per vehicle-mile. <sup>2</sup>
Special cost savings	Tolls, parking fees, insurance discounts.	Varies.
Vehicle Ownership	Reductions in fixed vehicle costs.	\$3,000 per vehicle-year.
Residential Parking	Reduced residential parking costs from reduced vehicle ownership.	\$100-1,000 per vehicle-year.

*Reduced vehicle mileage can provide a variety of financial savings. (2001 U.S. dollars).*

<sup>1</sup> “Driving Costs,” *Online TDM Encyclopedia*, VTPI ([www.vtpi.org/tdm/tdm82.htm](http://www.vtpi.org/tdm/tdm82.htm)), 2002.

<sup>2</sup> See mileage depreciation factors at [www.intellichoice.com](http://www.intellichoice.com) and [www.edmunds.com](http://www.edmunds.com).

## Estimates

Note: all monetary units are in U.S. dollars unless indicated otherwise.

### Automobile

- The American Automobile Association publishes estimated costs of owning and operating various vehicle types as summarized in Table 5.1-2. This reflects costs during the first 60,000 miles of a vehicle's life and so has relatively high depreciation and insurance costs and no repair costs.

**Table 5.1-2 American Automobile Association Vehicle Cost Estimates<sup>3</sup>**

	Medium Car (Cavalier LS)	Large Car (Taurus SE)	Luxury Car (Grand Marquis)	SUV (Blazer)	Van (Caravan SE)
Gas & oil	6.1¢	7.1¢	8.3¢	7.9¢	7.1¢
Maintenance	3.9¢	4.1¢	4.3¢	4.1¢	3.9¢
Tires	1.5¢	1.8¢	2.2¢	1.5¢	1.6¢
<b>Operating costs/mile</b>	<b>11.5¢</b>	<b>13.0¢</b>	<b>14.8¢</b>	<b>13.5¢</b>	<b>12.6¢</b>
<b>Insurance</b>	\$181	1075	1050	\$950	\$873
License & registration	\$167	\$206	\$242	\$289	\$259
Depreciation	\$3,051	\$3,693	\$4,470	\$4,286	\$3,772
Financing	\$554	\$751	\$927	\$867	\$755
<b>Ownership costs/year</b>	<b>\$3,953</b>	<b>\$5,725</b>	<b>\$6,689</b>	<b>\$6,392</b>	<b>\$5,659</b>
<b>For 12,500 annual miles</b>	<b>\$5,391</b>	<b>\$7,350</b>	<b>\$8,539</b>	<b>\$8,080</b>	<b>\$7,234</b>
<b>Average cost per mile</b>	<b>\$0.43</b>	<b>\$0.59</b>	<b>\$0.68</b>	<b>\$0.65</b>	<b>\$0.58</b>

This table summarizes estimated costs for relatively new (first 6 years) vehicles in the U.S.

- The Canadian Automobile Association ([www.caa.ca](http://www.caa.ca)) also publishes a version of *Driving Costs*, summarized in Table 5.1-3.

**Table 5.1-3 Annual Costs for Cavalier Sedan (2000 Canadian Dollars)<sup>4</sup>**

	Per KM	Per Year	Percent of Total
Fuel & oil	6.83¢	\$1,366	16.5%
Maintenance	2.80¢	\$560	6.7%
Tires	1.42¢	\$284	3.4%
<b>Operating costs/mile</b>	<b>11.05¢</b>	<b>\$2,210</b>	<b>26.6%</b>
Insurance	5.96¢	\$1,191	14.4%
License & registration	0.6¢	\$128	1.5%
Depreciation	19.9¢	\$3,975	48.0%
Financing	3.9¢	\$777	9.4%
<b>Ownership costs/year</b>	<b>41.41¢</b>	<b>\$6,071</b>	<b>73.3%</b>
<b>Total Expenses</b>	<b>52.46¢</b>	<b>\$8,281</b>	<b>100%</b>

<sup>3</sup> AAA, *Your Driving Costs 2003*, American Automobile Association ([www.aaamissouri.com/news/library/drivingcost](http://www.aaamissouri.com/news/library/drivingcost)), 2003. Based on Runzheimer International data.

<sup>4</sup> *Your Driving Costs 2000*, Canadian Automobile Association (Ottawa; [www.caa.ca](http://www.caa.ca)). Also see Transport Canada T-Facts data on transport costs ([www.tc.gc.ca/pol/en/t-facts\\_e/statistical\\_data\\_menu.htm](http://www.tc.gc.ca/pol/en/t-facts_e/statistical_data_menu.htm)).

*This table summarizes estimated costs for relatively new (first 6 years) vehicles in Canada. Assumes 20,000 annual kilometers.*

- The *Black Book*, Hearst Business Media Corporation ([www.blackbookusa.com](http://www.blackbookusa.com) and [www.canadianblackbook.com](http://www.canadianblackbook.com)), and the *Kelley Blue Book* ([www.kbb.com](http://www.kbb.com) and [www.cars.com](http://www.cars.com)) provide wholesale and retail price estimates for new and used vehicles, taking into account model, age, condition, mileage, accessories and geographic location.
- Runzheimer International ([www.runzheimer.com](http://www.runzheimer.com)), sells estimates of typical annualized ownership and operating costs for several types of vehicles, which is the basis for automobile association estimates.
- The U.K. Automobile Association ([www.theaa.co.uk](http://www.theaa.co.uk)) provides ownership and operating costs for various types of vehicle. Table 5.1-4 illustrates typical costs.

**Table 5.1-4 U.K. Car Ownership and Operating Costs (1999)<sup>5</sup>**

Engine Size (cc):	<1100	1100-1400	1400-2000	2000-3000	3000-4500
Road Tax (£ per year)	100	155	155	155	155
Insurance	281	376	452	698	721
Depreciation	1,064	1,568	2,218	4,008	5,501
Breakdown Coverage	74	74	74	74	74
<i>Total Ownership Costs</i>	<i>£1,520</i>	<i>£2,173</i>	<i>£2,899</i>	<i>£4,935</i>	<i>£6,452</i>
Petrol (Pence per mile)	7.83	8.95	10.44	14.24	15.66
Oil	0.34	0.35	0.36	0.44	0.70
Tires	0.74	0.96	1.17	2.25	2.92
Servicing	0.94	0.94	0.94	1.47	2.07
Repairs	3.08	3.51	3.57	5.47	5.63
<i>Total Vehicle Operation</i>	<i>12.93p</i>	<i>14.71p</i>	<i>16.48p</i>	<i>23.87p</i>	<i>26.98p</i>

*This table summarizes estimated costs for vehicles in the U.K.*

Most published vehicle cost estimates assume a relatively new vehicles (typically the first four or six years of vehicle life), and so tend to overstate depreciation and insurance costs and understate maintenance and repair costs compared to the overall vehicle fleet. Table 5.1-5 summarizes estimated lifecycle costs for selected types of motor vehicles.

<sup>5</sup> *Petrol Car Cost Tables*, UK Automobile Association ([www.theaa.co.uk/motoring/tables.asp](http://www.theaa.co.uk/motoring/tables.asp)), 1999.

**Table 5.1-5 Lifecycle Costs for Selected Vehicle Types (2001 ¢/mile)<sup>6</sup>**

	Sub-Compact	Intermediate	Full-size Van	Full-size Pickup
Fuel and oil	4.6	6.0	10.5	8.1
Fuel Taxes	1.7	2.2	3.9	3.0
Tolls and Parking	1.7	1.7	1.7	1.7
Tires	0.9	1.3	1.8	1.6
<i>Total Variable Costs</i>	<i>8.8¢</i>	<i>11.2¢</i>	<i>17.9¢</i>	<i>14.3¢</i>
Depreciation*	11.2	13.9	18.5	12.4
Insurance	9.2	9.1	11.1	9.4
Maintenance*	5.2	5.5	5.5	5.6
Finance Charges	2.1	2.6	3.8	2.9
Licensing & Registration	1.0	1.2	1.6	1.2
<i>Total Fixed Costs</i>	<i>28.7¢</i>	<i>32.2¢</i>	<i>40.3¢</i>	<i>31.3¢</i>
<b>Overall Total</b>	<b>37.6¢</b>	<b>43.4¢</b>	<b>58.2¢</b>	<b>45.6¢</b>

*This table summarizes estimated lifecycle costs for vehicles in the U.S.*

Table 5.1-6 summarizes actual average household transportation expenditures from the annual *Consumer Expenditure Survey*, which provides detailed data on what consumers actually spend on their vehicles by demographic and geographic group since 1984.

**Table 5.1-6 Average Vehicle Expenditures, 1999<sup>7</sup>**

	Per Household	Portion of Household Total	Per Vehicle Year	Per Vehicle Mile
Cars and trucks, used	\$1,641	23.4%		
Cars and trucks, new	\$1,627	23.2%		
Other vehicles	\$34	0.5%		
<i>Total Vehicle Purchases</i>	<i>\$3,302</i>	<i>47.1%</i>	<i>\$1,738</i>	<i>14.4¢</i>
Gasoline and oil	\$1,052	15%	\$554	4.6¢
Vehicle insurance	\$757	10.8%	\$399	3.3¢
Maintenance and repairs	\$666	9.5%	\$351	2.9¢
Vehicle rental, lease, license, and other charges	\$512	7.3%	\$269	2.2¢
Vehicle finance charges	\$323	4.6%	\$170	1.4¢
<b>Total</b>	<b>\$6,612</b>	<b>100%</b>	<b>\$3,481</b>	<b>28.7¢</b>

*This table summarizes household expenditures on vehicles in the U.S.*

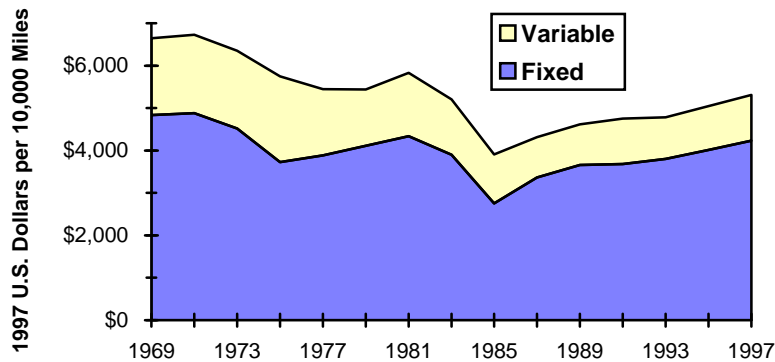
<sup>6</sup> Jack Faucett Associates, *The Costs of Owning and Operating Automobiles, Vans and Light Trucks, 1991*, FHWA (Washington DC), 1992. Values increased 30% to account for 1991-2001 inflation.

<sup>7</sup> Consumer Expenditure Survey, BLS ([www.bls.gov](http://www.bls.gov)), annual report.

Vehicle operating costs per mile vary depending on driving patterns and conditions. Fuel consumption per vehicle-mile tends to increase at speeds over 55 mph, under 20 mph, and under stop-and-go driving conditions ([Energy and Emission Reductions](#)).<sup>8</sup> Vehicle operating costs are about 40% higher on urban arterials than highways, and costs increase proportional to travel time when congestion reduces traffic speed to 30 mph on a highway or 20 mph on an arterial (see discussion in Chapter 5.5).<sup>9</sup> Roadway investment models provide detailed vehicle cost estimates (fuel, oil and tires, and sometimes maintenance) for various vehicle classes and road conditions.<sup>10</sup> They are designed to predict the vehicle cost savings resulting from roadway improvements. These models include:

Figure 5.1-1 illustrates average vehicle costs trends. Real costs per vehicle-year (taking into account inflation) declined for much of this period, and variable costs declined as a portion of total costs. Average automobile fuel costs per mile decreased from about 20¢ per mile in 1950 to 9¢ in 1994, due to declining real fuel prices and increased fuel efficiency.<sup>11</sup> Fuel is one of the largest categories of motor vehicle costs. It can vary significantly between different times and locations.

**Figure 5.1-1 Passenger Car Costs 1969-1997 (Adjusted by CPI)<sup>12</sup>**



This figure illustrates how vehicle costs have changed over time in the U.S., in inflation-adjusted dollars.

<sup>8</sup> ORNL, *Transportation Energy Book*, Oak Ridge National Laboratories, U.S. Department of Energy ([www-cta.ornl.gov/data](http://www-cta.ornl.gov/data)), updated annually.

<sup>9</sup> Kenneth Small, *Urban Transportation Economics*, Harwood (Chur), 1992, p. 76.

<sup>10</sup> Peter Bein, et al., *British Columbia Vehicle Operating Costs*, Planning Services Branch, British Columbia Ministry of Transportation and Highways (Victoria, [www.th.gov.bc.ca/bchighways](http://www.th.gov.bc.ca/bchighways)), 1996; TransFund, *Project Evaluation Manual*, TransFund New Zealand ([www.transfund.govt.nz](http://www.transfund.govt.nz)), 1998; *Highways Design and Maintenance (HDM) 4 Model*, World Bank (<http://hdm4.piarc.org/main/home-e.htm>); *MicroBENCOST*, Texas Transportation Institute (<http://tti.tamu.edu>), 1997.

<sup>11</sup> William Allen Jr., "Forecasting the Cost of Driving," *ITE Journal* ([www.ite.org](http://www.ite.org)), Feb. 1996, pp. 44-51.

<sup>12</sup> *Facts and Figures '97*, American Automobile Manufacturers Association (Detroit), 1997, p. 58, based on data from Runzheimer International.

### Electric and Hybrid Cars

Electric and Hybrid cars currently have relatively high purchase costs (150% to 200% the price of a comparable gasoline car). Electric cars require new battery sets every 20,000-30,000 miles costing \$2,000-\$3,000 (averaging 6-15¢ per vehicle-mile), and consume 0.25 to 0.5 kWh per mile, so energy costs average 2-5¢ per mile based on typical residential energy rates.<sup>13</sup> Hybrid cars consumer about half the fuel as a conventional car. The table below compares the costs of an electric, a hybrid and a conventional car.

**Table 5.1-7 Gasoline and Electric Car Costs**

	<b>Electric Car</b>	<b>Hybrid</b>	<b>Medium Car</b>
Fuel	3.0¢	2.5¢	5.0¢
Maintenance (including battery replacements)	12¢	2.9¢	2.9¢
Tires	1.3¢	1.3¢	1.3¢
<b>Operating costs/mile</b>	<b>16.3¢</b>	<b>6.7¢</b>	<b>9.2¢</b>
Insurance	\$912	\$912	\$912
License & registration	\$175	\$175	\$175
Depreciation	\$4,229	\$4,229	\$2,819
Financing	\$897	\$897	\$598
<b>Ownership costs/year</b>	<b>\$6,213</b>	<b>\$6,213</b>	<b>\$4,504</b>
<i>For 12,500 annual miles</i>	<i>\$8,250</i>	<i>\$7,050</i>	<i>\$5,655</i>
<b>Average cost per mile</b>	<b>66¢</b>	<b>56¢</b>	<b>45¢</b>

*This table compares estimated costs for regular and electric vehicles.*

### Transit

Table 5.1-8 summarizes U.S. transit service expenses and revenues. Expenditures are divided into *capital* (facilities, vehicles and equipment) and *operation* (labor, fuel and maintenance). Revenues are divided into *fares* (user payments) and *subsidies* (other sources of revenue).

Transit fares and operating costs vary, depending on conditions and perspective.<sup>14</sup> Urban peak travel tends to have high costs and high revenue, while off-peak and rural travel costs and revenue are low. Transit costs also vary depending on the situation and perspective.<sup>15</sup> Per-mile fares are highest for short trips paid and lowest for longer-distance trips. Routes with high load factors tend to have low costs per passenger mile and high cost recovery. Transit service experiences economies of scale: unit costs decline with increased ridership. Marginal costs tend to be lower than the average costs (a 10% increase in transit usage requires less than a 10% increase in costs and subsidies).

<sup>13</sup> USDOE *Alternative Fuels Data Center* ([www.afdc.doe.gov](http://www.afdc.doe.gov)) and *Fuel Economy Website* ([www.fueleconomy.gov/feg/hybrid\\_sbs.shtml](http://www.fueleconomy.gov/feg/hybrid_sbs.shtml)).

<sup>14</sup> Todd Litman, *Evaluating Public Transit Benefits and Costs*, VTPI ([www.vtpi.org](http://www.vtpi.org)), 1999.

<sup>15</sup> William Vickrey “Pricing in Urban and Suburban Transport,” *Public Economics; Selected Papers by William Vickrey*, Cambridge University Press ([www.uk.cambridge.org](http://www.uk.cambridge.org)), 1994.

**Table 5.1-8 U.S. 1999 Public Transit Expenses and Revenues<sup>16</sup>**

	Bus	Commuter Rail	Demand Response	Heavy Rail	Light Rail	Trolley Bus	Total
Capital Expenses (m)	\$3,249	\$1,622	\$122	\$2,707	\$1,005	\$90	\$8,794
Operation Expenses (m)	\$11,714	\$2,575	\$1,419	\$3,693	\$546	\$167	\$20,114
Total Expenses (m)	\$14,963	\$4,197	\$1,541	\$6,400	\$1,550	\$257	\$28,908
Average Fare Per Trip	\$0.74	\$3.31	\$1.59	\$0.92	\$0.56	\$0.50	\$0.90
Total Fare Revenues (m)	\$4,175	\$1,309	\$159	\$2,323	\$164	\$60	\$8,189
Subsidies (m)	\$10,788	\$2,888	\$1,383	\$4,077	\$1,387	\$197	\$20,720
Vehicle Rev. Miles (m)	1,973	244	608	561	48	14	3,447
Passenger Miles (m)	21,205	8,766	813	12,902	1,206	186	45,078
Avg. Vehicle Occupancy	10.7	36.0	1.3	23.0	25.2	13.7	13.1
Total Cost Per Pass. Mile	\$0.71	\$0.48	\$1.90	\$0.50	\$1.29	\$1.38	\$0.64
Fare Rev. Per Pass. Mile	\$0.20	\$0.15	\$0.20	\$0.18	\$0.14	\$0.32	\$0.18
Subsidy Per Pass. Mile	\$0.51	\$0.33	\$1.70	\$0.32	\$1.15	\$1.06	\$0.46
Percent Subsidy	72%	69%	90%	64%	89%	77%	72%

m=million

### Rideshare Passengers

A rideshare passenger using an otherwise empty seat generally incurs minimal incremental vehicle costs, consisting of a 5% increase in fuel consumption and other variable costs (that is, adding 20 passengers approximately doubles variable costs).

### Motorcycles

Although motorcycles are less expensive than a car to purchase and operate, their costs per passenger-mile tend to be relatively high due to low annual mileage and occupancy. An average motorcycle is driven 2,500 miles annually and travels 50 miles per gallon of fuel.<sup>17</sup> The table below compares typical motorcycle costs with a mid-size automobile.

**Table 5.1-9 Comparing Motorcycle and Average Automobile**

	Motorcycle	Medium Size Car
Fuel	2.5¢	5.0¢
Maintenance	3.0¢	2.9¢
Tires	1.3¢	1.3¢
<b>Operating costs/mile</b>	<b>6.8¢</b>	<b>9.2¢</b>
Insurance	\$912	\$912
License & registration	\$175	\$175
Depreciation	\$1410	\$2,819
Financing	\$299	\$598
<b>Ownership costs/year</b>	<b>\$2,802</b>	<b>\$4,504</b>
<b>For 2,600 annual miles</b>	<b>\$2,979</b>	<b>\$5,655</b>
<b>Average cost per mile</b>	<b>\$1.15</b>	<b>45¢</b>

<sup>16</sup> APTA, *Public Transportation Fact Book Statistics*, American Public Transit Association ([www.apta.com/stats](http://www.apta.com/stats)); FTA, *National Transit Database*, Federal Transit Administration ([www.fta.dot.gov/ntl/database.html](http://www.fta.dot.gov/ntl/database.html)). Both are updated annually.

<sup>17</sup> BTS, *National Transportation Statistics*, Bureau of Transport Statistics ([www.bts.gov](http://www.bts.gov)), annual report.

### Bicycling and Walking

A good commuting bicycle with accessories can cost \$500-1,000, and \$100 annually for maintenance. Many households already own a bicycle suitable for transport purposes at little extra cost. Shoes typically last 500-5,000 miles of walked. Walking and cycling burn calories that may increase food requirements, although most North Americans benefit from losing weight, so increased energy consumption may be a benefit rather than a cost. If bicycling or walking for transportation substitutes for other exercise activities they can be considered to have zero or negative costs (i.e., if bicycling or walking reduces the need to pay health club dues or reduces medical costs, it can be considered to save money).

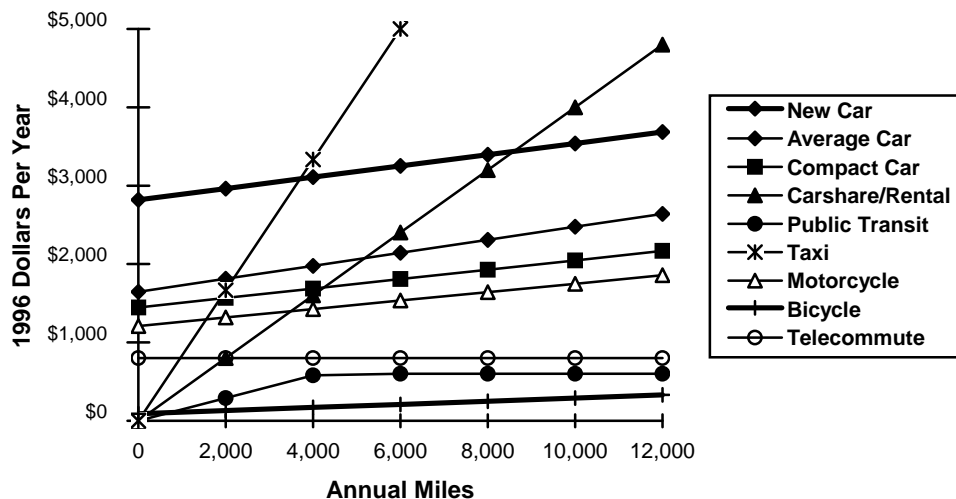
### Telework

Telework often uses home office space, telecommunications equipment and services that can cost hundreds or thousands of dollars annually, but many households make such investments for personal use, and these costs can be partly offset by savings in business office space. The incremental equipment cost of telework is therefore likely to average \$500-1,500 annually for a typical part-time teleworker.

### Comparison of Vehicle Costs

Figure 5.1-2 illustrates the differences in vehicle costs for various modes. It shows how some modes (such as automobile) have relatively high fixed costs and relatively low variable costs, as least as they are normally perceived (as described above, a portion of depreciation costs are actually variable, but this is not always recognized by users), while other modes such as taxi and carsharing have minimal fixed costs but higher variable costs. Walking, cycling and transit have relatively low vehicle costs.

**Figure 5.1-2 User Expenses for Various Modes<sup>18</sup>**



*Automobile travel has high fixed costs and low variable costs, taxi and carshare have low fixed costs and high variable costs, while transit and cycling have low financial costs.*

<sup>18</sup> Based on estimates in this chapter; \$50 monthly transit pass; \$1.25 per mile average taxi fares; \$0.40 per mile average rental car charges; “New Car” from *Your Driving Costs*, AAA.

## Variability

There is considerable variation in vehicle costs depending on the vehicle and its use. An old but reliable, uninsured automobile may cost only a few hundred dollars a year, while an expensive vehicle can cost ten times as much. Walking, cycling and transit incremental costs also vary depending on the situation and perspective.

## Equity and Efficiency Issues

Vehicle costs are internal (paid directly by users). The main equity issue is [Transportation Affordability](#), the ability of lower-income people to afford basic mobility (travel to medical services, school, work, etc.). Higher vehicle costs and transit fares are often considered regressive.

Many vehicle costs are not inefficiently priced.<sup>19</sup> For example, insurance claims and road wear tend to increase with annual vehicle mileage, but this is not reflected in insurance premiums or vehicle registration fees.

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<sup>19</sup> Todd Litman, *Socially Optimal Transport Prices and Markets*, VTPI ([www.vtpi.org](http://www.vtpi.org)), 2000.

## Conclusions

Ownership and operating costs for average car, vans and light trucks are calculated using published vehicle cost estimates, adjusted to represent lifecycle costs (rather than just the first six years of operation). Electric and Hybrid car costs are calculated as described in Table 5.1-7. Rideshare passengers impose no additional fixed cost and a 0.4 mpg reduction in fuel efficiency. Fixed costs are applied equally to all driving conditions; variable costs are assumed to represent Urban Off-Peak driving, and are increased 15% for Urban Peak travel and decreased by 15% for Rural travel.<sup>20</sup> Diesel Bus fares average 21¢ and Electric Bus/Trolley 30¢ per passenger-mile, based on Table 5.1-8. Transit is considered to have no fixed costs from a user perspective.

Motorcycles purchase and fuel costs are half of a medium-size automobile. Bicycling costs 7¢ per mile, most of which is fixed, and walking costs 4¢ per mile. Telework is estimated to cost 20¢ per mile, assuming \$400 annual incremental equipment and utility expenses to telework 100 days a year, avoiding 20 commute miles per day.

### *Estimate* Fixed Vehicle Ownership Costs (1996 U.S. Dollars per Vehicle Mile)

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.206	0.206	0.206	0.206
Compact Car	0.181	0.181	0.181	0.181
Electric Car	0.258	0.258	0.258	0.258
Van/Light Truck	0.268	0.268	0.268	0.268
Rideshare Passenger	0.000	0.000	0.000	0.000
Diesel Bus	0.000	0.000	0.000	0.000
Electric Bus/Trolley	0.000	0.000	0.000	0.000
Motorcycle	0.252	0.252	0.252	0.252
Bicycle	0.050	0.050	0.050	0.050
Walk	0.000	0.000	0.000	0.000
Telework	0.200	0.200	0.200	0.200

### *Estimate* Variable Vehicle Operating Costs (1996 U.S. Dollars per Vehicle Mile)

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.147	0.128	0.109	0.124
Compact Car	0.107	0.093	0.079	0.090
Electric Car	0.207	0.180	0.153	0.175
Van/Light Truck	0.207	0.180	0.153	0.175
Rideshare Passenger	0.003	0.003	0.002	0.002
Diesel Bus	5.250	1.050	1.050	1.890
Electric Bus/Trolley	9.000	2.400	2.400	3.720
Motorcycle	0.062	0.054	0.050	0.054
Bicycle	0.020	0.020	0.020	0.020
Walk	0.040	0.040	0.040	0.040
Telework	0.000	0.000	0.000	0.000

<sup>20</sup> Based on fuel efficiency ratings which indicate that urban driving incurs about 30% higher fuel costs per mile than highway driving. These same ratios are assumed to apply to other variable costs.

Diesel transit bus subsidies average 44¢ per passenger mile, and Trolley Bus subsidies average 54¢ per passenger mile, based on Table 5.1-8. It can be difficult to allocate cost responsibility between peak and off-peak transit use. Peak trips tend to set capacity requirements and so incur high capital costs, particularly for rail transit, but have higher load factors and therefore fare revenues. As a result, urban-peak transit runs often recover their full operating costs and sometimes their full capital costs (a transit company that only provides such service could be profitable). Such runs can be considered to subsidize off-peak and rural transit operating costs, or at least require less subsidy per passenger-mile. For this analysis we assign subsidies costs equally to all trips.

As previously described, marginal transit costs tend to be lower than average costs, particularly for off-peak transit travel. We estimate that a 10% increase in transit use increases costs by 7%, meaning that marginal Diesel Bus costs total about 46¢ per passenger mile, of which 21¢ is fares and 25¢ is subsidy, and marginal Electric Bus/Trolley costs total 59¢ of which 29¢ is subsidies.

Significant electric vehicle development costs are government funded, and cross subsidies within automobile companies are estimated at \$10,000 to \$20,000 per electric vehicle sold,<sup>21</sup> but are excluded from this estimate due to uncertainty and the possibility that they may be recouped over the long term and are therefore a legitimate business expenses.

**Estimate Vehicle Operating Subsidies (1996 U.S. Dollars per Vehicle Mile)**

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.000	0.000	0.000	0.000
Compact Car	0.000	0.000	0.000	0.000
Electric Car	0.000	0.000	0.000	0.000
Van/Light Truck	0.000	0.000	0.000	0.000
Rideshare Passenger	0.000	0.000	0.000	0.000
Diesel Bus	6.250	2.000	1.250	2.550
Electric Bus/Trolley	8.700	2.900	2.900	4.060
Motorcycle	0.000	0.000	0.000	0.000
Bicycle	0.000	0.000	0.000	0.000
Walk	0.000	0.000	0.000	0.000
Telework	0.000	0.000	0.000	0.000

**Automobile Cost Range:** The Minimum value is a rounded lower estimate and the Maximum is based on the Automobile Association estimate.

	<u>Minimum</u>	<u>Maximum</u>
Fixed	\$0.18	\$0.36
Variable	<u>\$0.10</u>	<u>\$0.15</u>
Total	\$0.28	\$0.51

<sup>21</sup> Richard Neufville, *et al.*, “The Electric Car Unplugged,” *Technology Review*, January 1996, pp. 30-36.



## Information Resources

*Information sources on vehicle costs are described below.*

CAA, *1999 Driving Costs*, Canadian Automobile Association (Ottawa; [www.caa.ca](http://www.caa.ca)), provides estimates of typical annualized ownership and operating costs for several types of vehicles.

ECONorthwest and PBQD, *Estimating the Benefits and Costs of Public Transit Projects*, TCRP Report 78, (<http://gulliver.trb.org/publications/tcrp/tcrp78/index.htm>), TRB ([www.trb.org](http://www.trb.org)), 2002.

The *Black Book*, Hearst Business Media Corporation ([www.blackbookusa.com](http://www.blackbookusa.com) and [www.canadianblackbook.com](http://www.canadianblackbook.com)), and the *Kelley Blue Book* ([www.kbb.com](http://www.kbb.com) and [www.cars.com](http://www.cars.com)) provide wholesale and retail price estimates for new and used vehicles.

*Highway Design and Maintenance (HDM) 4 Model* (<http://hdm4.piac.org/main/home-e.htm>) and *MicroBENCOST* (<http://tti.tamu.edu>) calculate the economic benefits of roadway improvements, with formulas for calculating vehicle operating costs under various roadway conditions.

*Intellichoice* ([www.intellichoice.com](http://www.intellichoice.com)), provides new and used vehicle price estimates.

Jeffrey R. Kenworthy and Felix B. Laube, *The Millennium Cities Database for Sustainable Transport*, International Association of Public Transport ([www.uitp.com](http://www.uitp.com)), 2001.

*Runzheimer International* ([www.runzheimer.com](http://www.runzheimer.com)), sells annualized ownership and operating cost estimates for several types of vehicles.

SCAA, *Your Driving Costs in Southern California*, Southern California Automobile Association ([www.aaa-calif.com](http://www.aaa-calif.com)), provides estimates of typical vehicle ownership and operating costs.

*SIDRA* ([www.akcelik.com.au/SIDRA/Cost\\_Fuel\\_Emissions.htm](http://www.akcelik.com.au/SIDRA/Cost_Fuel_Emissions.htm)) is a computer model that estimates fuel consumption, operating cost and pollutant emissions for various traffic conditions.

UK Automobile Association ([www.theaa.co.uk](http://www.theaa.co.uk)), provides estimates of typical annualized ownership and operating costs for several types of vehicles.

*Way To Go Seattle Car Cost Worksheet* ([www.cityofseattle.net/carsmart/carcostworksheet.htm](http://www.cityofseattle.net/carsmart/carcostworksheet.htm)) calculates your car cost and compare it to other transportation options.

Fuel price data is available from the *International Energy Agency* ([www.iea.org](http://www.iea.org)), the *American Petroleum Institute* ([www.api.org](http://www.api.org)), the *Canadian Petroleum Communication Foundation* ([www.pcf.ab.ca](http://www.pcf.ab.ca)), and the *Transportation Energy Data Book* ([www.ott.doe.gov](http://www.ott.doe.gov)).

VTPI, *Online TDM Encyclopedia*, VTPI ([www.vtpi.org](http://www.vtpi.org)), chapters:

“Driving Costs” ([www.vtpi.org/tdm/tdm82.htm](http://www.vtpi.org/tdm/tdm82.htm)).

“Transportation Affordability” ([www.vtpi.org/tdm/tdm106.htm](http://www.vtpi.org/tdm/tdm106.htm)).