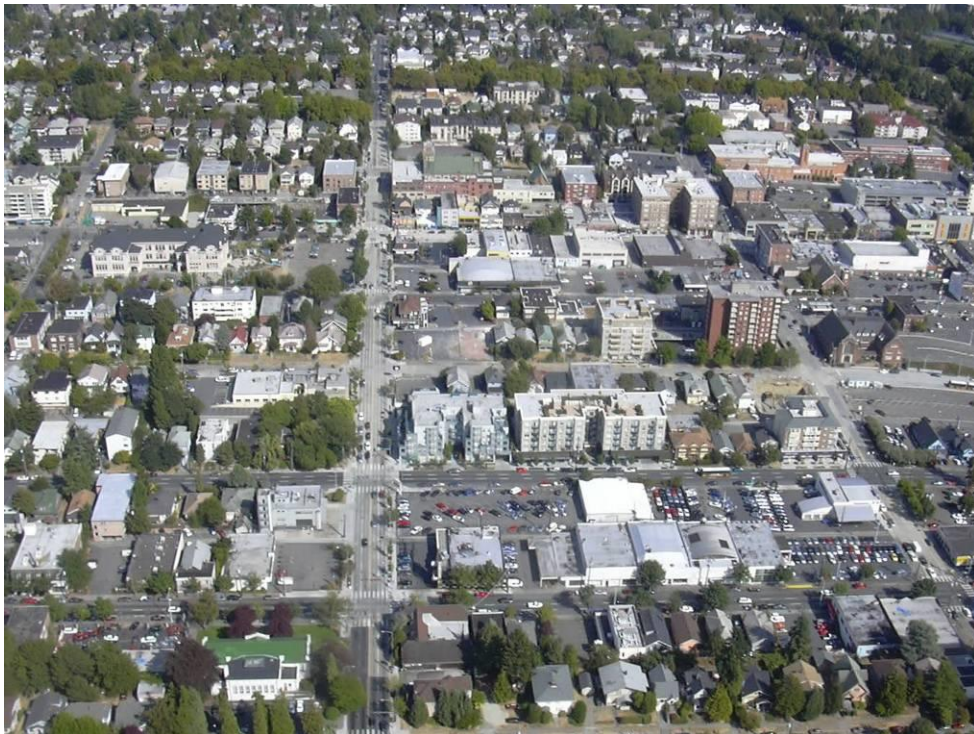


## Transportation Land Valuation

*Evaluating Policies and Practices that Affect the Amount of Land  
Devoted to Transportation Facilities*

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*A relatively large portion of urban land is devoted to roads and parking facilities.*

### Abstract

This paper explores the relationships between transportation, land use and taxation. It investigates how current land tax and regulatory practices affect the amount of land devoted to roads and parking facilities, and how this affects transport patterns. It discusses ways to measure the amount of land devoted to transport facilities, examine how this varies under different circumstances, estimate the value of this resource, evaluate how tax policies and regulations policies treat this land, and analyze whether current practices are optimal in terms of various economic and social objectives.

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## Introduction

This report summarizes research exploring the relationships between transportation, land use and taxation. It investigates whether current transportation and land use practices result in an economically optimal amount of land being devoted to transportation facilities, particularly roads and parking.

Roads are essential for most forms of mobility, and parking is essential for automobility (travel by automobile). However, just because these facilities provide benefits does not mean that current policies are optimal. Just as doctors must be careful to avoid prescribing too much medicine, transport policies must prescribe just the right amount of road and parking capacity in each situation. Policies that result in excessive amounts of land being devoted to transportation facilities are harmful to the economy, social activities and the environment.

Decisions that affect the amount of land devoted to roads and parking relate to several policy and planning issues:

- *Development Patterns.* Practices that increase the amount of land devoted to roads and parking facilities tend to favor urban fringe development over urban infill, and encourage low-density urban fringe development (“sprawl”). Alternative policies are advocated as part of Smart Growth.
- *Transportation Pricing.* Practices that increase road and parking capacity encourage underpricing of automobile use (increased supply tends to reduce prices, often making it difficult to justify any price). This makes automobile travel cheaper relative to other modes and other consumer expenditures.
- *Automobile Dependency.* The combination of sprawled land use and underpriced automobile travel can have synergistic effects, resulting in increased automobile dependency and reduced transportation alternatives (“Automobile” refers to cars, vans, light trucks and SUVs). Some planners advocate efforts to create a more balanced transportation system.
- *Impervious Surface.* Increasing the amount of land paved for roads and parking increases impervious surface, which tends to reduce greenspace, imposes stormwater management costs, reduces groundwater recharge, and leads to an urban “heat island” effect.
- *Equity.* Roads and parking facilities are subsidized in various ways. These subsidies favor people who drive more than average. Since economically and physically disadvantaged people tend to drive less than average, these benefits tend to be both unfair and regressive.
- *Housing Affordability.* Generous parking requirements increase housing costs, particularly in urban areas. Although middle- and upper-income households can absorb these costs, they make it difficult or impossible to develop new affordable housing. (Two parking spaces per housing unit typically represent only 10% of the cost of a \$250,000 home, but may increase the costs of a \$100,000 unit by 25%).

This research reflects a shift occurring in the field of transport planning. During much of the last century planners generally assumed that *transportation* means motor vehicle travel. Many analysis tools and decision-making practices reflect this assumption, such as roadway Level-of-Service ratings based on vehicle delay, and dedicated highway funds (Litman 2003). This lead to planning decisions favoring automobile travel at the expense of other accessibility options, resulting in increased automobile dependency (“Automobile Dependency,” VTPI, 2005). Although automobile transportation provides benefits, marginal benefits decline and costs increase as per capita vehicle ownership and use increase. It is therefore possible that current planning practices that favor automobile travel result in economically excessive levels of land devoted to transportation (“Market Principles,” VTPI, 2005; Litman 2005).

Several previous studies suggested that current policies result in excessive amounts of land devoted to transport facilities (Lee 1999; Willson 1995; Shoup 1999). Noble prizewinner William Vickrey estimated that the current road system is a quarter to a third overbuilt compared with what is optimal (Hau, 2000, footnote #1). Most of these studies consider just one or two distortions, such as unpriced road space and parking, biased investment policies, or excessive facility requirements in zoning codes. This paper applies a more comprehensive analysis of policies that affect transport land supply.

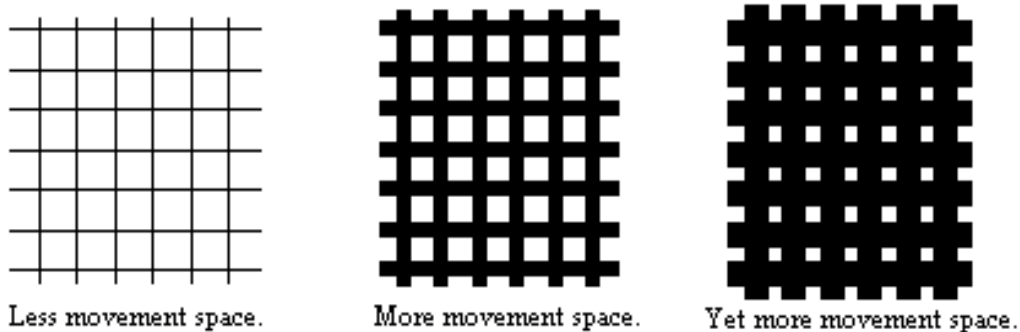
#### **Transport Land Costs Increase With Wealth and Urbanization**

With increased wealth and urbanization, land costs become an increasingly important factor in transportation problem solving. Traffic and parking congestion problems tend to increase with wealth because consumers purchase more vehicles, which increases the amount of space needed for travel (a car trip typically requires an order of magnitude more space than the same trip made by walking, cycling or transit). Although increased wealth allows greater expenditures on facilities (such as structured parking facilities), the supply of land does not increase. Road and parking facilities must compete for land that is increasingly expensive due to demand by other uses, so land costs become an increasing portion of project costs and a limiting factor in roadway and parking capacity expansion. Although sprawl may seem to overcome this problem by shifting travel to the urban fringe where land costs are lower, dispersed development increases per-capita vehicle mileage, requiring more lane-miles and parking spaces per capita, so land costs continue to be a major constraint. As a result, traffic and parking congestion problems tend to increase, and alternative modes and demand management tend to become more important with increased wealth and urbanization.

Planning decisions often involve trade-offs between *mobility* (physical movement of people and goods) and *accessibility* (the ability to reach desired goods and activities). Incremental increases in road and parking capacity tend to create more dispersed land use patterns, increasing the amount of mobility required to achieve a given level of accessibility. This favors automobile travel and reduces the utility and efficiency of other transport modes, since large parking lots and wide streets create landscapes that are

difficult for walking, and therefore for transit access. By increasing the amount of land required for a given amount of development, generous road and parking requirements favor urban fringe development, where land prices are lower. As a result, to some degree, automobile-dependency can be a self-fulfilling prophesy: practices to make driving more convenient make alternatives less convenient and increase automobile-oriented sprawl.

**Figure 1      Land Used for Roads and Parking**



*Automobile transport requires relatively large amounts of land for roads and parking, which reduces the amount of land available for other activities. This tends to disperse destinations.*

Even relatively modest increases in per capita vehicle ownership and use can significantly increase the amount of urban land needed for roads and parking facilities, reducing the amount of land available for other activities. This forces development to either disperse, creating lower-density automobile-dependent land use patterns, or to increase in height and therefore costs, with multi-story parking structures and high rise buildings. Described differently, shifts from driving to alternative modes for urban commuting allows development of more compact, walkable urban centers.

For example, to be walkable a commercial center or urban village should have a diameter of about a half-mile, which is about 125 gross acres or about 100 net acres for basic roads and sidewalk rights of way. With 70% lot coverage, this represents 70 acres of buildable area. If buildings are only one story tall and average 4 employees per 1,000 square feet, the center can accommodate about 12,000 employees if none use surface parking, but only about 5,000 if all employees drive to work and use surface parking. If buildings average 3 stories, the area can accommodate 36,000 employees if none use surface parking, but only about 7,000 if all employees use surface parking (since the additional land freed by using multi-story buildings only accommodates a relatively small amount of additional parking spaces).

## Measuring the Amount of Land Devoted to Transportation

*This section describes a review of literature concerning the amount of land devoted to transportation facilities, particularly roads and parking.*

### *Roads*

A few studies have estimated the amount of land devoted to roads and parking, and its value ("Roadway Land Value," Litman, 2004; Manville and Shoup 2005). Most roads are publicly owned. Highways and major arterials are usually funded and owned by state (in Canada, provincial) governments, while minor roads and streets are usually owned and funded by local governments (roads in new developments are often funded originally by private developers but turned over to local governments). A small (but not insignificant) amount of land is devoted to private roads and driveways.

Most roads have two to four lanes, each 10-14 feet wide, plus shoulders, sidewalks, drainage ditches and landscaping area, depending on conditions. Road rights-of-way width (the land that is legally devoted to the road) usually range from about 24 up to 100 feet. Most roads in developed countries are paved. In high density urban areas road pavement often fills the entire right-of-way, but in other areas there is often an undeveloped area that may be planted or left in its natural condition.

The amount of land devoted to roads is affected by:

- Projected vehicle traffic demand (which determine the number of traffic lanes).
- Road design standards (which determine lane and shoulder widths). Such standards are usually adopted by transportation agencies based on recommendations developed by professional organizations such as the Institute of Transportation Engineers (ITE) or the American Association of State Transportation and Highway Officials (AASHTO), to reflect vehicle size, vehicle diversity, traffic speed and safety requirements.
- On-street parking practices (which determine the number of parking lanes).
- Additional design features, such as shoulders, sidewalks, ditches and landscaping.

The table below shows one estimate of the total amount of land devoted to roads. It indicates that in the U.S. more than 13 thousand square miles of land is paved for roads (about 0.4% of continental U.S.), and more than 20 thousand square miles is devoted to road rights of way (about 0.7% of continental U.S.). Manville and Shoup (2005) summarize a number of studies concerning the portion of urban land devoted to streets.



**Table 1 Land Area Devoted to Roads in the U.S. (Delucchi, 1998, Table 6-A.1)**

	A	B	C	D	E	F	G	H	I	J
	Avg. Lanes	Lane width	Shoulder & dividers	Total width road	Paved roads	Private paved rd. factor	Paved road area	Extent of unpaved roads	Private unpaved rd. factor	Total road area
<i>Units</i>		<i>Feet</i>	<i>Feet</i>	<i>Feet</i>	<i>Miles</i>		<i>Miles<sup>2</sup></i>	<i>Miles</i>		<i>Miles<sup>2</sup></i>
<b>Urban</b>										
Interstate freeway	5.4	12.0	40	105	11,603	1.00	231	0	1.00	231
Other freeway	4.5	12.0	30	84	7,714	1.00	123	0	1.00	123
Principal Arterial	3.4	11.5	15	54	52,349	1.00	532	0	1.00	532
Minor Arterial	2.5	11.3	10	39	74,516	1.00	546	463	1.00	550
Collector	2.1	11.1	8	32	76,251	1.01	463	846	1.02	468
Local road	1.8	10.9	8	28	491,926	1.03	2,650	34,196	1.04	2,837
<i>Subtotal urban</i>					<i>714,359</i>		<i>4,545</i>	<i>35,505</i>		<i>4,739</i>
<b>Rural</b>										
Interstate freeway	4.1	12.0	35	84	33,677	1.00	533	0	1.00	533
Other Highway	2.5	11.7	30	60	85,729	1.00	971	0	1.00	971
Principal Arterial	2.1	11.5	15	39	142,866	1.00	1,058	0	1.00	1,058
Major collector	2.0	10.9	10	32	388,611	1.00	2,355	48126	1.00	2,647
Minor collector	2.0	10.1	5	25	196,006	1.01	941	97,494	1.05	1,428
Local road	1.7	10.0	4	21	720,229	1.05	3,008	1,426,697	1.10	9,250
<i>Subtotal rural</i>					<i>1,567,118</i>		<i>8,867</i>	<i>1,572,317</i>		<i>15,888</i>
<b>Total</b>					<b>2,281,477</b>		<b>13,412</b>	<b>1,607,822</b>		<b>20,627</b>

*The table shows one estimate of the total amount of U.S. land devoted to roads.*

**Table 2 Road Supply As a Percentage of Urbanized Area (Vasconcellos, 2001)**

City	Portion of Land Used for Roads
<b>Developing Countries</b>	
Kolkata (India)	6.4%
Shanghai, China	7.4%
Bankok, Thailand	11.4%
Seoul, South Korea	20.0%
Delhi, India	21.0%
Sao Paulo, Brazil	21.0%
<b>Developed Countries</b>	
New York, USA	22.0%
London, UK	23.0%
Tokyo, Japan	24.0%
Paris, France	25.0%

*The table shows one estimate of the amount of urban land devoted to roads in various countries.*

TeleCommUnity (2002) estimated that U.S. roadway rights of way total 625,517,587,200 square feet or 22,437 square miles.

### *Parking*

A few studies have examined the amount of land devoted to parking facilities and their value (“Parking Costs,” Litman, 2004). There are several categories of parking to consider (“Parking Evaluation,” VTPI, 2005):

- *On-street* (also called *curb*) *parking*, located within roadways. A significant portion of road space is often devoted to parking. Most urban streets have one or two parking lanes that typically represent 20-30% of their width, and rural roads often shoulders used for parking.
- *Residential*, bundled with housing costs.
- *Non-residential, unpriced*, provided free to employees, customers and clients.
- *Commercial*, rented or leased for profit.
- Unimproved, unmaintained land, used for parking.

A parking space is typically 8-10 feet wide and 18-20 feet deep, totaling 144 to 200 square feet. This is approximately doubled to 300+ square feet per space when access lanes are included, allowing about 125 spaces per acre (Hunnicut, 1922, p. 651).

A few studies have estimated total parking spaces. A study by Purdue Professor Bryan Pijanowski (2007) found approximately three non-residential parking spaces per vehicle Tippecanoe County, a typical rural county.

Scharnhorst (2018) developed comprehensive parking inventories and cost estimates for New York, Philadelphia, Seattle, Des Moines, and Jackson, Wyoming. Parking was categorized by type: on-street, off-street surface and off-street structured. Table 3 summarizes the results. Where land is less expensive, a greater share of parking is surface, and where it is more expensive, a greater share is surface, but total parking supply tends to increase with density, so supply is often greater where it is less visible.

**Table 3      Parking Spaces and Costs in Five U.S. Cities** (Scharnhorst 2018)

	New York	Philadelphia	Seattle	De Moines	
Population	8,537,673	1,567,872	704,352	215,472	10,529
Parking Spaces	1,965,377	2,172,896	1,596,289	1,613,659	100,119
Spaces Per HH	0.6	3.7	5.2	19.4	27.1
Total Value	\$20.55 billion	\$17.46 billion	\$35.79 billion	\$6.42 billion	\$711 million
Value Per HH	\$6,570	\$29,974	\$117,677	\$77,165	\$192,138

*Scharnhorst used various data sources to measure parking supply and costs in five cities.*

Manville and Shoup (2007) estimate the portion of land devoted to roads and parking facilities in U.S. cities. They conclude that transportation land per acre tends to increase with population density, but transportation land per capita tends to decrease with density. Table 4 shows the estimated portion of land devoted to road rights-of-way and

parking facilities in different countries. These values are relatively small when measured as a portion of total land area, but roads and parking facilities tend to be constructed in areas with high population and industrial concentrations. This suggests that there are probably about one residential and two non-residential off-street parking spaces per motor vehicle in a typical urban area.

**Table 4** Land Area Devoted to Road Rights of Way (Kauffman, 2001)

	Roadway Rights of Way	Portion of Total Land Area	Area Per Capita	Area Per Motor Vehicle
	Hectares		Meters <sup>2</sup>	Meters <sup>2</sup>
United States	15,920,615	1.7%	573	746
Canada	2,276,656	0.2%	734	1319
Mexico	863,832	0.4%	87	1100
Japan	1,316,591	3.5%	104	184
France	1,020,586	1.9%	173	308
Germany	749,725	2.1%	91	164
United Kingdom	425,149	1.8%	72	137
Sweden	241,146	0.6%	268	566

Bruun and Vuchic (1995) developed *time-area analysis* to compare the total amount of land required for different forms of transport. Time-area is the product of the land area consumed by a vehicle for a particular time period. It is measured by multiplying width times length times minutes of time for both travel (path, road, rail line) and parking, to produce units such as square meter-minutes.

**Table 5** Land Devoted To Streets (Meyer and Gomez-Ibanez 1983, p. 181)

	Persons/Sq. Mi.	Portion of Land Devoted to Streets	Square Feet Of Street Per Capita
New York	24,697	30%	345
Newark, N.J.	17,170	16%	257
San Francisco	16,559	26%	441
Chicago	15,836	24%	424
Philadelphia	15,743	19%	365
St. Louis	12,196	25%	609
Pittsburgh	11,171	18%	455
Cleveland	10,789	17%	416
Miami	8,529	24%	778
Milwaukee	8,137	20%	724
Cincinnati	6,501	13%	573
Los Angeles	5,451	14%	741
Atlanta	3,802	15%	1,120
Houston	2,860	13%	1,585
Dallas	2,428	13%	1,575



A frequently repeated statement is that, “In American cities, close to half of all the urban space goes to accommodate the automobile; in Los Angeles, the figure reaches two-thirds” (Renner, 1988). However, that statement seems to be exaggerated (see box below). They appear to reflect the portion of land devoted to roads and parking in major commercial centers, but not for cities as a whole.

**The Birth of a Statistic about Cities** (by Donald Shoup)

I have often wondered how much land is devoted to streets and parking for cars in cities. I realize that there are definitional problems in this question. For example should a driveway that leads from the street to a garage at the back of a house be counted as a street or as parking? Maybe neither, because some driveways serve primarily as open space between adjacent houses, and may rarely be used by a car. Nevertheless, it would be good to have even a rough estimate of the share of urban land that is devoted to streets and parking.

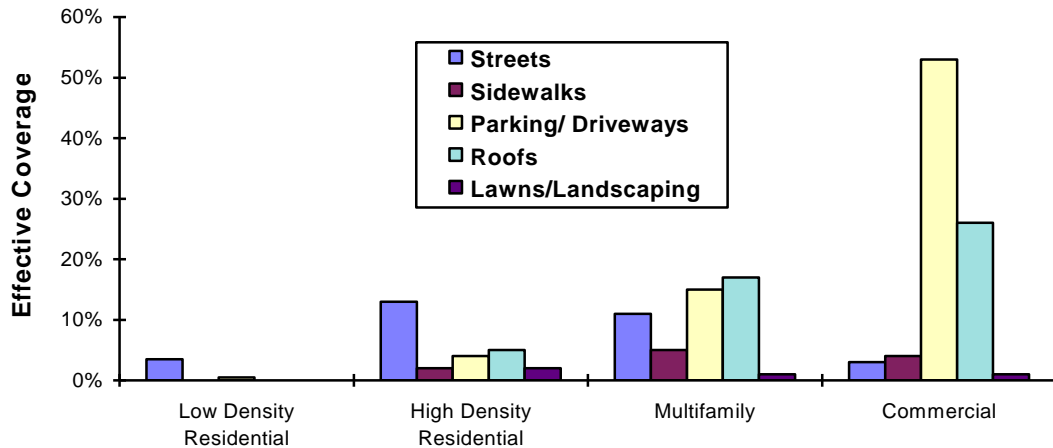
In reading the wonderful new book by Michael Southworth and Eran Ben-Joseph (*Streets and the Shaping of Towns and Cities*), I found the answer to my question. Cars consume half of the land in cities, and almost two-thirds of the land in Los Angeles. Although this information was not important for the rest of their excellent book, the authors cited two references for it, and I was curious to follow them up. In tracing the references to their source, here is what I found.

1. Michael Southworth and Eran Ben-Joseph in *Streets and the Shaping of Towns and Cities* (New York: Mc Graw-Hill, 1997, pp. 4-5) say: “In the urban United States, the automobile consumes close to half of the land area of cities; in Los Angeles the figure approaches two thirds.”
2. For this information Southworth and Ben-Eran cite: Mark Hanson, “Automobile Subsidies and Land Use,” *Journal of the American Planning Association*, 58:1 (Winter 1992) 66; Michael Renner, *Rethinking the Role of the Automobile*, World Watch Institute, 1988.
3. Mark Hanson (“Automobile Subsidies and Land Use,” p. 66) says: “In U.S. cities, close to half of all urban area goes to accommodating the automobile, while in Los Angeles the figure reaches two-thirds (Renner 1988).”
4. Michael Renner (*Rethinking the Role of the Automobile*, p. 46) says: “In American cities, close to half of all the urban space goes to accommodate the automobile; in Los Angeles, the figure reaches two-thirds.”
5. For this information, Michael Renner cites: Kirkpatrick Sale, *Human Scale* (New York: Coward, McCann, & Geohagan, 1980)
6. Kirkpatrick Sale (*Human Scale*, p. 253) says: “It [the car] demands enormous amounts of space, both in the countryside, where it has so far caused 60,000 square miles of land to be paved over, and in the cities, where roughly half of all the land (in Los Angeles 62 percent) is given over to its needs.” (italics in the original)
7. Kirkpatrick Sale does not give the source of this information.

Figure 2 illustrates the results of a study of urban impervious surface coverage. Roads typically represent 10% of land area in a fully developed area (for example, within a particular development), and parking can represent as much as 50% of total land area in dense commercial centers (such as a retail mall or employment center), but a smaller

portion of an entire urban region when parks, school yards, and other types of undeveloped land are included. Increased urban density tends to increase the percentage of impervious surface coverage, but reduce *per capita* coverage.

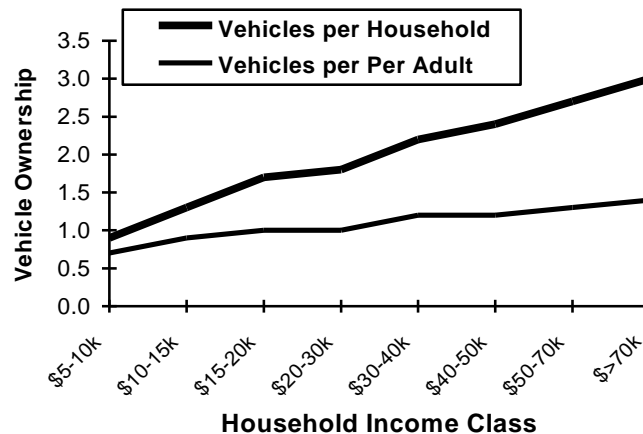
**Figure 2** Surface Coverage (Arnold and Gibbons, 1996)



*This figure illustrates the coverage of land in various urban conditions from one study.*

Road and parking standards tend to reflect “average” conditions. Various factors affect per capita vehicle ownership and use, including land use factors such as density and mix (“Land Use Impacts on Transportation,” VTPI, 2005) and demographic factors such as household income (Figure 3). This suggests that such standards should be adjusted to reflect these factors. For example, parking requirements should be reduced in lower-income urban areas, and in areas that have mobility management programs.

**Figure 3** Vehicle Ownership by Household Income (BLS, 1997)



*Lower income households own fewer automobiles than wealthier households.*

### Allocating Road Space by Mode

Road space requirements increase with vehicle size and speed. Faster vehicles need more *shy distance* between them and other objects. A person typically requires 10 square feet while standing, and 20 square feet while walking. A bicycle requires 10-20 square feet when parked and about 50 square feet when ridden at 10 mph. An automobile occupies 150-400 square feet when parked, 1,500 square feet when traveling at 30 mph, and more than 5,000 square feet when traveling at 60 mph. A bus requires about 2-3 times as much road space as an automobile, but can carry 40-60 passengers, and curb space for bus stops.

**Figure 4 Peak-Period Time-Area Consumption by Mode** (Bruun, 1992)

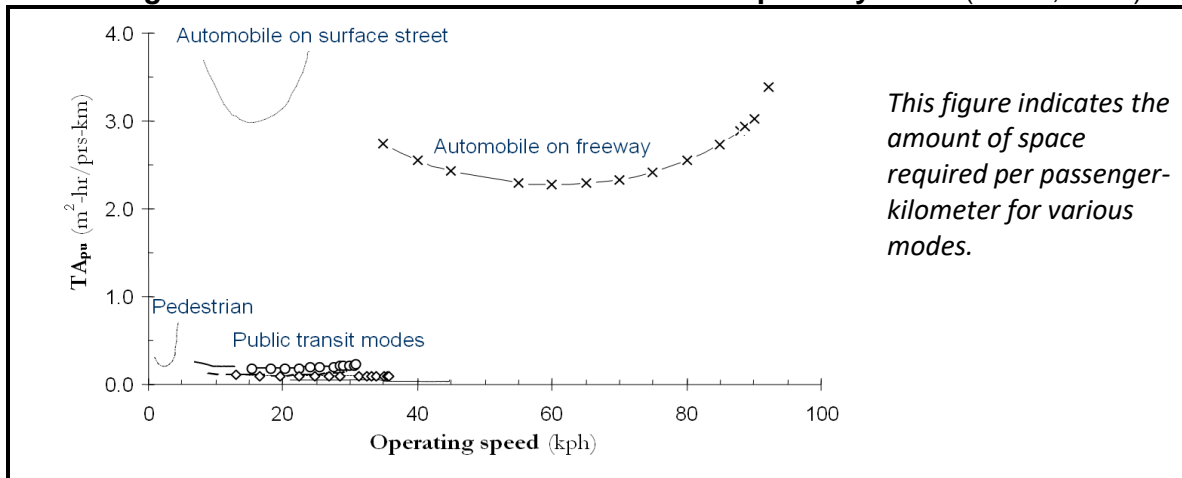


Figure 4 and Table 6 compare the amount of space required by various transport modes.

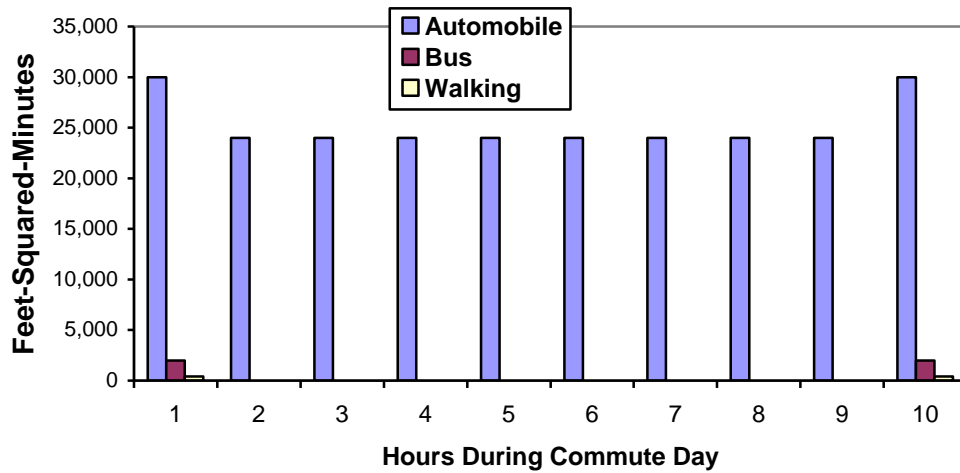
**Table 6 Typical Travel Space Requirements by Mode**

	Speed	Standing/Parked	Traveling
	Mph	Square Feet	Square Feet
Pedestrian	3	10	30
Bicycle	10	20	100
Bus Passenger	15	20	20
Automobile	20	100	300
Automobile	60	200	3,000

*This table compares typical space requirements for different modes of travel*

Bruun and Vuchic (1995) developed *time-area analysis* for comparing *total* space requirements of different forms of transport. Time-area is the product of the time and the land area used by a vehicle during a particular time period, including space for travel (path, road or rail space) and parking, measured in square-meter-seconds. For example, an automobile commute trip occupies a large amount of road area for a relatively short period of time while driving, and then occupies a relatively small amount of parking area for a longer period. Figure 5 illustrates this concept.

**Figure 5** Peak-Period Time-Area Consumption By Mode (Bruun 1992)



At 30 mile-per-hour (mph) automobile travel requires about 15 feet of width and 100 feet of length, including shy distance, totaling 1,500 square feet ( $F^2$ ). A 20-minute automobile commute averaging 30 mph therefore uses 30,000 square-foot-minutes ( $F^2M$ ) for travel. Automobiles also require parking, typically about 400  $F^2$ , including parking spaces and access lanes, or 24,000  $F^2M$  per hour. Automobile commuting therefore requires 252,000  $F^2M$  per day for travel and parking. A bus requires about twice as much road space as an automobile but carries about 30 passengers and requires no user parking, and so totals about 4,000  $F^2M$  per day. Walking requires about 20  $F^2$  and requires no parking, so a 20-minute walking commute requires about 800  $F^2M$  per day.

Table 7 shows time-area analysis applied to various transportation modes, measured in square-foot-minutes, for a 20-mile round-trip commute (10 miles each way) with 8 hours of parking (pedestrian travel has no parking requirements). This indicates that automobile travel requires far more space per travel mile than other modes. Because motorists tend to travel farther per year than non-drivers (typically three to five times as much), their total per capita land requirements for transportation are even greater.

**Table 7** Time-Area Requirements By Mode (From Table 5)

Mode	Average Speed	Standing Area	Moving Area	Travel Area	Parking Area	Total Area
	Miles/Hr	Square Feet	Square Feet	Sq.Ft.- Minutes/Mile	Sq.Ft.- Minutes/Mile	Sq.Ft.- Minutes/Mile
Walking	3	10	30	400	-	400
Bicycling	10	20	100	400	960	1,360
Bus Transit	15	20	20	53	-	53
Solo Driving – Arterial	20	100	300	600	2,400	3,000
Solo Driving - Highway	60	200	3,000	2,000	1,600	3,600

This table compares time-area requirements, measured in square-foot-minutes (square feet times the number of minutes) for a 20-mile round-trip commute with 8 hours of parking.

This does not mean that automobile-oriented transport systems always actually require several times as much land for transport facilities as multi-modal systems. Even cities built before the automobile often had wide roads to accommodate wagons and parades, and to provide adequate sunlight and air flow. But high per capita vehicle ownership and use tend to increase transport facility land requirements. Walking cities typically devote less than 10% of land to transport while automobile-oriented cities devote 20% to 50% (Dimitriou, 1993, p. 136). Newman and Kenworthy (1998, table 3.9) found that automobile dependent cities average about 7 meters of road length per capita, while European cities, which have more balanced transport systems, average about 2.5 meters. Parking supply follows a similar pattern. This indicates that automobile-orientation increases transport land requirements 3 to 5 times. Put another way, 66% to 80% of the land devoted to roads and parking facilities in modern cities results from the greater space requirements of automobile-oriented transport.

Ports, airports and railway facilities use significant amounts of land in some areas, although their total land requirements are relatively modest, and except for passenger railway stations are usually located outside of cities. Urban rail systems can be space efficient in terms of land required per passenger-trip, but since few rail lines carry their full capacity so in practice their land requirements per rider are moderate.

### *Costs of Land Devoted to Transport Facilities*

*This section discusses various costs that should be considered when evaluating the amount of land devoted to transportation facilities. For additional information see Litman, 2002.*

#### **Economic Value of Land**

We sometimes say that roads and parking “consume” land, although that is inaccurate since the land still exists. However, land that is paved is unable for most other economic and ecological functions, and can disrupt other activities (e.g., highways may block pedestrian and wildlife movement, and reduces groundwater recharge). This implies that there is an opportunity cost to using land for transportation facilities.

Table 8 indicates typical parking costs for various types of parking facilities. Land costs typically represent between a quarter and half of total annualized costs. This portion is higher for surface parking in areas with high land values, and low or non-existent where land values are low, and for structured or underground parking.

**Table 8 Typical Parking Facility Financial Costs (VTPI, 2003)**

Type of Facility	Land Costs	Land Costs	Construction Costs	O & M Costs	Total Cost	Monthly Cost
	<i>Per Acre</i>	<i>Per Space</i>	<i>Per Space</i>	<i>Annual, Per Space</i>	<i>Annual, Per Space</i>	<i>Per Space</i>
Suburban, On-street	\$50,000	\$200	\$1,500	\$200	\$360	\$30
Suburban, Surface, Free Land	\$0	\$0	\$1,500	\$200	\$342	\$28
Suburban, Surface	\$50,000	\$455	\$1,500	\$200	\$384	\$32
Suburban, 2-Level Structure	\$50,000	\$227	\$6,000	\$300	\$888	\$74
Urban, On-Street	\$250,000	\$1,000	\$2,000	\$200	\$483	\$40
Urban, Surface	\$250,000	\$2,083	\$2,000	\$300	\$685	\$57
Urban, 3-Level Structure	\$250,000	\$694	\$8,000	\$400	\$1,221	\$102
Urban, Underground	\$250,000	\$0	\$20,000	\$400	\$2,288	\$191
CBC, On-Street	\$2,000,000	\$8,000	\$2,500	\$300	\$1,291	\$108
CBD, Surface	\$2,000,000	\$15,385	\$2,500	\$300	\$1,988	\$166
CBD, 4-Level Structure	\$2,000,000	\$3,846	\$10,000	\$400	\$1,707	\$142
CBD, Underground	\$2,000,000	\$0	\$22,000	\$500	\$2,388	\$199

*This table illustrates the costs of providing parking under various conditions. The “Parking Cost, Pricing and Revenue Calculator” ([www.vtpi.org/parking.xls](http://www.vtpi.org/parking.xls)) calculates these costs.*

In a detailed analysis, Delucchi (1998) estimated the value of road right-of-way land to total \$218 billion in 1991 (Table 8). Assuming 8% return on investment, this represents an annualized value of \$17.5 billion, or 0.8¢ per vehicle mile. He estimates that off-street parking costs include \$15.4 to \$41 billion for residential parking, \$48 to \$162 billion for business supplied parking, and \$12 to \$20 billion for municipal and institutional supplied parking, unpriced parking is worth \$148 to \$288 billion (in 1991 U.S. dollars). This averages \$788 to \$1,531 per motor vehicle year, or 6.3¢ to 13.3¢ per motor vehicle mile. As mentioned earlier, Delucchi’s analysis overlooked several land use categories, and so probably underestimated the total value of parking facilities.



**Table 9**      **Calculated Value of Unpaid Parking** (Delucchi, 1998, Table 6-B.1)

Cost Item	High	Low
Workers 16 years old or older ( $10^6$ )	115.1	115.1
Of total workers, the fraction that uses motor vehicles	0.866	0.866
Persons per vehicle, for commute trips	1.14	1.14
Of those who drive to work, the fraction that parks free on the street	0.10	0.05
Of those who drive to work, the fraction that pays for parking	0.048	0.048
Calculated average monthly parking rate, excluding taxes (\$/month)	42.4	62.7
<i>Potential revenues from unpriced commuter parking, excluding taxes (<math>10^9</math> \$/year)</i>	<i>37.9</i>	<i>59.3</i>
Non-commute trips that require offstreet, non-residential improved parking ( $10^6$ )	73,796	93,457
Of total non-commute trips the fraction that pays full cost for parking	0.04	0.02
Calculated average hourly parking rate, excluding taxes	0.78	1.00
Average time spent in parking space per trip (hours)	2.00	2.50
<i>Potential revenues from unpriced non-commute parking, excluding taxes (<math>10^9</math> \$/year)</i>	<i>110.3</i>	<i>228.6</i>
<b>Total potential revenues from unpriced parking, excluding taxes (<math>10^9</math> \$/year)</b>	<b>148.2</b>	<b>287.9</b>
Total calculated payments for presently priced parking, excluding taxes	6.73	7.82
<i>Total potential revenues from parking for all trips, excluding taxes (<math>10^9</math> \$/year)</i>	<i>155.0</i>	<i>295.8</i>

*This table summarizes one estimate of the value of U.S. parking subsidies.*

here is probably about one residential and two or more non-residential off-street parking spaces per motor vehicle in a typical urban area, with an average annualized cost of \$400 per on-street space, \$600 for a residential off-street space, and \$800 per non-residential off-street space, this totals \$3,000 annually per vehicle. Cost per space are lower in suburban and rural areas, due to lower land costs, but there tend to be more spaces per vehicle in such areas, so parking cost per vehicle are probably similar. An estimated third of this value consists of land. This suggests that parking facility costs total more than \$500 billion annually in the U.S., more than three times as large as total expenditures on public roads, of which perhaps \$200 billion is for land (Litman, 2004).

The cost of land devoted to parking can be exaggerated in two ways. First, a parcel of land often has areas unsuitable for a building but suitable for parking. This may result from an odd-shaped of a parcel, or to maintain a distance between buildings to allow in sunlight and to reduce noise. It could be argued that there is no cost of using this land for parking. However, such land usually does have alternative uses, often as greenspace, so the economic cost is the lost value of a lawn or garden. Second, land used for parking sometimes serves other functions. For example, retail stores sometimes hold special sales in their parking lots.

TeleCommUnity (2002) estimated that U.S. roadway rights of way total 625,517,587,200 square feet or 22,437 square miles, with a total value of \$3,565 billion, or up to \$10.9 trillion using a comparable transaction valuation methodology. Using U.S. federal data they estimate that the entire roadway system has a present value of \$4,676 billion, of which \$3,565 billion (76%) is land value and \$1,110 billion (24%) is for improvements.

Using a different valuation methodology they estimate that entire value of the nation's rights of way for a single year produces an annual rental value range between \$305 and \$366 billion. Assuming normal sales prices for real estate are based on 30 times annual lease payments, comparable rates for the rights-of-way ranges between \$9,153 and \$10,984 billion. They comment, "...the cost of acquiring a right-of-way corridor necessarily is more expensive than simply the ATF (Across the Fence) value of the abutting land. Applying the lowest corridor enhancement factor now employed by appraisers suggests the value is \$7.1 Trillion. These results are consistent and conservative when measured against comparable transactions reported by federal government agencies."

Some people argue that land devoted to roads and parking has no economic cost because its value is more than offset by improved access, and increased value to adjacent land. They argue that there is an abundance of developable land on earth, and improved access to outlying areas allows the total amount of accessible land to increase. A unit of urban land devoted to roads and parking is offset by urban expansion. They assume that there is no economic cost to a more spread city, provided that transportation costs are low. There are several weaknesses to this argument.

The assumption that expanding roads and parking improves access only applies to automobile travel. There are other forms of access, most of which have less land requirements. Roads and parking facility expansion tend to reduce the efficiency of other forms of access: wide roads and expanded parking facilities create barriers to walking and disperse destinations, reducing pedestrian and public transit accessibility. Ignoring transport facility land values favors space intensive travel modes such as automobile travel over more land efficient alternatives such as walking, cycling and public transit.

From some perspectives, and under some conditions, the amount of available land is limited. For example, many jurisdictions cannot expand, so any increase in the amount of land devoted to transportation facilities means less land available for other productive uses within that jurisdiction. Some pieces of land have unique historic or environmental attributes. Similarly, a new highway that bisects an existing neighborhood may cause harm in terms of reduced community cohesion, even if the homes and businesses are physically replaced elsewhere in the region.

A hectare of land at the urban fringe is not a perfect substitute for a hectare of dense urban land due to agglomeration economies (productivity benefits that result when activities are located close together). Land devoted to roads and parking must be located adjacent to activity centers. Marginal increases in road and parking land requirements spread activities. This increases the amount of travel required for access, and reduces pedestrian (and therefore transit) transport options.

For example, it tends to be easier to perform several errands in a dense, walkable commercial center than in a lower-density, automobile-oriented commercial strip. The former emphasizes *access*, while the latter emphasizes *automobility*. Residents of lower-density urban regions tend to spend the same amount of time and significantly more money on transport than people living in more clustered, multi-modal areas (Newman and Kenworthy, 1998). In the short-run (for a given land use pattern), increased land for roads and parking increases access for motorists, but over the long-run it can reduce access overall by creating more dispersed land use. This is particularly burdensome to people who for any reason cannot rely on automobile transportation.

Although agglomeration benefits are difficult to measure, they appear to be large (Anas, Arnott and Small, 1997; Lee, 1999). Agglomeration can increase economic productivity and development. It also reduces household transportation costs. One published study found that doubling a county-level density index is associated with a 6% increase in state-level productivity (Haughwout 2000). This suggests that marginal increases in the portion of urban land devoted to roads and parking reduces economic productivity.

Some transportation economists argue that agglomeration benefits have disappeared due to increased mobility. They claim that businesses and residents can now locate efficiently almost anywhere in a modern urban region. This suggests that there is little cost to reduced density, but empirical evidence indicates that location and agglomeration still has significant value: Although rent gradients have declined, they have not disappeared, and under some circumstances they are quite high. For example, major commercial and employment centers have developed in modern, automobile-oriented cities. "High tech" centers have developed, despite the fact that such industries deal with products (design and software) that have minimal transport requirements.

No single model calculates the opportunity cost of roadway land, but this value can be bracketed. The high end is indicated by the value of adjacent land, the low end by average urban fringe land values. Where within this range a parcel should be assigned depends on various assumptions, particularly the economic productivity value of density and proximity. A reasonable estimate might use average land values within a general land use categories, such as high, medium and low value urban land, high, medium and low value suburban land, and high, medium and low value rural lands.

Lee (1995) uses a similar approach. He applies the FHWA's prototypical land acquisition cost per mile for 9 roadway classes to the entire U.S. road system to estimate total land value and calculate annual interest forgone to be \$75 billion, an estimate he considers to be conservative. This value is approximately equal to total annual roadway user payments (fuel taxes and vehicle registration fees), suggesting that roadway user charges would more than double to capture rents as well as facility construction costs. Delucchi estimates that U.S. roadway land value totals \$218.1 billion in 1991 dollars, which represents an annualized value of \$17.5 billion.

### *Low-Density, Urban Fringe Development (Sprawl)*

As described above, increasing the amount of urban land devoted to roads and parking tends to encourage lower-density, urban fringe development (sprawl). Generous minimum parking requirements and other regulations that limit development density tend to encourage suburban development (where land is cheaper) over urban development (where land costs are higher). There are a number of social costs associated with such development patterns (Burchell, et al, 1998; Litman, 2002):

- Increases costs of providing many municipal services.
- Increases total vehicle use and associated social costs.
- Reduces transit service efficiency and overall accessibility.
- Reduces agricultural land, greenspace and wildlife habitat.
- Increases per capita energy use.
- Reduces sense of community.
- Reduces historic preservation.
- Contributes to inner-city deterioration.

### *Environmental Impacts*

Paving land for roads and parking facilities imposes a number of environmental costs ("Land Use Impact Costs," Litman 2004):

- Loss of greenspace, including a displacement of wildlife habitat and farmlands.
- Increased impervious surface, including increased stormwater management, hydrologic disruption, heat island effects and loss of habitat (Arnold and Gibbons, 1996; USEPA, 1999).
- Increased "heat island" effect, which increases urban temperatures by 2-8° F during summer due to increased solar gain from dark colored roads and parking lots. These higher temperatures increase energy demand, smog and human discomfort (USEPA, 1992).
- Aesthetic degradation. Wide roadways and large parking facilities often create a less attractive landscape and places constraints on urban design.

Table 10 indicates stormwater fees in various jurisdictions. If an average motor vehicle requires approximately 3,000 square feet of urban pavement (3 off-street parking spaces with 333 square feet of pavement, and twice this amount of land for roads), and these stormwater utility costs are representative of urban areas, stormwater management costs average \$10-45 per vehicle-year, or 0.1-0.4¢ per vehicle mile ("Water Pollution and Hydrologic Impacts," Litman 2004).

**Table 10      Impervious Surface Stormwater Fees** (Project Clean Water 2002)

Location	Fee	Annual Fee/1000 sq. ft
Columbia County Stormwater Utility, Augusta, GA	\$1.75 monthly per 2,000 sq. ft.	\$10.50
Spokane County Stormwater Utility, Spokane, WA	\$10 annual fee per ERU.	\$3.13
City of Oviedo Stormwater Utility, Oviedo, FL	\$4.00 per month per ERU	\$15.00

"Equivalent Run-off Unit" or ERU = 3,200 square foot impervious surface.

### *Reduced Housing Affordability*

Parking requirements raise housing costs, decrease maximum potential densities, and reduce developers' incentive to build affordable housing. Based on typical affordable housing development costs, one parking space per unit increases costs by about 12.5% and two parking spaces increase costs by more than 25%, compared with no off-street parking (Litman, 1998). Since parking costs increase as a percentage of rent for lower priced housing, and housing represents a larger portion of household expenditures for poorer households, parking costs are highly regressive.

### *Reduced Property Tax Revenues*

Because it is in public ownership, land devoted to roads and some parking facilities is property tax exempt, which is a market distortion which tends to result in excessive land being devoted to transportation facilities and reduced tax revenue compared with other, taxable uses of the same land (Braid, 1995; Roth, 1996; Poole, 1997). The American Planning Association's Policy on Transportation Planning (October 1990) states, *"Equal tax treatment requires that transportation facilities and services not be exempted from general property and sales taxes that contribute revenues to the general-purpose operation of government."*

In addition, private land devoted to driveways and parking is often assessed at a lower rate than if it were used for other purposes, on the assumption that these are a necessary support for productive facilities. For example, if half a parcel of land is devoted to a building and the other half is devoted to unpriced parking, assessors may treat only the building as providing revenue. The land devoted to parking is treated as a non-revenue producing support facility. These practices encourage increased land being devoted to roads and parking facilities compared with charging taxes on such land.

Economic efficiency requires economic neutrality, meaning that taxes are applied at the same rate to all goods unless a subsidy (discount or exemption) is specifically justified. A certain amount of land can be devoted to roads for the sake of "basic mobility," which can be considered a social good that benefits people regardless of how much they drive. Basic mobility can typically be provided by a single lane of roadway (the amount of roadway that people usually choose when building their own driveway). Additional road capacity beyond that amount should be charged to users. This suggests that roadway users should be charged property taxes on about  $\frac{3}{4}$  of the value of roadway rights-of-way.

## How Zoning Practices Affect Land Devoted to Road and Parking

*This section describes zoning codes and how they affect the amount of land devoted to transportation facilities.*

Most communities have minimal parking requirements such as those in Table 11, based on parking and traffic generation field studies published by professional organizations such as the Institute of Transportation Engineers (ITE). Although this seems rational and accurate, the standards are actually arbitrary and often excessive, for the following reasons.

**Table 11**      **Typical Off-Street Parking Requirements** (Homburger, et al., 1992)

Building Type	Unit	Spaces
Single Family Housing	Dwelling Unit	2.0
Multi-Family Housing	Dwelling Unit	1.8
Apartments	Dwelling Unit	1.5
Neighborhood Commercial	100 sq. m. GLA	4.7
Community Commercial	100 sq. m. GLA	5.3
Regional Commercial	100 sq. m. GLA	5.8
Office Building	100 sq. m. GFA	3.2
Fast-Food Restaurant	Seats	0.85
Church	Seats	0.5
Hospital	Beds	2.6
Light Industry	100 sq. m. GFA	2.2

GLA = Gross Leasable Area

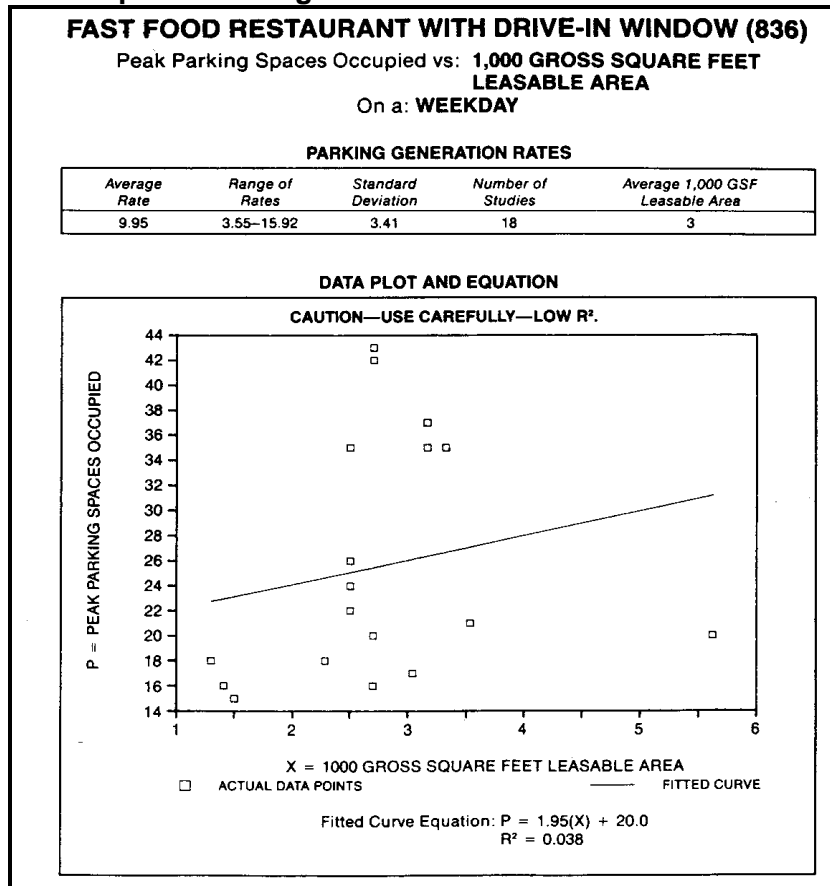
GFA = Gross Floor Area

Most published demand studies are performed at relatively isolated sites because they are easiest to perform. For example, if a barbershop, grocery store and theater share parking facilities it would be difficult to determine which vehicles are attracted by which business. Parking generation studies tend to be performed in high growth areas. As a result, the studies over represent suburban, automobile dependent sites. Most study sites have free parking. Basing parking requirements on demand studies at zero price results in a self-fulfilling prophecy: standards are so generous it would be uneconomical to charge for parking since most spaces would be unused if priced.

Transportation engineers tend to apply the highest parking requirement that might be justified. They often use an “85<sup>th</sup> Percentile” standard when setting standards, which means that 85 out of 100 sites will have excess capacity even during peak-periods. The studies themselves show highly scattered data, as indicated in Figure 6. It shows that fast food restaurants with 2,000-3,000 sq. feet of floor area had between 15 and 43 parking spaces used. Similar ranges exist for most other building types and sizes. Standards based on average values from such studies result in excessive parking supply at many destinations.



**Figure 6** Example of Parking Demand Studies



*This summarizes studies used to establish parking standards for one type of land use. Note the large degree of scatter, yet a curve is still plotted, implying that this data can be used to predict the parking requirements at a particular site.*

Parking demand is affected by a variety of geographic, demographic and economic factors, such as land use density, residents' income, and whether parking is priced ("Parking Evaluation," VTPI, 2005). ITE parking studies do not take these factors into account, so cannot accurately determine parking demand at a particular site.

As a result of these various factors, parking capacity is often economically excessive. One study of worksites found that average parking supply was 30% greater than peak-period demand (Kadesh and Peterson, 1996). Other studies find similar levels of oversupply (Willson, 1995). Roadway capacity standards also tend to be generous, resulting in wider lanes and greater capacity than is required for mobility and safety (Burden and Lagerwey, 1999). For example, planners in Eugene, Oregon found that local road rights-of-way could be easily reduced 16-20% over standard practices without reducing performance (West and Lowe, 1997).

## Economic Analysis

*This section evaluates current practices in terms of economic criteria.*

### *Requirements For Efficient Road And Parking Land Use*

An efficient market requires adequate consumer choice, cost-based pricing, and economic neutrality (“Market Principles,” VTPI, 2005). Transportation markets often violate these requirements (Litman, 2003). Current planning practices and public policies tend to favor automobile travel at the expense of other modes that reduces consumer options, and road and parking facilities are generally underpriced.

In an efficient market, motorists would pay directly for using roads and parking, including rent and property taxes on land used for these facilities. A portion of roadway land might be unpriced to provide “basic mobility,” and some uses might be subsidized for horizontal equity, but such adjustments would represent a minor portion of total facility costs. Road users would be charged a congestion fee when driving on congested roads, and road capacity would be expanded only when these fees exceed capacity expansion costs. There would be no need for minimum parking requirements: the market would determine how much parking supply is optimal. User fees would include payment for environmental mitigation of impacts caused by road and parking facilities.

Paying directly for roads, roadway land value, traffic services and roadway environmental impacts would approximately double per-mile vehicle fees, from about 10¢ per mile up to about 20¢ per mile, with higher fees under urban-peak conditions and lower fees under rural conditions (Litman, 2005). Such fees can be expected to reduce travel by about 20-30%, which would reduce roadway capacity requirements.

In addition, charging motorists directly for parking (including unbundling residential parking where possible) would increase average per-mile vehicle costs by 5-10¢ per mile, resulting in a small (5-10%) reduction in vehicle ownership and a 10-30% reduction in vehicle travel. This should allow parking supply to be reduced by a comparable amount. Of course, these are rough, order-of-magnitude estimates, actual impacts should vary significantly depending on geographic, demographic and management factors.

It is impossible to predict exactly how land use would change overall from more efficient transportation markets, but the resulting changes would probably be large, particularly over the long-run, and supported by efficient land use planning practices.

Although motorists would pay more to use roads and parking facilities, these would not represent an overall increase in costs; they simply represent direct rather than indirect payment for using these facilities, and application of rent and taxes to roadway lands for economic neutrality. Increased user payments would be offset by reductions in other taxes and fees which are currently used to subsidize roads, traffic services and parking

facilities, and by the increased economic efficiency and reduced external costs resulting from efficient pricing, and the improved consumer transportation options that result from more neutral policies. As a result, consumers should benefit overall.

### *Possible Justifications for Generous Road and Parking Capacity*

For better or worse, the world is not managed by economists applying market principles. Public policies are usually made by officials and professionals who have specific objectives and concerns. It is therefore useful to consider how policies that affect the amount of land devoted to roads and parking are perceived by these decision makers, businesses and the general public. These issues are discussed below.

#### **Motorists Convenience**

Abundant road and parking capacity makes driving more convenient. With conventional payment systems (toll booths and parking meters) pricing is inconvenient. However, new, electronic payment systems reduce much of this inconvenience, and efficient pricing increases user convenience in many ways (reducing congestion, increasing parking turnover, and improving access by alternative modes).

#### **Avoiding Conflict**

Abundant parking capacity reduces conflicts over parking, and therefore the need to negotiate disputes and enforce parking regulations. This is probably perceived as a major benefit to public officials, who are often the people who must deal with such problems.

#### **Economic Development**

Highway improvements are a traditional way to stimulate economic development in an area. Although such benefits appear to be small now that the road system is mature (alternative public investments can usually provide much greater benefits), many decision-makers may assume that such benefits are significant, and planning and funding institutions exist to implement roadway projects (Boarnet and Haughwout, 2000).

#### **Equity/Affordability**

Strategies that result in free parking may be considered a way to benefit lower-income people by making parking (and therefore driving) affordable. But the equity impacts of such fees depend on travel choices and how revenues are used. If consumers have good alternatives to driving and revenues benefit lower income households (they replace regressive taxes, fund services that benefit the poor, or provide cash rebates), higher user charges can be neutral or progressive overall. Policies that favor automobile travel are regressive because they reduce travel options for non-drivers and force people who drive less than average to subsidize the costs of those who drive more than average. For these reasons, distortions that favor automobile travel are inappropriate ways to increase equity.

Although these factors may justify some distortions, they do not appear to justify the high levels of distortions that favor road and parking facilities. Although it may not be possible to create absolutely perfect markets, it appears economically feasible to correct many distortions. Many current distortions result from older social objectives (i.e., to

stimulate vehicle production) and technologies (i.e., mechanical toll collection) that longer appear relevant. For example, it may not be appropriate to charge for all parking everywhere, but there is little doubt that society would benefit overall by increasing the portion of roads and parking facilities that are priced.

## **Alternative Policies' Impacts on Transportation Land Use**

Various policy changes have been proposed to reduce the amount of land devoted to roads and parking without significantly reducing access. These are justified for various reasons: many reflect market principles and therefore improve economic efficiency and equity, they help solve specific problems such as traffic congestion and accidents, and they can be justified on second-best grounds, until transportation and land use market reforms are implemented. Examples are described below (Litman, 2001; VTPI, 2005):

### *Price Road and Parking*

Charge users directly for use of roads and parking tends can significantly reduce traffic and parking demand. Daily parking fees of \$1.50 to \$3.00 typically reduces solo commuting by 20-40%. Since consumers pay for free parking indirectly (through taxes, retail prices, and employee benefits), this need not increase users' overall costs if they receive a portion of the savings.

### *More Flexible and Accurate Road and Parking Requirements*

Current parking requirements are arbitrary and excessive (Shoup, 1999). Parking standards are based on studies that are typically performed at new, suburban sites with unpriced parking, and are therefore excessive for urban areas, where parking is priced, or where Transportation Demand Management programs are implemented. Parking requirements can be reduced by using standards that more accurately reflect each site's needs, such as lower requirements at more accessible, multi-modal urban locations than in lower-density, automobile-dependent suburban locations.

### *Share Parking Facilities*

Sharing parking spaces typically allows 15-25% more users than assigning each motorist a particular space. For example, 50 employees may share 35-40 parking spaces. Even greater reductions are possible with mixed land uses, since different activities have different peak demand times. For example, a restaurant can share parking efficiently with an office complex, since restaurant parking demand peaks in the evening while office parking demand peaks during the middle of the day.

### *Reduce Road and Parking Requirements In Exchange for TDM Programs.*

Road and parking requirements can be reduced at sites that implement TDM programs. For example, a developer's parking requirements could be reduced 20% if they implement a Commute Trip Reduction program or charge users directly for parking.

### *Unbundling Parking*

Parking facilities are often “bundled” with building costs, which means that a certain number of spaces are included with building purchases or leases. This assumes that all building users (residents, businesses, employees, etc.) have equal and unchangeable parking requirements. It is more fair and efficient to sell or rent parking separately, so building occupants pay for just the number of spaces that they require, and can adjust their parking supply as their needs change.

### *Cashing Out Free Parking*

Cashing Out parking means that commuters who are offered subsidized parking are also offered the cash equivalent if they use alternative travel modes. This tends to reduce automobile commuting by 15-25%.

### *Location Efficient Mortgages (LEMs)*

LEM means that lenders consider potential transportation cost savings to households located in accessible neighborhood (where services and public transit are convenient) in mortgage analysis. Housing in such locations has lower parking requirements because residents tend to own fewer cars. This encourages households to choose housing in more multi-modal neighborhoods.

### *Develop Overflow Parking Plans*

Excessive parking is sometimes required to meet infrequent demand peaks that occur during special events. Parking requirements can be reduced if facility managers develop overflow Parking Management plans that make use of off-site parking.

### *Regulate Onstreet Parking Facilities*

On-street parking can be regulated to make it available for priority uses and encourage turnover.

### *Tax Parking*

Some communities impose taxes on parking facilities. This can be an effective TDM strategy provided that the tax is borne directly by users rather than being paid by businesses. It tends to be a revenue generation strategy.

## Conclusions

A large amount of land is used for transportation facilities, particularly roads and parking. This land has a significant value, particularly because transportation facilities must be located near important destinations where land costs are high. Transportation facility land is one of the most valuable assets owned by many jurisdictions and a major component of real estate development costs.

However, this value is often overlooked. Roadway and parking facility land values are not generally calculated or tracked as specific assets. Transportation land is often considered a sunk cost, with little current value, which is generally incorrect, since virtually all land has alternative potential uses, so devoting land to roads and parking facilities represents an opportunity cost. Paving land for roads and parking facilities imposes environmental and aesthetic costs, and each incremental amount of land devoted to roads and parking facilities reduces the amount of land available for development within a given area, which tends to disperse destinations, resulting in sprawl and automobile dependency. This increases the amount of travel required to maintain a given level of accessibility, and reduces transportation options.

A few studies have tried to estimate the total amount of land devoted to roadways and parking facilities, and the value of this land. In major commercial centers more than half of all land is devoted to these uses, although the portion is much smaller (probably about 10%) for urban areas overall. Claims that half of all city land is devoted to roads and parking are a misrepresentation of the data.

A variety of planning and market distortions increase the amount of land devoted to roads and parking facilities beyond what is economically efficient or socially desirable. In an efficient market users would generally pay directly for using roads and parking facilities, including appropriate charges representing rent and property taxes on roadway land. Although a minimum amount of public land might be devoted to roads without charge in order to provide basic access to adjacent properties, this usually only requires a single traffic lane, any additional land should be required to earn income or provide broad social benefits comparable to potential alternative uses. The marginal amount of land devoted to roads and parking would compete with other land uses, and would be increased only if user fees were adequate to pay for such land, and would be reduced if other land uses could pay more in user fees or social benefits.

A variety of market reforms and planning strategies can correct existing distortions, reducing the amount of land devoted to roads and parking facilities. In more optimal transportation and land use markets, motor vehicle ownership and use, and the amount of land devoted to roads and parking facilities would probably decline somewhat, but people would be better off overall, due to reductions in taxes and other fees, improved economic efficiency and productivity, reduced external costs, and improved transportation and land use options.



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