5.4 Parking Costs

This chapter explores the costs of providing parking. It investigates the costs of different types of parking facilities, the number of spaces per vehicle, and the distribution of parking costs.

5.4.1 Chapter Index

5.4.2 Definitions

Parking costs include parking facility land, construction and operating costs, plus indirect costs such as stormwater management costs. There are various types of parking facilities:

- *On-street parking* consists of parking lanes provided within public road rights-of-way.
- *Off-street parking* are parking facilities on their own land, not on road rights-of-way.
- *Surface parking* refers to parking lots directly on land.
- *Structured parking* (also called *parkades* or *ramps*) are parking facilities in or under multi-story buildings.

5.4.3 Discussion

Land Area and Value

A typical parking space is 8-10 feet (2.4-3.0 meters) wide and 18-20 feet (5.5-6.0 meter) deep, totaling 144-200 square feet (13-19 sq. meters).[1] Off-street parking typically requires 300-350 square feet per space, including access lanes and landscaping, allowing 100-150 spaces per acre (250-370 per hectare), depending on design. Land costs can vary from thousands of dollars per acre in rural areas to millions of dollars per acre in central business districts (CBDs). Because parking must be located near destinations, it often requires relatively high-value land. Parking facility land is sometimes considered to have little or no value. For example, building or campus managers sometimes consider land as free, and so only consider operating and maintenance expenses when calculating parking costs. But there is usually an opportunity cost to devoting land to parking, since it could be used for buildings, landscaping, leased or sold. Similarly, parking lanes can be converted to traffic lanes, busways, bike lanes, landscaping, or additional sidewalk space. Some cities even convert parking spaces to "parklets" (small sidewalk parks).[2]

Construction Costs

Parking facility construction costs are affected by size per space, size and shape of site (small and irregular shaped sites increase unit costs), number of levels (more levels increase unit costs), topography (slopes and poor soil conditions increase costs), design (exterior aesthetic treatments can increase costs), and geographic location. Structured parking involves a trade-off between construction and land costs. Structured parking typically becomes cost effective when land prices exceed about $1 million per acre.

Table 5.4.3-1 **Parking Structure Construction Costs**[3]

City	Cost Per Space	City	Cost Per Space
Atlanta	$14,028	Los Angeles	$16,842
Baltimore	$14,479	Miami	$14,043
Boston	$17,947	Minneapolis	$17,079
Charlotte	$12,441	New Orleans	$13,825
Chicago	$17,869	New York	$20,326
Cleveland	$15,474	Philadelphia	$17,604
Denver	$14,774	St Louis	$15,178
Dallas	$13,281	San Francisco	$19,253
Detroit	$16,049	Seattle	$16,158
Kansas City	$15,878	*National Average*	*$15,552*

Overall, U.S. parking structure construction costs are reported to average about $15,000 per space or $44 per square foot in 2008, however this may include ground floor spaces

[1] James Hunnicutt (1982), "Parking, Loading, and Terminal Facilities," in *Transportation and Traffic Engineering Handbook*, Institute of Transportation Engineering/Prentice Hall, 1982, p. 651.
[2] *Pavement to Parks* (http://sfpavementtoparks.sfplanning.org) San Francico Parks Department.
[3] Carl Walker (2009), "Parking Structure Cost Outlook for 2009," *Industry Insightes*, Carl Walker, First Qr.; at www.carlwalker.com/press/newsletters.

which should not be counted.[4] In addition to these "hard" costs, facility development usually involves "soft" costs for project planning, design, permits and financing, which typically increase project costs by 30-40% for a stand-alone project. Shoup documents construction costs ranging from $13,712 to $31, 500 per space at a California university between 1990 and 2002.[5] He notes that most spaces in parking structures cost more than the cars that occupy them. Future construction costs may increase above the rate of inflation due to increased petroleum costs and carbon taxes or cap-and-trade costs on emissions from concrete and steel manufacturing.

Operation and Maintenance

Operation and maintenance costs include cleaning, lighting, maintenance, repairs, security, landscaping, snow removal, access control (e.g., entrance gates), fee collection (for priced parking), enforcement, insurance, labor and administration. Parking facilities require resurfacing and repaving every 5-10 years, and parking structures require major reconstruction or replacement after 20-40 years, with higher maintenance costs in areas with harsh climates, particularly with frequent salt exposure. Parking structures may require elevators, fire control and mechanical ventilation. Private parking facilities must pay taxes and provide profits. The incremental cost of fee collection ranges from less than $50 annually per vehicle for a simple pass system with minimal enforcement, to more than $500 per space for facilities with attendants or automated control systems. A 1998 study found that typical annual costs per space ranged from about $200 for basic maintenance of a surface lot, up to $800 for a facility with tollbooth attendants.[6]

A 1996 survey found that commercial parking operating expenses average about $500 annually per space, about half of which is associated with fee collection and security:[7]

Cashiering Salaries & Benefits	$120
Management and supplies	85
Security	67
Utilities	58
Insurance	16
Routine Maintenance	19
Structural Maintenance	50
Snow removal	4
Equipment maintenance	11
Other expenses	64
Total	*$494*

[4] Joey D. Rowland (2008), "Contruction Cost Outlook for 2008," *Industry Insights*, Carl Walker Parking (www.carlwalker.com); at www.carlwalker.com/sites/default/files/pdfnews/1st_quarter_4up_final_ag.pdf.
[5] Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org). Table 7-3 p 211. Values not adjusted for inflation.
[6] John Dorsett (1998), "The Price Tag of Parking," *Urban Land*, Urban Land Institute (www.uli.org), May 1998, pp. 66-70.
[7] ITE (1999), *Transportation Planning Handbook*, ITE (www.ite.org) p. 535.

Table 5.4.3-2 shows operating costs at several commercial parking facilities from a 2005 survey, indicating that costs typically range from $500 to $800 per space per year, including employee wages and benefits, facility maintenance and cleaning, utilities, taxes, and insurance.

Table 5.4.3-2 **Sample Commercial Parking Facility Annual Operating Expenses**[8]

	Fort Collins, CO	Phoenix, AZ	Boise, ID	Portland, OR
Number of parking spaces	903	744	495	413
Total operating costs	$416,400	$519,100	$361,800	$349,400
Cost per space	$461	$698	$731	$846

Marginal Costs

Parking facility costs are often perceived as sunk. Land devoted to parking is often treated as having no opportunity costs, so the only costs of increasing supply are construction and maintenance expenses. Once a parking space is built or leased, facility owners and managers often assume there are minimal savings if parking demand were reduced, for example, if employees shift modes and leaving parking spaces unoccupied. However, reducing parking demand usually can provide savings and benefits, by avoiding the need to add parking to accommodate growth, by allowing parking facilities to be leased or rented for other users, or the land can be converted to other uses such as buildings or greenspace, or sold. Opportunity costs are particularly large in growing urban areas where parking demand and land prices are high and increasing, and in areas with high environmental values where reducing pavement provides substantial benefits.

Environmental and Indirect Costs

Paving land for parking imposes environmental costs, including greenspace loss (reduced landscaping, farmland, wildlife habitat etc.), increased impervious surfaces, and related stormwater management costs, heat island effects and aesthetic degradation.[9] Generous parking requirements and low parking prices tend to discourage infill development, encourage sprawl (low density, dispersed development patterns).[10] As a result, it tends to increase per capita vehicle ownership and use and reduces the viability of other modes such as walking, cycling and public transit. Generous residential parking requirements also tend to reduce housing affordability.[11]

The construction of parking facilities, particularly parking structures, consumes large quantities of energy and results in significant emissions of greenhouse gases from the production of concrete and steel. Ongoing operations and maintenance also requires

[8] PT (2005) "What's It Cost You To Run Your Garage?," *Parking Today* (www.parkingtoday.com), May, pp. 30-32.
[9] Todd Litman (2002), *Evaluating Transportation Land Use Impacts*, VTPI (www.vtpi.org); at www.vtpi.org/landuse.pdf.
[10] Richard Willson (1995), "Suburban Parking Requirements; A Tacit Policy for Automobile Use and Sprawl," *Journal of the American Planning Association*, Vol. 61, No. 1, Winter 1995, pp. 29-42.
[11] Todd Litman (2008), *Parking Requirements on Housing Affordability*, VTPI (www.vtpi.org); at www.vtpi.org/park-hou.pdf.

energy and materials that have environmental costs. Shoup cites a UCLA (Los Angeles, California) Environmental Impact Report data to estimate external congestion costs of $73 per month per space and pollution costs of $44 for a total external cost of $117 per month per space assuming 83 one-way trips per space totaling 727 vehicle miles.[12] This estimate does not include the additional greenhouse gas emission costs from increased vehicle travel and parking structure construction.

Parking Versus Mobility and Accessibility
There are often conflicts between the use of curb lanes for parking or for *mobility*, including general lanes, special lanes for buses, high-occupancy-vehicles or bicycle, or for wider sidewalks. In some situations, converting parking lanes to other uses can be justified if it will result in a shift from driving to alternative modes, reducing parking demand in an area. For example, about 30,000 people commute to downtown Victoria each day, about 20,000 by automobile and 3,000 by bicycle. If converting one-mile of on-street parking to bicycle lanes reduces parking supply by 100 spaces, but by improving cycling conditions would shift an additional 1% of automobile commuters (i.e., 200 commuters) to cycling, the result would be a net increase of 100 spaces in downtown parking supply. Similarly, shifting parking to busways or HOV lanes can make these modes more attractive, reducing automobile trips to downtown that may partly or completely offset the loss of parking spaces downtown.

Parking planning can also face conflicts between *mobility* (i.e., physical movement) and *land use accessibility* (common destinations located close together). Generous parking requirements tends to create automobile-oriented transportation systems and land use patterns, with dispersed destinations that require more mobility, while parking management tends to support more clustered land use patterns where less mobility is needed. For example, with commercial strip development, businesses are scattered along a highway, each with its own abundant supply of parking. To run a dozen errands it is necessary to take a dozen individual automobile trips from one business to another. A downtown or other urban center, has narrower streets and less parking supply, which reduces mobility, but it tends to have better accessibility because more destinations are located within convenient walking distance. To run a dozen errands generally takes only one or two car trips, with most destinations accessible by walking.

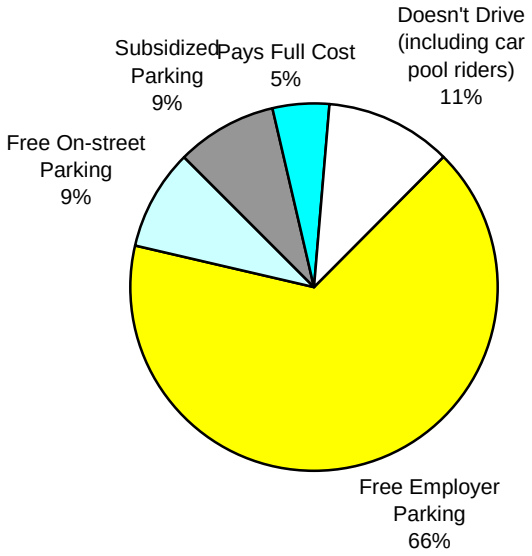
Similarly, the area around a transit station can be developed as a park-and-ride center or as an urban village, with businesses and higher-density residential development clustered around the station (called *Transit Oriented Development*). Park-and-ride facilities tend to increase mobility, allowing suburban commuters to use public transit, while urban villages increase accessibility, and therefore help reduce total per capita vehicle travel. Effective parking management can help balance these conflicting objectives, allowing a certain amount of park-and-ride activity without spoiling the ability of a transit station to be a catalyst for an accessible urban village.

[12] Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org). p. 197.

Parking Cost Distribution

Motorists use unpriced parking for most trips; of the 95% of US commuters who drive, only about 5% pay full parking costs and 9% pay a subsidized rate, while unpriced parking is provided for more than 99% of non-commute trips.[13] Overall, probably about 5% of non-residential parking costs are paid directly by users. The costs of unpriced parking are borne by businesses and governments, and ultimately by customers and taxpayers. Most employee parking is income tax exempt, a benefit to automobile commuters worth up to $1,800 per year. The foregone taxes can also be considered a parking subsidy.

Figure 5.4.3-1 **Employee Parking Subsidy Patterns**[14]



Most commuters who drive use unpriced parking.

There is some debate among economists as to whether unpriced parking should be considered a *subsidy*, since most of these costs are ultimately borne by motorists through housing costs, taxes, retail purchases and as a portion of employment benefits.[15] Some prefer to call it a *bundled good*, that is, something included with a purchase. But regardless of whether they are called a *subsidy* or a *bundled good*, unpriced parking is a market distortion that violates the basic principles of economic efficiency: that consumers should have viable options to choose from, and that prices should reflect marginal costs.

Amount of Land Devoted to Parking Facilities[16]

[13] USDOT(1992), 1990 NPTS, *Summary of Travel Trends*, (www.dot.gov).
[14] Miller and Moffet (1993), *The Price of Mobility*, National Resource Defense Council (www.nrdc.org).
[15] José Gomez-Ibañez (1997), "Estimating Whether Transport Users Pay their Way," *The Full Costs and Benefits of Transportation*, Springer (Berlin), pp. 149-172.
[16] Todd Litman (2000), *Transportation Land Valuation*, VTPI (www.vtpi.org).

Table 5.4.3-3 shows estimated U.S. off-street U.S. parking spaces for commercial buildings. This may overestimate actual commercial parking spaces, since some buildings have fewer than currently recommended supply, because they are older or are located in Central Business Districts (CBDs), but this is offset by the fact that some types of facilities with off-street parking, such as public parks, are not included.

Table 5.4.3-3 **Estimated U.S. Commercial Parking Spaces, 2003**[17]

Building Type	Total Floor Area	Parking Spaces	Parking Spaces
	Million Sq. Feet	Spaces/1,000 Sq. Ft	Thousands
Education	9,874	3	29,622
Food Sales	1,255	3	3,765
Food Service	1,654	4	6,616
Health Care	3,163	3	9,489
Lodging	5,096	3	15,288
Mercantile	11,192	4	44,768
Office	12,208	4	48,832
Public Assembly	3,939	4	15,756
Pubic Order and Safety	1,090	3	3,270
Religious Worship	3,754	3	11,262
Service	4,050	3	12,150
Warehouse and Storage	10,078	1	10,078
Other	1,738	2	3,476
Vacant	2,567	2	5,134
Total	*71,658*		*219,506*

Chester, Horvath and Madanat estimate there are between 105 million and 2.0 billion on- and off-street parking spaces in the U.S., based on the five scenarios summarized below, which indicates between 0.5 to 8 parking spaces per vehicle.

Table 5.4.3-4 **Estimated U.S. Parking Spaces**[18]

Type	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
On-street	35	92	180	150	1,100
Surface	36	520	520	610	790
Structure	34	110	110	84	120
Total	*105*	*730*	*820*	*840*	*2,000*

This table summarizes various estimates of U.S. parking spaces.

Delucchi estimated 125 to 200 million non-residential, off-street parking spaces in the US in 1991, 0.5 to 0.8 spaces per capita, or 0.7 to 1.1 spaces per vehicle, as summarized below, but this estimate excluded some land use categories that generally include parking

[17] EIC (2003), *2003 Commercial Buildings Energy Consumption Survey—Overview of Commercial Buildings Characteristics*, Energy Information Administration, U.S. Department of Energy (www.eia.doe.gov); at www.eia.doe.gov/emeu/cbecs/cbecs2003/introduction.html

[18] Mikhail Chester, Arpad Horvath and Samer Madanat (2010), "Parking Infrastructure: Energy, Emissions, And Automobile Life-Cycle Environmental Accounting," *Environmental Research Letters*, Vol. 5, No. 3; at http://dx.doi.org/10.1088/1748-9326/5/3/034001; project of the UC Berkeley Center for Future Urban Transport (www.sustainable-transportation.com).

such as religious institutions, vehicle dealers, stadiums and parks. Pijanowski found approximately three non-residential off-street parking spaces per vehicle in Tippecanoe County, a typical rural county.[19] Shoup calculates that, including on-street parking, US cities have an average of about of eight parking spaces for each car. [20]

Table 5.4.3-5 **Calculation of Land Area Devoted to Parking**[21]

Nonresidential Offstreet Parking	Low	High
Offstreet nonresidential parking spaces (millions)	125	200
Fraction in lots as opposed to garages	0.65	0.65
Size of parking space (ft2)	150	150
Total ground footprint of parking lot/total parking area	2.17	2.17
Total ground footprint of garage/total parking area	0.20	0.33
Residential offstreet parking		
Housing units with a garage or carport (million HUs)	58.2	58.2
Average area to cars, per garage or carport (ft2)	167	225
Average area per residential driveway (ft2)	190	238
HUs with offstreet residential parking other than own garage or carport (million HUs)	36.0	36.0
Parking spaces per HU with offstreet parking in lot, carport, or driveway	1.09	1.19
Parking spaces per HU with other offstreet residential parking in garage	1.02	1.10
Fraction of other spaces in lots as opposed to garages	0.87	0.87
Total ground footprint of parking lot/total parking area	2.17	2.17
Total ground footprint of garage/ total parking area	0.27	0.72
Calculated total land area devoted to parking cars (square miles)	*2,146*	*3,064*

Davis, et al. (2010) used detailed aerial photographs to estimate the number of parking spaces in surface lots in Illinois, Indiana, Michigan, and Wisconsin.[22] Parking lots were identified as paved surfaces with stripes painted on the surface or where more than three cars were parked in an organized fashion, which excluded on-street and structured parking spaces (other than the top floor if the structure has an open roof), and residential parking spaces not in parking lots. They identified more than 43 million parking spaces in these four states, which averages approximately 2.5 to 3.0 off-street, non-residential parking spaces per vehicle. They estimate that these four states allocate 1,260 km^2 of land to parking lots, with a lower bound estimate of 976 km^2 and an upper bound of 1,745 km^2. This accounts for approximately 4.97% of urban land, with a higher proportion where urban sprawl is most prevalent.

[19] Bryan Pijanowski (2007), *Parking Spaces Outnumber Drivers 3-to-1, Drive Pollution and Warming*, Purdue University (www.purdue.edu); at www.purdue.edu/uns/x/2007b/070911PijanowskiParking.html.
[20] Donald Shoup (2005), *The High Cost of Free Parking.* Planners Press (www.planning.org).
[21] Mark Delucchi (1997), *Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991*, Vol. 6, Institute of Transport Studies (http://engineering.ucdavis.edu/), Table 6-A.1.
[22] Amélie Y. Davis, Bryan C. Pijanowski, Kimberly D. Robinson and Paul B. Kidwell (2010), "Estimating Parking Lot Footprints In The Upper Great Lakes Region Of The USA" *Landscape and Urban Planning*, Vol. 96, Issue 2, 30 May 2010, Pages 68-77; at www.citeulike.org/article/6869205.

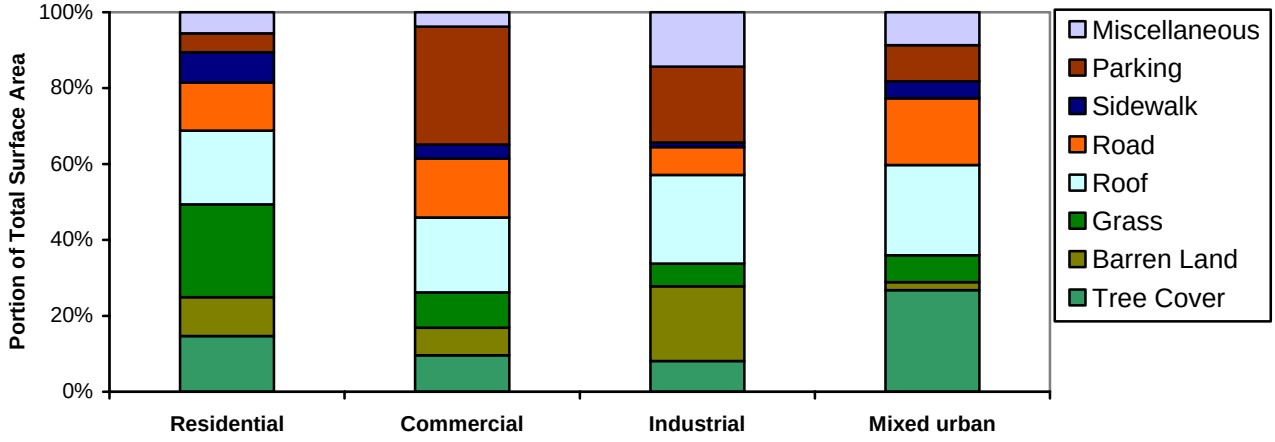
Table 5.4.3-6 **Calculated Surface-Area Percentages**[23]

	Tree Cover	Barren Land	Grass	Roof	Road	Sidewalk	Parking	Miscellaneous
Residential	14.7	10.2	24.5	19.4	12.7	8.0	4.9	5.6
Commercial/service	9.6	7.3	9.3	19.8	15.5	3.7	31.1	3.8
Industrial	8.1	19.7	6.0	23.4	7.3	1.3	20.0	14.3
Transport/communications	0.0	4.0	0.0	5.0	80.0	1.0	10.0	0.0
Industrial and commercial	2.8	15.6	5.6	19.2	10.3	1.3	32.1	13.1
Mixed urban	26.8	2.1	7.1	23.7	17.6	4.5	9.5	8.7

This table summarizes the surface area of various types of land uses in Sacramento, California.

Overall, pavement covers about 35% of the surface area of most residential areas and 50–70% in most non-residential areas and summarized in Table 5.4.3-6 and Figure 5.4.3-2.

Figure 5.4.3-2 **Calculated Surface-Area Percentages**[24]



This figure illustrates the surface area of various types of land uses in Sacramento, California.

This suggests that there are probably at least three off-street parking spaces per vehicle (one residential and two non-residential), plus two urban on-street spaces, although the estimated number of on-street spaces is arbitrary since most suburban and rural roads have shoulders suitable for parking but are not located near destinations. The number of parking spaces per vehicle tends to be lower in urban areas where parking is shared and higher in suburban and rural areas where each destination supplies all its own parking. Multi-story parking structures require less land per space, and underground parking can be considered to use no additional land.

Total Parking Costs

[23] Hashem Akbari, L. Shea Rose and Haider Taha (2003), "Analyzing The Land Cover Of An Urban Environment Using High-Resolution Orthophotos," *Landscape and Urban Planning* (www.sciencedirect.com/science/journal/01692046), Vol. 63, Issue 1, pp. 1–14.
[24] Akbari, Rose and Taha (2003)

The table below illustrates typical parking facility financial costs per space, which vary from about $670 annually for surface parking where land is considered free, to $4,000 in central business districts. These do not include indirect and environmental costs.

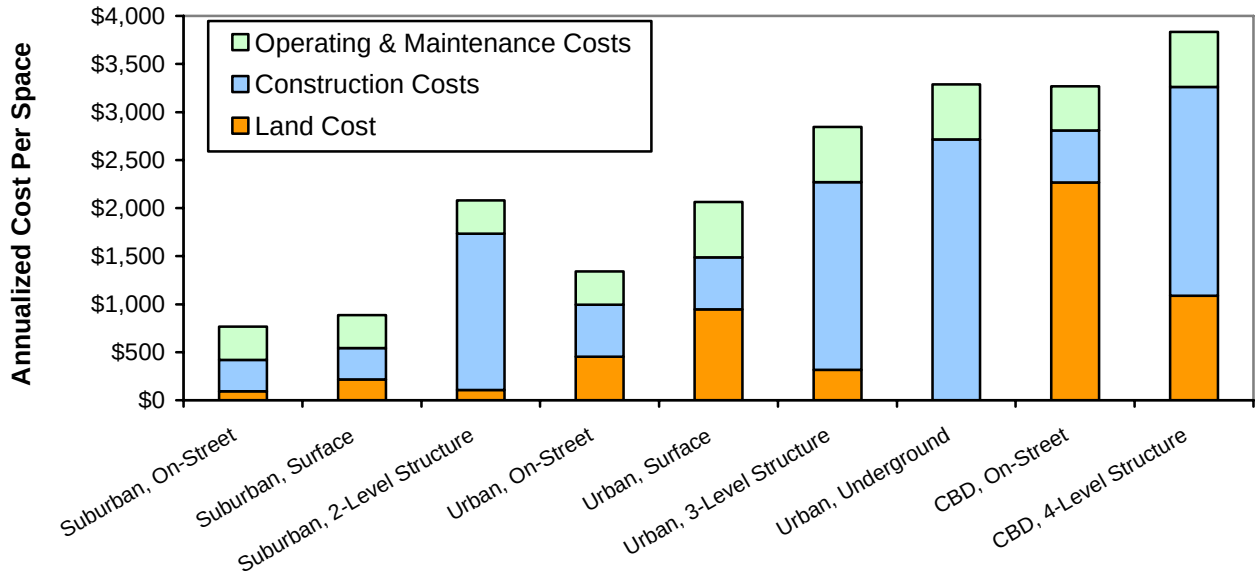
Table 5.4.3-7 **Typical Parking Facility Financial Costs (Parking Spreadsheet)**

Type of Facility	Land Cost Per Acre	Annualized Land Cost Per Space	Annualized Construction Costs	Annual O & M Costs	Total Annual Cost	Total Monthly Cost
Suburban, On-Street	$250,000	$94	$326	$345	$765	$64
Suburban, Surface, Free Land	$0	$0	$326	$345	$671	$56
Suburban, Surface	$250,000	$215	$326	$345	$885	$74
Urban, On-Street	$1,200,000	$453	$543	$345	$1,341	$112
Urban, Surface	$1,200,000	$944	$543	$575	$2,062	$172
Urban, 3-Level Structure	$1,200,000	$315	$1,954	$575	$2,844	$237
Urban, Underground	$1,200,000	$0	$2,714	$575	$3,289	$274
CBD, On-Street	$6,000,000	$2,265	$543	$460	$3,268	$272
CBD, 4-Level Structure	$6,000,000	$1,089	$2,171	$575	$3,835	$320
CBD, Underground	$6,000,000	$0	$3,776	$575	$4,007	$334

This illustrates typical parking facility costs. The "Parking Cost, Pricing and Revenue Calculator" (www.vtpi.org/parking.xls) calculates these costs based on specific input values.

Figure 5.4.3-3 illustrates these annualized costs.

Figure 5.4.3-3 **Typical Parking Annualized Costs per Space (2007 USD)**[25]



This figure illustrates estimated annualized costs per parking space. As noted above, values can vary significantly depending on factors such as local land values.

[25] VTPI (2008), *Parking Cost, Pricing and Revenue Calculator*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/parking.xls.

Assuming two on-street and three off-street parking spaces (one residential and two commercial) per vehicle in a typical urban area, with annualized costs averaging $600 per on-street, $800 per residential off-street, and $1,200 per non-residential off-street space, this totals $4,400 per vehicle. Costs 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. As mentioned previously, only about 5% of total non-residential parking costs are paid directly by users. Table 5.4.3-8 summarizes estimated parking costs, indicating that about three-quarters of total parking costs are borne indirectly, and can be considered external, since they are borne by non-users.

Table 5.4.3-8 **Estimated Annualized Parking Costs Per Vehicle**

	Spaces Per Vehicle	Annual Cost *Per Space*	Paid Directly By Users	Directly-Paid Costs	External Costs	Total Costs
Residential	1	$800	100%	$800	0	$800
Non-res. Off-street	2	$1,200	5%	$120	$2280	$2,400
On-street	2	$600	5%	$60	$1140	$1,200
Totals	*5*			*$980 (22%)*	*$3420 (78%)*	*$4,400 (100%)*

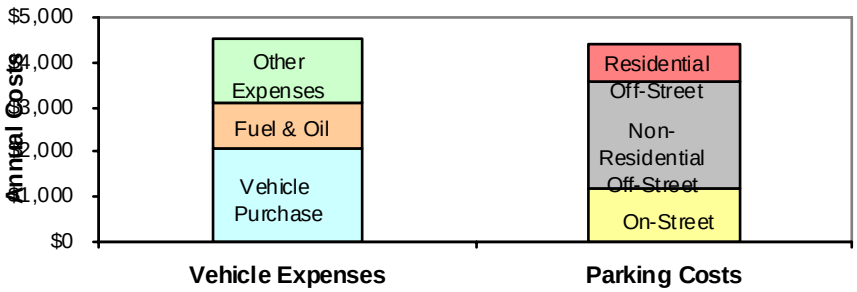
This table estimates parking costs per vehicle. Users pay directly for only about a quarter of total parking costs. The rest are borne indirectly through taxes, reduced wages, and additional retail prices.

Shoup estimates that unpriced off-street parking costs between $127 billion and $374 billion annually in the US.[26] Including on-street parking probably raises this $500 billion annually, more than three times total expenditures on public roads, and more than half as large as total expenditures on private vehicles. For each dollar motorists spend directly on their car somebody bears more than 50¢ in parking costs. This does not include indirect and non-market costs, such as the additional stormwater management costs, heat island effects, and other environmental costs that result when open space is paved for parking.

Parking costs can be a significant portion of facility development costs and rents. Parking represents about 10% of typical building development costs, and sometimes more, particularly for urban redevelopment and suburban projects with relatively high land or environmental costs. For example, a study of the effects of introducing parking requirements in Oakland California shows that construction costs per apartment increased 18% and density decreased 23%.[27] Generous parking requirements reduce the supply of affordable housing, and shifts affordable housing to less accessible sites where land prices are lower but fewer services can be reached by walking or public transit.[28]

Figure 5.4.3-4 **Comparing Vehicle and Parking Costs**

[26] Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org). p. 218.
[27] Brian Bertha (1964), "Appendix A" in *The Low-Rise Speculative Apartment*, by Wallace Smith. Cited in Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org). pp. 143-144.
[28] Wenya Jia and Martin Wachs (1998), *Parking Requirements and Housing Affordability*, Research Paper 380, University of California Transportation Center (www.uctc.net).



U.S. motorist spend an average of about $4,500 annually per vehicle on direct expenses.[29] There are an estimated five parking spaces per vehicle with total annualized costs of $4,400, much of which consumers bear indirectly[30].

Calculations of per-vehicle parking costs and revenues should take into account *load factors*, that is, the portion of parking spaces that are used at a particular time, or the portion of hours or days per year that a space is used. For example, if parking spaces rent for $60 per month with a 50% average load factor, revenues average $30 per space.

A reduction in parking demand does not always provide a comparable cost savings. For example, if a business has abundant parking supply there may be no immediate parking cost savings if employees shift to alternative commute modes. Their parking spaces will simply be empty. However, over the long run virtually all parking facilities have an opportunity cost: reduced demand reduces parking congestion (for example, parking become more convenient for customers), avoids the need to increase parking supply (for example, if a business expands, or a new business is established nearby), excess spaces can be rented to other nearby users who need them, or the land can be converted to another use (sold, used for an additional building, or converted to greenspace).

When evaluating parking cost savings it may be appropriate to apply an adjustment factor to reflect the lag time between when parking demand is reduced and savings are fully captured. For example, if a commute trip reduction program reduces parking demand by 20 spaces, each with a $1,000 annualized value, it is possible that during the first year only half the potential savings will be captured (20 x $1,000 x 0.5 = $10,000), because the freed-up spaces have no immediate use. However, within two to five years alternative uses will usually be found (the need to expand other parking lots can be avoided, or the land converted to other uses), so the full $20,000 annual value will be achieved.

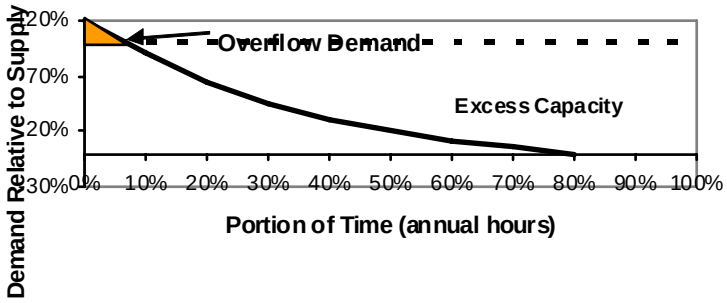
[29] BLS (2004), Consumer Expenditure Survey, (www.bls.gov). Values adjusted by CPI to 2007 USD.
[30] From Table 5.4.3-5 above.

Parking demand reductions tend to provide economic savings more quickly in denser, growing areas with parking problems (where reduced parking demand provides direct benefits in reduced parking congestion and avoided costs for increasing supply), and more slowly in economically stagnant areas which have abundant parking supply and low land costs. This is also affected by parking regulation flexibility (whether businesses may reduce their parking supply if demand declines), and whether it is common for businesses in an area to share, lease or sell excess parking to other users.

Parking Space Valuation

It is sometimes useful to calculate the marginal value of parking spaces. For example, a planner or developer may need to determine how many spaces to supply at a particular destination. A simple, but inaccurate approach is to calculate *average* benefits provided by a group of parking spaces. For example, the value of each parking space at a store would be calculated by dividing total store revenue by the total number of parking spaces to determine average revenue per space. If the store earns $100,000 per day and has 100 parking spaces, each space would be considered to generate $1,000 per day.

Figure 5.4.3-5 **Typical Parking Facility Occupancy**



This figure indicates the portion of available parking spaces occupied over a year for a typical parking facility. Most facilities only fill a few hours each year, and usually have excess capacity.

However, in most cases it is more appropriate to use *marginal* analysis, the incremental benefit of each space. Motorists usually use the most convenient parking spaces, typically those located closest to building entrances. Out of 100 parking spaces serving a destination such as a store, a few (perhaps 20-40) are typically used most, while other spaces (the remaining 60-80) are only occupied during peak periods, as indicated by Figure 5.4.3-5. If inadequate parking is a constraint on business activity the marginal value may be high, because adding a parking space may increase business, but in many situations, parking supply can be reduced with little or no cost, particularly if parking management strategies are implemented.[31]

[31] VTPI (2005), "Parking Management," *Online TDM Encyclopedia*, VTPI (www.vtpi.org/tdm).

5.4.4 Other Estimates

Note: Although many of these estimates are presented in per mile units, the cost is better measured per trip, since parking costs are unaffected by trip length. All monetary units are in U.S. dollars unless indicated otherwise.

Summary Table of Parking Cost Estimates

Table 5.4.4-1 **Parking Cost Estimate Summary Table – Selected Studies**

Publication	Costs	Cost Value	2007 USD
Apogee Research (1994)	Per mile (Boston, MA)	$0.18 (1994 USD*)	$0.25 per mile
	Per mile (Portland, ME)	$0.043	$0.06 per mile
Cambridge Systematics (1998)	Surface stall	$68 / month (1997 USD)	$88 per month
	Above ground structure	$135	$174 per month
	Below ground	$240	$310 per month
Delucchi (1996)	Total US unpriced non-residential	$148-$288 billion (1991 USD)	$225 - $438 billion per year
	Subsidy per motor vehicle year	$788 - $1531	$1,198 - $2,327 per vehicle year
	Non-residential subsidy per vehicle mile	$0.063 - $0.133	$0.10 - $0.20 per mile
Greenberg (2005)	Increase in housing unit cost per residential space	$52,000 to $117,000 (2005*)	$54,000 to $120,000
Shoup (2005)	Per space in structure	$127 (2002 USD/month)	$149 per month
	Per mile	$0.22	$0.26 per mile

*More detailed descriptions of these studies are found below, along with summaries of other studies. 2007 Values have been adjusted for inflation by Consumer Price Index[32]. * Indicates that the currency year is assumed to be the same as the publication year.*

General and Non-Residential Studies

- A study by Barter investigated parking regulations, supply, pricing and management practices in various Asian cities including Beijing, Guangzhou, Hong Kong, Seoul, Taipei, Tokyo, Ahmedabad, Dhaka, Bangkok, Hanoi, Jakarta Kuala Lumpur, Manila and Singapore.[33] It found that, although these cities are very dense, with high land values and intense congestion, most cities have adopted Western practices designed to insure adequire parking supply and low prices. Parking pricing is widespread, although poorly regulated and sometimes collected by criminals. Nevertheless, the study found a surprising proportion of parking is free-of-charge for motorists, even in dense cities with high property prices and therefore high opportunity cost for parking space.

[32] For discussion of other way to adjust for inflation see: Samuel H. Williamson (2008), *Six Ways to Compute the Relative Value of a U.S. Dollar Amount*, MeasuringWorth (www.measuringworth.com).

[33] Paul Barter (2010) *Parking Policy in Asian Cities*, Asian Development Bank (www.adb.org); at https://docs.google.com/leaf?id=0ByEszG9z8sBUYTBhNzdmZmQtNjc3Zi00MmRkLWIzMWEtZWUxNGY0ODJmODRi&hl=en&authkey=CN6Rg-0J.

- Chester, Horvath and Madanat calculate parking facilty lifecycle energy consumption, greenhouse gas and air pollution emissions (CO, SO_2, NO_X , VOC, and PM_{10}) based on five parking supply scenarios.[34] The results are incorporated into their life-cycle environmental analysis of various vehicles (sedans, sports utility vehicles, and pickups). Parking energy consumption is estimated to average from 14–18 kJ/Passenger-Km (Scenario 1) to 240–310 kJ/Passenger-Km (Scenario 5), and GHG emissions range from 1.3–1.7 gCO_2e/PKT (Scenario 1) to 19–25 g CO_2e/PKT (Scenario 5). This represents 0.5% to 12% of total estimated transport system lifecycle energy consumption and greenhouse emissions, and 24% to 81% other air pollutants, depending on vehicle type and scenario.

- In a study of parking supply and demand in Hulme-Moir found that charging users directly for parking would increase the financial cost of driving 30-90% for an average shopping trip and about 100% for an average commuting trip, and that about a quarter of central city area land is devoted to parking facilities .[35]

- The National Parking Association's *Parking In America; Annual Review of Parking Rates in the United States and Canada* includes information on parking facility costs, employee wages, and hourly, daily and monthly rates for commercial parking in various North American cities.[36] The 2009 study found:
    - Parking garage construction costs range from $2,000 to $45,000 per space, with an average of $19,650 per space.
    - Surface parking lot construction costs ranged from $1,000 to $15,000 per space, with an average of $5,000 per space.
    - Condomenium parking space prices ranged from $17,000 to $100,000, with an average price of $45,400.
    - Average starting hourly wage of parking facility employees ranged from $5.85 to $12.50, with an average of $8.30.

- Colliers International publishes parking fee data in different cities, indicating how prices vary depending on location and type of parking used.[37]

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[34] Mikhail Chester, Arpad Horvath and Samer Madanat (2010), "Parking Infrastructure: Energy, Emissions, And Automobile Life-Cycle Environmental Accounting," *Environmental Research Letters*, Vol. 5, No. 3; at http://dx.doi.org/10.1088/1748-9326/5/3/034001; project of the UC Berkeley Center for Future Urban Transport (www.sustainable-transportation.com).

[35] Angus Hulme-Moir (2010), *Making Way for the Car: Minimum Parking Requirements and Porirua City Centre*, Thesis, School of Geography, Environment and Earth Sciences, Victoria University of Wellington (http://researcharchive.vuw.ac.nz/handle/10063/1458).

[36] NPA (2009), *Parking In America, The National Parking Association's First Annual Review of Parking Rates in the United States and Canada*, National Parking Association (www.npapark.org); at www.npapark.org/pdfs/NPA_Full_Report_Web_Resolution.pdf.

[37] Colliers (2009), *Global CBC Parking Rate Survey*, Colliers International (www.colliers.com); at www.colliersmn.com/PROD/ccgrd.nsf/publish/0EB9D100B7A442F8852575F600699A07/$File/globalcolliersparkingratesurvey2009.pdf.

- Cambridge Systematics estimated parking costs as summarized in the table below.

Table 5.4.4-3 **Total and Monthly Costs per Parking Space (1997 U.S. Dollars)**[38]

	Surface Lot			Above-Ground Multi-Level Structure			Below Ground		
	Low	High	Average	Low	High	Average	Low	High	Average
Land	$600	$12,000	$6,300	$500	$1,000	$750	$0	$0	$0
Construction	$1,500	$4,000	$2,750	$8,800	$20,000	$14,400	$16,000	$40,000	$28,000
Design, Contingency	$200	$800	$500	$1,800	$5,000	$3,400	$3,200	$10,000	$6,600
Present Value	$2,300	$16,800	$9,550	$12,100	$26,000	$19,050	$19,200	$50,000	$34,600
Interest Payments	$2,100	$14,700	$8,400	$9,700	$22,700	$16,200	$16,800	$43,700	$30,250
Operating Costs	$700	$2,800	$1,750	$2,800	$5,600	$4,200	$2,800	$5,600	$4,200
Break-Even Cost	$5,100	$34,300	$19,700	$24,600	$53,300	$38,950	$38,800	$99,300	$69,050
Monthly Equivalent	$18	$119	$68	$85	$185	$135	$135	$345	$240

This table summarizes total costs amortized over a 24-year service life at a 9% annual interest.

- Delucchi estimated that non-residential, unpriced, off-street parking has a total value of $148 to $288 billion (in 1991 U.S. dollars) as summarized in Table 5.4.4-4. This represents a subsidy averaging $788 to $1,531 per motor vehicle year, or 6.3¢ to 13.3¢ per motor vehicle mile (in 1991 dollars).

Table 5.4.4-4 **Calculated Value of Unpaid Parking**[39]

Cost Item	High	Low
Workers 16 years old or older (millions)	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
Total potential revenues from unpriced commuter parking, net taxes (Billions $/year)	37.9	59.3
Non-commute trips that require offstreet, non-residential parking (10^6)	73,796	93,457
Fraction of total vehicle trips 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
Potential revenues from unpriced parking for other purposes (billions $/year)	110.3	228.6
Total potential revenues from unpriced parking, excluding taxes (billions $/year)	148.2	287.9
Total calculated payments for presently priced parking, excluding taxes	6.73	7.82
Total potential revenues from parking for all trips, excluding taxes (billions $/year)	155.0	295.8

This table summarizes the estimated value of non-residential, unpriced, off-street parking.

[38] Richard J. Kuzmyak, Rachel Weinberger and Herbert Levinson (2003), *Parking Management and Supply*, TCRP Report 95, Chapter 18, TRB (www.trb.org), based on Cambridge Systematics (1998), *Economic Impact Analysis of Transit Investments*" TCRP 35, TRB (www.trb.org).

[39] Delucchi (1996), *Annualized Social Cost of Motor-Vehicle Use in the U.S., 1990-1991*, Vol. 6, Institute of Transportation Studies (http://engineering.ucdavis.edu/), UCD-ITS-RR-96-3 (6), Table 6-B.1.

- A 1995 study estimates that businesses provide 294 million parking spaces to employees and 39 million parking spaces to customers.[40] Assuming $500 average annualized value per parking space and a 3% annual growth rate, this indicates approximately $200 billion in annualized value in 2000.

- Manville and Shoup estimate parking spaces per hectare and job in various central business districts in the world, and calculate a *parking coverage rate*, the portion of downtown that would be devoted to parking if all parking were provided in surface lots.[41] This varies from under 10% to more than 80%. They argue that a high parking coverage rate tends to spoil many desirable urban environment attributres, including walkability and cost efficiency.

- Russo estimates the costs of different types of parking facilities, as summarized in the table below. It indicates that urban surface parking typically costs about $10,000 per space, and structured parking costs two to four times as much.

Table 5.4.4-5 **Selected Examples of Parking Facility Costs**[42]

Per Space	Cost Components	Description
$10,000	Surface parking construction costs (Excludes land)	Average from national survey of public garage costs, adjusted for Bay Area costs
$14,000	Construction costs of above ground structures. (Excludes land and architectural fees.)	Average from national survey of public garage costs, adjusted for Bay Area costs. Excludes sprinkler and ventilation system costs required for underground parking.
$9,450	Land costs.	Assuming a parking space averages 315 square feet (including access lanes) and land costs $30 a square foot, land alone for parking costs nearly $10,000 per space.
$25,600	Parking Garage. Per space added (Includes land.)	Average cost per space added (in 1998 dollars) of six parking structures built on the UCLA campus since 1977.
$17,848 $16,373 $13,000 $6,751 $8,500 $10,000	Palo Alto Walnut Creek Mountain View Mill Valley Concord Berkeley	In-Lieu Parking Fees. Cities sometimes allow developers to pay the amount listed at left per space they are required to build as per the zoning code in-lieu of building the space. Since in-lieu fees fund public parking construction, they are a proxy of cost per space
$39,000 or $46,000	Housing prices (condominium and single family unit).	The increased market price per housing unit that includes a parking space compared to housing that does not.
$50,700	Design, administration, construction and financing	Two new parking garages in downtown Palo Alto providing 905 spaces cost a total of $45.9 million.

This survey of parking facility costs indicates that urban surface parking typically costs about $10,000 per space, and structured parking two to four times as much.

[40] KPMG study, described in Richard J. Kuzmyak, Rachel Weinberger and Herbert S. Levinson (2003).
[41] Michael Manville and Donald Shoup (2005), "People, Parking, and Cities," *Journal Of Urban Planning And Development*, American Society of Civil Engineers (www.asce.org), December, pp. 233-245; at http://shoup.bol.ucla.edu/People,Parking,CitiesJUPD.pdf; in *Access 25* (www.uctc.net), Fall 2004, pp. 2-8.
[42] Ryan Russo (2001), "Examples of Parking Costs," *Planning For Residential Parking: A Guide for Housing Developers and Planners*, Nonprofit Housing (www.nonprofithousing.org).

- Shoup estimates that providing minimum parking requirements costs an average of $31 or more per square foot of developed building floor area in typical U.S. cities, 4.4 times more than all other impact fees combined.[43] He identified various costs resulting from subsidized parking, including increased parking and travel demand, urban sprawl, higher development costs, reducing housing affordability, and inequity.[44] He estimates that parking costs average $12,000 per vehicle (about twice the value of a vehicle), and external parking costs total $127-374 billion in the U.S., more than the value of the total roadway system, averaging more than 22¢ per vehicle mile.

- Richard Willson estimates the monthly cost that developers would need to charge for "free" suburban surface and structure parking to be approximately $50 and $100 per space, but because generous parking requirements lead to tremendous oversupply, the "utilization-adjusted break-even fee" would be about twice these amounts, $92 per for surface parking and $161 per for structure parking.[45]

- Transport 2021 estimates residential parking stall costs average $746 Canadian per house and $743 per apartment. Total parking costs average 3.7¢ total Canadian per km (about 4.6¢ U.S. per mile).[46]

- The average cost of providing a parking space in the Vancouver, BC region (not just the CBD) is about $115 Canadian ($80 U.S.) per month.[47]

- Woudsma, Litman, and Weisbrod developed practical methods for quantifying the values of land used for transport facilities, including roads, railroads, ports and airports.[48] They use property value data to calculate average land values in geographic zones, with separate techniques for urban and rural conditions to reflect land markets and data availability differences. The results indicate that urban land values typically range from $100 to $200 per square meter, and rural land from $0.40 to $0.60 per square meter (2000 Canadian dollars).

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[43] Donald C. Shoup (1999), "In Lieu of Required Parking," *Journal of Planning Education and Research*, Vol. 18, pp. 307-320.
[44] Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org).
[45] Richard Willson (1995), "Suburban Parking Requirements; A Tacit Policy for Automobile Use and Sprawl," *American Planning Association Journal* (www.planning.org), Vol. 61, No. 1, Winter, pp. 29-42.
[46] Transport 2021 (1993), *Costs of Transportation People in the British Columbia Lower Mainland*, Greater Vancouver Regional District, (Vancouver), pp. 13-16.
[47] Urban Systems (1996), *A Comprehensive Parking Management Strategy*, Greater Vancouver Regional District (www.gvrd.bc.ca).
[48] Clarence Woudsma, Todd Litman, and Glen Weisbrod (2006), *A Report On The Estimation Of Unit Values Of Land Occupied By Transportation Infrastructures In Canada*, Transport Canada (www.tc.gc.ca); at www.tc.gc.ca/pol/en/aca/fci/transmodal/menu.htm.

Residential

- Greenberg estimates that each additional residential parking space effectively increases typical U.S. urban housing unit costs by $52,000 to $117,000, with a mid-range value of $85,627. These figures are derived from observed differences in housing prices, reduced loan eligibility because of increased car-related household costs, public infrastructure costs associated with accommodating developments that are more dispersed due to parking requirements, and direct financial impacts on neighbors of new developments.[49]

- Klipp found the financial return to Bay Area developers per square unit of parking is much less (about half) the return of housing, because minimum parking requirements in zoning codes and other market distortions require far more parking than consumers demand (that is, what they would choose to purchase if optional).[50] He estimates that developers must charge at least 27.5% more to get the same per-square foot rate of return on housing with versus without parking. The lower financial return constrains developers' lending options and reduces construction of new housing, particularly lower-priced housing in urban areas with high land costs.

Stormwater Management

The Project Clean Water (www.projectcleanwater.org) describes stormwater district fees summarized in the table below. If these fees represent real stormwater management costs and an average off-street parking space requires 333 square feet of pavement, these costs range from about $1-7 per off-street parking space.

Table 5.4.4-6 **Water District Funding Sources Based on Impervious Surface**[51]

Location	Fee	Annual Fee/333 sq. ft.
Chaple Hill, NC	$39 annual 2,000 sq. ft.	$6.50
City of Oviedo Stormwater Utility, FL	$4.00 per month per ERU	$5.00
Columbia Country Stormwater Utility, GA	$1.75 monthly per 2,000 sq. ft.	$3.50
Kitsap County, WA	$47.50 per 4,200 sq. ft.	$4.00
Raleigh, NC	$4 monthly per 2,260 sq. ft.	$6.00
Spokane Country Stormwater Utility, WA	$10 annual fee per ERU.	$1.00
Wilmington, NC	$4.75 monthly per 2,500 sq. ft.	$7.50
Yakima, WA	$50 annual per 3,600 sq. ft.	$6.50

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

[49] Allen Greenberg (2005), *How New Parking Spaces May Effectively Increase Typical U.S. Urban Housing Total Unit Costs by $52,000 to $117,000*, TRB 84th Annual Meeting (www.trb.org).
[50] Luke Klipp (2004), *The Real Costs Of San Francisco's Off-Street Residential Parking Requirements: An Analysis Of Parking's Impact On Housing Finance Ability And Affordability*, Transportation for a Livable City (www.livablecity.org); at www.livablecity.org/resources/Parking_Housing_Affordability_Final.pdf
[51] Project Clean Water (2002), *Some Existing Water District Funding Sources*, Legislative and Regulatory Issues Technical Advisory Committee, Project Clean Water (www.projectcleanwater.org).

5.4.5 Variability

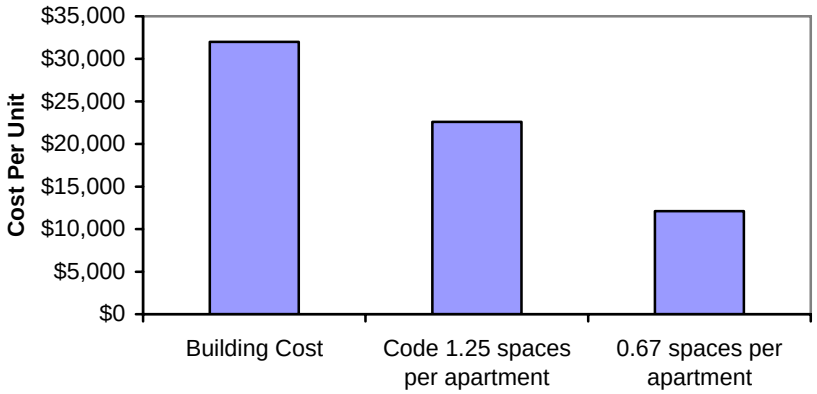
Parking costs and the portion that is external varies depending on location and use. Parking facility costs tend to high in central business districts, due to high land prices, although a greater portion of such parking is directly user paid. Parking costs tend to be relatively high per commute trip since employees use a space for several hours. Non-commute parking costs probably equals or exceeds that of commuter parking.

5.4.6 Equity and Efficiency Issues

Excessive parking requirements have a number of effects that increase housing costs and the overall cost of living in cities. Some of these costs directly add to the cost of housing, such as construction costs for parking structures in new residential construction. Other costs are indirect such as the public land and funds used to provide parking at non-residential facilities, land and funds which are not then available for other public purposes such as providing affordable housing or public transit.

One of the most obvious impacts of parking requirements is the direct construction costs paid by the funders of non-profit housing projects. Extreme examples arise where parking requirements are tied to the number of units in a building, and the unit sizes are very small. For example, in Palo Alto California in 1998 a development with 260 square foot apartments managed to get the parking requirement reduced from the normal 1.25 spaces per one-room apartment to 0.67 spaces. At a construction cost of $32,000 per apartment and $18,100 per parking spot, it would have cost $22,600 to provide parking for each $32,000 apartment, 71% as much as the cost of building the apartments. With the reduced requirements, parking still cost $12,100 per apartment, or 38% of the apartment construction cost, as shown below in Figure 5.4.6-1

Figure 5.4.6-1 **Reduced Parking Requirement Savings**[52]



Despite a substantial reduction in the parking required, parking still accounted for 38% of the building cost. Note that this is an extreme example as the apartments are very small.

[52] Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org). p151

Since parking costs increase as a percentage of rent for lower priced housing, housing represents a larger portion of household expenditures for poorer households, and vehicle ownership increases with income, parking costs are regressive and unfair to many lower-income households that own fewer than average cars. Current parking standards are an ineffective mechanism for matching parking supply with demand because the number of vehicles per housing unit varies significantly between households and over time. Various parking management strategies can increase affordability, economic efficiency and equity.[53]

[53] Todd Litman (2008), Parking Management *Strategies, Evaluation and Planning*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/park_man.pdf

5.4.7 Conclusions

Parking is a substantial cost of driving, much of which is external. To avoid double counting costs in chapters 5.1 and 5.6, out-of-pocket parking charges and the costs of providing on-street parking are excluded from this chapter's cost estimates here. Only market costs are considered because non-market costs are included in chapters 5.14 (Land Use Impacts), and 5.15 (Water Pollution and Hydrologic Impacts).

Internal Parking Costs: To avoid double counting user parking fees that are included in Chapter 5.1, only residential parking costs are considered here. An Average Automobile residential parking space is estimated to cost approximately $950 per year, or 8¢ per mile for a vehicle driven 12,000 miles per year. Some residents park their cars on the street, but this seems to be balanced by others who have more off-street parking spaces than cars, so one off-street space is assumed to exist for each registered automobile. Rural parking space costs are estimated at half of urban due to lower land values.

Compact cars can use "Small Car" spaces, offering an estimated 20% space savings 25% of the time, for 5% total saving. Ride share passengers, buses and trolleys incur no incremental parking cost.[54] Motorcycles are estimated to use half-size parking spaces 50% of the time, for a 25% saving over an automobile, while bicycle parking costs are estimated at 5% of an automobile, due to minimal space requirements, and the ability to use otherwise unused space. Walking and telework incur no parking cost.

Estimate **Internal Parking Costs (2007 U.S. Dollars per Vehicle Mile)**

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.080	0.080	0.040	0.067
Compact Car	0.072	0.072	0.037	0.061
Electric Car	0.080	0.080	0.040	0.067
Van/Light Truck	0.080	0.080	0.040	0.067
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	0.064	0.064	0.032	0.053
Bicycle	0.005	0.005	0.002	0.003
Walk	0.000	0.000	0.000	0.000
Telework	0.000	0.000	0.000	0.000

External Parking Costs: Most estimates place off-street parking costs around or over $1100 per year or $4.00 per day per space. The $4.00 average parking space cost is divided by 22 average commute miles and subtract 8% for commuter paid parking, which gives an estimated average external commute parking costs of 16.7¢ per commute mile. Based on these estimates, 17¢ per commute mile is used for Urban Peak driving. Commercial parking subsidies are estimated to total $115 billion. Subtracting the $55 billion estimated for work parking from this figure leaves $60 billion. Divided by 1,840

[54] Curbside bus stops use space that might otherwise be available for on-street parking, but this is considered a road cost rather than a parking cost.

billion Urban Off-Peak and Rural miles, this averages about 3¢ per vehicle mile. An estimate of 6¢ is used for Urban Off-Peak driving and 3¢ for Rural driving, to represent differences in land value.

External Parking Costs: Conservative estimates place average off-street parking costs around $1000 per year or $3.75 per day per space, and place total U.S. employee parking subsidies at between $65 and $95 billion per year. A value of $70 billion is used. Dividing that amount by 460 billion peak period[55] miles gives an average employee parking subsidy of 15¢ per commute mile. An alternative approach is to divide the $3.75 average parking space cost by 22 average commute miles and subtract 8% for commuter paid parking, which gives an estimated average external commute parking costs of 15.7¢ per commute mile. Based on these estimates, 15¢ per commute mile is used for Urban Peak driving. Commercial parking subsidies are estimated to total $150 billion. Subtracting the $70 billion estimated for work parking from this figure leaves $80 billion. Divided by 1,840 billion Urban Off-Peak and Rural miles, this averages about 4¢ per vehicle mile. An estimate of 5¢ is used for Urban Off-Peak driving and 2.5¢ for Rural driving, to represent differences in land value.

As described above compact cars, motorcycles, and bicycles are estimated to be 5%, 25%, and 95% cheaper to park than an average automobile. Rideshare passengers, buses, trolleys, walking and telework incur no user parking costs.

Estimate **External Parking Costs (2007 U.S. Dollars per Vehicle Mile)**

Vehicle Class	Urban Peak	Urban Off-Peak	Rural	Average
Average Car	0.150	0.050	0.025	0.062
Compact Car	0.143	0.047	0.024	0.059
Electric Car	0.150	0.050	0.025	0.062
Van/Light Truck	0.150	0.050	0.025	0.062
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	0.113	0.037	0.018	0.046
Bicycle	0.008	0.003	0.001	0.003
Walk	0.000	0.000	0.000	0.000
Telework	0.000	0.000	0.000	0.000

Automobile Cost Range: Minimum and maximum estimates per vehicle mile are based on cited estimates.

	Minimum	Maximum
Internal	$0.04	$0.12
External	$0.05	$0.14

[55] Urban Peak travel is used to represent commuting in this exercise. Although total mileage has increased, the portion of urban-peak is similar. Dollar values are adjusted by consumer price index to 2007 values.

5.4.8 Information Resources

Information sources on parking costs and parking management strategies are described below.

Hashem Akbari, L. Shea Rose and Haider Taha (2003), "Analyzing The Land Cover Of An Urban Environment Using High-Resolution Orthophotos," *Landscape and Urban Planning* (www.sciencedirect.com/science/journal/01692046), Vol. 63, Issue 1, pp. 1–14.

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