VICTORIA Transport Policy INSTITUTE
EFFICIENCY • EQUITY • CLARITY

www.vtpi.org
Info@vtpi.org
Phone: 250-508-5150

Parking Management

Comprehensive Implementation Guide

17 June 2025

by
Todd Litman
Victoria Transport Policy Institute

Abstract

Parking management refers to various policies and programs that result in more efficient use of parking resources. This guide describes and evaluates more than two-dozen such strategies. It investigates problems with current parking planning practices, discusses the costs of parking facilities and the savings that can result from improved management, describes specific parking management strategies and how they can be implemented, discusses parking management planning and evaluation, and describes how to develop the optimal parking management program in a particular situation. Cost-effective parking management programs can usually reduce parking requirements by 20-40% compared with conventional planning requirements, providing many economic, social and environmental benefits.

Contents

Introduction

A typical automobile is parked 23 hours each day and uses several parking spaces each week. Parking facilities are an essential component of a transportation system. They are also costly; for every dollar motorists spend on their vehicles, somebody (drivers, employers, local government, businesses, etc.) spend about a dollar on parking facilities for its use (Litman 2023). Parking conflicts are among the most common problems local officials face (Grabar 2023). Such problems are often defined as inadequate *supply* (too few spaces available), but they can also be defined as *inefficient management* (existing supply could be better utilized). Motorists often complain that they cannot find parking even when unoccupied spaces are available nearby, due to inadequate information, difficult walking conditions between parking facilities and destinations, restrictions on who may use parking facilities, or slow parking turnover.

Management solutions tend to be better because they support more strategic goals:

- Reduced development costs and increased affordability.
- More compact, multi-modal community planning (smart growth).
- Encourage use of alternative modes and reduce motor vehicle use (thereby reducing traffic congestion, accidents and pollution problems).
- Improved user options and quality of service, particularly for non-drivers.
- Improved design flexibility, creating more functional and attractive communities.
- Ability to accommodate new uses and respond to new demands.
- Reduced impervious surface and related environmental and aesthetic benefits.

Parking management refers to various policies and programs that result in more efficient use of parking resources (Barter 2014; Goldin 2017). Parking management includes several specific strategies; nearly two dozen are described in this guide. When appropriately applied parking management can significantly reduce the number of parking spaces required in a particular situation, providing a variety of economic, social and environmental benefits. When all impacts are considered, improved management is often the best solution to parking problems.

Parking Management Principles

These ten general principles can help guide planning decision to support parking management.

1. *Consumer choice.* People should have viable parking and travel options.
2. *User information.* Motorists should have information on their parking and travel options.
3. *Sharing.* Parking facilities should serve multiple users and destinations.
4. *Efficient utilization.* Parking facilities should be sized and managed so spaces are frequently occupied.
5. *Flexibility.* Parking plans should accommodate uncertainty and change.
6. *Prioritization.* The most desirable spaces should be managed to favor higher-priority uses.
7. *Pricing.* As much as possible, users should pay directly for the parking facilities they use.
8. *Peak management.* Special efforts should be made to deal with peak-demand.
9. *Quality.* Parking facility quality (aesthetics, convenience, safety, etc.) is as important as quantity.
10. *Comprehensive analysis.* All significant costs and benefits should be considered in parking planning.

Parking management generally improves *travel options* (better walking, bicycling, public transit, carsharing, etc.), *parking options* (allowing motorists to choose between more convenient but higher priced or less convenient but cheaper spaces), and *pricing options* (hourly, daily or monthly fees, electronic payment, etc.). Parking management is becoming more feasible due to new technologies, services and planning goals.

Parking Management Benefits

- *Parking facility cost savings.* Reduces costs to governments, businesses, developers and consumers.
- *Improved service quality.* Many strategies increase consumer options, improve user information, reduce congestion, and create more attractive parking facilities.
- *More flexible facility location and design.* Parking management gives planners, architects and designers more ways to address parking needs.
- *Supports equity objectives.* Management strategies can reduce the need for parking subsidies, improve travel options for non-drivers, and increase housing affordability.
- *Revenue generation.* Some management strategies generate revenues that can fund parking facilities, transportation improvements, or other desirable projects.
- *Reduced congestion.* Parking management encourages non-auto travel and reduces the number of vehicles cruising for available spaces (Hampshire and Shoup 2018; Weinberger, et al. 2023).
- *Reduces land consumption.* Improved management can reduce the amount of land needed for parking facilities, leaving that land for other productive uses.
- *Reduces stormwater management costs, water pollution and heat island effects.* Parking management can reduce impervious surface area and incorporate design features such as on-site percolation and shade trees, that enhance the local environment.
- *Supports transportation demand management (TDM).* Parking management is an important component of efforts to encourage more efficient travel, which helps reduce problems such as traffic congestion, roadway costs, pollution emissions, energy consumption and traffic crashes.
- *Supports Smart Growth.* Parking management helps create more accessible and efficient land use patterns, and support other land use planning objectives.
- *Improves walkability.* By allowing more compact development and sidewalk-oriented buildings, parking management helps create more walkable communities.
- *Supports public transit.* Parking management encourages transit use and transit oriented development.
- *More livable communities.* Parking management can help create more attractive and efficient communities by reducing paved areas, increasing walkability and allowing more flexible design.

This guide describes various parking management strategies, how to evaluate these strategies and develop an integrated parking plan, plus examples and resources for more information. It describes *contingency-based planning*, which deals with uncertainty by identifying possible responses to future conditions, such as the set of strategies that will be implemented if the current parking supply turns out to be inadequate sometime in the future.

Examples

Below are three examples of parking management programs. More examples and case studies are described later in this guide.

Reducing Building Development Costs

A mixed-use building is being constructed in an urban or suburban area that will contain 100 housing units and 10,000 square feet of commercial space. By conventional standards this requires 200 parking spaces (1.6 spaces per housing unit plus 4 spaces per 1,000 square feet of commercial space), costing from $2 million for surface parking (about 9% of the total development costs), up to $6 million for underground parking (about 25% of total development costs). However, because the building is in a relatively accessible location (on a street that has sidewalks, with retail business and public transit services located nearby) and on-street parking is available nearby to accommodate occasional overflows, the building owners argue that a lower standard should be applied, such as 1.2 parking spaces per housing unit and 3 spaces per 1,000 square feet of commercial space, reducing total requirements to 150 spaces. To further reduce parking requirements the developer proposes the following:

- Unbundle parking, so parking spaces are rented separately from building space. For example, rather than paying $1,000 per month for an apartment with two parking spaces renters pay $800 per month for the apartment and $100 per month for each parking space. This typically reduces parking requirements by 20%.
- Encourage businesses to implement commute trip reduction programs for their employees, including cashing out free parking (employees are offered $50 per month if they don't use a parking space). This typically reduces automobile commuting by 20%.
- Regulate the most convenient parking spaces to favor higher-priority uses, including delivery vehicles and short errands, and handicapped users.
- Include four carshare vehicles in the building. Each typically substitutes for 5 personal vehicles, reducing 4 parking spaces.
- Incorporate excellent walking facilities, including sidewalk upgrades if needed to allow convenient access to nearby destinations, overflow parking facilities and transit stops.
- Incorporate bicycle parking and changing facilities into the building.
- Provide information to resident, employees and visitors about transit, rideshare and taxi services, bicycling facilities, and overflow parking options.
- Develop a contingency-based overflow parking plan that indicates where is available nearby if on-site facilities are full, and how and spillover impacts will be addressed. For example, identify where additional parking spaces can be rented if needed.

This management program allows total parking requirements to be reduced to 100 spaces, providing $100,000 to $500,000 in annualized parking facility capital and operating cost savings (compared with $20,000-$50,000 in additional expenses for implementing these strategies), as well as providing improved options to users and reduced vehicle traffic.

Increasing Office Building Profits and Benefits

An office building has 100 employees and 120 surface parking spaces, providing one space per employee plus 20 visitor spaces. The building earns $1,000,000 annually in rent, of which $900,000 is spent on debt service and operating expenses, leaving $100,000 annual net profit.

Parking management begins when a nearby restaurant arranges to use 20 spaces for staff parking during evenings and weekends for $50 per month per space, providing $12,000 in additional annual revenue. After subtracting $2,000 for walkway improvements between the sites, and additional operating costs, this increases profits 10%. Later a nearby church arranges to use 50 parking spaces Sunday mornings for $500 per month, providing $6,000 in annual revenue. After subtracting $1,000 for additional operating costs, this increases profits by another 5%. Next, a commercial parking operator arranges to rent the building's unused parking to general public during evenings and weekends. This provides $10,000 in net annual revenue, an additional 10% profit.

Inspired, the building manager develops a comprehensive plan to take full advantage of the parking facility's value. Rather than giving each employee a reserved space, spaces are shared, so 80 spaces serve the 100 employees. A commute trip reduction program is implemented with a $40 per month cash-out option, which reduces parking requirements by another 20 spaces. As a result, employees only need 60 spaces. The extra 40 parking spaces are leased to nearby businesses for $80 per month, providing $32,000 in annual revenue, $12,000 of which is used for cash-out payments and other management costs, leaving $20,000 net profits.

Because business is growing, the tenant wants additional building space for 30 more employees. Purchasing land for another building would cost approximately $1 million, and result in two separate work locations, an undesirable arrangement. Instead, the building manager stops leasing daytime parking and raises the cash-out rate to $50 per month, which causes an additional 10 percentage point reduction in automobile commuting. With these management strategies, 87 parking spaces are adequate to serve 130 employees plus visitors, leaving the land currently used by 33 parking spaces available for a building site. To address concerns that this parking supply may be insufficient sometime in the future, a contingency plan is developed which identifies what will be done if more parking is needed, which might involve an overflow parking plan, providing additional commuter incentives during peak periods, leasing nearly parking, or building structured parking if necessary.

This parking management plan saves $1 million in land costs, a $50,000 annualized value. Parking spaces can still be rented on weekends and evenings, bringing in an additional $25,000. These parking management strategies increased total building profits about 75%, allow a business to locate entirely at one location, and provide parking to additional users during off-peak periods. Other benefits include increased income and travel options for employees, reduced traffic congestion and air pollution, and reduced stormwater runoff.

Downtown – Addressing Parking Problems

A growing downtown is experiencing parking problems. Most downtown parking is unpriced, with 2-hour limits for on-street parking. During peak periods 90% of core-area parking spaces are occupied, although there is virtually always parking available a few blocks away, and many of the core spaces are used by commuters or long-term visitors, who moved their vehicles every two hours to avoid citations. During peak periods, a major portion of downtown traffic consists of vehicles cruising for parking (Hampshire and Shoup 2018).

Local businesses asked the city to build a $5 million parking structure, which would either require about $500,000 in annual subsidies or would require user charges. Experience in similar downtowns indicates that if most public parking is unpriced, few motorists will pay for parking so the structure would be underutilized and do little to alleviate parking problems. Local officials decide to first implement a management program, to defer or avoid the need for a parking structure. Parking surveys are performed regularly to track utilization and turnover rates, in order to identify problems. The program's objectives are to encourage efficient use of parking facilities, insure that parking is convenient for priority uses (deliveries, customers and short errands), and maintain parking utilization at about 85%. It includes the following strategies:

- Increase enforcement of regulations, particularly during busy periods, but insure that enforcement is friendly and fair.
- Reduce on-street time limits (e.g., 2-hours to 90 minutes) where needed to increase turnover.
- Expand core area boundaries to increase the number of spaces managed for short-term use.
- Encourage businesses to share parking, so for example, a restaurant allows its parking spaces to be used by an office building during the weekdays in exchange for using the office parking during evenings and weekends.
- Encourage use of alternative modes. The city may partner with the downtown business organization to support commute trip reduction programs and downtown shuttle service.
- Develop special regulations as needed, such as for disabled access, delivery and loading areas, or to accommodate other particular land uses.
- Implement a residential parking permit program if needed to address spillover problems in nearby residential areas, but accommodate non-residential users as much as possible.
- Provide signs and maps showing motorists where they may park.
- Have an overflow parking plan for occasionally special events that attract large crowds.
- Establish high standards for parking facility design, including aesthetic and safety features, to enhance the downtown environment.
- Price parking, using convenient pricing methods. Apply the following principles:
    - Adjust rates as needed to maintain optional utilization (i.e., 85% peak occupancy).
    - Structure rates to favor short-term uses in core areas and encourage longer-term parkers to shift to other locations.
    - Provide special rates to serve appropriate uses, such as for evening and weekend events.
    - Use revenues to improve enforcement, security, facility maintenance, marketing, and transportation demand management programs that encourage use of alternative modes.

Types of Parking

Table 1 describes various types of parking facilities and the role they play in an efficient parking system.

Table 1 **Types of Parking Facilities**

Type	Images	Costs and Density	Role
On-Street (or Curb) Designated parking spaces located within a road right-of-way, usually in the curb lane.		Moderate construction costs and high density (relatively little land used per space) because they require no driveway.	Convenient to use, and can serve multiple destinations. On-street parking should be managed for maximum efficiency.
Surface Parking A parking lot directly on the ground (either paved or unpaved).		Low to moderate construction costs. Low density (they require lots of land per space, including driveways and circulation lanes.	Inefficient if they serve a single destination. Should be minimized and managed for efficiency.
Structured or Underground Any multi-story parking structure (often called a *parking garage*, *parkade* or *ramp*), including parking facilities within or under a building.		High construction costs but relatively low land costs and high densities.	Supports compact development but must be efficiently managed to justify their high construction costs.
Priced (or Metered) Any parking facility where motorists are charged directly for use, including on-street metered parking, and off-street lots where motorists pay by the hour, day, week, month or year.		Varies. Can be applied to any type of parking structure.	Pricing, particularly congestion pricing (fees are higher at times and places with high demand) tends to encourage efficient use of parking facilities.
Commercial Parking A for-profit parking lot available to any motorist and serves multiple destinations.		Varies. Can be applied to any type of parking structure.	Tends to be efficient because it is priced and usually serves multiple destinations.
Bicycle Parking. Parking for bicycles and e-bikes. This can include short-term parking, located for maximum convenience, and longer-term parking for commuters and residents.		Bicycle parking requires far less space and has far lower construction costs than automobile parking.	Encourages bicycling, and so can repay its costs if it causes even small shifts from driving to biking. Adequate bicycle parking should be provided at most destinations.

Parking facilities that are priced and serve multiple destinations tend to be most efficiently used.

Paradigm Shifts and Innovations

Parking planning is undergoing a *paradigm shift*, a fundamental change in how problems are perceived and solutions evaluated (Belmore 2019; Economist 2017; Pressl and Rye 2020). The old paradigm assumed that *transportation* means driving, so parking facilities should be as abundant and cheap as possible, with costs borne indirectly through taxes, higher building costs and higher prices. For example, a typical apartment rent is one- to three-hundred dollars higher, a monthly grocery bill costs a few dollars more, and the price of a drink at a restaurant includes a few extra cents to finance parking for customers who drive. This is inefficient and unfair; it increases parking demands and vehicle traffic and associated external costs, and forces households that drive less than average to subsidize the parking costs of those that drive more than average, and since vehicle travel increases with wealth, that is regressive.

The new paradigm strives to *optimize* parking supply and price. It assumes that transportation includes multiple modes and not everybody drives. It considers too much supply as harmful as too little, and underpricing as harmful as excessive prices. It manages facilities to maximize efficiency. It considers fully-occupied lots to be acceptable provided that additional parking is available nearby and any spillover problems are addressed. It favors efficient pricing that charges users for parking facilities with prices that vary with demand to reduce congestion. The old paradigm places a heavy burden of proof on innovation. The new paradigm recognizes that transport and land use conditions evolve, so parking policies need frequent adjustment. It shifts the burden of proof, allowing new approached to be tried to test their effectiveness, or lack thereof. Table 2 compares old and new parking paradigms.

Table 2 **Old and New Parking Paradigms Compared**

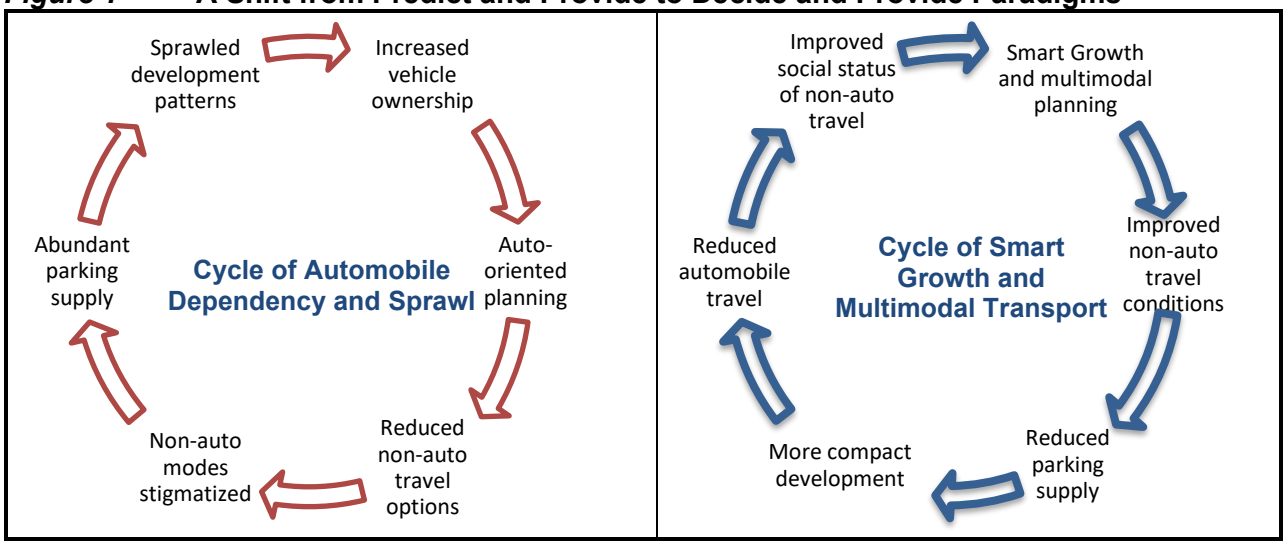
Old Paradigm	New Paradigm
Transportation means driving.	Not everybody uses automobiles. Transportation systems are multimodal.
Parking problem means inadequate parking supply.	There can be many types of parking problems including inadequate or excessive supply, inadequate user information, too low or high prices, and inefficient management.
Maximize parking supply.	Too much supply is as harmful as too little.
All parking demand should be satisfied on-site. Motorists should walk minimal distances to cars.	Parking can often be provided off-site, allowing parking facilities to serve multiple destinations.
Parking should be unpriced or as inexpensive as possible, funded indirectly.	As much as possible, users should pay directly for parking facilities.
Parking should be available on a first-come basis.	Parking should be prioritized to favor higher value users.
Analysis should focus on motorists' convenience.	Analysis should consider all impacts, including strategic goals.
Parking management is a last resort, to be applied only if facility expansion is infeasible.	Parking supply should be minimized and only expanded after all cost-effective management solutions are implemented.
Innovation faces a high burden of proof and should only be applied if proven and widely accepted.	Innovations should be encouraged, since even unsuccessful experiments can provide useful information.

Parking management changes the way parking problems are defined and solutions evaluated.

Emerging technologies and planning goals increase the feasibility and benefits of parking management (Rosenblum, Hudson and Ben-Joseph 2020). For example, new payment technologies reduce the inconvenience of parking pricing, and new planning goals such as housing affordability, public health, compact development and environmental protection, justify policies that minimize parking supply and increase parking fees, at least to cost recovery levels.

The old paradigm results in *predict and provide* planning, in which past trends are extrapolated to predict future demand, which planners try to satisfy. This often creates a self-fulfilling prophecy, since abundant parking supply increases vehicle use and sprawl, creating a cycle of increased automobile dependency, as illustrated below. Parking management represents *decide and provide* planning which strives to achieve objective and performance targets.

Figure 1 **A Shift from Predict and Provide to Decide and Provide Paradigms**



Many current policies contribute to a self-reinforcing cycle of automobile dependency and sprawl. A new paradigm creates a new cycle of compact development and multimodal transport planning.

Parking, land use and transportation planning decisions are intertwined. Excessive parking requirements create more dispersed, automobile-oriented land use development patterns, and encourage increased automobile ownership and use (McCahill, et al. 2016). They reduce housing affordability, particularly for lower-cost housing in areas with high land costs, and for housing with multiple bedrooms to accommodate families with children (Gould 2024). Parking management should be implemented as part of an integrated effort to reduce parking costs, encourage more compact development, and encourage use of resource-efficient transport options to reduce congestion, accidents and pollution emissions.

It is important to carefully define parking problems. For example, if people complain about inadequate parking it is important to determine the exact type, location and time. The table on the next page lists various parking problems and compares the impacts of increasing parking supply with management solutions. Increasing supply helps reduce parking congestion and spillover problems but increases most other problems. Management solutions tend to reduce most problems, providing a greater range of benefits and so are supported by more comprehensive planning.

Table 3 **Comparing Increased Supply and Management Solutions**

Problem	Increased Supply	Management Solutions
Parking congestion. Too many vehicles trying to use available parking facilities.	*Positive.* Increases number of available parking spaces.	*Positive.* More efficient use of available parking spaces.
Spillover. Problems from motorists parking where they are not wanted.	*Positive.* Reduces incentive for motorists to use off-site spaces.	*Mixed.* Some management strategies increase spillover problems, others reduce them.
Facility costs. Increased development and operating costs for parking facilities.	*Negative.* Increases facility costs.	*Positive.* Reduces parking facility costs.
Traffic congestion. Too many vehicles for existing road capacity.	*Negative.* Generous, free parking increases vehicle use.	*Positive.* Many management strategies reduce vehicle use.
Inequity. Distribution of costs, including cost burdens on people who do not use parking facilities, and the quality of accessibility options for `disadvantaged people.	*Negative.* Forces non-drivers to pay for parking they do not use, and reduces access` options for non-drivers.	*Positive.* Reduces costs borne by non-drivers and improves accessibility options.
Tax costs. Tax burden required to subsidize parking facilities.	*Negative.* Often involves public subsidy of parking.	*Positive.* Reduces the need to subsidize parking facilities.
Environmental impacts. Loss of greenspace, stormwater management costs, air pollution, unattractive landscapes.	*Negative.* Increases total paved land, and increases total vehicle ownership and use.	*Positive.* Reduces total parking requirements and vehicle use.
Sprawl. Encouraging dispersed, urban fringe development, and discouraging multi-modal, urban infill development.	*Negative.* Discourages infill and encourages dispersed, urban fringe, auto-oriented development.	*Positive.* Encourages smart growth development patterns.

This table compares the effects of increasing parking supply with parking management solutions. The more impacts that are considered, the more management solutions are justified.

Parking demands can be categorized in various ways that affect parking management opportunities and requirements:

- *Short-term parking* (less than one hours) consists of delivery, and most errand trips.
- *Medium-term parking* (one- to four hours) consists of some diners, shoppers, some service trips (plumbers and electricians), and some commuters and visitors.
- *Long-term parking* consists of commuting, residents and some service trips.

In addition, some trips involve heavy loads or people with disabilities that limit the distance that passengers can reasonably walk to destinations, and some motorists are more price sensitive than others. Parking management must respond to these differences. In general, short-term parking requires more convenience and shorter walking distances to destinations, while longer-term parking requirements lower unit prices ($2/hour may be a reasonable price for convenient downtown parking used for errands, but few commuters can afford to pay $16 per day to park).

Impacts of New Mobility Services and Technologies

New mobility services and technologies can affect parking management in various ways.

New telecommunications systems, such as integrated navigation and parking apps, electronic cards and RFID payment systems tend to increase the convenience and efficiency of parking and transportation demand management. These can help reduce the number of parking spaces needed to serve a destination, particularly if implemented with other demand management strategies, such as improved walkability and transit service quality.

Dynamic ridesharing and ridehailing services, such as Uber and Lyft affect travel and parking demands, including reducing urban vehicle ownership, commercial center parking demand, and airport vehicle rentals (Bergal 2017), and increasing total vehicle traffic and congestion in some city centres (Schaller 2017).

Autonomous vehicle technologies may affect future parking demands in several ways (DeLuca 2018). Some studies predict that autonomous taxis will replace most personal vehicle travel (Keeney 2017; Kok, et al. 2017), and by allowing vehicles to park closer together, autonomous vehicles could increase parking lot capacity up to 62% (Nourinejad, Bahrami and Roorda 2018). However, these technologies are unlikely to eliminate urban parking demand in the foreseeable future since many years will probably be required before they are sufficiently reliable and affordable that most vehicles can operate autonomously, and even when common many travellers may choose to continue owning personal vehicles, for convenience and status sake, and so will want to park near destinations so they are available with minimal delay (Mauchan, Long and Holmes 2017). As a result, during the 2020s and 2030s, growth in overall vehicle travel is likely to offset reductions due to these technologies. Parking demand may eventually decline in many areas, but it is unlikely to disappear. These innovations are likely to make parking and travel more price sensitive, so parking fees and transportation subsidies will reduce parking demands more than would otherwise occur. As a result, their impacts will be affected by public policies that affect travel options and prices.

This has several implications for parking planning and management. Overall parking demand growth is likely to decline as new apps, mobility services and technologies develop, although these changes will probably be gradual and variable, and sensitive to public policies. Their impacts are likely to be largest in denser urban areas where these innovations significantly improve travel and parking options, traffic and parking problems are most severe, and parking and transportation management programs are commonly implemented.

These innovations increase the justification for management strategies that encourage efficient travel and parking. If implemented without strategic planning, transport apps are likely to be uncoordinated, new mobility services will increase traffic congestion, and there may be few savings to consumers, businesses and governments. New services and technologies can be deployed in ways that favor space-efficient travel and parking options, such as high-occupant vehicle lanes and curb access, efficient road and parking pricing, integrated parking and navigation apps, and improvements to non-auto modes. In addition, parking facilities should be designed for flexibility, so they can accommodate other uses, including carsharing and ridehailing vehicle parking, storage, or developed into other building types (Fane 2018).

How Much Is Optimal?

The table below summarizes factors to consider when determining optimal parking supply.

Table 4 **Assumptions Affecting Parking Supply Requirements**

Factor	Favors Higher Supply	Favors Lower Supply
Driving and parking demands.	Everybody drives and wants abundant and free parking.	Not everybody drives, Non-drivers should not be forced to pay for costly parking facilities they do not need.
How frequently parking facilities may fill (all spaces are occupied).	Parking facilities should fill, at most, a few hours per year.	Parking facilities may frequently fill provided alternatives are available.
Whether all parking demand must be accommodated on site.	All parking demands should be accommodated on-site.	Off-site parking may be used, provided motorist have information about their options and good walking connections
Acceptable walking distances to parking.	300 feet maximum.	Up to 1,000 feet for longer-term uses, provided walking conditions are good.
Whether on-street parking can be counted toward parking supply.	All parking demand should be served by off-street lots.	Nearby on-street parking may count as a portion of parking supply.
Whether parking facilities should be priced, and if so the amount.	Parking should be free or as cheap as possible.	Parking should be priced to recover facility costs and to manage demand.
Which geographic, demographic and management factors affect parking minimums.	Parking minimums should be applied consistently, with a high burden of proof required for any adjustments.	Supply should be adjusted to reflect demands, with contingency plans to address uncertainty.
Whether parking supply should be reduced where costs are higher.	Parking minimums should be applied consistently, regardless of cost.	Parking minimums should be reduced where parking is more costly to supply.
Whether parking supply must be oversized to accommodate possible future growth.	Parking supply should anticipate possible future increases in demands.	Parking supply should be minimized, provided that a contingency plan is available to address future shortages.
Whether vehicle travel and urban expansion should be discouraged.	There is no reason to discourage driving or sprawl.	Parking policies should support vehicle travel and sprawl reduction goals.
Whether transportation and parking management is effective.	Travel and parking management are difficult and often ineffective.	Travel and parking management can be effective and beneficial.
Whether parking supply may be constrained to help achieve strategic planning objectives.	Parking minimums should be applied consistently, regardless of other objectives.	Parking minimums should be consistent with strategic planning objectives such as reducing traffic and sprawl.
Whether parking should be provided for non-auto modes.	Parking minimums only apply to automobiles.	Priority should be given to delivery and passenger vehicles, and bicycle parking.
Whether transportation and parking management programs can be implemented.	Parking management is only applied as a last resort, where increasing supply is infeasible.	Parking management should be implemented whenever cost effective, considering all benefits.

This table summarizes factors to consider when determining optimal parking supply. Conventional planning tends to use assumptions that justify high parking supply and minimal travel and parking management.

Different assumptions can result in very different conclusions concerning the number of spaces needed at a particular time and location. Conventional planning tends to apply assumptions that justify maximum parking supply and minimal investment in transportation and parking management. For example, most jurisdictions apply parking minimums, such as those in Table 5 which generally assume that parking should be abundant and free at most locations, regardless of costs or community goals such as increasing affordability and reducing traffic problems.

Table 5 **Typical Parking Minimums** (Stover and Koepke 2002)

Land Use Category	Unit	Index (85th Percentile)	Peak Parking Period
Single Family Housing	Dwelling Unit	2.0	Evening
Multi-Family Housing	Dwelling Unit	1.5	Evening
Elderly Housing	Dwelling Unit	0.5	Weekday
Hotel	Guest Room	1.0	Weekday-evening
Hospital	100 sq. m./Bed	5/2.6	Weekday-day
Retail – Shopping Center	100 sq. m. GLA	5.0	Saturday-day
Office Building	100 sq. m. GFA/Employee	3.3/0.9	Weekday-day
Light Industry	100 sq. m. GFA/Employee	2.2/1.0	Weekday-day
Heavy Industry	100 sq. m. GFA/Employee	1.7/0.6	Weekday-day
Fast-Food Restaurant	Seat	0.85	Weekday
Church/Synagogue/Mosque	Seat	0.2	Sunday/Saturday/Friday
Movie Theater	Seat	0.25	Saturday-Evening

GLA = Gross Leasable Area GFA = Gross Floor Area

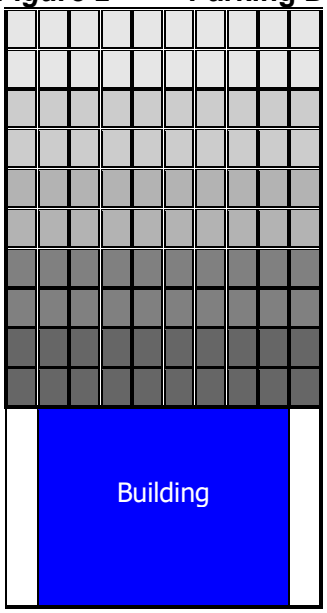
This table illustrates typical minimum parking requirements. These "unadjusted" values can often be significantly reduced based on various factors and management strategies described in this guide.

These are *unadjusted* values that generally reflect the maximum parking supply that could be needed. To appreciate why it is helpful to understand how they are developed. These minimums are based on parking demand field surveys, the results of which are collected and published in technical reports such as ITE's *Parking Generation*. The data are often limited. Fewer than a dozen surveys are used to set minimums for many land use categories. The analysis seldom accounts for geographic, demographic and economic factors that can affect parking demand, such as whether a site is urban or suburban, and whether parking is free or priced (Cervero, Adkins and Sullivan 2010; Daisa and Parker 2010). Most demand studies were performed in automobile-dependent locations. They generally reflect an 85th percentile demand curve (which means that 85 out of 100 sites will have unoccupied parking spaces even during peak periods), an 85th occupancy rate (a parking facility is considered full if 85% of spaces are occupied) and a 10th design hour (parking facilities are sized to fill only ten hours per year). These minimums often result in far more parking supply than is usually needed at most destinations, particularly where land use is mixed, there are good travel options, or parking is managed efficiently.

Typical North American communities have three to six off-street parking spaces per vehicle, including many government-mandated spaces that are seldom or never used (Bunt & Assoc. 2024; Litman 2023; Scharnhorst 2018). Volker and Thigpen (2024) found that more than 75% of Sacramento, CA households have enough off-street parking to park all their vehicles, and combining off-street and on-street parking those households have an average of 1.6 more spaces than vehicles. This oversupply is particularly severe in areas with transportation or parking management policies (Galdes and Schor 2022; Spack and Finkelstein 2014).

This process is said to measure parking *demand*, but demand is actually a function: the quantity consumers would purchase at a given price. Parking is free at most parking survey sites so their results are equivalent to determining the amount of food stores can give away. To truly measure demand analysis must determine how much parking would be used under various prices and conditions. For example, rather than saying, "A 12,500 sf commercial building requires 100 spaces," a planner should say, "A 100 employee office building requires 100 spaces at an automobile-dependent location with unmanaged and unpriced parking; 80 spaces at a multi-modal location; 60 spaces at a multi-modal location with shared parking; 40 spaces at a multi-modal location with parking efficiently managed and $2 per day prices; and 20 spaces at a multi-modal location, with efficiently managed parking and $5 per day prices" as illustrated below.

Figure 2 **Parking Demand Depends On Location, Price and Management**



100 spaces at an automobile-oriented location, unmanaged and unpriced.

80 spaces at a multi-modal location, unmanaged and unpriced.

60 spaces at a multi-modal location, managed efficiently and unpriced.

40 spaces at a multi-modal location, managed efficiently and $2 per day.

20 spaces at a multi-modal location, managed efficiently and $5 per day.

The number of parking spaces needed to serve a building can vary significantly depending on factors such as the quality of travel options available, and how parking facilities are managed.

The optimal parking supply should vary depending on geographic conditions (Wang and Liu 2022).

- In central business districts (CBDs), parking congestion problems are common, land costs are very high and travel is multimodal, so parking is highly regulated and priced.
- In urban areas, parking congestion problems are common, land costs are high, and travel is multimodal, so parking is often regulated and sometimes priced.
- In suburban areas, parking congestion problems tend to occur on weekends and holidays, land costs are moderate so parking is generally regulated but unpriced.
- In rural areas, land costs are low so parking is generally unregulated and unpriced.

Various planning and market distortions can result in economically excessive parking minimums, supply and demand, as summarized in Table 6. Correcting these distortions can significantly reduce parking requirements.

Table 6 **Parking Planning and Market Distortions and Corrections**

Distortions	Corrections
Most parking demand studies are performed at single-use, suburban sites where parking is unpriced, resulting in more parking supply than needed in other conditions.	Perform more research to determine how geographic, demographic and management factors affect parking demand.
Parking minimums are often not adjusted to reflect geographic, demographic and economic factors that affect demand.	Apply more accurate parking minimums that reflect specific conditions.
Minimums are based on 85% percentile demand, the 10th annual design hour, and 85-90% occupancy.	Apply more accurate parking minimums that reflect specific conditions.
Parking minimums are often designed to accommodate the highest level of demand the site may ever encounter, although this is excessive most of its operating life.	Apply more accurate parking minimums, with contingency-based solutions available to address future changes in demand.
Generous minimum parking minimums result in abundant parking supply, which discourages owners from charging for parking, creating a self-fulfilling prophesy.	Apply more accurate parking minimums and parking management solutions before expanding parking supply.
Governments often provide subsidized parking, which discourages businesses from charging for parking at their sites.	Price public parking efficiently.
Parking facility funding often cannot be used for management strategies even if they are more cost effective and beneficial.	Apply *least cost planning*, so funds can be used management strategies when cost effective.
Tax policies encourage employers to provide subsidized parking.	Make tax policy more neutral.
A heavy burden of proof is often placed on reductions from conventional minimums.	Shift the burden of proof to allow management solutions unless they are proven undesirable.
When demand can be calculated in various ways, zoning codes require use of the highest value.	Allow the most appropriate indicator to be used when calculating parking requirements.
Generous parking requirements are often imposed on new developments to remedy deficiencies at existing sites.	Apply management solutions to address existing parking problems.
Officials who set parking minimums often favor abundant supply and avoid other solutions since they do not bear the costs.	Encourage officials to support efficient parking management.
Evaluation often overlooks some costs such as land opportunity costs, stormwater management and environmental impacts.	Use comprehensive evaluation that considers all economic, social and environmental impacts.
Excessive minimums were created when land costs were lower and there was less concern about traffic impacts and sprawl.	Adjust parking planning practices to reflect changes in land values and planning objectives.
Older pricing methods (meters and passes) tend to be inconvenient, creating opposition to pricing.	Apply better pricing methods.
Current laws and planning practices often discourage shared parking, forcing each site to supply its own parking facilities.	Correct planning practices to support sharing and other management strategies.
Parking facilities are ignored when calculating *Floor Area Ratios* (FAR), which favors parking over other building amenities.	Include parking facilities when calculating FARs.
Current transportation policies and planning practices tend to be automobile-oriented, which increases parking demand.	Encourage more multi-modal planning.

This table summarizes various planning and market distortions that result in economically-excessive parking requirements, supply and demand, and how they can be corrected.

Although individually these distortions may seem modest and reasonable, their impacts are cumulative and synergistic (total impacts are greater than the sum of their individual impacts). For example, a public official or developer may specify generous supply thinking that a few extra parking spaces impose modest costs. But the total economic, social and environmental costs of this excessive supply are large, considering the indirect costs resulting from the additional automobile travel and land use dispersion stimulated by such generous parking requirements.

Planning practitioners often define high and inflexible parking minimums as being *conservative*, implying that this approach is cautious and responsible. Use of the word *conservative* in this context is confusing because it results in the opposite of what is implied. Excessive parking requirements waste resources, both directly, by increasing the money and land devoted to parking facilities, in indirectly, by increasing automobile use and sprawl. Better parking management actually tends to be more *conservative* overall.

Parking Demand in Compact, Multi-modal Areas
The following studies show that households in compact, multi-modal areas (often called *Smart Growth* or *Transit-Oriented Developments*) own fewer vehicles, generate fewer trips and require less parking than conventional models predict.

G.B. Arrington, et al. (2008), *Effects of TOD on Housing, Parking, and Travel*, Report 128, Transit Cooperative Research Program (www.trb.org/CRP/TCRP); at http://bit.ly/2pgkSYp; summarized in *ITE Journal* (www.ite.org), Vol. 79, No. 6, June 2010, pp. 26-29; at http://tinyurl.com/q2usu3r.

Daniel Baldwin Hess and Jeffrey Rehler (2021), "Minus Minimums," *Journal of the American Planning Association* (DOI: 10.1080/01944363.2020.1864225).

Reid Ewing, et al. (2017), *Trip and Parking Generation Study of Orenco Station TOD, Portland Region*, NITC-RR-767, Transportation Research and Education Center (TREC); at https://doi.org/10.15760/trec.157.

Fox Tuttle (2021), *Parking & Affordable Housing*, Shopworks Architecture (https://shopworksarc.com); summarized at https://bit.ly/3CK28Vz.

C.J. Gabbe, Gregory Pierce and Gordon Clowers (2020), "Parking Policy: The Effects of Residential Minimum Parking Requirements in Seattle," *Land Use Policy*, Vo. 91 (doi.org/10.1016/j.landusepol.2019.104053).

Adam Millard-Ball (2015), "Phantom Trips: Overestimating the Traffic Impacts of New Development," *Journal of Transportation and Land Use* (www.jtlu.org); at http://tinyurl.com/m6ay4ut; summarized in, *ACCESS 45*, pp. 3-8; at www.accessmagazine.org/articles/fall-2014/phantom-trips.

Daniel Rowe, et al. (2013), "Do Land Use, Transit and Walk Access Affect Residential Parking Demand?" *ITE Journal*, Vol. 83. No. 2, February, pp. 24-28; at https://bit.ly/3pStotR. This article summarizes the results of King County's *Right Size Parking Project* (www.rightsizeparking.org/index.php).

Robert J. Schneider, Susan L. Handy and Kevan Shafizadeh (2014), "Trip Generation for Smart Growth Projects," ACCESS 45, pp. 10-15; at http://tinyurl.com/oye8aqj. Also see the *Smart Growth Trip-Generation Adjustment Tool*, (http://ultrans.its.ucdavis.edu/projects/smart-growth-trip-generation).

Rachel Weinberger and Joshua Karlin-Resnick (2019), "Parking In Mixed-Use U.S. Districts: Oversupplied No Matter How You Slice the Pie," *Transportation Research Record*, 2537, pp. 177-184 (https://doi.org/10.3141/2537-19).

Ways to Determine Optimal Parking Supply

Conventional parking requirements often result in more supply than is efficient; surveys find that many parking facilities are never fully occupied even during peak periods (Quednau 2018), and increased parking supply tends to increase automobile ownership and use (Khazaeian 2021) and increases impervious surface area, which contradicts strategic planning goals. There are other ways to determine how much parking to supply at a particular site. *Efficiency-based minimums* are sized for optimal utilization. This means that parking lots may fill provided there are alternatives. For example, parking facilities at a store can be sized to fill most days provided that overflow parking is available nearby, motorists have information about available parking options, and regulations are adequately enforced to address spillover problems.

Efficiency-based minimums take into account geographic, demographic and economic factors that affect parking demand. They also reflect the relative costs and benefits of different options, so less parking is supplied where parking supply is relatively costly to provide or where management programs easy to implement. Efficiency-based minimums should also reflect strategic objectives such as a desire for more compact development or to reduce vehicle traffic. Current demographic and economic trends, including more compact development, more multimodal transport planning, and new mobility services and technologies, are reducing the number of parking spaces needed to serve travellers' needs (DeLuca 2018), and reducing parking supply is one of the most effective ways to reduce traffic (Christiansen, et al. 2017).

Various principles that can be used to determine optimal parking supply:

1. **Consumer sovereignty.** This means that policies should respond to consumer demands. This justifies providing more parking where vehicle ownership and use are higher and reducing supply where it is reduced. It also justifies unbundling parking so households that own fewer than average vehicles (zero cars, or just one car in an area where mandates require two spaces per home) can choose cheaper parking-free housing rather than being forced to pay for parking spaces they don't need.
2. **Parking demands and costs.** According to this principle, parking supply should respond to user demands and production costs. This implies that parking minimums should decline with factors that reduce vehicle ownership, such as poverty, density and quality of non-auto modes, and be reduced where parking is more costly to provide.
3. **Willingness to pay (efficient pricing).** According to this principle, optimal residential parking supply is the number of spaces that occupants would choose if they are charged cost-recovery prices (parking fees could pay the total costs of providing that space).
4. **Strategic goals.** According to this principle, parking regulations should support strategic goals such as affordability, equity, efficient mobility, traffic safety, emission reductions, and habitat protection. This implies that parking mandates should generally be minimized to support various strategic goals.
5. **Equity objectives.** According to this principle, residents should "get what they pay for and pay for what they get" unless subsidies are specifically justified, and policies should favor disadvantaged groups. This implies that residential parking should generally be unbundled, so motorists pay directly for the parking spaces they use, with exemptions or discounts for motorists who have disabilities or low incomes.

These principles tend to justify shifts from current parking mandates, which assume that parking should be as abundant and inexpensive as possible, to more responsive and flexible parking mandates which better reflect demands (including demands by car-free households for zero parking supply and cash out of parking subsidies), more efficient pricing, and more efficient parking management.

Many communities are now eliminating or significantly reducing off-street parking mandates (Parking Reform Network). This does not eliminate off-street parking, it simply allows property owners to determine the amount of parking to supply based on market demands. This generally results in far lower off-street parking supply than currently mandated, with those parking spaces being efficiently managed so each space can serve more users.

Parking Facility Costs

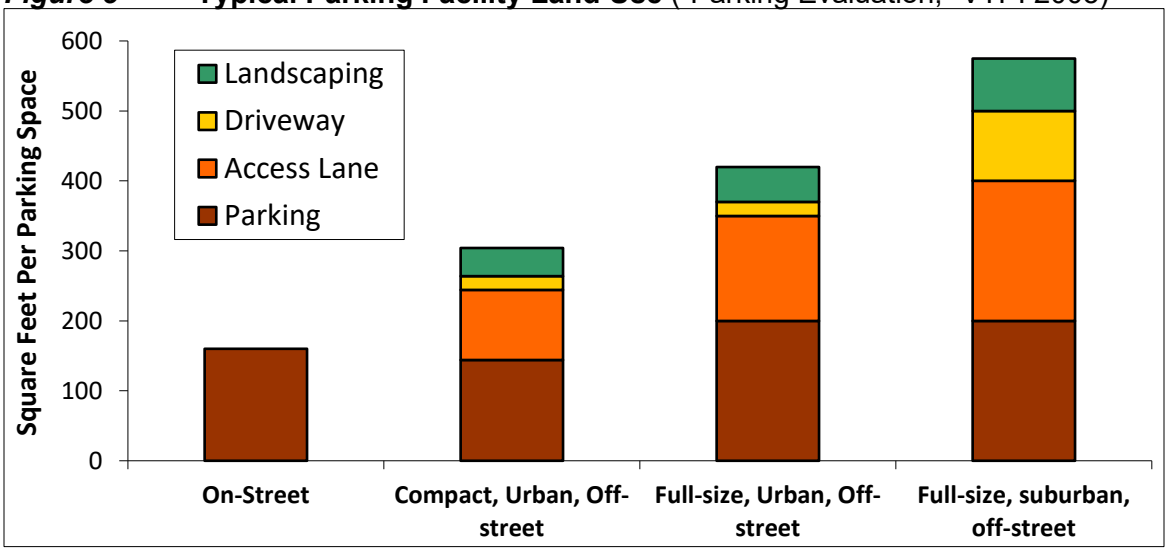
A major benefit of parking management is its ability to reduce facility costs. Parking facility costs are usually borne indirectly through rents, taxes and as a component of retail goods, so most people have little idea how much they really pay for parking facilities, and their potential savings from more efficient management.

Various types of parking costs are described below (Litman 2009 and 2022).

Land

A typical parking space is 8-10 feet (2.4-3.0 meters) wide and 18-20 feet (5.5-6.0 meter) long, totaling 144-200 square feet (13-19 sq. meters). Off-street parking requires driveways (connecting the parking lot to a road) and access lanes (for circulation within a parking lot), and so typically requires 300-400 square feet (28-37 square meters) per space, allowing 100-150 spaces per acre (250-370 per hectare). On-street parking is usually 7-8 feet wide (2.1-2.4 meter) and requires 20-22 feet (6.1-6.7 meters) of curb.

Figure 3 **Typical Parking Facility Land Use** ("Parking Evaluation," VTPI 2005)



Land requirements per parking space vary depending on type and size. Off-street spaces require driveways and access lanes. Landscaping typically adds 10-15% to parking lot area.

Because parking must be located near destinations, parking facilities often occupy high value land. The portion of total land devoted to parking varies depending on conditions. In typical urban or suburban areas, streets (partly used for parking) and off-street parking each cover 5-10% of land area, but in commercial and industrial areas, such as a downtown or retail mall, streets often cover 10-30% of land, while driveways and off-street parking cover 30-50% of land. Various studies have estimated the amount of land devoted to parking facilities (Chester, et al. 2015; Davis, et al. 2010; DiRaimo 2021; Kisin 2022; Marshall and Garrick 2006; McCahill and Garrick 2012; Pijanowski 2007)

Curb Space

On-street parking uses less land per space than off-street parking, because it requires no driveway, but the land it uses often has a high opportunity costs. Road space to parking displaces traffic lanes, bicycle lanes, sidewalks and greenspace. An on-street parking space typically requires 20-24 feet (6-8 meters) of curb, while a residential or light commercial driveway typically requires 12-20 feet (4-6 meters) of curb, so each driveway displaces about one on-street parking space. As a result, a residential driveway that serves one vehicle provides no net gain in total parking supply due to lost curb parking, and reduces the number of public parking spaces serving the community.

Construction Costs

Table 7 indicates typical construction costs for above-ground parking facilities under optimal conditions. Underground parking (such as in a building basement) typically costs about twice as much per space as above ground structured parking. Costs increase if soils are poor, lots are steep or irregularly shaped, if significant landscaping is required, or if washrooms and elevators are included. Actual costs are often far higher. In addition to these "hard" costs, there are "soft" costs for project planning, design, permits and financing, which typically increase costs by 30-40% for a stand-alone project.

Table 7 **Typical Parking Construction Costs Per Space** (PT 2000)

	Small Site (30,000 sf)	Medium Site (60,000 sf)	Large Site (90,000 sf)
Area Per Space	*350 sf*	*325 sf*	*315 sf*
Surface Parking	$1,838	$1,706	$1,654
Ground + 1 level	$7,258	$6,143	$5,705
Ground + 2 level	$8,085	$6,767	$6,284
Ground + 3 level	$8,407	$6,996	$6,491
Ground + 4 level	$8,747	$7,269	$6,747
Ground + 5level	$8,973	$7,451	$6,918
Ground + 6 level	$9,135	$7,581	$7,040
Ground + 7 level	$9,256	$7,678	$7,132
Ground + 8 level	$9,351	$7,754	$7,203

2000 U.S. dollars. Assumes rectangular site, good soil conditions, quality finish and no extra costs. ("sf" = Square Feet.)

Operation and Maintenance

Operation and maintenance costs include cleaning, lighting, maintenance, repairs, security services, landscaping, snow removal, access control (e.g., entrance gates), fee collection (for priced parking), enforcement, insurance, labor and administration. Parking facilities need periodic resurfacing and repaving. Parking structures typically have an operating life of 20-40 years, after which they require major reconstruction or replacement. Structured parking may require additional costs for fire control equipment and elevators, and underground parking may require mechanical ventilation. Private parking facilities must pay taxes and provide profits. Typical annual operating costs range from about $200 per space for basic maintenance of a surface lot, up to $800 per space for a facility with tollbooth attendants (Dorsett 1998).

Transaction Costs

Transaction costs are any ongoing incremental costs required for regulations and pricing, including costs for equipment (signs, parking meters, ticket printers, access gates), attendants, space (such as sidewalk area used by parking meters), administration and enforcement. The incremental cost of pricing parking 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. Pricing also imposes transaction costs on motorists for the time and inconvenience of paying fees.

Total Parking Cost

Various studies have calculated the number of parking spaces provided in a typical community (Marshall and Garrick 2006; Scharnhorst 2018). The table below illustrates examples of the direct, annualized costs of providing parking (not including indirect costs such as stormwater management, environmental impacts, aesthetic degradation, etc.). This varies from about $250 per space if otherwise unused land is available, and construction and operating costs are minimal, to more than $2,250 for structured parking with attendants. On-street parking spaces require less land per space than off-street parking, since they do not require access lanes, but their opportunity costs can be high if they use road space needed for traffic lanes or sidewalks. The *Parking Cost, Pricing and Revenue Calculator* (www.vtpi.org/parking.xls) can be used to estimate these costs in a particular situation.

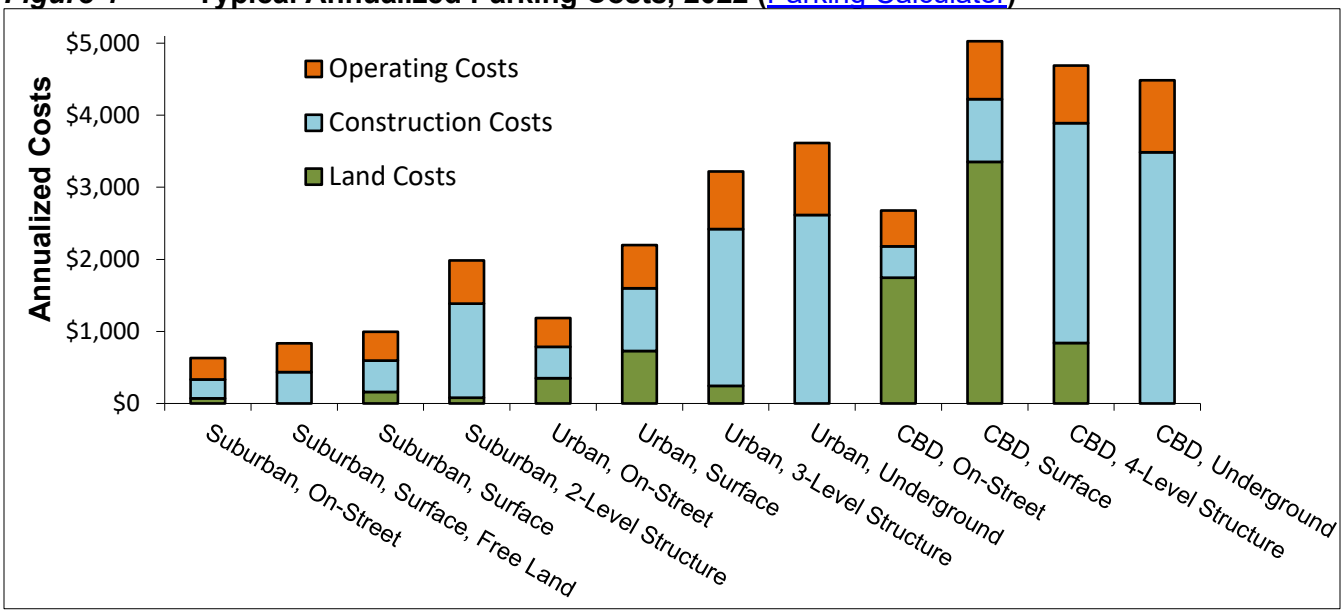
Table 8 **Typical Parking Costs, 2022** (Parking Calculator)

Type of Facility	Land Costs, Per Acre	Annualized Land Cost Per Space	Construction Costs Per Space	Annual Construction Costs	Annual O & M Costs	Total Annual Cost
Suburban, On-Street	$200,000	$70	$3,000	$262	$300	$631
Suburban, Surface, Free Land	$0	$0	$5,000	$436	$400	$836
Suburban, Surface	$200,000	$159	$5,000	$436	$400	$994
Suburban, 2-Level Structure	$200,000	$79	$15,000	$1,308	$600	$1,987
Urban, On-Street	$1,000,000	$349	$5,000	$436	$400	$1,185
Urban, Surface	$1,000,000	$727	$10,000	$872	$600	$2,198
Urban, 3-Level Structure	$1,000,000	$242	$25,000	$2,180	$800	$3,222
Urban, Underground	$1,000,000	$0	$30,000	$2,616	$1,000	$3,616
CBD, On-Street	$5,000,000	$1,744	$5,000	$436	$500	$2,680
CBD, Surface	$5,000,000	$3,353	$10,000	$872	$800	$5,025
CBD, 4-Level Structure	$5,000,000	$838	$35,000	$3,051	$800	$4,690
CBD, Underground	$5,000,000	$0	$40,000	$3,487	$1,000	$4,487

This table shows typical values from the "Parking Cost, Pricing and Revenue Calculator."

This analysis indicates that parking facility costs range from less than $1,000 annually for surface parking on low-priced land, to more than $5,000 for high-amenity parking in central business districts (CBDs). These do not include indirect and environmental costs.

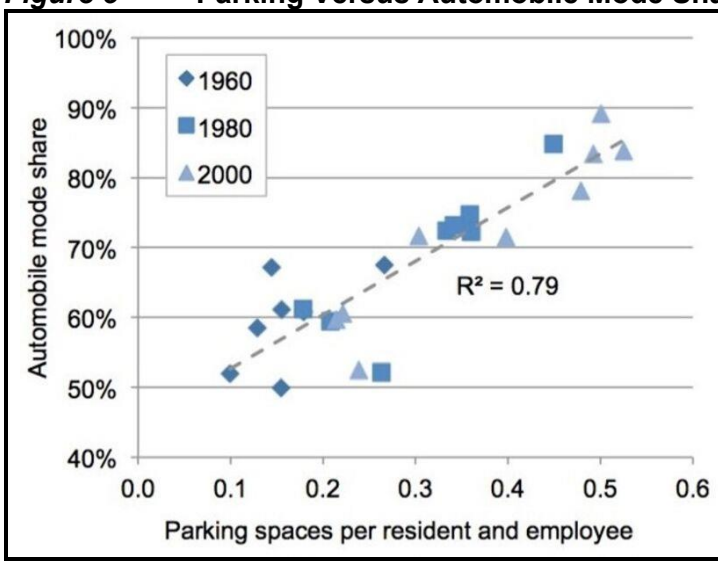
Figure 4 **Typical Annualized Parking Costs, 2022 (Parking Calculator)**



This figure illustrates annualized costs per parking space. CBD = Central Business District

In addition to these direct costs, increasing parking supply imposes indirect costs including increased higher stormwater management and heat island costs, degraded walking conditions, increased automobile use (McCahill 2016) which increases traffic problems (2010; Croeser, et al. 2022), plus health and sprawl-related costs (Garber, et al. 2025). The figure below illustrates the positive relationship between parking supply and automobile mode shares. Put more positively, parking management can help solve numerous economic, social and environmental problems, increase economic productivity, and benefit consumers overall.

Figure 5 **Parking Versus Automobile Mode Shares** (McCahill 2016)



This and other research show a strong positive relationship between parking supply and automobile travel. The researchers found that an increase in parking provision from 0.1 to 0.5 spaces per resident and employee is associated with an increase in automobile commute mode share of roughly 30 percentage points. Changes in parking supply predicted driving changes more powerfully than automobile mode share predicted parking supply, indicating that more parking causes more driving.

Parking Management Strategies

This section describes a variety of specific parking management strategies. For more information see DLCD (2024), ITDP (2023 and 2024), and the Parking Reform Network.

Shared Parking

Shared parking means that a parking facility serves multiple users and destinations. This can be done in the following ways.

- *On-street (curb) parking.* Curb parking tends to be visible and convenient, and can serve multiple users and destinations. For example, a curb space can serve delivery vehicles in the morning, shoppers during the day, restaurant patrons in the evening, and residents overnight. There are often conflicts over prime curb spaces so efficient sharing requires regulations, pricing and user information that favors higher value users (deliveries, passenger loading, short-term errands, etc.) over lower-value users (commuters, long-term errands and residents).

  There are often trade-offs between on- and off-street parking because each driveway typically displaces one on-street parking space. If houses have 40-foot frontages, an urban street can park two vehicles per house if there are no driveways but only one if it has a driveway. As a result, in a typical urban residential neighborhood where residents typically park one vehicle per driveway, off-street parking provides little or no increase in parking supply, and because on-street spaces can serve multiple destinations they are more efficient overall.

  Curb parking demands are increasing with more courier, on-line shopping and food delivery services, and more taxi, ridehailing and transit passenger services, motivating many cities to implement curb management plans (ITE 2019; Seattle 2022).

- *Sharing within a parking lot.* Motorists share parking spaces rather than being assigned reserved spaces. For example, 100 employees can usually share 60-80 spaces since at any time some are on leave or in the field, commuting by non-auto modes or working off-peak shifts. Hotels, apartments and dormitories can share parking spaces since the number of vehicles per housing unit varies over time. Sharing can be optional, so for example, motorists could choose between $60 per month for a shared space or $100 for a reserved space.

- *Share parking among destinations.* Parking can be shared among multiple destinations. For example, an office building can share parking with a restaurant or theater, since peak demand for offices occurs during weekdays, and on weekend evenings for restaurants and theaters, as indicated in Table 9. Sharing can involve mixing land uses on single site, such as a mall or campus, or by creating a sharing arrangement between sites located suitably close together.

Table 9 **Typical Peak Parking Periods For Various Land Uses**

Weekday	Evening	Weekend
Public services such as shops and banks		
Offices and other worksites	Auditoriums	
Park & ride facilities	Bars and dance halls	
Schools, colleges and daycare centers	Meeting halls	
Factories and distribution centers	Restaurants	Religious institutions
Medical clinics	Theaters	Parks
Professional services	Hotels	Shops and malls

Parking can be shared efficiently by land uses with different peaks.

- *Public rather than private parking.* Public parking, with parking facilities owned by governments or commercial operators, is more suited to sharing than private, on-site parking. "In lieu fees" mean that developers help fund public parking facilities instead of private facilities serving a single destination. Businesses in an area can be assessed a special assessment or tax to fund parking facilities in their area, as an alternative to each business supplying its own facilities. This can be implemented through a local organization, such as a business organization or transportation management association, that provides parking brokerage services.

The table below summarizes requirements for implementing parking facility sharing.

Table 10 **Shared Parking Requirements**

Shared Parking Type	Description	Implementation Requirements
Curb parking	Efficient curb parking management	Regulate and price on-street parking to favor higher-value uses (e.g. deliveries and urgent errands).
Within a parking facility	Multiple users share several spaces rather than assigned spaces.	Reduce parking requirements. Allow multiple users to share spaces, with a plan for addressing overflows.
Between destinations	Parking facilities serve multiple destinations.	Reduce requirements in compact, mixed-use areas. Establish sharing agreements between destinations with varied peaks. Improve walkability between parking and destinations. Create parking brokerage services.
Public rather than private parking	Rely on government or commercial parking, rather than private on-site parking.	Reduce parking requirements in compact, mixed-use areas. Build government or encourage commercial parking operators. Improve walkability and wayfinding.

There are many ways to share parking with various implementation requirements.

Regulate Parking

Parking regulations control who, when and how long vehicles may park, to favor higher value uses such as delivery and service vehicles, passenger loading, people with disabilities and other special needs, and rideshare vehicles (DLCD 2024). It is particularly appropriate for the most convenient parking spaces, such as those located near entranceways. There are three general steps to developing parking regulations.

First, rank parking facility use priorities. Here is a typical example:

1. Deliveries and service vehicles.
2. Vehicles used by people with disabilities.
3. Rideshare and transit vehicles.
4. Customers, tourists and visitors.
5. Employees and residents.
6. Long-term vehicle storage.

Second, choose appropriate regulations to favor priority uses, such as the following.

Table 11 **Common Parking Regulations**

Name	Description	Favored Uses
User or vehicle type	Spaces dedicated to loading, service, taxis, customers, rideshare vehicles, disabled users, buses and trucks.	As specified.
Duration	Limit parking duration (5-minute loading zones, 30-minutes adjacent to shop entrances, 1- or 2-hour limits).	Short-term users such as deliveries, customers and errands.
Time-based restrictions	Restrict when parking is allowed such as before 10 a.m. to discourage commuters or overnight to discourage residents.	Depends on restrictions.
Employee restrictions	Require or encourage employees to use less convenient parking spaces.	Customers, deliveries and errands
Special events	Have special parking regulations during special events.	Depends on restrictions
Special use parking	Provide special bulk parking passes or reserved spaces for delivery, service and construction vehicles.	Vehicles used for specified purposes
Residential parking permits	Use Residential Parking Permits (RPPs) to give area residents priority use of parking near their homes.	Residents.
Restrict overnight parking	Prohibit overnight parking to discourage use by residents and campers.	Shorter-term parkers
Street cleaning restrictions	Regulations that prohibit parking on a particular street one day of the week to allow street sweeping.	Street cleaning. Insures motorists move their vehicles occasionally.
Large vehicle restrictions	Limit on-street parking of large vehicles, such as freight trucks and trailers.	Normal-size vehicles
Arterial lanes	Prohibit on-street parking on arterials during peak periods, to increase traffic lanes.	Vehicle traffic over parking
Abandoned vehicles	Have a system to identify and remove abandoned vehicles from public parking facilities.	Operating vehicles

Various regulations can manage parking for efficiency and prevent problems.

Third, determine how regulations will be indicated and enforced. Use signs, curb paint, maps and brochures to denote which parking facilities are intended for which user type, and how violations will be punished.

In a commercial area, the most convenient 10-30% of parking spaces should typically be regulated for short-term use. Such spaces usually have 30-120 minute time limits, so each space serves 6-10 vehicles per day. Shorter time limits increase turnover but constrain the types of activities that can be accommodated, and may frustrate customers who are unable to complete a transaction due to limited parking time.

How Much Time?
One of the most common ways to manage parking is to limit parking duration. Shorter time periods increase turnover but constrain the activities that can be performed. Below are some general guidelines.

- Very short time periods (3-10 minutes) for passenger drop-off and deliveries. This is appropriate in busy loading areas, such as in front of transportation terminals, schools, theaters, hotels and hospitals. Some parking meters have a free 10-minute option to accommodate such stops.
- Short time periods (15-30 minutes) accommodate quick errands. This is appropriate for the most convenient parking spaces at post offices, convenience stores and other destinations that often involve quick errands.
- Medium time periods (1/2 – 4 hours) accommodate longer errands and activities such as shopping and dining. Customers often find that one hour is inadequate for a shopping trip, meal or errand, so 90-minute or 2-hour limits are common.
- Three- or four-hour limits are commonly used to prevent commuters from using parking spaces either in business districts or on nearby residential streets, although some commuters will simply move their vehicles once or twice each day to avoid citations.
- Long time periods (8-hours or more) accommodate commute trips and residential parking.
- Special time restrictions, such as parking prohibited before 10 am, to discourage use by employees, or between 10 pm and 5 am to discourage use by residents

In denser urban areas, such as downtowns and entertainment districts, curb space management is increasingly important to accommodate delivery vehicles and passenger drop-off/pick-up activities for taxi, ride-hailing (such as Uber and Lyft) and ridesharing trips (ITF 2018). This generally requires regulations that designates areas for these uses or limits parking to a few minutes, with policies to achieve 85% maximum occupancy in those areas, so parking spaces are virtually always available for high-value, short-term uses.

Reduced and More Accurate and Flexible Minimums

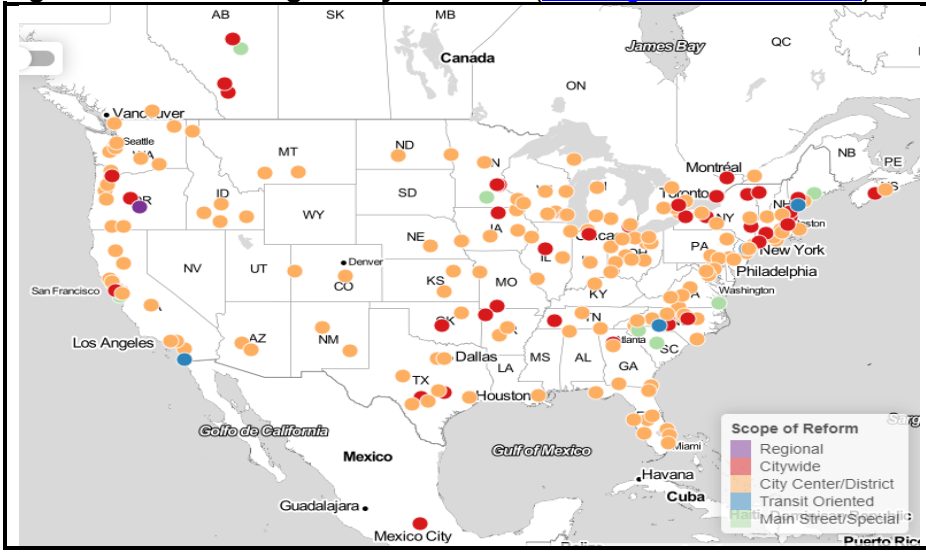
Reduced and more accurate minimums means that parking requirements are adjusted to reflect the needs of each location (Daisa and Parker 2010; Gies, Hertel and Tully 2021; ITE 2023; King Co. 2011; Spivak 2022) or eliminated altogether (Manjoo 2022; Strong Towns 2020). Table 12 summarizes various factors that should be used to adjust parking minimums.

Table 12 **Parking Minimum Adjustment Factors**

Factor	Typical Adjustments
Geographic Location. Vehicle ownership and use rates in an area.	Adjust requirements to reflect actual vehicle ownership and trip generation rates. 40-60% reductions are often justified in Smart Growth neighborhoods.
Residential Density. Number of residents or housing units per acre/hectare.	Reduce requirements 1% for each resident per acre (e.g. 15% where at 15 residents per acre and 30% at 30 res. Per acre).
Employment Density. Number of employees per acre/hectare.	Reduce requirements 10-15% in areas with 50 or more employees per gross acre.
Land Use Mix. Land use mix located within convenient walking distance.	Reduce requirements 5-15% in mixed-use developments. Additional reductions with shared parking.
Transit Accessibility. Nearby transit service frequency and quality.	Reduce requirements 10% within ¼ mile of frequent bus service, and 20-50% within ¼ mile of a rail transit station.
Carsharing. Whether carsharing services are located within or nearby a building.	Reduce residential requirements 10-20% if carshare vehicles are located onsite, or 5-10% if located nearby.
Walkability and bikability. Walking environment quality.	Reduce requirements 5-15% in very walkable and bikeable areas, and substitute bike parking for up to 10% of car parking.
Demographics. Age and physical ability of residents or commuters.	Reduce requirements 20-40% for housing for young (under 30), elderly (over 65) or disabled people.
Income. Average income of residents or commuters.	Reduce requirements 10-20% for the 20% lowest income households, and 20-40% for the lowest 10%.
Housing Tenure. Whether housing is owned or rented.	Reduce requirements 20-40% for rental versus owner-occupied housing.
Pricing. Parking that is priced, unbundled or cashed out.	Reduce requirements 10-30% for cost-recovery prices, and 10-20% for unbundling (parking rented separate from building space).
Sharing/overflow. Ability to share parking facilities with other nearby land uses.	Depends on the differences in peak demands with other land use. 20-40% reductions are often possible.
Management programs. Parking and mobility management programs implemented at a site.	Reduce requirements 10-40% at worksites with effective parking and mobility management programs.
Design Hour. Number of allowable annual hours a parking facility may fill.	Reduce requirements 10-20% if a 10th annual design hour is replaced by a 30th annual peak hour. Requires an overflow plan.
Contingency-Based Planning. Whether a plan is exists to deal with possible parking shortages.	Minimize supply if a development has a plan for additional management strategies that can be implemented if needed.

This table summarizes various factors that affect parking demand and optimal parking supply.

Figure 6 **Parking Policy Reforms** (Parking Reform Network)



This dynamic map produced by the Parking Reform Network identifies North American jurisdictions that are reforming their parking policies for efficiency and fairness.

The Institute of Transportation Engineer's *Multimodal Transportation Impact; Analysis for Site Development*, identifies ways to adjust traffic and parking generation predictions for compact and mixed-use developments. The "*Smart Growth Trip-Generation Adjustment Tool*" (http://bit.ly/1z2q5Dd) and the *Smart Location Mapping* (www.epa.gov/smartgrowth/smart-location-mapping) tools that predict how vehicle ownership and trip rates vary by location.

The study, *Travel Demand Management: An Analysis of the Effectiveness of TDM Plans in Reducing Traffic and Parking* found that, compared with standard trip generation rates, buildings that implemented TDM Plans generate, on average, 34% to 37% less traffic and need 17% to 24% fewer on-site parking spaces (Spack and Finkelstein 2014). Gabbe, Gregory and Clowers (2020), found that developers built about 40% fewer spaces when parking minimums were eliminated in central Seattle. Similarly, the article, *Don't Underestimate Your Property: Forecasting Trips and Managing Density over the Long Term* (Galdes and Schor 2022) summarizes experience with TDM programs in suburban Fairfax County. It found that residential and commercial developments with cost-effective TDM programs actually generate 49% fewer trips than predicted by ITE trip generation models. This reduces parking and roadway costs, and allows more development to occur on available land.

Surveys indicate that lower-income households in multifamily housing require far fewer, often less than half, of the parking spaces that zoning codes require (Translink 2018), particularly if parking is *unbundled* (rented separately from housing units), so car-free households are no longer required to pay for costly parking facilities they don't use.

Parking Maximums

Parking Maximums limit parking supply, either at individual sites or in an area. They are usually implemented in large commercial centers as part of programs to reduce excessive parking supply, encourage use of alternative modes and more compact development, create more attractive streetscapes, and preserve historic buildings. Area-wide limits are called *Parking Caps*. Maximums can apply to certain types of parking, such as long-term, free, or surface parking, depending on objectives. Excessive parking supply can also be discouraged by imposing parking taxes and enforcing regulations on temporary parking facilities.

Maximums are often unnecessary; simply reducing or eliminating parking minimums usually reduces supply, particularly in areas with high land values. However, parking minimums have been applied for decades, resulting in well-establish market distortions, so maximums are sometimes necessary. Since businesses may consider abundant on-site parking to convey a competitive advantage, individual firms often find it difficult to reduce supply; maximums that apply equally to all businesses may be an acceptable and effective way to reduce supply (Martens 2006). The City of Seattle requires that buildings which provide more than minimum required parking to develop a transportation management plan to reduce trip generation and parking demand (SMC 23.54.016). San Francisco places a two year limit on the use of vacant downtown parcels for parking lots to encourage redevelopment (Manville and Shoup 2005).

Remote Parking and Shuttle Service

Remote Parking (also called *Satellite Parking*) refers to the use of off-site parking facilities. This can use commercial (for profit) parking lots, or sharing arrangements such as office workers parking at a restaurant lot during the day in exchange for restaurant employees using the office lot during evenings and weekends. It can also use parking lots at the periphery of a business district or other activity center or other distant parking lots for special events that attract large crowds. Shuttle buses or free transit service may be provided to connect destinations with remote parking facilities, allowing them to be farther than acceptable walking distances. Another type of remote parking is use of *Park & Ride* facilities, often located at the urban fringe where parking is free or significantly less expensive than in urban centers. Remote parking requires providing adequate use information and incentives to encourage motorists to use more distant facilities. For example, signs and maps should indicate the location of peripheral parking facilities, and they should be significantly cheaper to use than in the core. Without such incentives, peripheral parking facilities are often underused while core parking is congested.

Smart Growth Development Policies

Smart growth is a general term for development policies that result in more efficient transportation and land use patterns, by creating more compact, development with multi-modal transportation systems ("Smart Growth," VTPI 2005; Tachieva 2010). Smart growth includes several overlapping strategies, as summarized below.

New Urbanism

New urbanism refers to a set of community design principles that help create mixed-use, walkable neighborhoods (sometimes called "urban villages") by clustering suitable activities together and improving pedestrian conditions. It is the local scale of smart growth. It includes design features to reduce the total amount of land devoted to parking, locating parking facilities behind or below buildings, and parking facility design improvements.

Location Efficient Development

Location efficient development consists of residential and commercial development located close to important services such as transit, schools and stores in order to reduce the need to own and use automobiles. It involves reducing parking requirements, unbundled parking and other parking management strategies to provide savings in such locations.

Transit Oriented Development

Transit oriented development (TOD) refers to residential and commercial areas designed to support transit and walking. It creates "transit villages" around transit stations, where a significant portion of local errands (travel to school, shops and other errands) can be performed by walking. It usually involves parking management to allow higher densities around transit stations and encourage use of alternative modes.

Smart growth supports and is supported by parking management. Parking management reduces the amount of land required for parking facilities, reduces automobile use and increases infill affordability. This, in turn, tends to reduce vehicle ownership and use, and so reduce parking demand (Lee, Rees and Watten 2010). It allows more sharing of parking facilities, shifts to alternative modes, and various types of parking pricing. Smart growth usually incorporates specific parking management strategies, as indicated below. Effective parking management is a key component of Smart Growth.

Table 13 **Conventional and Smart Growth Parking Policies**

Conventional Parking Policies	Smart Growth Parking Policies
Managed only for motorist convenience	Managed for transport system efficiency
Maximum parking supply	Optimal parking supply (not too little, not too much)
Prefers free parking	Prefers priced parking (user pays directly)
Dedicated parking facilities	Shared parking facilities
Favors lower-density, dispersed development	Favors compact development.

Smart Growth development policies manage parking for efficiency, so fewer spaces are needed to serve parking demands.

Ridesharing, Ride-Hailing and Pubic Transit Improvements

Ridesharing (car- and van-pooling), dynamic ridesharing (ridesharing organized for individual trips), ride-hailing services (for-profit personal mobility services such as Uber and Lyft), and public transit service improvements can reduce automobile ownership and use, and therefore parking demands.

Ridesharing is often implemented as part of Commute Trip Reduction programs, and is supported by High Occupancy Vehicle (HOV) priority lanes and Transportation Demand Management Associations. Some public transit agencies support ridesharing, particularly vanpooling. Dynamic ridesharing and ride-hailing services require regulatory approval, and can be encouraged with curb management policies that improve passenger drop-off and pick-up opportunities. Public transit services improvements can include new technologies, payment systems, increased service, faster and more reliable service, dedicated bus lanes and bus priority signal controls, nicer vehicles, nicer stations and waiting areas, and amenities such as on-board wifi access.

These services can significantly reduce parking demand and vehicle traffic. They tend to be most convenient and cost effective in urban areas where demand is concentrated and traffic problems are most severe, and so are particularly important in urban centers, but can also be effective in suburban and rural areas, particularly if supported with compact development and commute trip reduction programs. Residents of transit-oriented areas tend to own about half as many vehicles and generate half as many trips as in automobile-dependent areas (Arrington, et al. 2008), and in many commercial centers, and major portion of workers commute by ridesharing, ride-hailing and public transit, and their mode shares are likely to increase in the future with improved technologies and more transportation demand management. De Gruyter, Truong and Taylor (2020) calculate the each 10% improvement in public transport service is associated with a 0.9–1.2% reduction in car parking demand. As previously discussed, dynamic ridesharing and ridehailing services already affect travel and parking demands, including reducing urban vehicle ownership (Clewlow and Mishra 2017), commercial center parking demand, and airport vehicle rentals (Bergal 2017).

Improve Active Travel (Walking and Bicycling)

Improving active travel (walking, bicycling and variants such as wheelchairs and e-bikes) support parking management strategies in the following ways:

- Improved walkability expands the range of parking facilities that serve a destination, increasing the feasibility of using shared off-site parking.
- Increases "park once" trips, that is, parking in one location and walking rather than driving to nearby destinations, which reduces vehicle trip generation and parking demands.
- Allows walking and bicycling to substitute for some vehicle trips. E-bikes approximately double the portion of trips suitable for bicycling, increasing potential impacts and benefits.
- Improves transit access, since most transit trips have walking and bicycling links.

Walkability is affected by pedestrian facility quality (sidewalks, paths, crosswalks), and the distance between parking and destinations. Acceptable walking distances vary depending on the type of trip, the type of user and conditions, as summarized below. For typical urban conditions, LOS A is less than one block, LOS B is 1-4 blocks, LOS C is 4-8 blocks, and LOS D is more than 8 blocks between parking facilities and destinations.

Table 14 **Level of Service by Walking Distance** (in Feet) (PT 2000)

Walking Environment	LOS A	LOS B	LOS C	LOS D
	Best	Acceptable	Poor	Unacceptable
Climate Controlled	1,000	2,400	3,800	5,200
Outdoor/Covered	500	1,000	1,500	2,000
Outdoor/Uncovered	400	800	1,200	1,600
Through Surface Lot	350	700	1,050	1,400
Inside Parking Facility	300	600	900	1,200

This table indicates parking access Level of Service (LOS) rating under various conditions.

Parking facility design factors can affect walkability. Parking facilities (especially large lots) should have marked walkways that protect pedestrians from traffic and conveniently connect to sidewalks. In hot climates, walkways should be shaded. Parking lots can serve as mid-block walkways, providing pedestrian short-cuts, which improves nonmotorized accessibility and expands the number of destinations that a parking lot can serve.

Provide Carsharing and Bikesharing Services

Carsharing services provide convenient short-term vehicle rentals that substitute for private vehicle ownership. It is generally priced by the hour and day, has quick pick-up and drop-off procedures, and vehicles located within walking distance of homes and worksites. Carsharing is typically cheaper than owning a vehicle driven less than about 5,000 annual miles. Locating carshare services in a residential neighborhood can reduce private vehicle ownership and parking demand. Each carshare vehicle typically substitutes for 10 to 20 private automobiles. Bikesharing can provide convenient travel for short trips.

Increase Capacity of Existing Parking Facilities

Increase capacity of existing parking facilities means that parking supply increases without using more land or major construction (DLCD 2024). There are various ways to do this:

- Allow households to park in front of their own driveway. Cities can issue permits for residents, their guests and service workers, to block their driveways.
- Use currently wasted areas (corners, edges, undeveloped land, etc.). This can be particularly appropriate for small car spaces, motorcycle and bicycle parking.
- Where there is adequate street width, change from parallel to angled on-street parking.
- Maximize the number of on-street parking spaces, for example, by using a curb lane for parking rather than traffic during off-peak periods, and designating undersized spaces for small cars or motorcycles.
- Provide special, small parking spaces for motorcycles. Allow and encourage motorcycles to share parking spaces when possible.
- Reduce parking space size. Shorter-term parking requires larger spaces, but employee and residential parking spaces can be somewhat smaller. A portion of spaces can be sized for compact vehicles, which require about 20% less space than full-size stalls.
- Use car stackers and mechanical garages. These can significantly increase the number of vehicles parked in an area. However, they are only suitable for certain applications. They generally require an attendant to move lower-level vehicles when needed to access upper-level vehicles, and stackers may be unable to accommodate larger vehicles such as SUV, vans and trucks.
- Use valet parking, particularly during busy periods. This can increase parking capacity by 20-40% compared with users parking their vehicles. Commercial lots often have attendants park vehicles during busy periods, but not off-peak.
- Remove or consolidate non-operating vehicles, equipment, material and junk stored in parking facilities, particularly in prime locations.

Figure 7 **Carstackers**

Carstackers allow more vehicles to be stored in a given area.

Transportation Demand Management

Transportation Demand Management (*TDM*, also called *mobility management*) is a general term for strategies that increase transportation system efficiency by changing travel behavior. It may affect travel frequency, mode, destination or timing (for example, shifting from peak to off-peak). There are many TDM strategies, as summarized in the table below.

Table 15 **Transportation Demand Management Strategies** (VTPI, 2003)

Improved Transport Options	Incentives to Shift Mode	Land Use Management	Policies and Programs
Alternative Work Schedules	Bicycle and Pedestrian Encouragement	Car-Free Districts	Access Management
Bicycle Improvements	Congestion Pricing	Compact Land Use	Campus Transport Management
Bike/Transit Integration	Distance-Based Pricing	Location Efficient Development	Data Collection and Surveys
Carsharing	Commuter Financial Incentives	New Urbanism	Commute Trip Reduction
Guaranteed Ride Home	Fuel Tax Increases	Smart Growth	Freight Transport Management
Security Improvements	High Occupant Vehicle (HOV) Priority	Transit Oriented Development (TOD)	Marketing Programs
Park & Ride	Pay-As-You-Drive Insurance	Street Reclaiming	School Trip Management
Pedestrian Improvements	Parking Pricing		Special Event Management
Ridesharing	Road Pricing		Tourist Transport Management
Shuttle Services	Vehicle Use Restrictions		Transport Market Reforms
Improved Taxi Service			
Telework			
Traffic Calming			
Transit Improvements			

TDM includes various strategies that affect vehicle travel behavior. Many affect parking demand.

Transportation demand management both supports and is supported by parking management. These programs often reduce parking demand, and many parking management strategies help reduce vehicle traffic create more accessible land use patterns or support other mobility management objectives.

As previously mentioned, various studies indicate that developments with TDM Plans actually generate 34% to 50% fewer vehicle trips and require 17% to 24% fewer parking spaces than standard models predict (Galdes and Schor 2022; Spack and Finkelstein 2014). As one traffic engineer explained,

> "Overestimating trip generation can have deleterious effects on a neighborhood because trip generation is so closely linked to the amount of square footage that a property is allowed. More than any other feature of a development, vehicle trip generation estimates determine density limits and impacts." (Galdes and Schor 2022)

Efficient Pricing

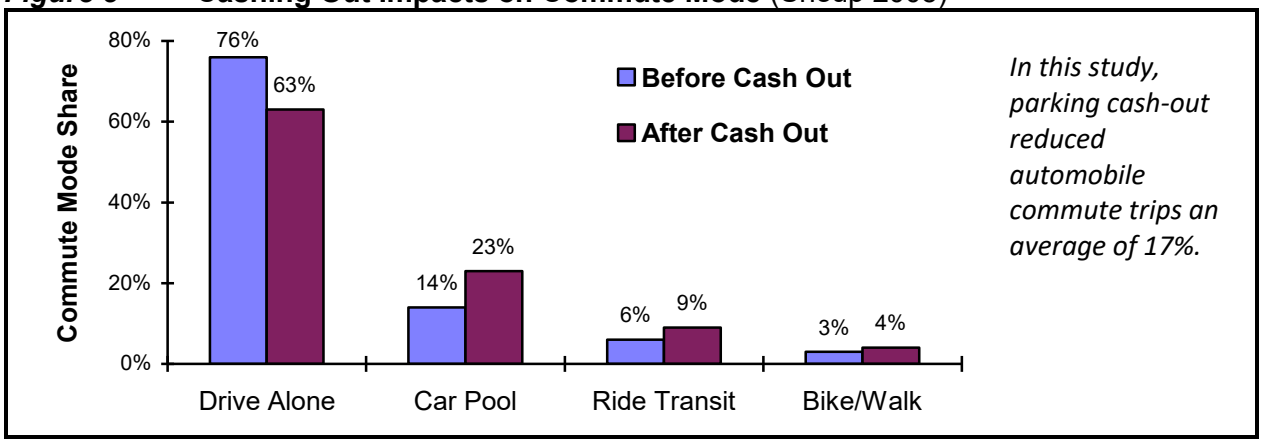
Efficient parking pricing means that motorists pay directly for using parking facilities, with rates that increase with demand (DLCD 2024; CARB 2014; ITDP 2021; Shoup 2006 and 2013; TPS 2023). This means that prices increase with demand and congestion. It uses shorter time units, such as hourly rather than daily rates, and daily rather than monthly rates, so motorists have more incentive to reduce parking use. This encourages turnover of the most convenient parking spaces (such as those located near building entrances) and favors higher value trips over value trips, ensuring that motorists can always find an unoccupied space when needed.

Efficient pricing is justified on fairness grounds (Litman 2019). Underpriced municipal parking forcing local taxpayers to subsidize out-of-town motorists, and parking mandates force non-drivers to subsidize the off-street parking facilities used by motorists.

Currently, most parking is inefficiently priced; it is provided free, subsidized or bundled (automatically included) with building purchases and rents, forcing consumers to pay for parking regardless of whether or not they want it. When parking is priced it is often a flat annual or monthly fee, providing little incentive to use an alternative mode occasionally. Cost-recovery parking pricing typically reduces automobile ownership and use by 10-30% (Ostermeijer, Koster and Ommeren 2019; Spears, Boarnet and Handy 2014). Khordagui (2019) found that a 10% commuter parking price increase causes a 1–2 percentage point average decline in the probability of driving to work. Charging by the day rather than monthly significantly reduces driving (Gutman 2017). Rates should be set to optimize parking facility use, called *performance-based pricing*, which means that about 15% of parking spaces are unoccupied at any time, so drivers can usually see a parking space near their destination (Shoup, 2006 and 2008).

Efficient pricing *cashes out* free parking, which means that non-drivers receive financial benefits equivalent to the parking subsidies provided to motorists. For example, if automobile commuters are offered a free parking space worth $5 per day, commuters who walk, bicycle, rideshare or use public transit would receive a $5 per day cash or transit fare (AF 2022). Some jurisdictions mandate parking cash out. California and Rhode Island require it statewide, and Washington DC's *Transportation Benefits Equity Act of 2020* requires employers to offer 'Clean Air Transportation Fringe Benefits' equivalent in value to parking subsidies (Wilson 2022).

Figure 8 **Cashing Out Impacts on Commute Mode** (Shoup 2005)



Cashing out parking typically reduces automobile travel 10-30%, depending on the value of the incentive, and various factors. Figure 8 illustrates the effects of parking cash-out in one study, indicating a 17% average reduction in car trips. The more flexible the incentive the greater the impact. For example, parking cash-out tends to cause the greatest automobile trip reduction because it rewards any alternative mode. Transit benefits have less impact because they only encourage shifts to transit, but not shifts to walking, cycling or telework.

Efficient parking pricing be implemented as a parking management strategy (to reduce parking problems), a TDM program (to reduce traffic problems), to recover parking facility costs, or to raise revenue for any purpose (such as funding local transport programs or downtown improvements). It is often intended to achieve a combination of objectives.

Below are specific parking pricing strategies:

- As much as possible, charge motorists directly for using parking facilities to efficiently manage demand, encourage use of alternative modes and generate revenue.
- Charge higher rates and use shorter price periods at more convenient locations to favor higher-priority uses and increase turnover (called *performance pricing*). For example, charge 25¢ per 15-minutes for the most convenient spaces and $4 per day at less convenient locations.
- Set prices to maintain optimal demand, such as 85% maximum occupancy during peak periods. Vary rates to achieve these targets (Sfpark 2014). For example, charge $1 per hour for parking downtown during weekdays, $0.75 per hour for parking downtown during evenings and weekends, and $0.50 per hour for parking in other locations.
- Use short pricing periods. For example, for short-term parking change by the minute rather than the hour, and for long-term parking charge by the hour rather than the day or month.
- Minimize early-bird and long-term discounts. For example, set daily rates at least 6 times the hourly rates and monthly rates at least 20 times daily rates. Even better, eliminate long-term passes and charge for each hour or day, so motorists always save when they reduce driving.
- *Cash-out free parking*, so commuters who use non-auto modes receive a financial benefit equivalent in value to parking subsidies provided to motorists.
- *Unbundle parking*, so parking is rented separately from building space. For example, rather than paying $2,400 per month for an apartment with two “free” parking spaces, occupants pay $2,000 per month for the apartment plus $200 per month for each space they want.
- Expand when and where parking is priced to limit demand and recover costs. Where on-street parking is congested sell a limited number of permits and install parking meters.
- Vary parking fees based on vehicle weight (Zipper 2024). For example, Montreal charges only C$115 (US$90) annually to park the lightest cars but C$205 (US$150) for the heaviest, with discounts for electric or hybrid cars, and residents with disabilities or low incomes.
- Use improved pricing methods to be more cost effective, convenient and fair. For example, use pricing systems that charge for just the amount of time a vehicle is parked.
- Create Parking Benefit Districts, with revenues used to benefit local communities.
- Set parking prices to equal or exceed transit fares. For example, set daily rates to equal or exceed two single fares, and monthly rates to equal or exceed a monthly pass price.

Parking Pricing Design Factors

1. *Area and time*. Prices can be applied to specific spaces, blocks, lots or districts. Efficient (also called responsive) prices are higher for the most convenient spaces during peak periods, and lower at less busy locations and times.
2. *Pricing units*. Prices can be measured per minute, hour, day or month, and vary by time, location, and user type, such as discounts for people with disabilities and lower incomes.
3. *Exemptions.* Exemptions may be provided for quick, high-value stops such as for goods delivery, passenger loading, and quick errands. This is typically 3-10 minutes on busy streets and up to 20 minutes in less busy areas.
4. *Technology.* Mechanical or electronic meters, pay-per-space systems, permits, access control, or other methods.
5. *Revenue targets.* Targets can reflect cost recovery (enough to pay for facilities) or profit maximization.
6. *User information and enforcement.* Information can be provided using signs, maps, websites and apps.

A detailed study for the U.S. Federal Highway administration, *An Assessment of the Expected Impacts of City-Level Parking Cash-Out and Commuter Benefits Ordinances* (Abou-Zeid, et al. 2023) modelled the effect of five parking pricing reforms in nine U.S. cities. It estimated that basic monthly cash-out requirements would reduce commute-related VMT by an average of over 7% across all analyzed cities, with wide variation among the cities—from about a 3% reduction in New York City, where few employees currently receive free parking, to a 13% reduction in Philadelphia. Daily versus monthly cash-out policies may yield greater impacts. The most aggressive option tested, which involved eliminating commuter parking subsidies and offering a $5 daily cash benefit to commuters that use non- single occupancy vehicle modes is predicted to reduce commute vehicle travel by 17% to 36%. Since most of this reduction would occur during peak commute hours, parking cash-out can significantly reduce congestion and other negative traffic externalities.

Unbundle Parking

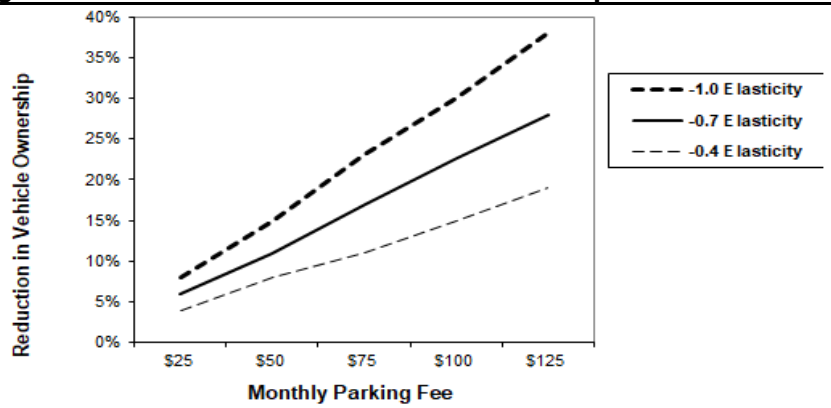
Unbundling means that parking is rented or sold separately, rather than automatically included with building space. For example, rather than renting an apartment with two parking spaces for $2,400 per month, the apartment rents for $2,000 per month, plus $200 per month for each parking space. This is more equitable and efficient, since occupants only pay for parking they need (Nelson/Nygaard 2022; Schmitt 2018). Parking can be unbundled in several ways:

- Facility managers can unbundle parking when renting building space, or offer discounts to renters who use fewer than average parking spaces.
- Developers can make some or all parking optional when selling buildings.
- Parking costs can be itemized in lease agreements to help renters understand the parking costs they bear, and to help them negotiate reductions.
- Informal unbundling can be encouraged by helping create a secondary market for available spaces. For example, office, apartment and condominium managers can maintain a list of residents who have excess parking spaces available for rent to other occupants.

Unbundling is equivalent to pricing. The figure below shows the reduction in vehicle ownership resulting from various residential parking fees. For example, a $50 per month parking fee is likely to reduce automobile ownership 8-15%, and a $100 per month fee a 15-30% reduction, assuming average consumers and adequate enforcement of offsite parking regulations. De

Gruyter, Butt and Davies (2024) found that 35% of Melbourne, Australia apartment households experience mismatch between off-street parking supply and demand, and 42% were receptiveness to unbundling off-street car parking.

Figure 9 **Reduction in Vehicle Ownership from Residential Parking Prices**



This figure illustrates typical vehicle ownership reductions due to residential parking pricing, assuming that the fee is unavoidable (free parking is unavailable nearby).

Improve Pricing Methods

Much of the resistance to parking pricing results from inconvenient pricing methods ("Pricing Methods," VTPI, 2005; FHWA, 2007):

- Many require payment in specific denominations (coins or bills).
- Many require motorists to predict how long they will be parked, with no refund available if motorists leave earlier than predicted.
- Some payment systems cannot easily handle multiple price structures or discounts.
- Some are confusing or slow to use.
- Some have high equipment or enforcement costs.
- Enforcement often seems arbitrary or excessive.

Better payment methods are available, as summarized in the table below. Newer electronic systems are more convenient, accurate, flexible and cost effective. They can accommodate various payment methods (coins, bills, credit and debit cards, mobile phone and Internet transactions), charge only for the amount of time parked, automatically adjust for day and time and incorporate multiple rates and discounts. Some can be integrated with payment systems for other public services such as transit, roads tolls, and telephone use. Some employ contactless technology which automatically deducts payment. Newer systems also produce printed receipts and record data for auditing, which prevents fraud and increases convenience for customers, operators and local governments. They can also automatically record data on utilization and turnover, which improves planning and administration.

Alternatively, parking pricing can be more convenient and secure if parking lots have attendants. Some parking facilities use attendants during peak periods, and rely on mechanical or electronic payment during off-peak periods. Better equipment maintenance and more courteous enforcement can also improve pricing.

Table 16 **Summary of Parking Pricing Options** ("Pricing Methods," VTPI, 2005)

Type	Description	Capital Costs	Operating Costs	User Convenience	Price Adjustability	Enforce-ability
Pass	Parkers purchase and display a pass.	Low	Low	Medium	Poor to medium.	Good
Time-Coded Tickets	Parkers purchase a ticket for a certain amount of time (such as 2-hours). Punch out tabs indicating start time.	Low	Medium	Medium	Medium	Good
Single-Space Meters	Parkers prepay a mechanical or electronic meter located at each space.	High	High	Mechanical meters: low; electronic meters: medium.	Mechanical meters: poor; electronic meters: good.	Mechanical meters: poor; electronic meters: good.
Smart Meters	Parkers prepay electronic meters located at each space. Detectors determine when vehicles leave and reset meters.	High	High	Medium.	Good	Good
Pay Box	Parkers prepay into a box with a slot for each space.	Low	Medium	Low	Poor to medium.	Poor
Pay-And-Display Meters	Parkers prepay a meter, which prints a ticket that is displayed in their vehicle.	Medium	Medium	Medium	Mechanical meters: poor; electronic meters: good.	Good
Electronic Pay-Per-Space	Parkers prepay an electronic meter.	Medium	Medium	Medium	Very good.	Good
Debit Card	Prepay meters with debit cards. Some rebate unused time.	Medium	Medium	Medium	Very good.	Good
In-Vehicle Meter	Parkers display a small electronic meter with prepaid credits inside their vehicle when it is parked.	Medium	Low	High	Moderate	Good
Attendant	Parkers pay an attendant when entering or leaving parking lot.	High	High	High	Good	Good
Valet	Parkers pay an attendant who parks their car.	Low	High	High	Good	Good
Automated Controlled Access System	Parkers pay a machine when entering or leaving parking lot.	High	Moderate	Medium	Good	Poor
Automatic Vehicle Identification	System automatically records vehicles entering and leaving a parking area.	High	Medium	High	Good	Good
Global location technology	Satellite-based systems track vehicle location and automatically calculate fees.	High but declin-ing	High but declining	High	Very high	Good

Various systems can be used to price parking. Newer systems tend to provide various advantages.

Parking Tax Reform

Parking tax reform includes various tax policies that support parking management:

- *Commercial parking taxes.* This is a special tax on user-paid parking transactions. This is common and relatively easy to implement, but tends to discourage parking pricing (since it makes free parking relatively more valuable to motorists), and is geographically inequitable and encourages sprawl (since it is imposed primarily in urban areas).
- *Per-space levies.* This is a special tax imposed on parking facilities, such as a $30 annual tax on each non-residential parking space (TPS 2023). If applied specifically to employee parking it is called a *workplace parking levy.* This is more difficult to implement than a commercial parking tax, since it requires identifying individual parking spaces, but it tends to be more efficient and fair, because it applies to all parking.
- *Free parking levies.* This is a special tax imposed on unpriced parking, for example, a $50 annual tax per space provided free to employees. This is a variation on per-space levies designed to discourage unpriced parking.
- *Stormwater management fees.* This is a utility fee based on impervious surface area to fund stormwater management services, such as a $15 annual fee per 1,000 square feet of pavement, or a $5 annual fee per parking space.
- *Car-free tax discounts.* This is a property tax discount provided to households that do not own an automobile, reflecting their lower roadway and traffic service costs they impose. For example, if municipal roadway maintenance and traffic service costs average $200 annually per vehicle owned in the community, a tax discount up to this amount could be provided to households that do not own a car.
- *Income tax policy reforms.* This means that employee parking subsidies are treated as a taxable benefit, employee parking tax exemptions are limited (for example, only $100 per month is income tax exempt), or tax exemptions are provided to subsidies of other modes, such as employer-provided transit passes. Current tax policies make parking subsidies an attractive employee benefit: A typical employee must earn $1,500 or more in pre-tax income to pay for a parking space that costs their employer only $1,000 to provide. Transit benefits are income tax exempt in the U.S., but other countries have yet to implement such reforms, and many employers have yet to offer them to employees (Dutzik, et al. 2017).
- *Smart Growth Tax and Price Reforms.* Several tax and pricing reforms can encourage compact development and discourage sprawl. For example, development fees, utility rates and tax rates can reflect the higher costs of providing public services to more dispersed locations.

These tax reforms may be justified on several grounds: They can help correct current distortions that undertax parking facilities compared with other land uses. Special parking taxes, and car-free discounts, can be a surrogate for road user fees. They support efforts to reduce total parking supply and paved area. Parking tax revenues can be used to fund parking facilities and transportation programs, to fund stormwater management programs, or as a source of general revenues. If governments must tax something, parking facilities and activities can be particularly appropriate because it helps achieve parking and transport management objectives in addition to raising revenue, providing what economists call a “double dividend.”

Bicycle Parking and Changing Facilities

Bicycle parking and changing facilities increase the convenience and security of bicycle transportation (CARB 2014; VTPI 2005). In some situations, bicycle parking facilities can substitute for a portion of automobile parking, particularly if implemented as part of a comprehensive bicycle improvement and encouragement program.

Optimal bicycle parking supply depends on the level of bicycling that occurs in that community and the type of destination. Some destinations, such as schools, campuses and recreation centers have 10-20% of visitors arrive by bicycle during fair weather. Below are examples of recommended bicycle parking, which should be adjusted to meet specific conditions. To determine whether additional bicycle parking may be needed, observe entrance areas to see if bicycles are frequently locked to posts and trees, indicating that existing facilities are inadequate due to insufficient supply, poor design or location. Survey existing and potential bicyclists to determine what additional facilities they want.

Table 17 **Examples of Bicycle Parking Requirements**

Type of Establishment	Minimum Number of Bicycle Parking Spaces
Primary or secondary school	20% of the number of students and 10% of employees.
College or university	20% of the number of students, plus 10% of the number of employees.
Dorms, fraternities and sororities	One space per 2 residents.
Commercial – retail or office	One space per 1,000 sq. ft. of commercial space or 10-20% of the number of automobile spaces.
Sport and recreation center	10-20% of the number of automobile spaces.
Movie theater or restaurant	5-10% of the number of automobile spaces.
Industrial	5-10% of the number of automobile spaces.
Multi-unit housing	1 space per apartment.
Public transit stations	Varies, depending on usage.

This table indicates typical minimal bicycle parking requirements. These should be adjusted to reflect specific locations.

There are two general categories of bicycle parking requirements:

1. *Short-term* (Class II) for shorter stops such as errands and shopping. It should be visible and close to destinations. At least some spaces should be protected from the weather (a portion can be unprotected, since demand tends to increase during dry weather).
2. *Long-term* (Class I) for longer duration stops such as commuting and overnight stays. It requires a high degree of security and weather protection, with well-designed lockers or racks in storage rooms or fenced and covered areas with restricted access.

Improve User Information and Marketing

User information refers to information for travelers about parking availability, regulations and price, and about travel options, such as walking, ridesharing and transit. Many parking problems result in part from inadequate user information. User information can be provided by signs, maps, brochures, websites, and electronic guidance systems (DLCD 2024; Poon 2018). Advanced parking management systems that provide real-time information on parking availability and price can increase motorist satisfaction, increase parking space utilization and encourage shifts to alternative modes.

Local governments can produce brochures and websites that identify the location of parking facilities, indicate parking prices, describe parking planning and management activities, explain parking regulations, describe opportunities for citizen involvement, and answer other common questions about parking issues. An *access guide* is a document that provides concise, customized information on how to reach a particular destination, including information on parking options. Parking information can be incorporated into other visitor materials, such as event announcements, yellow pages and newspaper advertisements. All materials should have parking program contact information, such as a telephone number or website.

User information is one component of marketing. *Marketing* is concerned with determining consumer needs and preferences, and providing suitable information and encouragement to help achieve an objective. It involves studies to help understand consumer needs, preferences and attitudes, plus barriers and opportunities for changing parking and travel behavior. It can also involve outreach campaigns to involve stakeholders in parking planning activities. Marketing can help planners anticipate and address possible objections to parking management. It is often useful to educate the public about the full costs of expanding parking supply, and the benefits of parking management programs, to help build community support for innovations.

Intelligent Transportation Systems (ITS) includes various communications technologies use to improve transportation services, including many that involve parking information, such as changeable signs and in-vehicle guidance systems that provide price and directional information on parking in a particular area. The 511 area code number is reserved for transportation information, including parking services, traffic reports and transit information. Some parking facilities have sensors that indicate which spaces are occupied, allowing motorists to quickly determine where parking is available.

Improve Enforcement and Control

Improve Enforcement and Control means that parking regulations and pricing enforcement be more rational, effective and considerate. Evading parking regulations is a popular folk crime: Many upstanding citizens who otherwise never steal will proudly ignore parking regulations and evade payments, reducing their effectiveness. Regulations often include unjustified exemptions (Manville and Jonathan Williams 2011). As parking management activities expand, so too should enforcement activities.

To be effective and politically acceptable, the enforcement process – from identification of the offence to follow up, appeals against penalties and debt collection – must be perceived as efficient, considerate and fair. The need for citations should be minimized by providing adequate user information and options. For example, motorists sometimes violate parking regulations simply out of ignorance, because they lack the denomination required by a parking meter, or because a meeting took longer than expected. Better user information and newer pricing methods can help address these problems, reducing violations. It may be appropriate to have exemptions to parking regulations and fines, such as "First Time Free," so the first time a motorist violates parking rules they are given information about parking regulations instead of a citation. Survey motorists who receive parking citations to determine how their parking needs can be better met.

Parking enforcement should be prioritized to focus on areas where parking violations create the greatest problems, such as arterials and downtown streets. New, hand-held data systems allow enforcement officers to track individual vehicles, identifying those that overstay (for example, commuters who feed meters), and habitual violators (motorists who ignore numerous parking regulations). It is important to have a system to collect outstanding parking fines. This may include use of a "boot" (a clamp that immobilizes a vehicle) or towing of vehicles with numerous unpaid fines, restrictions on renewing vehicle registrations or drivers licenses if parking fines are outstanding, or use of collection agencies.

Parking enforcement officers must be given adequate training and clear guidelines concerning how to enforce parking rules. They should be friendly, considerate and helpful. Parking enforcement officials should strive to be perceived as helpful community ambassadors. They should provide maps and brochures about local parking options, as well as general directions and tourist information.

Parking passes sold or allocated to employees, officials or visitors should have clear limitations regarding where, when and by whom they may be used. They should be audited regularly.

It is also important to enforce parking management agreements with developers and facility managers. For example, cities may require bonds or have special penalties for non-compliance if a developer fails to implement a trip reduction program, or a facility manager fails to support a parking sharing agreement as promised.

Transportation Management Associations and Parking Benefit Districts

Transportation Management Associations (TMAs) are private, non-profit, member-controlled organizations that provide transportation and parking management services in a particular area, such as a commercial district, mall or medical center ("Transportation Management Associations," VTPI 2005). TMAs are typically funded through dues paid by member businesses, and local government grants. A Parking Benefit District (PBD) is an area where a portion of parking meter revenue is dedicated to providing local services (Kindler 2023).

A TMA or PBA may provide these services:

- Coordinate parking planning.
- Maintain an inventory of parking facilities.
- Perform regular parking utilization surveys.
- Provide parking brokerage services (described below).
- Coordinate shared parking. For example, help establish and enforce sharing agreements.
- Produce user information.
- Administrate commuter financial incentives, such as parking cash-out.
- Coordinate shuttle services.
- Manage overflow parking programs.
- Provide bicycle parking.
- Deal with spillover problems.
- Provide other mobility management services.
- Advise on parking facility design and management.
- Advise on regulations and enforcement policies.
- Coordinate enforcement services.
- Monitor parking problems.

TMAs can provide *parking brokerage services* (sometimes called a *parking exchange* or *parking bank*), helping businesses share, trade, lease, rent and sell parking facilities. For example, it matches businesses that have extra parking supply with nearby businesses that need parking at a particular time. This helps businesses deal with changing parking demands, and lets businesses benefit when their parking management programs free up existing parking spaces. TMAs can also be responsible for monitoring activities to identify potential problems and evaluate program effectiveness. A *Parking Authority* or *Parking Management Association* can provide many of the same services, but has a narrower scope that often excludes activities such as commute trip reduction programs.

Overflow Parking Plans

Overflow parking plans describe the management strategies that will be applied when parking facilities fill, for example, during special events, peak shopping periods, or temporary reductions in parking supply. Below are some possible components of an overflow parking plan:

- Provide signs with directions to alternative parking facilities nearby.
- Establish shared and remote parking arrangements, with walkability improvements and shuttle services if necessary.
- Provide information on parking and travel options for special event participants, highlighting those that can be used to avoid parking problems. For example, include a brochure showing the location of parking facilities and describing how to arrive by transit with tickets to a major sport or cultural event.
- Encourage travelers to shift mode or use remote parking during peak periods. For example, retail employees can be required to use remote parking facilities or alternative commute modes during the holiday shopping season.
- Apply special parking regulations to favor priority vehicles (emergency, service, HOV, disabled, etc.) during busy periods.
- Provide special parking and transport services during peak periods, such as shuttle buses to remote parking, and valet parking to increase parking facility capacity.
- Design plazas, basketball courts and lawns so they can be used occasionally for vehicle parking.
- Provide adequate traffic and parking management staff during peak periods. Additional staff may be hired for special events.

Because most parking facilities are sized to accommodate peak demands that seldom or never occur, having an overflow parking plan can significantly reduce the amount of parking needed, and provide reassurance that reduced supply will not create problems. This is an important component of contingency-based planning.

Address Spillover Problems

Spillover parking problems refers to the undesirable use of offsite parking facilities, such as when business customers and employees park on nearby residential streets or use another businesses' parking lot. Concerns about spillover impacts are used to justify excessive parking requirements and opposition to management solutions. Addressing spillover problems can increase parking management program acceptability and effectiveness.

There are several ways to address spillover parking problems:

- Provide information indicating where motorists may and may not park.
- Use regulations to control spillover impacts, such as time limits and permit programs on residential streets near activity centers.
- Use pricing to control spillover impacts, such as charging non-residents for parking on residential streets near activity centers, and businesses charging non-customers for using in their parking facilities.
- Create *Parking Benefit Districts* in areas that experience parking spillover problems, so on-street parking is priced (residents can be exempt).
- Compensate people who bear spillover parking impacts. For example, a high school can send complementary sport event tickets to residents of nearby streets who experience spillover parking problems.
- Establish a monitoring program to identify where parking spillover is a problem. This may include surveys to identify who is parking where, and ways for residents and businesses to report spillover problems.

Improve Parking Facility Design and Operation

Parking facility design and operation refers to physical layout and day-to-day management. Improved design and operation can better integrate parking facilities into communities, improve service quality, support parking management, and help address various problems (Bojack 2020). Below are factors to consider:

- **Access Management** – This refers to coordination between roadway design and land use development, such as limiting the number of driveways and clustering land use activities.
- **Accessibility** (also called Universal Design) – This refers to accommodating people with disabilities and other special needs.
- **Aesthetics** – Attention to landscaping, materials, public art and other design features can improve parking facility appearance and the overall aesthetics of a site, street or city.
- **Asset Management** – This refers to programs that preserve the long-term value of facilities.
- **Circulation** – Parking lots can be designed to facilitate traffic circulation. Dead ends should be avoided, and multiple entrances should be provided if possible.
- **Flexibility** – Facilities can be designed to accommodate changing needs and temporary uses such as storage, recreation and community activities.
- **Heat Island Effect** – This refers to solar heat gain on dark surfaces. This can be reduced by limiting pavement area, shading, and use of light-colors materials.
- **Lighting** – Adequate lighting is important for user comfort, safety and security.
- **Orientation** – Many planners recommend locating buildings close to the sidewalk to improve pedestrian access, with parking located behind or at the side of a building.
- **Preservation and Enrichment** – Parking facilities can be designed to protect and enhance historic, cultural and natural resources.
- **Security** –Parking facilities can be designed to maximize security through natural surveillance, lighting, patrols, emergency alarms and closed circuit video observation.
- **Size and Scale** – Parking lot size can be minimized, and larger lots divided into smaller units.
- **Stormwater Management** – Newer stormwater management and pollution controls, can reduce environmental impacts and infrastructure costs.
- **Traffic Calming** – This includes design features to reduce vehicle traffic speeds and volumes on a particular road or driveway, some of which incorporate on-street parking.
- **Traffic Safety** – Parking lots can have features to control traffic speeds, improve visibility and protect pedestrians.
- **User Amenities** – Parking facilities can be designed with walkways, sheltered waiting areas, benches, drinking fountains, telephones, vending machines and washrooms.
- **User Information** – Wayfinding information should be provided in parking facilities.
- **Weather Protection** – Parking lots can be shaded with trees and awnings to increase user comfort and reduce vehicle pollution emissions.

Contingency-based Planning

Contingency-base planning identifies possible responses that can be implemented if the current parking supply turns out to be inadequate sometime in the future. Contingency-base planning requires a shift in the burden of proof for parking supply reductions: current practices place a high burden of proof, contingency-base planning allows any reasonable reduction provided that it includes a plan which indicates how parking shortages will be managed. City officials may be allow or encourage this when negotiating developments, and it may require additional administration to review and enforce parking management plans.

Where parking is oversupplied due to concerns about possible demand growth, contingency-based planning can reduce supply, often by 10-30%. If the plan includes trip reduction strategies, such as ridesharing, Commute Trip Reduction programs, and parking price increases, it can also reduce total vehicle travel.

Summary

The table below summarizes the parking management strategies in this guide.

Table 18 **Parking Management Strategies**

Strategies and Descriptions
Strategies That Increase Parking Facility Efficiency
Share facilities. Parking facilities serve multiple users or destinations, such as shared rather than reserved spaces, and parking lots that serve multiple destinations.
Regulations. Regulate parking to favor higher-value uses, increase turnover and address spillover problems.
More accurate and flexible minimums. Adjusted parking minimums to reflect geographic, demographic and management factors that affect vehicle ownership and parking demands.
Parking maximums. Establish maximum parking requirements.
Remote parking. Use off-site parking facilities, and improve user guidance and access to those locations.
Smart growth. Encourage more compact, mixed, multi-modal development.
Walking and bicycling improvements. Improve active travel conditions to expand the range of destinations serviced by a parking facility and reduce automobile trips.
Carsharing. Provide carsharing services as a substitute for private vehicle ownership.
Increase parking facility capacity. Use otherwise wasted space, smaller stalls, car stackers and valet parking.
Strategies That Reduce Parking Demand
Transportation Demand Management (TDM). Provide vehicle travel reduction incentives.
Ridesharing and transit. Improve and encourage ridesharing (car- and vanpooling) and public transit travel.
Efficient parking pricing. Charge cost-recovery fees with prices that increase at peak times and locations.
Unbundle parking. Rent or sell parking facilities separately from building space.
Financial incentives. Provide financial incentives to shift mode such as parking cash-out and transit benefits.
Improve pricing methods. Use better charging techniques to make pricing more convenient and cost effective.
Parking tax reform. Reform vehicle and property taxes to support parking management objectives.
Bicycle facilities. Provide bicycle storage and changing facilities.
Support Strategies
Improve user information. Provide convenient and accurate information on parking availability and price using signs, maps, websites and apps.
Improve enforcement. Insure that parking regulation enforcement is efficient, considerate and fair.
Transport Management Associations (TMAs). Establish organizations that provide transportation and parking management services in a particular area.
Overflow parking plans. Establish plans to deal with parking demand peaks.
Address spillover problems. Use management, enforcement and pricing to address spillover problems.
Parking facility design and operation. Improve facilities to solve problems and support parking management.
Contingency-based planning. Identify additional strategies that can be implemented if needed in the future

This table summarizes the parking management strategies described in this guide.

The table below indicates whether a strategy directly reduces total vehicle traffic (and therefore provides benefits such as reduced traffic congestion and pollution emissions), and the typically parking requirement reduction it provides.

Table 19 **Typical Reductions in Vehicle Traffic and Parking Requirements**

Strategy	Reduced Parking Requirements			Traffic Reductions
	Low	Medium	High	
Shared parking	10%	20%	30%	
Parking regulation reforms	10%	20%	30%	
More accurate minimums	10%	20%	30%	
Parking maximums	10%	20%	30%	
Remote parking	10%	20%	30%	
Smart growth development	10%	20%	30%	✓
Walking and bicycling improvements	5%	10%	15%	✓
Carsharing services	10%	20%	30%	✓
Increase capacity of existing facilities	5%	10%	15%	
TDM programs	10%	20%	30%	✓
Parking pricing	10%	20%	30%	✓
Unbundle parking	10%	20%	30%	✓
Financial incentives	10%	20%	30%	✓
Improve pricing methods	NA	NA	NA	✓
Parking tax reform	5%	10%	15%	✓
Bicycle facilities	5%	10%	15%	✓
Improve user information	5%	10%	15%	✓
Improve enforcement and control	NA	NA	NA	
Transportation management associations	NA	NA	NA	✓
Overflow parking plans	NA	NA	NA	
Address spillover problems	NA	NA	NA	
Parking facility design	NA	NA	NA	
Contingency-based planning	NA	NA	NA	

This table indicates typical reductions in the number of parking spaces needed compared with conventional practices, and whether a strategy reduces vehicle traffic, thereby providing additional benefits. NA = Not Appropriate, indicating it does not directly affect parking requirements.

Not every strategy is appropriate in every situation. Actual impacts vary depending on geographic and demographic factors, how a strategy is implemented and other factors. Below are some general guidelines.

- Impacts are higher where there are more parking and travel options. For example, parking pricing will have greater demand reduction impacts if implemented in conjunction with improvements in rideshare and public transit services.
- Financial incentives tend to have greater impacts on lower-income consumers.
- Some strategies are complementary. For example, shared parking becomes more effective if implemented with suitable regulations, pricing and walkability improvements.
- Impacts generally increase over time as programs mature. A Low value may be appropriate the first year, but increases to Medium after two or three years, and High in five or ten years.

The table below summarizes potential parking management strategies and their impacts.

Table 20 **Parking Management Strategies' Impacts**

Strategy	Description	Typical Reduction	Traffic Reduction
Shared parking	Parking spaces serve multiple users and destinations.	10-30%	
Parking regulations	Favor higher-value uses such as deliveries, customers, quick errands, and people with disabilities.	10-30%	
More Accurate and Flexible Minimums	Adjust parking minimums to more accurately reflect demand in a particular situation.	10-30%	
Parking maximums	Establish maximum parking minimums.	10-30%	
Remote parking	Provide off-site or urban fringe parking facilities.	10-30%	
Smart growth	Encourage more compact, mixed, multi-modal development.	10-30%	✓
Walking and Bicycling Improvements	Improve walking and bicycling conditions to expand the range of destinations serviced by a parking facility.	5-15%	✓
Carsharing services	Provide carshare services that substitute for private vehicles	10-30%	✓
Increase Capacity of Existing Facilities	Increase parking supply by using otherwise wasted space, smaller stalls, car stackers and valet parking.	5-15%	
Transportation demand management (TDM)	Encourage more efficient travel patterns, including changes in mode, timing, destination and vehicle trip frequency.	10-30%	✓
Parking pricing	Charge motorists directly and efficiently for using parking facilities.	10-30%	✓
Improve pricing methods	Make parking pricing more convenient and cost effective.	Varies	✓
Financial incentives	Provide financial incentives to shift mode such as parking cash out.	10-30%	✓
Unbundle parking	Rent or sell parking facilities separately from building space.	10-30%	✓
Parking tax reform	Change tax policies to support parking management objectives.	5-15%	✓
Bicycle facilities	Provide bicycle storage and changing facilities.	5-15%	✓
Improve Information and Marketing	Provide convenient and accurate information on parking availability and price, using maps, signs, brochures and the Internet.	5-15%	✓
Improve enforcement	Insure that regulation enforcement is efficient, considerate and fair.	Varies	
Transport management assoc.	Establish member-controlled organizations that provide transport and parking management services in a particular area.	Varies	✓
Overflow parking plans	Establish plans to manage occasional peak parking demands.	Varies	
Address spillover problems	Use management, enforcement and pricing to address spillover problems.	Varies	
Parking Facility Design and Operation	Improve parking facility design and operations to help solve problems and support parking management.	Varies	

This table summarizes the parking management strategies described in this report. It indicates the typical reduction in the amount of parking required at a destination, and whether a strategy helps reduce vehicle traffic, and so also provides congestion, accident and pollution reduction benefits.

Table 21 indicates the appropriateness of various strategies for different types of parking demands. Short-term parking management should insure that convenient parking is available for deliveries and errands (including shoppers, visitors and service vehicles). In general, this should maintain less than 85% occupancy rates so drivers can usually see an unoccupied parking space near their destination. Long-term parking management should accommodate commuters and residents with minimal costs, and so can usually have higher occupancy rates and require greater walking distances. The application of parking management strategies often differs between different parking demands. For example, visitors need different types of user information than commuters.

Table 21 **Short- and Long-term Parking**

Management Strategies	Shorter Term	Longer Term
	Deliveries and errands	**Commuters and residents**
Shared parking	Use on-street parking.	Share off-street parking
Parking regulations	Encourage turnover of the most convenient spaces.	Encourage use of less-convenient spaces.
More accurate minimums	As appropriate	As appropriate
Parking maximums	As appropriate	As appropriate
Remote parking	Only if very close	Often appropriate
Smart growth	Supports sharing and “park once” trips	Supports sharing and use of alternative modes.
Walking and bicycling Improvements	Where possible	Where possible
Carsharing services		Reduces vehicle ownership
Increase Capacity of Existing Facilities	Where possible	Where possible
TDM		Often very appropriate
Parking pricing	Encourage turnover of the most convenient spaces.	Encourage use of less-convenient spaces.
Unbundle parking		Often appropriate
Financial Incentives (parking cash out)		Often appropriate
Improve pricing methods	Improve meters	Improve passes
Parking tax reform		Often appropriate
Bicycle facilities	Short-term bike racks in convenient locations	Long-term bicycle parking and changing facilities
Improve user information	Helps guide visitors to additional parking options	
Improve Enforcement and Control	Increases turnover.	Insures that longer-term parker use less-convenient spaces
Transportation management associations	Supports other strategies	Supports other strategies
Overflow parking plans	Sometimes appropriate	Often appropriate
Address spillover problems	Often appropriate	Often appropriate
Parking facility design	Often appropriate	Often appropriate

This table indicates which management strategies apply to short- and long-term parking demands.

Evaluating Potential Strategies

The Institute for Transportation and Development Policy's *Off-Street Parking Simple Calculator of Project Effects* (ITDP 2024) is a user-friendly tool for estimating the potential climate and air quality impacts of off-street parking strategies in a particular city.

Special care is needed when predicting the impacts of a program that includes multiple parking management strategies. Be careful to take into account strategies with overlapping impacts. For example, Transportation Management Associations (TMAs) provide an institutional framework for implementing strategies that directly affect parking requirements. While it would be true to say that a TMA can reduce parking requirements by 10-30% compared with not having such an organization, it would be incorrect to add the demand reductions of the TMA to the impacts of the individual strategies it helps implement.

Here is an illustration. Without a TMA, parking sharing, pricing and transportation demand management may each reduce parking requirements by 10%, but with a TMA they become more effective, providing 15% reductions. The table below illustrates the incremental gain that can be attributed to the TMA, due to the increase in the effectiveness of other strategies. In this example, the TMA causes an additional 12% reduction in parking requirements by enhancing the effects of other management strategies.

Table 22 **TMA Parking Requirement Reductions**

	Without TMA	With TMA	Reduction
Shared Parking	10%	15%	5%
Parking Pricing	10%	15%	5%
TDM	10%	15%	5%
Total Impacts	*100%-(90% x 90% x 90) = 27%*	*100%-(85% x 85% x 85%) = 39%*	*12%*

This table shows how a transportation management association can reduce parking requirements by helping to implement specific management strategies.

Total impacts are multiplicative not additive. For example, shared parking reduces the parking requirements by 10%, to 90% of the original level. The 10% reduction of Parking Pricing reduces this further to 81% of the original level, and another 10% reduction from TDM results in 73% of the original level, a 27% reduction, somewhat less than the 30% reduction that would be calculated by adding three 10% reductions.

Some combinations of strategies have synergistic effects (total impacts are greater than the sum of their individual impacts), and so become more effective if implemented together. For example, sharing parking and walkability improvements may each reduce parking requirements just 10% if implemented alone, but 25% if implemented together because they are complementary.

Developing an Integrated Parking Plan

Below are recommendations for integrated parking planning. Of course, this may be adjusted to reflect the needs of a particular situation.

Define the Scope

Define the geographic scope of analysis. Parking planning can be performed at the site, street, district/neighborhood and regional scale. It is desirable to plan for a walkable area, such as a business district or neighborhood, since this is the functional scale of parking activities. For example, when planning for parking at a building, it best to survey parking supply and demand within about six blocks to help identify opportunities for sharing off-site parking facilities, and the severity of potential spillover parking problems.

Define Problems

Carefully define parking problems. For example, if people complain of inadequate parking it is important to determine where, when and to whom this occurs, and for what types of trips (deliveries, commuting, shoppers, tourists, etc.). Consider other types of parking problems, such as high costs of providing parking facilities, inadequate user information, inconvenient pricing methods, inconsiderate enforcement, difficulties walking between parking facilities and destinations, inadequate security, and unattractive parking facilities.

Strategic Planning Context

Parking planning should be coordinated with a community's overall strategic vision. This helps insure that individual decisions reflect broader community objectives. There may be several possible solutions to a parking problem, some of which support strategic objectives, while others contradict them. For example, both increasing parking supply and improved management of existing supply can address parking congestion problems, but one approach may support other community planning objectives, such as encouraging use of alternative travel modes, and reducing urban sprawl.

Establish Evaluation Framework

Develop a comprehensive *evaluation framework*. This provides the basic structure for analyzing options, insuring that critical impacts are not overlooked and different situations are evaluated consistently. A framework identifies:

- Perspective and scope, the geographic range and time-scale of impacts to consider.
- Goals (desired outcomes to be achieved) and objectives (ways to achieve goals).
- Evaluation criteria, including costs, benefits and equity impacts to be considered, such as those listed in Table 23.
- Evaluation method, how impacts are to be evaluated, such as benefit/cost analysis.

Performance indicators, practical ways to measure progress toward objectives, such as increased availability of parking to customers, or reduced complaints of spillover parking.
Base Case definition, that is, what would happen without the policy or program.
How results are presented, so results of different evaluations can be compared. For example, results can be presented as annualized cost per parking space, or net present value.

Table 23 **Impacts to Consider for Comprehensive Analysis**

Name	Description
Land costs	Value of land devoted to parking facilities.
Construction costs	Project construction expenses.
Operation and maintenance costs	On-going operation and maintenance expenses.
Implementation	Ease of implementation.
User convenience	The relative ease of use.
Consumer choice	Impacts on the range of parking, transport and housing options available.
User financial impacts	Additional consumer payments, savings or benefits.
Revenues	Additional revenue to facility owners.
Spillover impacts	May cause undesired use of off-site parking spaces.
Economic development impacts	Changes in employment and business activity.
Travel impacts	Shifts in parking location, mode, destination, time, etc. Some are considered desirable, and others undesirable, depending on conditions and perspective.
Traffic impacts	Changes in vehicle traffic volumes, including reductions in car trips and increased cruising for available parking spaces.
Accessibility impacts	Changes in the location and dispersion of activities.
Greenspace preservation	Changes in the amount of land devoted to landscaping, farms and habitat.
Stormwater management and heat island effects	Changes in the amount of impervious surface, stormwater management costs, and solar heat gain.
Fairness and equity	Changes in unjustified subsidies (user pays principle), and impact on people who are physically, economically or socially disadvantaged.

This table lists impacts (costs and benefits) to consider when evaluating parking management programs.

Survey Conditions

Survey parking supply (the number of parking spaces available in an area) and demand (the number of parking spaces occupied during peak periods) in the study area. Collect the following data on all parking facilities in an area:

1. Location and ownership of parking facility.
2. Type of facility (on-street, off-street surface, off-street structured, underground).
3. Number of spaces.
4. Intended users (customers, employees, residents, etc.).
5. Regulation (i.e., “One Hour Maximum,” “Delivery Vehicles Only”).
6. Prices (hourly, daily, weekly, monthly fees).
7. *Utilization* (how many spaces are occupied), *turnover* (the number of different vehicles using a space during a time period) and *duration* (length of time vehicles are parked).
8. Types of problems identified (parking congestion, spillover conflicts, poorly maintained facilities, inadequate enforcement, inadequate security, etc.)

Identify Options

Develop a list of potential solutions using ideas from this guide and stakeholder ideas. This list may include a combination of capacity expansion and management solutions. Management solutions can consist of individual strategies or integrated programs that include a coordinated set of strategies.

Evaluate Options

Evaluate each option with respect to evaluation criteria. Some impacts, such as equity and land use effects, are unsuited for *monetization* (measuring in monetary units). They can be evaluated using a rating system. For example, a community may have established equity objectives to improve mobility for non-drivers and provide affordable mobility for non-drivers, and land use objectives to reduce total impervious surface and discourage sprawl. A committee of experts or stakeholders rates each option according to these objectives. The results are presented in a matrix, as illustrated below.

Table 24 **Evaluation Matrix Example** (Litman 2001)

	Cost Effectiveness	Mobility for Nondrivers	Affordability	Impervious Surface	Discourages Sprawl	Total Points
Option 1	-2	4	4	3	4	*14*
Option 2	-1	4	-1	4	4	*10*
Option 3	-4	5	3	4	1	*9*
Option 4	-1	3	-4	5	3	*6*
Option 5	-3	2	4	-3	5	*5*

Each option is rated from –5 (negative) to 5 (positive) based on how well it helps achieve each objective.

Prioritize Options

Potential solutions should be prioritized, as illustrated in the examples below.

Single Building Example

Conventional standards require 100 parking spaces (90 employee and 10 visitor) for a 100-employee office. Each space has an annualized cost of $600. Various management strategies are considered and ranked by cost effectiveness (annualized dollars per space).

- Sharing rather than assign spaces reduces needed parking supply by 20 spaces, with an estimated annualized cost of $10 per space to deal with occasional problems.
- Arranging to use parking at a nearby church in exchange for their use of office parking Sunday mornings reduces the need for 10 spaces at $50 annualized cost per space.
- Allowing more employees to telecommute and installing bicycle storage and changing facilities reduces parking requirements by 5 spaces, at $200 annually per space.
- A $15 per month cash-out payment to 20 employees (10 who currently use alternative modes and 10 more who would shift if offered this incentive) would reduce parking requirements by 10 spaces at $360 per space (20 employees x $15/month x 12 months = $3,600 ÷ 10).
- A $25 per month cash-out benefit is predicted to reduce parking requirements by 15 spaces at a cost of $500 per space (25 employees x $25/month x 12 months = $7,500 ÷ 15).
- Additional spaces could be rented at $65 per month.

The table below summarizes the results, ranked from lowest to higher unit costs.

Table 25 **Office Parking Management Evaluation Example**

Strategy	Unit Cost	Spaces Provided	Cumulative Increase	Cumulative Cost
	$/space/year		Total spaces	$/year
Shared Parking	$10	20	20	$200
Remote Parking & Improved Walkability	$50	10	30	$700
Bicycle Parking and Allow Telecommuting	$200	5	35	$1,700
Cash-out A, $15/month to 20 employees	$360	10	45	$5,300
Cash-out B, $25/month to 25 employees	$500	15	50	$9,200
Build Additional Parking Capacity	*$600*	*No Limit*		
Additional Remote Parking, Leased at $65/month	$780	20	75	$31,700

This table ranks strategies by cost effectiveness. Management strategies should be implemented if they are cheaper than capacity expansion. Note, only one of the three Cash-out options can be selected.

The developer should therefore implement all parking management strategies up to the $25 per month parking cash-out benefit and provide 50 rather than 100 parking spaces to minimize direct financial cost. Additional management strategies may be implemented to help achieve other objectives, such as reduces traffic congestion and pollution emissions.

Commercial District Example

A growing commercial district is experiencing parking congestion problems. The area has 10,000 parking spaces: 1,000 free on-street; 3,000 public, priced off-street; and 6,000 private, off-street spaces currently unavailable to the general public. Most on-street spaces are occupied, but many off-street spaces are vacant during peak periods. Planners identify various parking management and capacity expansion options and rank them by increasing unit costs. Here is what they find.

- 200 on-street parking spaces are unregulated and used all day by commuters. These can have 2-hour limits to encourage turnover. The cost is estimated to total $1,000 per year for additional signs and enforcement.
- Signs and maps can be provided to help motorists find parking. This is predicted to increase peak-period customer parking supply by an equivalent of 300 spaces, the number of spaces that are unused because customers don't know about them. This project is estimated to cost $6,000 per year for materials. This increases user convenience with no evident indirect costs.
- A program can encourage employees to use remote parking. This is estimated to increase customer parking supply by 100 spaces. Costs are estimated to total $5,000 per year for program materials and administration. The main indirect cost is inconvenience to employees.
- Free shuttle bus service could be provided during peak days (summer weekends and holiday shopping periods) between the commercial district, remote parking facilities, and a transit terminal. This is predicted to provide the equivalent of 500 additional parking spaces within

the commercial district. Costs are estimated to total $35,000 per year. This would increase user convenience and reduce some traffic congestion.

- A transportation management association could provide trip reduction services, help establish parking sharing arrangements, provide parking information and enforcement services, and support other parking management strategies. Three options are considered:
  - A minimal program, costing $50,000 annually, which is predicted to increase peak-period parking supply available to the public by 500 spaces.
  - A moderate program, costing $150,000 annually, which is predicted to increase peak-period parking supply available to the public by 1,000 spaces.
  - A maximum program, costing $500,000 annually, which is predicted to increase peak-period parking supply available to the public by 2,000 spaces.

- 300 surface spaces could be added on otherwise unused city land for $200 annualized cost per space, but any more spaces will require structured parking, with annualized costs of $1,500 per space. Although the city could charge for use of this parking, existing parking structures are generally not filled, so net revenues from this additional capacity would be minimal.

Table 26 summarizes these options. The city can begin implementing the most cost effective options, and work down to more costly strategies if needed. Although it may initially be difficult to predict the effectiveness of some management strategies, this will become easier with experience. For example, the first year a parking management association is established it may only free up 250 parking spaces, but this should increase over time as its services develop and are better tailored to meet local needs.

Table 26 **Community Parking Management Evaluation Example**

Strategy	Unit Cost	Spaces Provided	Cumulative Increase	Cumulative Cost
	$/space/year		total spaces	$/year
Regulate currently unregulated parking	$5	200	200	$1,000
Provide user information	$20	300	500	$7,000
Encourage employees to use less-convenient spaces	$50	100	600	$17,000
Provide free shuttle bus service	$70	500	1,100	$52,000
A. Parking Management Association: Minimum	$100	500	1,600	$102,00
B. Parking Management Association: Moderate	$150	1,000	2,100	$202,000
Add surface parking	*$200*	*300*	*2,400*	*$262,000*
C. Parking Management Association: Maximum	$250	2,000	3,100	$552,000
Add structured parking	$1,500	No Limit		

This table ranks various strategies by increasing unit costs. Management strategies should be implemented if they are cheaper than building additional capacity. Note that only one of the three Parking Management Association options can be selected.

Developing an Implementation Plan

Once the components of a parking management plan are selected, the next step is to develop an implementation plan. This may include various phases and contingency-based options. For example, some strategies will be implemented the first year, others within three years, and a third set will only be implemented if necessary, based on performance indicators such as excessive parking congestion or spillover problems. Table 27 illustrates an example of such a plan.

Once a general implementation plan is established, create a workplan that identifies specific tasks to be accomplished, when they should be completed, and who is responsible for them.

Innovative strategies can first be implemented with pilot projects. This helps overcome a frequent barrier to innovation: that the costs and effectiveness of a new strategy are difficult to predict. For example, a facility manager might first implement shared parking in a relatively small area, and expand the program after gaining experience.

Table 27 **Example of Contingency-Based Parking Management Plan**

Phase	Timing	Strategies
1	Implement within one year.	Improve information on parking availability and price with signs, maps and apps. Shift from dedicated to shared parking spaces within each lot. Impose 2-hour limitations on the most convenient parking spaces. Encourage long-term parkers and employees to use less convenient spaces. Improve enforcement of regulations and fees. Establish an evaluation program, to identify impacts and possible problems.
2	Implement within two years.	Price the most convenient spaces. Expand regulations that limit parking duration and user types. Arrange sharing agreements with neighbors that have excess parking supply. Install bicycle storage and changing facilities. Establish a commute trip reduction program.
3	Implement if peak-period occupancy exceeds 85%.	Gradually and predictably increase fees (e.g., 10% annual price increases). Improve area walkability and address security concerns. Provide real-time information on parking availability using apps and dynamic signs.
4	Implement as needed, based on peak-period occupancy rates.	Address spillover parking problems. Address barriers to walking between remote parking and destinations. Develop overflow parking plans for special events and peak periods.
5	Implement if problems continue.	Expand the portion of parking spaces that are priced and regulated. Increase support for commute trip reduction programs. Provide shuttle van services to bus stops and remote parking during peak periods.

This table illustrates a parking management plan. Some strategies are implemented right away; others over a longer period, and some are only implemented if needed, based on specific indicators such as excessive parking congestion or spillover problems.

Generic Outline for a Parking Management Plan

Introduction
Describe what this plan is intended to achieve. Describe, in a general way, the project and its context, and the benefits of more efficient parking management. Discuss the change now occurring in the way planners think about parking problems and solutions.

Context
Describe the geographic area, such as the city, district and neighborhood. Highlight any strategic planning documents that support smart growth, transportation demand management, neighborhood redevelopment and parking management.

Project Description
Describe the project. Highlight features that support parking management, such as:

- Site and neighborhood design that limits on-site parking supply.
- Geographic factors, such as compact, mixed use development, within the project or the neighborhood.
- Proximity to high quality public transit, good walkability and cycling facilities.
- Demographic factors that reduce parking demands, such as lower-income, young, or disabled occupants and visitors.
- Potential management strategies including sharing of parking facilities, development of an off-site overflow plan, efficient regulations and pricing, improved user information, incentives to use alternative modes (such as parking cash out or transit subsidies), bicycle parking and promotion, carsharing services, etc.
- Facility design features that support parking management, such as good pedestrian access to nearby offsite parking facilities.

Analysis
Indicate how much parking would be required by conventional zoning or generic ITE parking generation analysis, and then identify how specific adjustment factors and management strategies can reduce these requirements. For example, estimate the parking demand reduced due to proximity to transit services and demographic factors, and additional reductions that can be achieved through management strategies. Provide evidence supporting each of these adjustment factors.

Parking Management Plan
Identify specific actions that can be taken to more efficiently manage parking and address any problems that may occur. Indicate which of these will be implemented, with specific details of what, who and when these actions will be taken. Also indicate contingency actions that *can* be deployed in the future if needed. Indicate your monitoring plan which determine if problems develop and additional parking management strategies are needed.

References
Provide documentation that supports your arguments.

Examples and Case Studies

All strategies described in this guide have been successfully implemented. Examples are described in ITDP (2023), MTC (2021), Nelson/Nygaard (2022); the Parking Reform Network, and Strong Towns (2019).

Reforming Parking Minimums (https://parkingreform.org)
Many North American towns and cities are reducing or eliminating parking minimums, as illustrated below. Last year, officials in Buffalo, New York and Hartford, Connecticut eliminated parking minimums for commercial and residential developments.

Parking Reform for Local Economic Development (https://bit.ly/3mgDYwU)
The free e-book, *Stuck in Park: How Mandatory Parking Minimums Hurt American Cities* (Strong Towns 2019) uses case studies, with maps and figures, to illustrate why and how North American communities can reduce or eliminate parking minimums in order to support community livability and local economic development.

Parking Policies for Sustainable Urban Mobility Plans
The European Commission encourages towns and cities to develop Sustainable Urban Mobility Plans or SUMPs. The Eltis Urban Mobility Observatory provides guidance documents and information resources including Park4SUMP, which helps cities integrate innovative parking management. The report, Parking and Sustainable Urban Mobility Planning: How to make parking policies more strategic, effective and sustainable is a useful overview, and their videos provide examples and information resources in an easy-to-understand format.

Integrated Parking and Transit Payments
A University of Minnesota study, *Parking FlexPass at ABC Ramps: Integrating Parking and Transit Options for Sustainable Mobility*, concluded that some commuters will shift from driving to transit if, rather than paying for parking by the month they had an affordable *FlexPass* which offered unlimited transit use along with parking for 10 or 14 days per month.

TDM Plans (Boston 2021)
The City of Boston requires all large new developments (over 500,000 sq. ft.) to create a Transportation Demand Management (TDM) plan. The goal is to prioritize safety, manage parking demand, and improve walking, biking and public transit. The city developed a list of potential TDM strategies, and an analysis tool to help evaluate them for implementation in a particular situation. At the end of this process, the developer signs a legal agreement with the Boston Transportation Department called a Transportation Access Plan Agreement (TAPA). The city also put a cap on allowable parking supply in some locations.

Commercial District Parking Management (Gibbs 2013)
In his book *Principles of Urban Retail*, Gibbs (2013) describes various ways to create more attractive urban retail centers, including ways to manage parking for shopper convenience. It emphasizes the importance of convenience and secure parking that accommodates various types of customers. Regional shopping centers parking ratios have declined significantly in recent decades, from 10 down to 4.0 spaces per 1,000 square feet, and that this can be further reduced with more efficient management. Gibbs recommends pricing the most convenient parking spaces to insure that parking spaces are always available to shoppers in a hurry.

Downtown Pasadena Redevelopment (Kolozsvari and Shoup 2003)
During the 1970s Old Pasadena's downtown had become run down, in part due to the limited parking available to customers. The city proposed pricing on-street parking to increase turnover and make parking available to customers. Many local merchants originally opposed the idea. As a compromise, city officials agreed to dedicate all revenues to public improvements that make the downtown more attractive. A Parking Meter Zone (PMZ) was established within which parking was priced and revenues were invested. Merchants began to see parking meters as a way to fund projects and services that directly benefit them, including police patrols, more street and sidewalk cleaning, pedestrian and landscaping improvements, and marketing. This created a *virtuous cycle* in which parking revenue funded community improvements that attracted more visitors, new businesses and residential development, which increased parking revenue, allowing more improvements. Parking is no longer a problem, customers can almost always find a convenient space. Local sales increased faster than in other shopping districts with cheaper parking. This shows that efficient parking pricing supports urban redevelopment.

TOD Parking Demand
The Denver Regional Transportation District's *Residential Parking in Station Areas: A Study of Metro Denver* (RTD 2020), found that Denver station-area developments provide substantially more parking than residents use. The 86 properties analyzed provide 42% more parking than residents use at peak demand and, 50% more in income-restricted properties. The 65 market-rate properties analyzed provide an average of 1.23 parking spaces per unit, but only 0.74 parking spaces per unit are used. The 16 income-restricted properties provide an average of 0.72 spaces per unit, but residents only use 0.36 parking spaces per unit.

Smart Growth and TOD Parking Demand
Various studies (Arrington, et al. 2008; Ewing, et al. 2017; Metro Vancouver 2018; Rowe, et al. 2013; Schneider, Handy and Shafizadeh 2014) indicate that more compact, mixed, multimodal developments (i.e., Smart Growth and Transit Oriented Development) generate only 35-70% of trip generation and 25-75% of the parking demand recommended by standard guidelines published by the Institute of Transportation Engineers.

Parking Management Mitigation (https://bit.ly/2TCxtBD)
The report, *Modernizing Mitigation: A Demand-Centered Approach*, (Sundquist, et al. 2018) provides practical guidance and useful examples of ways that cities and regions can encourage or require developers and other stakeholders to support vehicle travel reductions in order to mitigate traffic and parking congestion problems and achieve other community goals.

Managing Urban India's Parking Needs
The 2018 report, *Pampering Parking: How to Manage Urban India's Parking Needs*, by the Centre for Science and Environment, describes why and how cities can develop *Parking Area Management Plans* (PAMPs) that result in more efficient and equitable management of parking facilities, including regulations and enforcement, efficient pricing, facility sharing, protect local greens and parks, provide for night-time parking of public transport and commercial vehicles, ensure unhindered lanes for passage of emergency vehicles, and enable overall street improvement for all road users. The report describes specific steps and principles.

Parking Impacts on Downtown Economic Success (https://bit.ly/2rXBzXm)

The study, "Is Parking Supply Related to Turnover of Shopping Areas?" (Mingardo and Meerkerk 2012) investigated the degree that parking pricing affects retail sales in Dutch commercial districts. It found no significant relationship between parking supply and sales volumes in most shopping districts, but a positive relationship between parking supply and turnover in large regional shopping centers. It found a significant positive relationship between parking fees and turnover per sales floor area. They conclude that this indicates that in most shopping districts, customers value the convenience of priced parking (pricing favors *spenders* over *cheapskates*).

Right-Size Parking Study

The *Right Size Parking Project* (www.rightsizeparking.org) developed tools for calculating parking demand and optimal parking supply in a particular location, taking into account development type and geographic and economic factors. The study found that parking demand per unit declines with increased transit proximity, local population and employment density, and parking price, and increases with rents, unit size and number of bedrooms.

GreenTRIP (www.transformca.org/GreenTRIP)

GreenTRIP is a Traffic Reduction + Innovative Parking certification program for new residential and mixed use developments. It rewards projects that reduce traffic and greenhouse gas emissions. GreenTRIP expands the definition of green building to include robust transportation standards for how people get to and from green buildings. Each certified project receives a *Project Evaluation Report* which describes the project location, details and inventories how the project meets GreenTRIP standards. The GreenTRIP program provides the following support:

- Tailored Traffic Reduction Strategies – Experts work with developers, designers and operators to identify the most appropriate transportation and parking management strategies in a particular situation.
- Public Hearing Testimony - GreenTRIP staff will explain the traffic and emission reduction benefits provided by GreenTRIP projects to decision-makers and the public.
- Market Differentiation - Use of the GreenTRIP name and logo in promotional materials, and a plaque to mount on the project when built.

Suburban TDM (Galdes and Schor 2022)

The article, *Don't Underestimate Your Property: Forecasting Trips and Managing Density over the Long Term* summarizes experience with TDM programs in suburban Fairfax County, particularly Tyson's Corner. It found that residential and commercial developments that had comprehensive but cost-effective TDM programs actually generate 49% fewer trips than predicted by ITE trip generation models. This reduces parking and roadway costs, and allows more development to occur on available land. As one traffic engineer explained,

> "Underestimating trip generation can have deleterious effects on a neighborhood because trip generation is so closely linked to the amount of square footage that a property is allowed. More than any other feature of a development, vehicle trip generation estimates determine density limits and impacts." (Mike Workosky, President of Wells + Associates)

Office Complex Travel Demand Management Evaluation (Spack and Finkelstein 2014)
A detailed study, *Travel Demand Management: An Analysis of the Effectiveness of TDM Plans in Reducing Traffic and Parking* measured trip generation at various Minneapolis-St. Paul metropolitan region office buildings. It found that, compared with Institute of Transportation Engineers' average trip generation rates, buildings that implemented TDM Plans generate, on average, 34% to 37% less traffic and need 17% to 24% fewer on-site parking spaces.

Downtown Residential Parking Demand Analysis
Gribb (2015) mapped downtown residential and commercial parking demands, and measured their distance to available on- and off-street parking spaces in downtown Laramie, Wyoming. Street interviews provided information on parking duration, purposes of visit, and downtown destinations. A three-dimensional land use inventory supplied detailed locations of all activities in each building and floor for the 28 blocks of downtown Laramie. The results indicate that the downtown has 2,130 total parking spaces, but most have restricted uses, so only about a quarter of off-street spaces (about 420) are available for overnight use by the 51 downtown housing units that currently lack designated parking. The authors recommend applying various parking management strategies to ensure that parking spaces meet future demands.

Seattle Reduces Parking Requirements (Rosenberg 2016)
Real estate market trends and public policy changes are reducing the number of parking spaces included in new apartments in Seattle. Between 2004 and 2016, the average number of parking spaces built per apartment declined from 1.91 to 1.29 in suburban areas and from 1.57 to 0.63 in City of Seattle. This reflects the high costs of building parking, averaging $30,000 or more per space, improved travel options, including major rail and bus system expansions, and changing consumer preferences toward more car-free lifestyles. Parking is no longer required for apartment buildings in many districts including Downtown, Capital Hill, the University District and Northgate and parts of Ballard, Fremont and Greenwood.

Nottingham Commuter Parking Levies (WWF 2017)
Nottingham, England introduced a workplace parking levy on large employer in 2012. The £379 annual charge is levied on approximately 25,000 spaces, representing 42% of total spaces. In its first three years the levy raised £25.3 million of revenue, which is dedicated to improving the city's transport infrastructure, including the largest fleet of electric buses. The levy has helped increase public transport mode share to over 40%, and reduce carbon emissions by 33%.

San Francisco Regional Value Pricing Parking Program (http://regionalparking.mtc.ca.gov)
The Value Pricing Pilot Parking Pricing Regional Analysis Project is part of Metropolitan Transportation Commission's 2014-2015 Parking Initiative. The Project uses case studies, academic research, policy analysis and data analysis to address the relationship between parking pricing, policies, parking supply, and parking demand in cities around the Bay Area.

Key Findings:

1. Most locations have significant amounts of unused parking even during the peak periods. Although there is excess demand on some streets at some times, parking is almost always available nearby.
2. Prices between on-street and off-street parking are uncoordinated and inefficient. On-street parking is often free or cheaper than off-street, resulting in traffic and parking congestion.
3. Parking requirements fail to respond to demographic and geographic factors that affect demand such as residents incomes, development density and transit proximity.

4. There is little analysis of transit parking demand, costs and optimization.
5. Employee parking pricing is effective at reducing commute auto trips but few employers charge for parking or cash-out free parking.
6. Parking reforms can support Sustainable Community Strategy (SCS). Regional policies can.

Redeveloping Transit-Station Area Parking Lots (CNT 2006)

The study, *Paved Over: Surface Parking Lots or Opportunities for Tax-Generating, Sustainable Development?*" (www.cnt.org/repository/PavedOver-Final.pdf), evaluates the potential economic and social benefits if rail station area parking lots were developed into mixed-use, pedestrian friendly, transit-oriented developments. The analysis concludes that such development could help to meet the region's growing demand for affordable, workforce, senior, and market rate housing near transit, and provide a variety of benefits including increased tax revenues and reduced per capita vehicle travel. The parking lots in nine case studies are estimated to be able to generate 1,188 new residential units and at least 167,000 square feet of new commercial space, providing additional tax revenues, plus significant reductions in trip generation and transportation costs compared with more conventional development.

Residential Garage Conversions (www.ci.santa-cruz.ca.us/pl/hcd/ADU/adu.html)

Santa Cruz, CA has a special program to encourage development of *Accessory Dwelling Units* (ADUs, also known as *mother-in-law* or *granny* units) to increase housing affordability and urban infill. These often consist of converted garages. The city has ordinances, design guidelines and information for such conversions. The Vancouver, BC firm *Smallworks* (http://smallworks.ca) specializes in small lane-way (alley) housing, which are often converted garages.

Bike Versus Parking Lanes (Sztabinski 2009)

A survey of merchants along Toronto's busy Bloor Street found that a majority of customers arrive by walking or cycling (only 10% drive) and that those who arrive by nonmotorized modes tend to spend more. On street parking is seldom fully occupied and offstreet parking lots could accommodate additional demand. More merchants believe that a bike lane or widened sidewalk would increase business than merchants who believe such changes would reduce business.

Optimizing Transit Oriented Development Area Parking

Willson and Menotti (2007) analyzed the ridership and fiscal outcomes that result from devoting land around rail transit stations to housing or parking. They find that only in low-density suburban areas with little development potential is it optimal to maximize the amount of land devoted to parking; in other conditions, developing the land for housing and commercial activity tends to provide greater economic benefits by providing land rents and creating housing and destinations that tend to generate high rates of transit ridership. This analysis indicates that transit agencies should favor housing development over commuter parking around stations. Translink (2018), *Regional Parking Study Technical Report*, Translink and Metro Vancouver (www.metrovancouver.org); at https://tinyurl.com/3mvwz899.

A Recommended Approach to Neighborhood Management: Parking Benefit Districts

Pricing is the most efficacious means of managing on-street parking when occupancy routinely exceeds practical capacity. A *Parking Benefit District* (PBD) program could be made available to neighborhoods facing parking challenges, regardless of whether the neighborhood is currently covered by an RPP. Such a program should incorporate the following components:

Allow neighborhoods to opt-in. Neighborhoods could elect (through an adopted administrative process) to create a PBD. If the neighborhood is currently covered by an RPP, the PBD would replace the RPP (or applicable portion thereof).

Employ price-based regulation and associated elements. Variable pricing is necessary to effectively manage on-street parking in high-demand neighborhoods. New technology would be deployed to allow for variable pricing, user information, and enhanced enforcement. The hours during which parking is priced would be evaluated and modified as necessary. Conventional strategies, such as provision of loading zones, would be reevaluated and adjusted appropriately.

Expand metering to areas with peak parking demands in excess of 85%. All blocks with practical capacity issues warrant price-based management. Expansion of metering into areas traditionally designated as "residential" could potentially be paired with an exemption for preferential permit holders (priced at higher than current rates, as discussed above) at all or some times of day.

Provide parking privileges to preferential permit holders at an appropriate price point. Residents of the neighborhood would be permitted to purchase monthly permits for on-street parking on residential streets in the neighborhood. Permits should be priced at a high enough level to appropriately value on-street space and reduce demand for on-street parking (by encouraging offstreet parking, reduced vehicle ownership, etc.).

Invest a portion of net new revenues within the neighborhood and involve the community in prioritizing expenditures. This is the central element of PBDs. By pairing the PBD concept with price-based regulation there is even greater opportunity for neighborhoods to reap the benefits of pricing—through improved parking reductions and a reduction in traffic volumes, as well as through funding available to invest in local transportation projects.

Recognize the limits of fully addressing peak demand in residential areas. In many neighborhoods, demand for overnight on-street parking is especially high. Overnight parking demand is likely to be managed to some extent by higher preferential permit fees, but even a price-based PBD program must recognize the limits of using price during very late hours when enforcement is more of a challenge. It is important to note that on-street occupancies in excess of 85 percent may be more tolerable during the late-night periods, when traffic volumes are light, and businesses and other activities are less dependent on prioritizing short-term parking and ensuring sufficient availability.

These strategies represent a significant change for any neighborhood. As such, neighborhoods should be involved in choosing the amount and type of price-based regulation and supporting strategies that are desired in a given area. Because more aggressive strategies will provide more revenue, higher levels of benefit should returned to those neighborhoods that are most willing to proactively manage on-street parking through price-based regulation and restructured residential permit parking.

Conclusions

Every time somebody purchases a motor vehicle they expect governments and businesses to provide parking for their use. These are costly: many parking spaces (particularly structured and underground) cost more than the vehicles that occupy them, and because government mandates result three to six parking spaces per vehicle in most communities, total parking facility costs equal or exceed total vehicle costs.

Current parking planning practices are inefficient, resulting in economically excessive parking supply, increased automobile traffic, and more dispersed destinations, contributing to various economic, social and environmental problems. There are many reasons to use management strategies that result in more efficient use of parking resources, in order to address parking problems without expanding supply.

We can do better! Governments can efficiently manage on-street parking and reduce or eliminate parking mandates. To be efficient, parking facilities should serve multiple destinations and be regulated or priced to favor higher value users (delivery vehicles and customers over commuters and residents). On-street and commercial parking are particularly suitable for this type of management, and so should be favored over unpriced, off-street parking that serves a single destination.

This guide describes more than two-dozen management strategies that result in more efficient use of parking resources. These strategies are technically feasible, cost effective, and can provide many benefits to users and communities. Although all of these strategies have been implemented successfully in some situations, they are not being implemented as much as economically justified, due to various institutional barriers. Parking management implementation requires changing the way we think about parking problems and expanding the range of options and impacts considered during planning.

Most parking management strategies have modest individual impacts, typically reducing parking requirements by 5-15%, but their impacts are cumulative and synergistic. A comprehensive parking management program that includes an appropriate combination of cost-effective strategies can usually reduce the amount of parking required at a destination by 20-40%, while providing additional social and economic benefits.

Management solutions represent a change from current practices and so various obstacles must be overcome for parking management to be implemented as much as optimal. Current planning practices are based on the assumption that parking should be abundant and provided free, with costs borne indirectly, incorporated into building construction costs or subsidized by governments. Current parking minimums tend to be applied inflexibly, with little consideration of demographic, geographic and management practices that may affect parking requirements. Parking management requires changing current development, zoning and design practices. This requires that public officials, planners and the public change the way they think about parking problems and solutions, and become familiar with the full menu of parking management strategies available and the benefits they can provide. It requires an institutions and relationships, such as transportation management associations, and activities to improve enforcement and addressing potential spillover impacts.

References and Resources for More Information

Gabriella Abou-Zeid, et al. (2023), *An Assessment of the Expected Impacts of City-Level Parking CashOut and Commuter Benefits Ordinances*, Federal Highway Adm. (https://fhwa.dot.gov); at https://ops.fhwa.dot.gov/publications/fhwahop23023/fhwahop23023.pdf. Summarized in, *'Free' Employee Parking Is Actually Costing the Climate and Commuters* (https://bit.ly/3MU1eeQ).

AF (2022), *D.C.'s "Parking Cash-Out" Law: Your Choices Impact Employees*, Action Figure (https://actionfigure.ai); at https://actionfigure.ai/blog/dc-parking-cash-out-law-employees.

David Baker and Brad Leibin (2018), "Toward Zero Parking: Challenging Conventional Wisdom for Multifamily," *Urban Land* (https://urbanland.uli.org); at https://bit.ly/2IRcuV7.

Paul A. Barter (2014), "A Parking Policy Typology for Clearer Thinking on Parking Reform," *International Journal of Urban Sciences* (www.tandfonline.com/loi/rjus20), at http://dx.doi.org/10.1080/12265934.2014.927740.

Paul Barter (2016), *On-Street Parking Management: An International Tool-kit*, Sustainable Urban Transportation Technical Document #14, GIZ and SUTP (www.sutp.org); at https://bit.ly/2JyHJt7.

Bruce Belmore (2019), "Rethinking Parking Minimums," *ITE Journal*, Vol. 89, No. 2, p. 4 (www.ite.org); at https://bit.ly/2DZULvE.

Jenni Bergal (2017), "Uber, Lyft Cut into Parking Revenue that Keeps Airports Running," *Governing* (www.governing.com); at https://bit.ly/2uh6jFN.

Doug Bojack (2020), *It's Not Just Parking Minimums that Can Shrink*, Strong Towns (www.strongtowns.org); at https://bit.ly/3fVzggz.

Boston (2021), *Transportation Demand Management (TDM) Point System*, City of Boston (www.boston.gov); at https://bit.ly/3DP1Z1q.

Bunt & Assoc. (2024), *Metro Vancouver / Fraser Valley Industrial Parking Study*, Commercial Real Estate Dev. Assoc. (https://naiopvcr.com); at https://naiopvcr.com/page/parkingstudy2023.

CARB (2014), *Research on Impacts of Transportation and Land Use-Related Policies*, California Air Resources Board (https://arb.ca.gov); at https://bit.ly/2XrM1uI.

Center for Watershed Protection (www.cwp.org).

Robert Cervero, Arlie Adkins, and Cathleen Sullivan (2010), "Are Suburban TODs Over-Parked?" *Journal of Public Transportation*, Vol. 13, No. 2; at www.nctr.usf.edu/jpt/pdf/JPT13-2.pdf.

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 (http://dx.doi.org/10.1088/1748-9326/5/3/034001).

Mikhail Chester, et al. (2015), "Parking Infrastructure: A Constraint on or Opportunity for Urban Redevelopment? A Study of Los Angeles County Parking Supply and Growth, *Journal of the American Planning Association*, Vol. 81/4, pp. 268-286 (doi: 10.1080/01944363.2015.1092879); at https://bit.ly/1XkDUGo; also see www.transportationlca.org/losangelesparking.

Will Chilton and Paul Mackie (2018), *The High Cost of Free Parking*, Mobility Lab (www.youtube.com/watch?v=Akm7ik-H_7U).

Petter Christiansen, et al. (2017), "Parking Facilities and the Built Environment: Impacts on Travel Behaviour," *Transportation Research A*, Vo. 95, pp. 198-206, (doi.org/10.1016/j.tra.2016.10.025).

Regina R. Clewlow and Gouri Shankar Mishra (2017), *Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States*, UCD-ITS-RR-17-07, Institute of Transportation Studies (https://itspubs.ucdavis.edu); at https://bit.ly/2E55p3i.

CNT (2006), *Paved Over: Surface Parking Lots or Opportunities for Tax-Generating, Sustainable Development?* Center for Neighborhood Technology (www.cnt.org); at https://bit.ly/36ma1yb.

CNT (2016), *Stalled Out: How Empty Parking Spaces Diminish Neighborhood Affordability*, Center for Neighborhood Technology (www.cnt.org); at https://bit.ly/2Rwrvnu.

CORDIS (1999-2000), *Parking Policy Measures and the Effects on Mobility and the Economy*, Cost-Transport, CORDIS (www.cordis.lu); at https://bit.ly/2r2bZk8.

Thami Croeser, et al. (2022), "Finding Space for Nature in Cities: The Considerable Potential of Redundant Car Parking," *Urban Sustainability*, Vo. 2/27 (doi.org/10.1038/s42949-022-00073-x).

CSE (2018), *Pampering Parking: How to Manage Urban India's Parking Needs*, Centre for Science and Environment (www.cseindia.org); at www.cseindia.org/pamp-ering-parking-8483.

W. Bowman Cutter, Sofia F. Franco and Autumn DeWoody (2010), *Do Parking Requirements Significantly Increase the Area Dedicated to Parking?,* Paper No. 20403, Munich Personal RePEc Archive (http://mpra.ub.uni-muenchen.de); at https://bit.ly/2unFInq.

James M. Daisa and Terry Parker (2010), "Trip Generation Rates for Urban Infill Uses in California," *ITE Journal* (www.ite.org), Vol. 79, No. 6, June, pp. 30-39; at https://bit.ly/2r9tWx4.

Chris De Gruyter, Andrew Butt and Liam Davies (2024), "Exploring the Potential for Unbundling Off-Street Car Parking in Residential Apartment Buildings," *Transport Policy*, (https://doi.org/10.1016/j.tranpol.2024.06.015).

Angela DeLuca (2018), *Ending the Search for Parking*, Urbanism Next (https://urbanismnext.uoregon.edu); at https://bit.ly/2q6uTWD.

Ryan DiRaimo (2021), *Seattle Has the Space*, The Urbanist (www.theurbanist.org); at www.theurbanist.org/2021/03/25/seattle-has-the-space.

Chris De Gruyter, Long T. Truong and Elizabeth J. Taylor (2020), "Can High Quality Public Transport Support Reduced Car Parking Requirements for New Residential Apartments?, *Journal of Transport Geography*, Vol. 82 (https://doi.org/10.1016/j.jtrangeo.2019.102627).

DLCD (2024), *Parking Management Jumpstart Guide*, Department of Land Conservation and Development (www.oregon.gov/lcd); at www.oregon.gov/lcd/TGM/Documents/ParkingManagementJumpStartGuide2up.pdf.

Tony Dutzik, et al. (2017), *Who Pays For Parking? How Federal Tax Subsidies Jam More Cars into Congested Cities, and How Cities Can Reclaim Their Streets*, Frontier Group and Transit Center (https://transitcenter.org); at https://bit.ly/2Xv637D.

The Economist (2017), "Parkageddon: How Not to Create Traffic Jams, Pollution and Urban Sprawl. Don't Let People Park for Free" *The Economist* (www.economist.com); at https://econ.st/2pdbYaD.

EU CORDIS Transport Projects (www.cordis.lu/transport/src/project.htm) includes various research projects to promote more balanced transportation.

Yingling Fan, et al. (2023), *Parking FlexPass at ABC Ramps: Integrating Parking and Transit Options*, Center for Transportation Studies (www.cts.umn.edu); at http://bit.ly/3JbJtGu.

Kate Fane (2018), "Parking Spaces will no Longer be Just for Cars," *Mother Jones* (https://motherboard.vice.com); at https://bit.ly/2HW3VMk.

Ríos Flores, et al. (2014), *Practical Guidebook: Parking and Travel Demand Management Policies in Latin America*, Inter-American Development Bank, (www.iadb.org); at https://bit.ly/2PcLRAv.

Fox Tuttle (2021), *Parking & Affordable Housing*, Shopworks Architecture (https://shopworksarc.com); summarized at https://bit.ly/3CK28Vz.

C.J. Gabbe, Gregory Pierce and Gordon Clowers (2020), "Parking Policy: The Effects of Residential Minimum Parking Requirements in Seattle," *Land Use Policy*, Vol. 91 (https://doi.org/10.1016/j.landusepol.2019.1040530); version at https://bit.ly/2W2v59L.

Camille A. Galdes and Justin Schor (2022), *Don't Underestimate Your Property: Forecasting Trips and Managing Density*, Wells and Associates (www.wellsandassociates.com); at https://bit.ly/3CW2itO.

Henry Grabar (2023), *Paved Paradise: How Parking Explains the World*, Penguin Press (www.penguinrandomhouse.com); at https://bit.ly/3sHFQSq. Summarized in "*The Hidden Force that Shapes Everything Around Us: Parking*" *Vox* (www.vox.com); at https://bit.ly/480J7fQ.

Michael D. Garber, et al. (2025), "Parking and Public Health," *Current Environmental Health Reports*, 12:2 (https://doi.org/10.1007/s40572-024-00465-4).

Robert Gibbs (2012), "Parking Demand," *Principles of Urban Retail*, John Wiley; summary at https://bit.ly/2RSH1Ye.

Jürgen Gies, Martina Hertel and Susan Tully (2021), *Parking Standards as a Steering Instrument in Urban and Mobility*, Sustainable Urban Mobility Plans (https://park4sump.eu); at https://bit.ly/36EJUF1.

GIZ (2012), *Sustainable Parking Management*, Transfer Project (http://transferproject.org); at https://bit.ly/2AdQdzV.

Evan Goldin (2017), *A Cheat Sheet On Professor Donald Shoup's Groundbreaking Work*, Parkade (https://parkade.com); at https://bit.ly/3EJhNVW.

Catie Gould (2024), *The State of Parking Mandates in Washington*, Sightline Institute (www.sightline.org); at www.sightline.org/the-state-of-parking-mandates-in-washington.

Green Values Calculator (http://greenvalues.cnt.org) automatically evaluates the economic and hydrological impact of green versus conventional stormwater management.

GreenTRIP (www.transformca.org/GreenTRIP) is a Traffic Reduction + Innovative Parking certification program for new residential and mixed use developments.

William J. Gribb (2015), "3-D Residential Land Use and Downtown Parking: An Analysis of Demand Index," *CityScape*, Vol. 17, No. 1, pp. 71-84; at https://bit.ly/2QV0iHd.

Zhan Guo, et al. (2012), *Amenity or Necessity? Street Standards as Parking Policy*, Mineta Transportation Institute (http://transweb.sjsu.edu); at http://bit.ly/25oAFE6.

David Gutman (2017), "The Not-so-Secret Trick to Cutting Solo Car Commutes: Charge for Parking by the Day," *Seattle Times*, at https://bit.ly/2iLwp0R.

Robert Hampshire and Donald Shoup (2018), "What Share of Traffic is Cruising for Parking," *Journal of Transport Economics and Policy*, 52(3), 184–201; summarized at https://bit.ly/35bFd33.

Daniel B. Hess (2017), "Repealing Minimum Parking Requirements in Buffalo: New Directions for Land Use and Development," *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, http://dx.doi.org/10.1080/17549175.2017.1310743.

Christopher G. Hoehne, et al. (2019), "Valley of the Sun-Drenched Parking Space: The Growth, Extent, and Implications of Parking Infrastructure in Phoenix," *Cities*, Vol. 89, pp. 186-198 (doi.org/10.1016/j.cities.2019.02.007); at https://bit.ly/3fW3ArJ.

International Conference on Parking Reforms for a Livable City, Centre for Science and Environment (www.cseindia.org), 17 August 2011, New Delhi; at www.cseindia.org/node/2911.

International Parking Institute (www.parking.org) provides information and other resources for Parking Management professionals.

Stephen Ison and Corinne Mulley (2014), *Parking Issues and Policies, Transport and Sustainability Volume 5*, Emerald Group (www.emeraldinsight.com); at http://bit.ly/2EhgsFM.

ITDP Parking Management (www.itdp.org/tag/parking-management) provides numerous resources for efficient parking management in both developed and developing cities.

ITDP (2021), *On-Street Parking Pricing: A Guide to Management, Enforcement, and Evaluation*, Institute for Transportation and Development Policy (www.itdp.org); at https://bit.ly/3hXm68h.

ITDP (2023), *Breaking the Code: Off-Street Parking Reform Lessons Learned*, Institute for Transportation and Development Policy (www.itdp.org); at www.itdp.org/publication/breaking-the-code-off-street-parking-reform-lessons-learned.

ITDP (2024), *The Opportunity of Reforming Parking: A Taming Traffic Deep Dive Report*, Institute for Transportation and Development Policy (https://itdp.org); at https://itdp.org/publication/the-opportunity-of-reforming-parking. Also see the *Off-Street Parking Simple Calculator of Project Effects (SCOPE)*; at https://tinyurl.com/3czfdhjn.

ITE (2019), *Curbside Management Practitioners Guide*, Institute of Transportation Engineers (www.ite.org); at https://bit.ly/2Lp2g4S.

ITE (2023), *Multimodal Transportation Impact; Analysis for Site Development*, ITE Transportation Planning Council (www.ite.org); at https://bit.ly/3lIBRSb.

ITF (2018), *The Shared-Use City: Managing the Curb*, International Transport Forum (www.itf-oecd.org); at www.itf-oecd.org/sites/default/files/docs/shared-use-city-managing-curb_3.pdf.

Tasha Keeney (2017), *Mobility-As-A-Service: Why Self-Driving Cars Could Change Everything*, ARC Investment Research (http://research.ark-invest.com); at http://bit.ly/2xz6PNV.

Omid Khazaeian (2021), *Estimating The Impact of Parking on Car Ownership and Commute Mode Choices*, Te Herenga Waka-Victoria University (doi.org/10.26686/wgtn.16575005.v1).

Evan Kindler (2023), *Parking Benefit Districts*, Parking Reform Networks (https://parkingreform.org); at https://parkingreform.org/playbook/pbd.

Nagwa Khordagui (2019), "Parking Prices and the Decision to Drive to Work," *Transportation Research A*, Vo. 130, pp. 479-495 (doi.org/10.1016/j.tra.2019.09.064).

King County (2018), *Right Size Parking Project and Calculator*; at https://rightsizeparking.org.

Katya Kisin (2022), *Every Parking Lot in the U.S.*, KatWorld (http://kat.world); at http://kat.world/map.html. Described in, *Less Parking, More People Space*, Strong Towns (www.strongtowns.org/journal/2022/6/20/less-parking-lots-more-people-space).

Michael Kodransky and Gabrielle Hermann (2011), *Europe's Parking U-Turn: From Accommodation to Regulation*, Institute for Transportation and Development Policy (www.itdp.org); at https://bit.ly/2Ib95Ei.

Irem Kok, et al. (2017), *Rethinking Transportation 2020-2030: The Disruption of Transportation and Collapse of Internal-Combustion Vehicle*, RethinkX (www.rethinkx.com); at http://bit.ly/2pL0cZV.

Douglas Kolozsvari and Donald Shoup (2003), "Turning Small Change Into Big Changes," *Access 23*, UC Transportation Center (www.uctc.net), Fall, pp. 2-7; at https://bit.ly/2Kid8ge.

Richard Lee, Robert Rees and Mackenzie Watten (2010), "Smart Growth Parking Requirements Review," *ITE Journal* (www.ite.org), Vo. 80, No. 12, December, 34-40.

Todd Litman (2009), "Parking Costs," *Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications*, Victoria Transport Policy Institute (www.vtpi.org/tca/tca0504.pdf).

Todd Litman (2006), *Parking Management Best Practices*, Planners Press (www.vtpi.org/PMBP_Flyer.pdf).

Todd Litman (2007), *Parking Taxes: Evaluating Options and Impacts*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/parking_tax.pdf.

Todd Litman (2008), *Recommendations for Improving LEED Transportation and Parking Credits*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/leed_rec.pdf.

Todd Litman (2010), *Parking Pricing Implementation Guidelines*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/parkpricing.pdf.

Todd Litman (2016), *Affordable-Accessible Housing in a Dynamic City: Why and How to Support Development of More Affordable Housing in Accessible Locations*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/aff_acc_hou.pdf.

Todd Litman (2017), *Pavement Busters Guide*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/pavbust.pdf.

Todd Litman (2018), *Parking Requirement Impacts on Housing Affordability*, Victoria Transport Policy Institute (www.vtpi.org); at www.vtpi.org/park-hou.pdf.

Todd Litman (2019), *Stop Giving Away Valuable Public Assets! A Fiduciary Obligation for Road and Parking Pricing*, Planetizen (www.planetizen.com); at https://bit.ly/2ZOZglU.

Todd Litman (2021), *Housing First; Cars Last. Underutilized parking lots are a costly waste. By managing parking more efficiently, cities can free up land to house people rather than cars*, Planetizen (www.planetizen.com); at www.planetizen.com/blogs/111790-housing-first-cars-last.

Todd Litman (2022), *Cool Planning for a Hotter Future*, Planetizen (www.planetizen.com); at www.planetizen.com/blogs/118535-cool-planning-hotter-future.

Todd Litman (2023), *Comprehensive Parking Supply, Cost and Pricing Analysis*, World Conference for Transportation Research (Montreal); at www.vtpi.org/pscp.pdf.

Location Efficiency Hub (http://locationefficiency.cnt.org) provides web-based tools to help planners, developers and individuals identify and create location-efficient communities.

Farhad Manjoo (2022), "We've Got to Stop Requiring Parking Everywhere," *New York Times* (www.nytimes.com); at www.nytimes.com/2022/06/02/opinion/california-parking.html.

Michael Manville and Donald Shoup (2005), "People, Parking, and Cities," *Journal of Urban Planning and Development*, December, 2005, pp. 233-245; at https://bit.ly/2NHojQc.

Michael Manville and Jonathan Williams (2011), *The Price Doesn't Matter if You Don't Have to Pay: Legal Exemption as an Obstacle to Congestion Pricing*, UCLA Institute of Transportation Studies (www.its.ucla.edu); at https://bit.ly/2NyRFS8.

Greg Marsden (2006), "The Evidence Base for Parking Policies - A Review," *Journal of Transport Policy*, Vol. 13, No. 6, pp. 447-457; at https://bit.ly/2qcaw9t.

Wesley E. Marshall and Norman W. Garrick (2006), "Parking at Mixed-Use Centers in Small Cities," *Transportation Research Record 1977*, Transportation Research Board (www.trb.org); at https://bit.ly/2vwE4Vs; also see, *'Place First' Parking Plans* (www.planetizen.com/node/34152).

Karel Martens (2005), *Effects of Restrictive Parking Policy on the Development of City Centers*, Environmental Simulation Laboratory, Tel Aviv University; at https://bit.ly/2PE5xL9.

Christopher McCahill and Norman Garrick (2014), "Parking Supply and Urban Impacts," *Parking Issues and Policies* (Stephen Ison and Jon Shaw editors), Emerald Press (www.emeraldinsight.com), pp. 33-55; at http://bit.ly/2EhgsFM.

Christopher McCahill, et al. (2016), "Effects of Parking Provision on Automobile Use in Cities: Inferring Causality," *Transportation Research Record*, 2543, pp. 159-165 (DOI: 10.3141/2543-19); at https://bit.ly/2XufqiP.

Adam Millard-Ball (2002), "Putting on Their Parking Caps," *Planning* (www.planning.org), pp. 16-21; at https://bit.ly/2yhkdJJ.

Adam Millard-Ball (2015), "Phantom Trips: Overestimating the Traffic Impacts of New Development," *Journal of Transportation and Land Use* (www.jtlu.org); at http://tinyurl.com/m6ay4ut; summarized in, *ACCESS 45*, pp. 3-8; at https://bit.ly/1HkHmt1.

Adam Millard-Ball, et al. (2021), "What Do Residential Lotteries Show Us about Transportation Choices?" *Urban Studies* (https://journals.sagepub.com/home/usj); at https://bit.ly/3tptDO5.

Giuliano Mingardo (2016), *Articles on Parking Policy*, PhD Dissertation, Delft University of Techonology; at www.verkeerskunde.nl/Uploads/2016/11/ProefschriftGiulianoMingardo.pdf.

Giuliano Mingardo and J. Meerkerk (2012), "Is Parking Supply Related to Turnover of Shopping Areas? The Case of the Netherlands, *Journal of Retailing and Consumer Services*, Vol. 19/2, , pp 195-201; at www.verkeerskunde.nl/Uploads/2016/11/ProefschriftGiulianoMingardo.pdf.

MRSC (2016), *Downtown Parking*, Municipal Research and Service Center of Washington (www.mrsc.org); at https://bit.ly/2Kitrdc.

MRSC (2016), *Parking Demand and Price*, Municipal Research and Service Center of Washington (www.mrsc.org); at https://bit.ly/2EnyzOg.

MTC (2021), *Parking Policy Playbook*, Metropolitan Transportation Commission (http://mtc.ca.gov); at https://abag.ca.gov/technical-assistance/parking-policy-playbook.

John Muhlhausen (2005), *Wayfinding is not Signage: Signage Plays an Important Part of Wayfinding – But There's More*, (www.signweb.com/ada/cont/wayfinding0800.html).

National Parking Institute (www.parking.org) is an organization for parking professionals.

Nelson\Nygaard (2022), *The New Transportation Demand Management: An Implementation Guide for City Officials*, Natural Resources Defense Council (www.nrdc.org); at https://nelsonnygaard.com/the-new-tdm-guide.

NEMO Project (www.canr.uconn.edu/ces/nemo) addresses impervious surface impacts.

Mehdi Nourinejad, Sina Bahrami and Matthew J. Roorda (2018), "Designing Parking Facilities for Autonomous Vehicles," *Transportation Research Part B: Methodological*, 2018; Vo. 109 (DOI: 10.1016/j.trb.2017.12.017); at https://bit.ly/2RSKoOS.

OMI (2022), *The Parking Paradox of Urban India: Creating a demand-supply equilibrium*, Ola Mobility Institute (https://olawebcdn.com); at https://bit.ly/3FWU7gY.

Ottawa (2015), *A 90 Second Lesson in How Parking Can Kill Cities*, City of Ottawa (https://bit.ly/2yLKRKi); at https://bit.ly/2QU5ivN.

Francis Ostermeijer, Hans RA Koster and Jos van Ommeren (2019), "Residential Parking Costs and Car Ownership: Implications for Parking Policy and Automated Vehicles," *Regional Science and Urban Economics* (doi.org/10.1016/j.regsciurbeco.2019.05.005); at https://bit.ly/3PQCZ10.

Parking Today Website (www.parkingtoday.com) has information and links to parking resources.

Parking Reform Network (www.parkingreform.org) promotes more efficient and equity parking policies.

Pavement to Parks (http://sfpavementtoparks.sfplanning.org) describes a program to convert on-street parking and other small areas of streetspace into "parklets."

Gregory Pierce and Donald Shoup (2013), "Getting the Prices Right: An Evaluation of Pricing Parking by Demand in San Francisco," *Journal of the American Planning Association*, Vol. 79, No. 1; at http://shoup.bol.ucla.edu/PricingParkingByDemand.pdf.

Bryan Pijanowski (2007), *Parking Spaces Outnumber Drivers 3-to-1, Drive Pollution and Warming*, Purdue University (www.purdue.edu/uns/x/2007b/070911PijanowskiParking.html).

Linda Poon (2018), *This Map Takes All the Guesswork Out of Confusing Street Parking Rules*, City Lab (www.citylab.com); at https://bit.ly/2Dt0ICW.

PRN (2022), *Progress on Parking Mandates Map*, Parking Reform Network (www.parkingreform.org); at https://parkingreform.org/resources/mandates-map.

Robert Pressl and Tom Rye (2020), *Good Reasons and Principles for Parking Management*, Sustainable Urban Mobility Plans (https://park4sump.eu); at https://bit.ly/3pNTw84.

Push and Pull (www.europeanparking.eu/en/activities/push-pull) project website provides information on various parking management programs in Europe.

Rachel Quednau (2018), *The Parking Problem that Wasn't*, Strong Towns (www.strongtowns.org); at https://bit.ly/2LKW0Qi.

Charles Rivasplata, et al. (2012), *Residential On-Site Carsharing and Off-Street Parking Policy in the San Francisco Bay Area*, Report 11-28 Mineta Transportation Institute (http://transweb.sjsu.edu); at https://bit.ly/2IbIdS1.

Issi Romem and David Garcia (2020), *Residential Redevelopment of Commercially Zoned Land in California*, Terner Center (https://ternercenter.berkeley.edu); at https://bit.ly/364yWZs.

Mike Rosenberg (2016), "Seattle Builds Lots of New Apartments, But not so Many Parking Spots," *Seattle Times* (www.seattletimes.com); at https://bit.ly/2RSKWUW.

Jeffrey Rosenblum, Anne W. Hudson and Eran Ben-Joseph (2020), "Parking Futures: An International Review of Trends and Speculation," *Land Use Policy*, Vol. 91 (https://doi.org/10.1016/j.landusepol.2019.104054).

Martha Roskowski (2021), *Ideas to Accelerate Parking Reform in the United States*, Institute for Transportation and Development Policy (www.itdp.org); at https://bit.ly/3bsDwUj.

Daniel Rowe, et al. (2013), "Do Land Use, Transit and Walk Access Affect Residential Parking Demand?" *ITE Journal*, Vol. 83. No. 2, February, pp. 24-28; at https://bit.ly/1UgmpEE. Summarizes the results of King County's *Right Size Parking Project* (https://bit.ly/2v0vUmZ).

Gabriel Roth (1965), *Paying for Parking*, Hobart Paper 33; at www.vtpi.org/roth_parking.pdf.

Gary Roth (2004), *An Investigation into Rational Pricing for Curbside Parking: What Will be the Effects of Higher Curbside Parking Prices?* Columbia University; at https://bit.ly/2PDOqt1.

RTD (2020), *Residential Parking in Station Areas: A Study of Metro Denver*, Denver Regional Transportation District (www.rtd-denver.com); at https://bit.ly/3dqO8Ur.

Andrés Sañudo, et al. (2013), *Impacts of the ecoParq program on Polanco*, Institute for Transportation and Development Policy (www.itdp.org); at https://bit.ly/1SeH628.

Bruce Schaller (2017), *Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York*, Schaller Consulting (schallerconsult.com); at https://bit.ly/33ujep2.

Eric Scharnhorst (2018), *Quantified Parking: Comprehensive Parking Inventories for Five U.S. Cities*, Mortgage Bankers Association (www.mba.org); at https://bit.ly/2LfNk4o.

Angie Schmitt (2018), *Landlords in Seattle Can't Force Renters to Pay for Parking Anymore*, Street Blog (https://usa.streetsblog.org); at https://bit.ly/2KcxyqW.

Robert J. Schneider, Susan L. Handy and Kevan Shafizadeh (2014), "Trip Generation for Smart Growth Projects," *Access 45*, Fall 2014 (http://bit.ly/1DHcCiG); also see the "*Smart Growth Trip-Generation Adjustment Tool*" (http://bit.ly/1z2q5Dd).

Seattle (2022), *Flex Zone/Curb Use Priorities in Seattle*, Seattle Department of Transportation (www.seattle.gov); at https://bit.ly/44wIDfP.

SFpark (2014), *SFpark Pilot Project Evaluation*, San Francisco Metropolitan Transportation Agency (www.sfmta.com); at http://SFpark.org/docs_pilotevaluation.

SFMTA (2019), *On-Street Parking Pricing Policies*, San Francisco Metropolitan Transportation Agency (www.sfmta.com); at https://bit.ly/3Edof82.

Donald Shoup (1997), "The High Cost of Free Parking," *Access 10* (www.uctc.net), Spring; at www.accessmagazine.org/spring-1997/the-high-cost-of-free-parking.

Donald Shoup (1999), "The Trouble With Minimum Parking Requirements," *Transportation Research A*, Vol. 33, No. 7/8, Sept./Nov., pp. 549-574; at www.vtpi.org/shoup.pdf.

Donald Shoup (2004), "Curb Parking: an Ideal Source of Public Revenue," *Regional Science and Urban Economics*, Vol. 34, pp. 753-784; at http://shoup.bol.ucla.edu/IdealSource.pdf.

Donald Shoup (2005), *The High Cost of Free Parking*, Planners Press (www.planning.org). Podcast at https://bit.ly/2OwxHLR.

Donald Shoup (2005), *Parking Cash Out*, Report 532, Planning Advisory Service (www.planning.org/pas), American Planning Association; at https://bit.ly/1J3wyji.

Donald Shoup (2007), "Cruising for Parking," *Access 30*, University of California Transportation Center (www.uctc.net), Spring, pp. 16-22; at www.uctc.net/access/access30.shtml.

Donald Shoup (2011), "Free Parking or Free Markets," *CATO Unbound* (www.cato-unbound.org); at https://bit.ly/2COMA5U; also in, *Access 38*, University of California Transportation Systems Center (www.uctc.net), Spring, pp. 29-35; at https://bit.ly/2ylY9gV.

Donald Shoup (2013), "Portland Should Consider Overnight Permits to Solve its Parking Headache," *Oregonian* (www.oregonlive.com); at http://tinyurl.com/oz557rs.

Mike Spack and Jonah Finkelstein (2014), *Travel Demand Management: An Analysis of the Effectiveness of TDM Plans*, Spack Consulting; at https://bit.ly/2JTTeXV.

Steven Spears, Marlon G. Boarnet and Susan Handy (2014), *Policy Brief on the Impacts of Parking Pricing*, California Air Resources Board (http://arb.ca.gov/cc/sb375/policies/policies.htm).

Jeff Spivak (2022), "A Business Case for Dropping Parking Minimums," *Planning Magazine* (www.planning.org); at https://bit.ly/3muQN3e.

Vergil G. Stover and Frank J. Koepke (2002), *Transportation and Land Development*, Second Edition, Institute of Transportation Engineers (www.ite.org).

Strong Towns (2019), *Stuck in Park: How Mandatory Parking Minimums Hurt American Cities*, (https://strongtowns.org); at https://bit.ly/3mgDYwU.

Eric Sundquist, et al. (2018), *Modernizing Mitigation: A Demand-Centered Approach*, State Smart Transportation Initiative (www.ssti.us); at https://bit.ly/2TCxtBD.

Fred Sztabinski (2009), *Bike Lanes, On-Street Parking and Business A Study of Bloor Street in Toronto's Annex Neighbourhood*, The Clean Air Partnership (www.cleanairpartnership.org); at www.cleanairpartnership.org/pdf/bike-lanes-parking.pdf.

Galina Tachieva (2010), *Sprawl Repair Manual*, Island Press (www.islandpress.org).

TPS (2023), *Just the Ticket: Parking Policy for Lower Carbon Travel*, Transport Planning Society (https://tps.org.uk); at https://tinyurl.com/2xy3d9wn.

Transform Scotland (2018), *Getting the Bill Right*, Transform Scotland, National Alliance for Sustainable Transport (http://transformscotland.org.uk); at https://bit.ly/2HKEmcM.

Translink (2018), *Regional Parking Study Technical Report*, Translink and Metro Vancouver (www.metrovancouver.org); at https://tinyurl.com/3mvwz899.

Jamey M.B. Volker and Calvin G. Thigpen (2024), "Not Enough Parking, You Say? A Study of Garage Use and Parking Supply for Single-Family Homes in Sacramento and Implications for ADUs," *Journal of Transport and Land Use*, Vo. 15, pp. 183-206 (https://doi.org/10.5198/jtlu.2022.1947).

VTPI (2005), *Online TDM Encyclopedia*, Victoria Transport Policy Institute (www.vtpi.org).

Siqin Wang and Yan Liu (2021), "Parking in Inner Versus Outer City Spaces: Spatiotemporal Patterns of Parking Problems and Their Associations with Built Environment Features," *Journal of Transport Geography*, Vo. 98 (doi.org/10.1016/j.jtrangeo.2021.103261).

Rachel Weinberger, et al. (2023), *Parking Cruising Analysis Methodology Project Report*, Federal Highway Adm. (https://fhwa.dot.gov); at https://bit.ly/45qXAjU; summary at https://bit.ly/3XzCStX.

Rick Williams (2013), *Parking Made Easy: A Guide to Managing Parking in Your Community*, Oregon Transport and Growth Management (www.oregon.gov/LCD); at https://bit.ly/2yHzLpC.

Richard Willson (2015), *Parking Management for Smart Growth*, Island Press (http://islandpress.org); at http://islandpress.org/book/parking-management-for-smart-growth.

Richard Willson and Val Menotti (2007), "Commuter Parking Versus TOD," *Transport. Research Record 2021*, pp. 118-125, TRB (www.trb.org); at https://bit.ly/2je2I57.

Kea Wilson (2022), *D.C. 'Parking Cash Out' Law Makes Employers Refund Workers Who Don't Drive*, StreetBlog USA (https://usa.streetsblog.org); at https://bit.ly/3tb5s8c.

World Resource Institute Parking Management Resources (https://wrirosscities.org/search/site/parking%2520management) provides guidance for efficient parking planning in developing cities.

WWF (2017), *Workplace Parking Levy, Nottingham*, International Case Studies for Scotland's Climate Plan, World Wildlife Fund (www.wwf.org.uk); at https://bit.ly/2l5fB2m.

David Zipper (2024), "Meet the Montreal Mayor Who Declared War on SUVs," *Bloomberg News* (www.bloomberg.com); at https://tinyurl.com/42ufhrma.

www.vtpi.org/park_man_comp.pdf