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PREFACE

Parking is an important, though often neglected, element of the urban transportation system. It plays a key role in mode choice and travel behavior, consumes a large amount of urban and suburban land, and has significant direct and indirect impacts on the environment. Policies that establish amounts and costs of parking are usually made solely by local governments, but often have regional impacts. In addition, parking policies can conflict with other transportation policies that attempt to reduce congestion or increase the use of transit or ridesharing.

This report reviews parking policies at both the regional and local government levels. It indicates the potential for parking policies to further goals of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), evaluates the extent to which current regional plans and transportation demand management (TDM) programs incorporate parking, reviews parking requirements in Midwestern cities, and compares these requirements to estimates of parking demand. Shared parking and flexible parking ordinances are described as ways to better coordinate parking demand and supply. In addition, the report illustrates the potential quantitative benefit of shared parking using Midwestern parking requirements and a hypothetical mixed-use development.

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CHAPTER 1
INTRODUCTION

At the end of the twentieth century, economic, social, and demographic trends are altering the physical landscape in many of Iowa's cities. In some cities, economic downturns have led to efforts to revitalize downtown areas, particularly in the face of continuing suburbanization. In other cities, strong economies have produced growth pressures in both central cities and suburbs, with much of the most rapid growth occurring on the urban fringe.

Future transportation systems in these cities will be shaped by new urban development, and also will help shape this development. Transportation systems and land use patterns are intricately related, both at the regional level and at the more detailed level of the city street or neighborhood. Transportation professionals are increasingly aware of the mutual influences of transportation and land use on each other and of the difficulty of untangling and clearly understanding those influences.

This broadening conceptual scope parallels recent federal mandates contained in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Clean Air Act Amendments of 1990, which altered the transportation planning process, particularly at the state and regional levels. Transportation plans developed by state departments of transportation and regional metropolitan planning organizations (MPOs) now must consider a number of factors that link transportation planning to other planning activities, as well as to a wider array of societal concerns.

Although these changes place new responsibilities on transportation planning agencies, they also present new opportunities. Among these are opportunities to view the transportation system more comprehensively, to work with other professionals involved in planning urban areas, and to use the transportation planning process not only to identify future capital facilities needs, but also to help the public and decision-makers reach their broader goals of creating and sustaining livable communities.

Parking policies are one of the most promising areas in which these new mandates and opportunities can be linked, tested, and advanced. Parking touches on many aspects of transportation and urban systems in general: it is a significant determinant of modal choice, an important ingredient of economic development efforts and land use plans, a contributing factor to air and water pollution, and a key element shaping building layout and design. Parking is also a significant expense, borne jointly by the public and private sectors. A careful review of parking policies at all levels of

government can ensure that such policies complement, rather than contradict, other transportation and land use goals.

This study identifies ways in which parking policies can more effectively be brought into congruence with state, regional, and local transportation goals. Although it emphasizes parking policies in urban areas within the state of Iowa, it uses materials from cities and regions across the United States, and the results of the study should be applicable in a variety of settings. State and regional planners and decision-makers are the study's primary audience, but the recommendations and conclusions address policies adopted by all levels of government as well as those developed by the private sector.

KEY ISSUES IN PARKING

Parking is rarely the focus of transportation studies in particular, or studies of urban systems in general. However, there are several reasons parking policies should be considered seriously as potential policy levers for implementing desired transportation or urban system changes.

- ***Parking is part of the overall transportation system.*** It therefore should be part of any comprehensive system overview, such as a state or regional long-range plan. In particular, parking significantly influences mode choice and can help or hinder efforts to modify or redirect travel behavior. Reviews of TDM programs indicate that parking policies, more than any other factor, may influence attempts to shift trips away from single-occupant vehicles (SOVs) (e.g., Comsis Corporation and the Institute of Transportation Engineers 1993).
- ***Parking plays a major role in shaping the built environment.*** Decisions about parking strongly influence pedestrian and transit accessibility to work, shopping, and other destinations. In addition, parking affects the layout and design of new developments and modifications to old developments. At times, building size or purpose is substantially constrained by parking requirements, leading to a less than optimal use of space by the building owner or tenant (NAIOP 1986).
- ***Parking impacts the environment both directly and indirectly.*** Direct impacts include paving over natural surfaces and redirecting storm water runoff while indirect impacts of parking include its influence on modal choice. Because the air quality impacts of modal choice have been widely discussed by transportation planners over the last quarter-century, they will not be elaborated on in this report. The effect of large amounts of paved surfaces on water pollution has received considerably less attention. Although parking areas typically are developed and graded to permit efficient storm water runoff, the amount of pollution accompanying such runoff can be significant. In addition, the absolute amount of runoff increases with the amount of pavement. Arnold and Gibbons (1996) report that 10 percent of the rain falling on natural ground cover becomes runoff; this increases to 55 percent of rain falling on land that is covered by a form of surface that is at least 75 percent impervious, such

as paved parking lots. A typical commercial lot has surfaces that are 85 percent impervious, a percentage which increases to 95 percent for shopping centers. A survey of commercial sites in Olympia, WA, found that 53 percent of such sites were devoted to parking and driveways. All other site uses, including buildings, lawns and landscaping, streets, and sidewalks, together accounted for less than half of the site land use (City of Olympia, WA, 1995). Parking clearly contributes substantially to water pollution problems that are the result of storm water runoff from impervious surfaces, a form of nonpoint pollution that is growing in severity in many urban areas.

- ***Parking is the subject of considerable local government action.*** An expert on land use law has written, "(p)arking requirements play a major role in modern zoning, partly because of the intrinsic importance of parking and partly…[because] parking areas (particularly open areas) require very large amounts of land. Modern zoning ordinances can therefore be thought of as having three basic sets of requirements: use regulations, bulk regulations, and parking requirements" (Williams and Taylor 1986). As use and bulk regulations were part of the initial zoning ordinances passed by most U.S. municipalities in the 1920s and 1930s, it is reasonable to say that the near-universal adoption of parking requirements represents the most substantial change to local zoning controls in the last 60 years.
- ***Parking illustrates both opportunities and difficulties in linking transportation and land use planning.*** As a result, parking can serve as an example of post-ISTEA efforts to place transportation planning in a broader context and increase its connections with other planning efforts.

This study emphasizes three ways to address parking requirements that may be helpful to local, regional, and state agencies.

1) ***Reduce parking requirements when evidence suggests that the requirements are too high.*** This can be done for selected land uses or for a wide range of land uses.
2) ***Permit or encourage shared parking.*** Shared parking provisions recognize that different types of land uses attract their peak patronage at different times of the day or on different days of the week. If the land uses are in close proximity, the same parking space can be shared among the land uses, reducing the total amount of parking needed. Such sharing of spaces is common in central business districts (CBDs), where daytime-oriented land uses such as office buildings have long shared the same parking spaces with land uses that peak in the nighttime and evening (e.g., theaters and restaurants). An informal sharing of parking spaces is much less likely to occur in the typical suburban and urban fringe development pattern of single-use zoning and isolated land uses. In these areas, efforts to provide joint spaces typically must rely on supportive language in the local zoning code.
3) ***Flexible parking requirements permit consideration of a variety of factors that may influence the parking demand of a particular development.*** Shared parking is one way to provide flexibility. Also, an

ordinance can allow for flexibility in parking requirements if developers participate in trip reduction programs, a building site is near transit, or the developer or others can demonstrate that the particular development will require less (or more) parking than an average development of its type and size. For parking provisions to be flexible, they must provide opportunities to tailor parking requirements to specific and clearly defined situations, so that required parking supply can be better matched with likely demand.

ORGANIZATION OF THE REPORT

The second chapter of this report considers the extent to which planning for parking can support efforts to comply with ISTEA mandates. It also reviews a selection of regional transportation plans from around the country and examines the extent to which these plans incorporate parking issues. The third chapter reviews parking strategies used in TDM and trip reduction programs and indicates the extent to which these strategies might be useful in Iowa cities. Chapter 4 analyzes parking requirements from roughly 70 municipal ordinances drawn from cities in Iowa, Minnesota, and Wisconsin. The total amount of parking required for various land uses is calculated and compared to estimates of parking demand as well as to requirements from other parts of the country. Chapter 5 describes shared and flexible parking policies in some detail. Examples of each are drawn from the municipal parking requirements described in Chapter 4, and the frequency of these policies in the local ordinances are discussed. In addition, the potential benefits of a shared parking program are illustrated using a hypothetical mixed-use development, applying the parking requirements calculated in Chapter 4. Chapter 6 summarizes the conclusions of the previous chapters and develops a set of recommended policy actions.

CHAPTER 2
PARKING IN FEDERAL LEGISLATION AND REGIONAL TRANSPORTATION PLANS

The recent passage of ISTEA has created a new framework within which transportation planning, particularly at the state and federal level, is to be conducted. Both the spirit and the letter of the legislation emphasize connections among disparate parts of the transportation system, and connections between the transportation system and other urban systems, such as land use and the environment. The intermodal language of the Act reflects the need to view transportation as a system from which travelers will choose the modes (and routes) that best meet their needs. The emphasis on efficiency is a reminder that resources for transportation investment are not limitless, and transportation planning must be bounded by fiscal realities.

Issues surrounding parking location, cost, and usage are in many instances identical to concerns addressed in the ISTEA legislation. ISTEA mandates that parking be provided in ways that will use scarce resources efficiently, such as by integrating land use and transportation planning, and providing for intermodal transfers between automobile travel and walking. In addition, parking policies can affect the destination choices people make and the modes they use to travel to them. The fact that these issues are rarely called out in parking provision regulations and ordinances does not diminish the need for planners to address them. To function efficiently and effectively, parking management programs and other parking policies must be integrated into the rest of the transportation system as well as the broader urban system.

A primary purpose of this study is to determine the role planning for parking might play in the efforts of the Iowa Department of Transportation and the MPOs within the state to meet federal mandates. Potential parking policies at the state or regional level were identified in two ways: through an examination of ISTEA factors directed at state and regional transportation planning efforts and through a review of post-ISTEA regional transportation plans from around the country. Parking is rarely mentioned explicitly in the ISTEA legislation, but it would seem to be an appropriate tool in addressing many of the transportation issues and principles ISTEA raises. The first section of this chapter relates parking to ISTEA mandates, while the remainder discusses parking policies identified in regional planning documents.

ISTEA FACTORS AND PARKING

To guide the transportation plans to be developed under the ISTEA framework, the Act identifies a number of factors that must be considered by the state DOT, the MPO, or both (Surface Transportation Policy Project 1994). These factors are summarized in Table 2–1. The list reveals a wide variety of issues and topics. It also suggests that no one transportation approach can encompass all or even most of these factors and that a well-constructed plan will identify and utilize a variety of techniques and strategies to produce a document that incorporates all the factors relevant to a particular state or urban area. With respect to parking, several factors at both the state and regional level identify concerns that directly or indirectly relate to parking policies. These factors are discussed below.

- State Factor 10 and Metropolitan Factor 1 both relate to the efficient use of existing transportation facilities, a topic directly related to parking provision in most cities. Parking may be inefficiently provided for several reasons, including:
  - ***Underpricing of parking.*** Underpricing of goods can result in overconsumption; Shoup (1995) notes that in most cities, ubiquitous free parking leads to greater use of parking than would be the case if market prices were charged. Although free parking may be popular with motorists, it is not an efficient way to use the space devoted to parking lots.
  - ***Oversupply of parking.*** Even when parking is free, many lots are never full (Willson 1995). Parking ordinances in many cities establish such high requirements for new developments that shopping centers and office parks develop acres of parking that are literally never filled. Bringing parking ordinance requirements into line with actual parking demand likely would reduce the amount of parking provided by many developments and permit developers to use their land more efficiently.
  - ***Lack of shared parking.*** The most efficient use of parking spaces can come about when a single space is kept occupied much of the time. This can be done through the sharing of parking by adjoining land uses with different patterns of peak demand. For example, an office building with daytime workers can effectively share parking with a restaurant that primarily serves customers in the evening.

  Both local regulations and metropolitan and state transportation and land use planning documents can contribute significantly to developing more efficient parking systems in urban areas.
- State Factor 11 and Metropolitan Factor 13 address "the overall social, economic, energy, and environmental effects of transportation decisions." This is a broad directive, and it is likely that every aspect of a transportation system touches on one or more of these effects. Parking clearly relates to these factors through its impact on modal choice; ubiquitous free or low-cost parking encourages driving alone, while various parking restrictions combined with

effective transit service encourage use of bus or rail. These modal choices in turn can have significant equity, energy, and environmental consequences. In addition, provision of parking can directly affect the environmental impacts of a project by requiring that many acres of land be paved over. The relatively impervious nature of the paving materials used for parking lots can increase storm water runoff in the immediate area and impact the local hydrologic system.

Table 2–1. ISTEA planning factors checklist

Factor	Factor numbers	
	State	MPO
• Coordination of transportation planning by metropolitan areas within the state and development of the transportation portion of the state implementation plan to the extent required by the Clean Air Act.	1	—
• Any federal, state, or local energy use goals, objectives, programs, or requirements.	2	2
• Strategies for incorporating bicycle transportation facilities and pedestrian walkways in projects where appropriate throughout the state.	3	—
• International border crossings and access to ports, airports, intermodal transportation facilities, major freight distribution routes, national parks, recreation and scenic areas, monument and historic sites, and military installations.	4	7
• The transportation needs of nonmetropolitan areas determined through a process that includes consultation with local elected officials with jurisdiction over transportation.	5	—
• Incorporation of metropolitan area plans.	6	—
• Connectivity between metropolitan areas within the state and with metropolitan areas in other states.	7	—
• Recreational travel and tourism.	8	—
• Any state plan developed pursuant to the Federal Water Pollution Control Act.	9	—
• Transportation system management and investment strategies designed to make the most efficient use of existing transportation facilities.	10	—
• The overall social, economic, energy, and environmental effects of transportation decisions.	11	13
• Methods to reduce traffic congestion and prevent it from developing in areas where it does not yet occur, including methods that reduce motor vehicle travel, particularly single-occupant motor vehicle travel.	12	—
• Methods to expand and enhance transit services and increase the use of such services.	13	14
• The effect of transportation decisions on land use and land development, including the need for consistency between transportation decision-making and the provisions of all applicable short-range and long-range land use and development plans.	14	4
• Transportation needs identified through ISTEA's management systems.	15	9
• Where appropriate, the use of innovative mechanisms for financing projects, including value capture pricing, tolls, and congestion pricing.	16	—
• Preservation of rights-of-way for construction of future transportation projects, including identification of unused rights-of-way that may be needed for future transportation corridors, and identification of those corridors for which action is most needed to prevent destruction or loss.	17	10
• Long-range needs of the state transportation system.	18	—
• Methods to enhance the efficient movement of commercial motor vehicles.	19	11

Table 2–1. ISTEA planning factors checklist—continued

Factor	Factor numbers	
	State	MPO
• The use of life-cycle costs in the design and engineering of bridges, tunnels, or pavement.	20	12
• The coordination of transportation plans and programs developed for metropolitan areas of the state with the state transportation plans and programs and the reconciliation of such plans and programs as necessary to ensure connectivity within transportation systems.	d1	—
• Investment strategies to improve adjoining state and local roads that support rural economic growth and tourism development, federal agency renewable resources management, and multipurpose land management practices, including recreation development.	d2	—
• The concerns of Indian tribal governments having jurisdiction over lands within the boundaries of the state.	d3	—
• Preservation of existing transportation facilities and, where practical, ways to meet transportation needs by using existing transportation facilities more efficiently.	—	1
• The need to relieve congestion and prevent congestion where it does not yet occur.	—	3
• Programming of expenditures for transportation enhancement activities.	—	5
• The effects of all transportation projects to be undertaken within the metropolitan planning area, without regard to the source of funding.	—	6
• Connectivity of roads within the metropolitan planning area with roads outside that area.	—	8
• Capital investments that would result in increased security in transit systems.	—	15

- State Factor 12 relates to methods of reducing traffic congestion, particularly by constraining the use of the single-occupant motor vehicle. As discussed in Chapter 3, parking policies often are found to be the single most effective component of TDM programs aimed at reducing drive-alone work trips. Parking strategies are apt to play a significant role in any effort to meet this objective. (Metropolitan Factor 3 also addresses relieving congestion, although it does not specifically target reductions in SOV use.)
- State Factor 13 and Metropolitan Factor 14 identify "methods to expand and enhance transit services and to increase the use of such services." As with the previous factor, parking policies have been shown to have a noticeable effect on mode choice and can be effective strategies for increasing transit ridership in urban areas.
- State Factor 14 and Metropolitan Factor 4 connect transportation and land use plans and decision-making. As parking is both a key element in any transportation system and a significant component of municipal land use systems, it provides an obvious linkage of transportation and land use policies, and should be viewed not as belonging to one or the other functional system, but to both. The transportation policies of an urban area will affect demand for parking, which should (although often it does not) affect parking supplies mandated by local governments. In turn, the parking supplies identified as appropriate for various types and amounts of land use in the local zoning codes play a clear role in encouraging particular transportation choices.

In sum, five factors in both the state and metropolitan area planning factors checklists can be shown to relate directly to planning for parking and the development of appropriate parking management strategies in many urban areas. Most of these topics will be elaborated on in the following discussion of parking policies at the regional level; at the outset, it is useful to recognize that although parking is rarely explicitly called out as an area of concern in ISTEA, planning for parking is very much in the spirit of this legislation.

PLANNING FOR PARKING AT THE REGIONAL LEVEL

To what extent do current regional transportation plans identify parking as a component of transportation planning? Do these plans use the factors discussed above—or other ISTEA requirements or recommendations—to establish a framework for consideration of parking policies? To answer these questions, a stratified sampling of regional plans was obtained from metropolitan planning organizations around the country. Virtually all of these plans were adopted after the December 1991 passage of ISTEA; many of the plans explicitly recognized the mandates of ISTEA as a challenge to produce a plan that did not reflect "business as usual." Most plans were the first post-ISTEA updates produced by their respective transportation agencies. A total of 69 plans were obtained, with 63 of them written or adopted since 1993.

Approximately equal numbers of plans were drawn from the Northeast, the Southeast, the Midwest, and the West (roughly corresponding to regional boundaries defined by the U.S. Census). In addition, sampling among small, medium, and large agencies was performed at a 2:2:1 ratio, reflecting the predominance of small and medium-sized metropolitan areas. It was believed that both size and geographical location might influence the nature of transportation problems in a metropolitan region and whether parking might be identified as either an important causal factor or as a potential mitigation strategy. (Small agencies were defined as those under 100,000 population, medium agencies as those between 100,000 and 500,000, and large agencies as those over 500,000.)

Plans were read thoroughly for discussions of parking issues (e.g., provision of park-and-ride lots or carpool or vanpool spaces) other than those related solely to high-occupancy vehicles (HOVs). Issues related to HOV parking have been addressed in other studies, notably reviews of TDM programs; this study focuses on parking policies that impact non-ridesharers. This leaves a wide variety of parking issues that could be addressed at the regional level: parking as a component of a TDM program or air quality program, parking as an economic lever for commercial development, parking as a factor in modal choice, and issues of pricing or parking subsidization, for example.

In addition to the review of regional plans from around the country, all MPOs in Iowa were contacted for information about parking policies contained in their plans. A summary of these results follows the discussion of nationwide MPO parking policies.

Should regional plans address parking?

Regional transportation plans are typically assembled by agencies sensitive to, but with no authority over, local land use issues. These plans might therefore be viewed as inappropriate places for discussion of a local matter such as parking, which is generally dealt with in zoning ordinances of local jurisdictions.

But regional plans often contain recommendations or suggestions for actions or policies to be adopted by other decision-making bodies, from revenue enhancement mechanisms to be supported at the state level to issues of transportation system management that must be enacted with the active participation of local governments and the private sector. Although regional agencies alone cannot fully implement such proposed actions, they often recognize a responsibility to raise such issues, identify an appropriate course of action, and propose actions to other agencies at various levels of government. The same is true of TDM measures including parking. To the extent that parking policies of local governments influence travel behavior and decision making and thus affect the regional transportation system, they are appropriate for regional transportation agencies to consider.

Parking in regional plans

Of the 69 plans received from regional agencies around the country, 41 discussed parking issues pertaining to non-HOVs. In general, plans from the Northeast and West were most likely to discuss parking, plans from the South were least likely, and plans from the Midwest fell in between (see Table 2–2). The size of the metropolitan area did not strongly influence whether parking issues were included in regional plans (see Table 2–3), although size did influence the specific parking issues that were considered (see below).

Table 2–2. Geographic distribution of regional plans

	Plans discussing parking		All plans
Area	Number	Percent	Number
Northeast	14	77.8%	18
South	3	21.4%	14
Midwest	9	47.4%	19
West	15	75.0%	20
Total	41	59.4%	69

Although more than half of the plans address parking to some extent, parking is often dealt with in the context of broader transportation programs. Seventeen of the 41 plans that mention parking do so when addressing TDM programs, and some of these simply list parking as one factor that could be considered in a TDM program. Other

plans note that parking may be a potential transportation control measure or a factor in a regional air quality plan.

Table 2–3. Size distribution of regional plans

	Plans discussing parking		All plans
Size of metro area (population)	Number	Percent	Number
Small (50,000–100,000)	16	61.5%	26
Medium (100,000–500,000)	13	52.0%	25
Large (500,000+)	12	66.7%	18
Total	41	59.4%	69

Plans differ in how strongly they advance parking issues. Some plans simply provide information about what has been done with parking policies or strategies in metropolitan or other areas. Other plans are slightly more assertive, suggesting that certain parking policies could be adopted. A third set of plans recommends various policies for adoption, indicating what should be done. A final set of plans indicates that various actions relating to parking are required. Table 2–4 presents the number of plans in each category.

Table 2–4. Strength of statements about parking

Parking issues presented as…	Number of plans
Information	8
Suggestion	12
Recommendation	13
Requirement	8

Although the above description provides a useful way to categorize different planning presentations of parking issues, it glosses over some significant differences within the categories. For instance, a parking "requirement" can take the form of an explicit policy to be adopted (e.g., in Tucson, AZ: "In major activity centers, parking fees for employee parking under public sector control shall reflect the fair market value of the space"), or it can describe a more general approach (such as evaluating parking management for individual employers and employment centers, as stated in the Las Vegas, NV, plan). Similarly, "recommendations" expressed in plans can target specific policies to adopt, general strategies to pursue, or future studies to undertake. A more complete picture of current regional transportation attitudes toward parking emerges when parking policies are categorized under several topical headings.

Parking cost, parking charges, and "cash-out" programs

A total of 22 plans, or 54 percent of the plans that mentioned parking, discuss some form of parking cost or charges. Eight plans propose or suggest charging "fair market prices" for employee parking. A policy in the Tucson plan states "in major activity centers, parking fees for employee parking under public sector control shall reflect the fair market value of the space. Private sector employers shall be encouraged to follow the same policy." The Eugene, OR, plan also encourages private sector employers to charge fair market prices for employee parking. Some plans phrase such policies as eliminating "subsidies" to parking, rather than charging market prices. For example, the Chicago, IL, plan states that "subsidized parking programs in all areas…should be discouraged" and the Baltimore, MD, plan lists "discourage subsidized parking programs" as a recommended TDM strategy.

Six plans discuss raising parking charges to promote modal shifts to transit or ridesharing. "Increase parking costs in activity centers" is a strategy to be implemented in support of the policy to "reduce SOV trips and trip distances" in Tucson. In Santa Barbara, CA, the regional plan notes that transit mode shares to the CBD have decreased in part due to "ample free or inexpensive parking," and the city has adopted various parking policies, including increased charges, to make parking less attractive to SOV commuters. Perhaps the clearest policy statement of this sort is made in the plan for Minneapolis/St. Paul, MN, which states "cities should…adopt parking controls and parking price mechanisms to encourage ridesharing and transit use." Berkshire County, MA, differentiates between employee and shopper parking in downtown areas, stating that "increased parking prices… aimed at employee parking… would provide an incentive for employees to use available transit or increase carpooling, thus leaving parking spaces for those who patronize the various downtown activities." Other uses of parking policy to effect modal shifts are discussed below.

Parking cash-out programs are described in three plans. Such programs typically charge employees the full cost of parking, then provide equivalent funds in the form of a transportation allowance added to their pay. The Modesto, CA, plan provides the most detailed description of such a program. California Assembly Bill 1963 (passed in 1994) requires all metropolitan areas in the state to consider parking cash-out programs as part of their Congestion Management Programs. The Modesto plan describes parking cash-out programs as only one possible component in congestion management plans, however. St. Louis, MO, and Poughkeepsie, NY, also identify parking cash-out programs as possible congestion reduction strategies.

In addition to the more specific strategies described above, three plans (Poughkeepsie, Baltimore, and Portsmouth, NH) mention parking charges as "possible" or "typical" TDM strategies. Although no specific policies that involve parking charges are adopted in these plans, parking charges might be used in the context of a broader TDM program.

Impacts of parking on mode choice

Of the 41 plans that discuss parking, 21 (51 percent) note its relationship to mode choice. Statements on parking and non-SOV modes range from a general recognition of the linkage ("Parking…heavily influences other modes of transportation, particularly in urban areas," from the Steubenville, OH, plan), through more explicit statements about management of parking to achieve policy objectives ("Limiting the parking supply can be an effective method to manage transportation demand since there is a strong correlation between parking availability and automobile usage," from the Chicago plan), to direct statements of intended policy ("Regional and local policies should discourage the provision of free or discounted parking to employees where ridesharing, public transportation, or other alternative modes can be used," from the Reno, NV, plan). The identification of parking policy as a tool to achieve mode split objectives is often stated within a TDM framework and is sometimes combined with non-parking policies. For example, a Reno policy states that "local governments should consider adding flexibility to off-street parking requirements and allowing for reductions in required parking in exchange for implementation of programs and facilities which encourage HOV use." As noted above, modal shifts can also be an explicit aim of parking cost policies, either alone or in conjunction with other policies.

Three plans or supplements to plans describe efforts to model the impacts of changing parking policies on modal split. When employee parking subsidies were replaced with transportation allowances, forecast transit and ridesharing percentages increased in Hartford, CT. Similar results were achieved in New Haven, CT, when parking costs were increased and no growth in parking in downtown New Haven was assumed. An attachment to the Baltimore plan describes results of several TDM sensitivity tests, including impacts of parking charge increases and parking subsidies on modal splits. Finally, the Seattle, WA, plan describes the results of a sensitivity analysis of various transportation pricing strategies, including regionwide employee parking charges. Modeling did indicate that such strategies could reduce vehicle miles traveled, total numbers of trips, and vehicle emissions, but modal split per se was not examined. In addition, parking charges were found to be less effective than vehicle mileage-based fees or regionwide congestion pricing.

Other parking issues

Parking charges and the impacts of parking policies on alternative modes are the two most common parking themes discussed in the regional plans. Several other noteworthy topics were mentioned by more than one agency, however, and are briefly described below.

Providing "adequate" parking. In eight metropolitan areas (all but one under or at about 100,000 population), the primary parking concern is to ensure there is sufficient parking downtown to provide adequate access to the CBD. A goal of the Muncie, IN, plan is to "promote the development of…parking facilities…within the Central

Business District," while the Cheyenne, WY, plan states that "providing adequate parking for redevelopments and new developments is not only in the City's interest but the developers' as well." The Berkshire County plan ties parking shortages downtown to the "relocation of stores and offices out of the urban centers into fringe outlying areas," and notes that "(t)his trend of business relocation conflicts with current efforts to revitalize existing downtown centers and with regional growth policies and objectives." Although the regional plan for the Philadelphia, PA, area contains no specific recommendations about parking, it notes that the city recommends that congestion be mitigated, in part, by providing more off-street parking for residents, commuters, and visitors.

Providing peripheral parking and feeder transit. Nine plans describe existing fringe parking with transit service to major activity centers within their metropolitan area and/or encourage the development or expansion of such facilities. For example, the Chicago plan states that "peripheral parking [in the Chicago central area] with convenient feeder transit service to employment areas should continue to be expanded." The Providence, RI, plan notes that existing fringe commuter parking lots have been well utilized and adopts a transportation system management measure that recommends, "as urban congestion and parking costs increase, [the development of] 'fringe' lots around Providence and Newport, coordinated with shuttle bus service into the downtown areas." Activity centers other than downtowns occasionally are identified as suitable for this transportation strategy. The Tucson plan recommends perimeter parking with shuttle bus service for the University of Arizona as well as downtown Tucson, while the plans for Las Cruces, NM, and Pocatello, ID, describe proposed programs for fringe lots with shuttle buses at New Mexico State and Idaho State Universities, respectively.

Shared parking. Provisions for shared parking in local zoning ordinances are mentioned in five plans. The Pueblo, CO, plan states that "shared parking opportunities should be pursued to the fullest," while the Minneapolis/St. Paul plan suggests that local comprehensive plans should "permit a reduction in parking spaces for developers who make commitments to promote alternatives to driving alone. [This] may include…shared-use parking arrangements." The plan for Cape Cod, MA, includes the county energy management plan in an appendix; this energy plan states that "development/redevelopment shall…encourage adjacent commercial uses to share parking and access points."

Reductions in parking requirements. Six plans indicate that parking requirements might be reduced under certain situations. As noted above, Reno and Minneapolis/St. Paul both propose that local governments permit reductions in numbers of required spaces if landowners implement programs that promote alternatives to driving alone. Eugene cites a reduction in minimum parking code requirements as one policy supporting the broader objective to "balance the need for parking with the need to promote the use of alternative modes and transit." The Tucson plan supports a policy to "reduce SOV trips and trip distances" with a strategy that states: "Conduct a

comprehensive review of zoning ordinance parking requirements with a goal of decreasing requirements where alternatives are available."

Related to reductions in minimum parking requirements are efforts to establish maximum amounts of parking for various types of land uses. One objective of *The Metropolitan Transportation Plan* for Bellingham, WA, is to "encourage jurisdictions to consider revising zoning code requirements to impose a maximum number of parking spaces allowed, in addition to or in place of a minimum."

Parking and ISTEA. As mentioned previously, ISTEA can be viewed as a framework within which parking policies can be developed that support and are supported by goals, objectives, and strategies for the rest of the transportation system. However, very few of the plans specifically link parking policies to ISTEA requirements. The Ithaca, NY, plan establishes the most direct connection, stating "it is recommended that local regulations be examined to ensure that the principles of ISTEA are implemented. For example, the number of parking spaces required by zoning regulations should not be excessive…." The plans for Las Vegas; Colorado Springs, CO; and St. Louis all indicate that "parking management" should be considered as part of the ISTEA-mandated Congestion Management System, but these plans do not relate parking management to any of the 15 ISTEA factors. The Boston, MA, plan refers to ISTEA Supplemental Factor #19, which reads "provide for involvement of traffic, ridesharing, parking, airport, port and toll authorities, and private providers" in the development of the regional transportation plan. Although parking is mentioned, it seems to be in the context of including parking providers in the planning process, rather than ensuring that the plan itself deals directly with parking. None of the plans that were reviewed linked parking to any other aspects of ISTEA, nor to any of the 15 factors.

Parking in Iowa's regional plans

In general, regional transportation plans produced by MPOs in Iowa have not explicitly dealt with parking. The two exceptions are Council Bluffs and Des Moines. The plan for the Omaha/Council Bluffs region briefly mentions parking as a possible TDM technique and states that "parking and terminal facilities also contribute to and influence the existing and future transportation system. Efforts should be made to incorporate and evaluate these items in the overall structure of transportation improvements in the MAPA [Metropolitan Area Planning Agency] area, and should be factors in the development of the long-range transportation needs."

The most extensive and clearly integrated set of parking policies among Iowa's MPOs is presented in the Des Moines regional plan. This plan discusses parking in detail as an important component of the regional transportation system; parking is tied to transit ridership and is an active element in the planned TDM program. The plan also recommends that parking cash-out strategies be studied. The plan notes that "the method used to promote parking management will most likely be controversial,

since the program could be a radical departure from traditional parking mechanisms," and recommends an aggressive educational program. Notably, the Des Moines plan was one of a handful of plans reviewed in the course of this study that explicitly referenced the ISTEA management systems when discussing parking policies.

CONCLUSION

This review of regional transportation plans indicates that parking is infrequently considered a key component of regional transportation systems, even under the new planning framework of ISTEA. However, it also suggests how parking policies and parking management strategies can be used to support and promote broader transportation or urban goals.

Not all regions address parking in the same manner, nor should they; appropriate regional parking policies will differ based on the size of the region, development patterns, existing transportation systems and capacities, and regional goals, among other considerations. But the wide range of metropolitan areas that do actively promote parking policies in their regional plans—from Tucson and Reno to Minneapolis/St. Paul and Burlington, VT—indicate that the same parking strategies and techniques can be usefully considered by a variety of regions facing disparate problems.

Opportunities exist within regional transportation plans to more effectively utilize parking policies and techniques to meet goals and objectives. Most of these policies and techniques are part of a broader range of strategies variously termed transportation demand management, transportation control measures, or trip reduction ordinances. Although these programs serve slightly different purposes, all are concerned with relieving congestion and/or improving air quality through modification of travel demand, perhaps combined with small-scale capital improvements. The following section will review the role of parking policies in such strategies, report on empirical results from various program evaluations, suggest which parking strategies and tactics may be most appropriate for various trip reduction and travel demand programs, and suggest how these strategies and tactics can be implemented.

CHAPTER 3
PARKING IN TRANSPORTATION DEMAND MANAGEMENT PROGRAMS

The most likely institutional location for parking management strategies and tactics is within a transportation demand management (TDM) program. TDM encompasses a variety of techniques aimed at reducing SOV traffic, almost always implemented on commute traffic at the work end of the trip. Even though parking is a central component of many TDM programs, it is still difficult to assess the role of policy changes in trip reductions or changes in travel behavior because parking policies are rarely implemented separate from other strategies. This chapter reviews a number of TDM programs to determine the extent to which parking was used as a policy lever to meet program goals and objectives. It also assesses existing evidence to estimate the extent to which parking policies might be expected to modify travel demand separately and in conjunction with other strategies.

STRATEGIES

A variety of transportation demand tactics have been used in various programs. These can be categorized by each of the three major modes of commute travel: SOVs, ridesharing (including carpools and vanpools), and transit. Parking strategies can be used to influence the use of any of these modes. For instance, park-and-ride lots, by providing parking some distance from the work site, allow carpools and vanpools to form and provide a centralized pick-up and drop-off site for transit. At the work site, preferential parking spaces reserved for carpools or vanpools can be an incentive for employees to use these modes, particularly if such spaces are significantly closer to the building. The primary use of parking management strategies in TDM programs, however, is to encourage a shift away from SOV use by restricting parking supply, charging (or charging more) for parking, removing parking lots to peripheral locations, or some combination of all three strategies. These approaches are further described below, as are results of studies assessing the effectiveness of these and other TDM strategies.

Restricting parking supply

Restricting parking supply is perhaps the most direct way to manage parking for the purpose of influencing transportation system impacts. Reductions in parking supply are most relevant at mixed-use sites that permit sharing of parking supplies or when municipal requirements or developer and lender preferences result in an oversupply of parking. Most parking supply strategies fall under one of three broad headings:

managing on-street parking, providing preferential parking for ridesharers, and efforts to reduce off-street parking supplies. Each of these is discussed briefly below.

Managing on-street parking. Management of on-street parking to achieve broader transportation system objectives is one of the oldest parking management tactics. Following World War II, many cities dealt with growing traffic congestion by eliminating on-street parking or restricting it to off-peak hours. This created additional capacity on the streets without actual roadway widenings and improved safety by reducing conflicts between moving vehicles and those pulling into or out of parking spaces. Those cities that continued to provide on-street parking often adopted restrictions on the amount of time curb space could be used for parking, typically reserving space for short-term shoppers while requiring long-term parkers (such as commuters) to seek parking elsewhere.

On-street parking controls continue to be an important component of many parking management strategies. A concern raised by proposals to limit off-street parking (see below) is that such parking restrictions in areas of high demand will lead to spillover parking impacting on local neighborhoods. On-street parking controls such as residential permit parking can alleviate concerns about the impacts of these projects. Similarly, permitting short-term on-street parking during off-peak hours can provide parking spaces for shoppers, an important consideration for many businesses, while ensuring maximum street capacity during peak hours and a tightened supply of long-term spaces to influence travel behavior by commuters. Enforcement is an important component of any program aimed at allowing on-street parking at some time or for some groups and not others. Strict enforcement often is perceived to be essential for successful on-street parking programs (Weant and Levinson 1990).

Preferential parking for ridesharers. Programs aimed at increasing carpooling and vanpooling often set aside parking spaces explicitly for rideshare vehicles. To reduce the wait for a space and thus provide an incentive to share rides, spaces could be located closer to building entrances or made more plentiful relative to the number of rideshare vehicles than is the case with the spaces available per SOV. Spaces for ridesharers can also be priced at lower rates than SOV parking (see below). If parking in general is plentiful and free, this strategy may not be effective. "This strategy is predominantly applied in Central Business Districts or large activity centers where there is a shortage of easily accessible and convenient, all day parking; the walking distance from the parked car to work is noticeably time consuming; and/or the commuter parking rates are high" (MacRae 1994, p. 75). In addition, preferential parking will be more likely to achieve trip reduction and air quality objectives in areas with relatively low transit ridership.

Reducing off-street parking supplies. As control of on-street parking has tightened, many communities have required new developments to meet their anticipated demand for off-street parking. Such requirements have become a standard feature of zoning codes, with required amounts of parking usually determined by applying a parking rate (often specific to a particular type of land use) to the anticipated size of

the development (in thousands of square feet or, less often, number of employees or another indicator of size). Although in many instances these standards have worked well, in others they have resulted in substantial oversupplies of parking (Willson 1995; Shoup 1995). Three characteristics of the manner in which these standards are generated may result in oversupplies of parking:

- Standards are often based on the mean parking demand estimated in reference works such as *Parking Generation*, by the Institute of Transportation Engineers (ITE 1987). For many land uses, parking demand estimates are based on a very small number of cases. For instance, the 1987 edition of *Parking Generation* notes five or fewer cases for such common land uses as supermarkets, industrial parks, and colleges and universities. As ITE notes, "Variations exist in parking generation characteristics for the same building classifications or land uses.... Because of these variations, sample size, and special characteristics of a site being analyzed, extreme care must be exercised in the use of this data. ***Users of this report should exercise extreme caution when utilizing data that is based on a small number of studies"*** (p. vii, emphasis in original). Despite these cautions, parking rates in this and similar references (e.g., Technical Committee of the Colorado/Wyoming Section of ITE 1987) are likely to become standards, simply because they are the best available data, and parking studies for individual land uses are time-consuming and expensive.
- So that parking demand can be more easily related to site characteristics, parking generation studies typically are performed at isolated sites where the traffic generated can be clearly linked to the land use under investigation. Although this produces a "cleaner" set of data, it says nothing about the ways different land uses can interact to reduce the total amount of parking required for a combination of activities. This topic will be explored further in Chapter 5.
- As a side effect of efforts to survey only stand-alone land uses, the vast majority of studied sites are in suburban areas with little or no transit ridership. The calculated parking demand is thus based on an implicit assumption that virtually 100 percent of the trips made to the site will use automobiles (either single-occupant or ridesharing).

In addition, as noted by Shoup (1995), parking charges can significantly reduce parking demand. Although *Parking Generation* provides no information on parking charges at their surveyed sites, it is likely that the vast majority of stand-alone suburban sites used as the source for parking data do not charge for parking.

Therefore, the numbers most commonly used to estimate parking demand and, by extension, the amount of parking required, are based on certain assumptions: that all persons traveling to a new development will arrive by automobile, will park for free, and will not walk from the development to any other activity without first moving their cars. These assumptions may all be appropriate for some developments, but one or more will not be correct for many other developments. Parking standards based on such incorrect assumptions will result in an oversupply of parking.

In recent years, several studies have documented the extent to which recent developments, particularly in suburban locations, have constructed more parking than is apt to be used. Data gathered from suburban office parks reveal an allocation of 3.5 to 4.0 spaces per thousand square feet of floor space (Shoup 1992). Surveys of usage in California and Texas have found that office workers require about 2.2 spaces per thousand square feet (Cervero 1989). Data on 24 office parks from *Parking Generation* (ITE 1987) show a mean peak parking rate of 2.5, slightly higher than the empirical data from California and Texas but well below the amount of parking required in most office parks. A 1991 survey of suburban office sites in the Seattle region found that the average supply of parking spaces exceeded the average demand for spaces by 36 percent. The highest levels of demand over two visits to each site were compared to parking supply on a per-thousand-gross-square-feet (GSF) basis; office sites averaged 3.78 spaces per thousand GSF, while the highest period of demand accounted for 3.05 spaces per thousand GSF (Kadesh and Peterson 1994). In a survey of office sites in southern California, Willson (1995) found that the amount of parking supplied averaged 3.8 spaces per thousand GSF, while only 2.1 spaces were used during peak times.

Iowa City, IA, recently conducted a parking study comparing peak use with parking supplies at several neighborhood commercial lots (City of Iowa City 1995). Counts were made on weekdays and Saturdays and included several counts in the ten-day period before Christmas, traditionally the busiest shopping period of the year. From 21 counts at five separate sites, the highest parking percentage was found at 5:30 PM on the Wednesday before Christmas at a drugstore (74 percent of the spaces were occupied). Over all the count periods, this site had the highest occupancy rate, with 53 percent of the spaces occupied. For all five sites, the average occupancy rate was 36 percent. The total parking supplied at the five sites closely matched the parking required by the zoning ordinance, with the number of spaces exceeding the code requirements by only two percent.

Based on these data, Iowa City reduced its parking requirements for neighborhood commercial lots from one space per 200 square feet of retail floor area to one space per 300 square feet. If this standard had been used to determine parking for the five surveyed sites, four of the sites still would not have exceeded the standard during the count period; the highest occupancy rate at any of these sites during any time period would have been 78 percent. The fifth site would have exceeded the parking supply during six of the 21 count periods, although never by more than 12 percent.

Several cities around the country have implemented various measures aimed at reducing excess parking. In some cases, the purpose of these measures has been to better bring parking supply requirements into line with demonstrated parking demand. In others, a restriction on parking supplies has been part of a broader TDM program to encourage shifts away from SOV commuting toward transit and ridesharing. The measures used in these programs can be classified as follows:

- ***Reducing minimum parking requirements.*** Parking rates in zoning ordinances often are expressed in terms of minimums, based on the particular land use being developed and its anticipated size at build-out. If existing parking requirements have resulted in excessive parking supplies in the past, a city might reduce its minimum requirements for particular land uses in the hope of achieving a better balance between number of spaces and parking demand. As with the establishment of parking rates, adjustments to such rates ideally should be based on empirical studies of similar developments and should take into account surrounding land uses, presence of transit service, and quality of transit service; each consideration might lower actual parking demand. Parking minimums are somewhat flexible; if a developer believes such a minimum would not be suitable for his/her development, nothing in a minimum parking requirement would prevent additional parking from being constructed.

  Lower minimum parking requirements have been used in several cities in the United States including Hartford, CT; Schaumberg, IL; and Palo Alto, CA. Experience from these and other cities suggests this strategy has had mixed results in encouraging developers to reduce parking supplies (RTA 1995). Although such programs can provide flexibility in parking codes, they will have an impact only to the extent that the development community takes advantage of them.

- ***Maximum parking requirements.*** Unlike minimum requirements, maximum parking requirements limit developers and property owners to a set amount of parking for a given development. This can be an effective tool in controlling excessive parking construction and implementing broader TDM goals, such as modal shifts. Maximum requirements are less likely to be popular with developers and building owners than are lowered parking minimums, however, because they limit the ability to adjust parking supply and developers and building owners may doubt the accuracy of the city's parking estimates. The recent Iowa City parking study of neighborhood commercial parcels has resulted in a maximum parking requirement for these land uses; specifically, "in order to avoid excessive amounts of paving, not more than 110 percent of the required amount of off-street parking may be provided without the approval of a special exception by the Board of Adjustment" (City of Iowa City 1995). Seattle and Bellevue, WA, and Portland, OR, also have placed parking maximums on commercial development within their cities. In Bellevue, specific requirements are negotiated on a case-by-case basis and set in developer agreements (Bhatt and Higgins 1989).

- ***Area-wide parking caps.*** Closely related to maximum parking requirements but instituted on a broader scale is the concept of area-wide parking caps. A total number of spaces is assumed to be sufficient or desirable for an area of the city. This total may presently exist or may not yet have been reached; but once the cap has been met, no new parking is permitted within the area (although certain land uses may be exempted). If existing parking is built out to the acceptable limit, the cap may also be termed a parking "freeze," which prohibits new construction of parking. To date, area-wide parking caps and freezes have been implemented only in large cities with ample alternative

transportation, such as San Francisco and Boston. Portland, OR, which had a cap on downtown parking supply for two decades, recently lifted the restriction because the air quality problems that had initially prompted the cap were largely mitigated (Oliver 1996). Experience with such caps suggests they require greater and more complex administration, planning, and decision-making than lowering minimum or establishing maximum parking requirements (RTA 1995). In particular, cities or regions may need to carefully consider potential problems of spatial mismatch between parking supply and demand. For example, the total amount of parking within an area may meet anticipated demand but also must be located within a reasonable distance of the terminal activities.

- ***Flexible parking requirements.*** Flexible parking requirements are often either 1) contingent on developer or tenant participation in TDM programs, or 2) based on the anticipated benefits (in terms of fewer vehicle trips) of TDM programs. Under such programs, developers who present a transportation plan that is anticipated to reduce the number of cars arriving on-site would be allowed to reduce their parking supply by the same amount. For instance, a ridesharing program that would eliminate five percent of SOVs could reduce the parking requirements by five percent. Hartford, CT, reduces minimum parking requirements in return for developer carpool and transit encouragement, as do Chicago, Sacramento, and Palo Alto, CA (Comsis Corporation and ITE 1993). In Sacramento County, one space reduction is permitted for every marked carpool space, and a two percent space reduction is permitted for developers that provide showers and bicycle lockers (Bhatt and Higgins 1989).

  Because providing parking is expensive, the foregoing options would seem to hold considerable promise in encouraging developers to participate in trip reduction programs. Reductions in parking supply based on anticipated reductions in demand, however, are not always greeted warmly by either developers or lenders. Investors in large developments may be concerned that if the parking reduction tactics do not work, the developments will have unacceptably low parking supplies and be difficult to lease. For their part, cities that historically have required developers to bear the full costs of providing parking through high minimum requirements may not wish to reduce such requirements without clear evidence that TDM programs will indeed reduce parking demand. To provide further flexibility, such parking reduction ordinances may permit or mandate parking set-asides in which the amount of space necessary to provide the full amount of parking (prior to the TDM program) will be provided by the developer on-site or nearby. In this way, the set-aside space can be used for parking should the TDM program not produce the expected reduction in parking demand. For example, Montgomery County, MD, requires that sufficient land be set aside to provide "parking spaces equal in number to the reduction granted." Palo Alto, CA, has a similar contingency provision (Bhatt and Higgins 1989). Parking set-asides also can be used to ensure that a change of building occupancy does not result in excess parking generation; if additional space is needed, it can be taken from the set-aside. Large projects that are constructed in phases can test the results of the TDM

program in the earlier phases; if the programs are successful in reducing parking demand, later phases can be built with reduced parking supplies.

If a municipality is considering modifying its parking requirements, it should carefully assess existing levels of parking demand and developer and lender preferences before instituting new minimums, maximums, or flexible requirements. If reductions in requirements are tied to developer requirements to participate in TDM or trip reduction programs, the methods of participation should be attractive to both developers and employees. In general, developers prefer one-time actions or fees (e.g., setting aside carpool and vanpool spaces) over long-term operational commitments (e.g., operating shuttles from peripheral parking lots).

- ***Shared parking.*** In a comprehensive review of TDM measures, Comsis Corporation and ITE (1993) identified shared parking as a potentially successful strategy for shifting drivers away from SOVs. In mixed-use areas, "localities can negotiate for parking supplies serving several compatible uses instead of separate and more extensive supplies serving each use" (p. 222). This reduces the overall amount of space devoted to parking; but without other TDM strategies (parking or otherwise), is unlikely to reduce the use of SOVs. If excess parking is being supplied for separate land uses with different peaking patterns, then reducing the excess would not be likely to cause a modal shift; the solo driver simply would have somewhat fewer spaces from which to choose. By itself, shared parking is not a promising TDM strategy.

Charging for parking

As with parking management strategies that restrict or modify parking supply, efforts to implement or increase parking charges can be addressed through a number of specific parking tactics. The most common of these tactics are described below. The primary purpose of most of these tactics is to encourage mode shifts by raising the out-of-pocket cost of parking.

Implement or increase fees. Shoup (1995) notes that 95 percent of all automobile commuters park for free at their work sites; for commuters outside of metropolitan areas, this rises to 98 percent. Commuters who do pay for parking often pay below market rates (Williams 1992; Shoup 1992). A primary factor leading to the provision of large amounts of free parking is the treatment of a parking space as a non-taxed employee benefit in the federal tax code. This encourages employers to provide parking as opposed to other benefits (including salary increases). Williams (1992) estimates that an employer in downtown Washington, D.C., could provide an extra $2,000 annually to employees either by granting salary increase, or by providing them with free parking spaces worth $167 per month. The parking option would cost the employer $2,000 per employee annually; the salary increase would cost $4,400 per employee annually, including the salary increase, taxes, social security, unemployment insurance, and other employer-based expenses tied to wages. Because no taxes or social security liability are associated with the free parking space, the employer saves money and the employee receives a useful benefit.

Still, parking is expensive. Costs vary widely depending on price of land, municipal regulations of width of spaces and aisles, and methods of financing, but typical costs of surface parking spaces range from $600 to $900 per space annually (Willson 1995; Comsis Corporation and ITE 1993). In their estimate of surface parking lot costs, Weant and Levinson (1990) estimate annual per space costs at approximately $800, based on land costs of ten dollars per square foot and construction costs of five dollars per square foot. Spaces in parking structures and underground garages can be considerably more expensive; Willson (1995) estimated annual costs of parking structure spaces in suburban Los Angeles at almost $1,200.

In addition, studies of TDM programs have generally shown that provision of free parking is the single most significant deterrent to the success of policies that attempt to shift travelers away from SOVs. Although untangling the relative contributions of various components of TDM programs is difficult, evidence points to parking charges as being a key factor—perhaps *the* key factor—in a successful program. A review of 22 TDM programs around the country classified the programs as achieving "high," "medium," or "low" trip reductions (Comsis Corporation and ITE 1993).[1] Of the six programs achieving high levels of reduction, five had implemented parking charges. The medium trip reduction group was similar, with seven of the nine programs implementing parking charges. Of the seven programs achieving a low level of trip reduction, only two had implemented parking charges. Although the numbers are small, the impact of parking charges as an important component of TDM programs (at least those aiming to reduce the number of vehicle trips) appears strong.

Parking charges can be based on market rates in the area, as in Montgomery County, MD, or tied to other factors. Bellevue, WA, has required parking charges to be no less than certain transit fares in the area, as specified in various developer agreements (Bhatt and Higgins 1989).

Studies have shown parking demand to be somewhat elastic with respect to price. Feeney (1986) reviewed several reports of actual or proposed changes in parking pricing and estimated elasticities in the general range of –0.3, meaning that a ten percent increase in parking costs would decrease parking demand by three percent. Shoup (1992) calculated elasticities of –0.16 for downtown Los Angeles sites, roughly half of the elasticities from Feeney's earlier review. It seems likely that demand elasticity for parking would be quite situation-dependent, with greater elasticities occurring in areas with at least moderate levels of alternative forms of transportation. Planners and others should be cautious in applying elasticities obtained from one setting to a second setting, particularly if the two settings are quite different. However, the available information suggests that fairly high percentage increases in parking costs may be necessary to achieve a moderate reduction in demand.

[1] "High" trip reductions were defined as those achieving at least a 30 percent reduction in trips, "Medium" as those achieving between 15 and 30 percent reductions, and "low" achieving less than a 15 percent reduction.

Implement parking discounts for ridesharers. If parking charges exist, a price differential can be established for carpools or vanpools. This can result in lower parking charges for rideshare vehicles or elimination of charges altogether. This policy is apt to be most effective in combination with other incentives to increase ridesharing, such as preferential parking spaces, aggressive rideshare matching programs, or capital facility improvements such as HOV lanes on local freeways. The biggest drawback of implementing this tactic in many areas, however, can be the lack of parking charges to discount.

As with other parking strategies, effective carpool or vanpool discounts are those considered in the context of the entire transportation system. The California Department of Transportation implemented a discount parking program for carpoolers, opening 480 new spaces. About 90 percent of the spaces were used by existing rather than new carpoolers; of the new carpoolers, about two-thirds shifted from transit. Trips into the area *increased* by 15 to 20 vehicles, and transit use declined by up to 220 riders (RTA 1995).

Develop transportation allowances. An alternative method to raising the cost of parking is to eliminate the subsidy that employees implicitly receive for parking. One way of addressing transportation costs is to establish a transportation allowance: employees receive a certain amount of funds to spend on transportation and can use it to purchase a parking space, pay transit fares, or pursue other travel options. If parking charges exceed the transportation allowance, employees would benefit financially by opting to share rides because their out-of-pocket parking costs would be reduced or eliminated. If the transportation allowance covers the cost of parking, however, it would produce no economic benefit for carpoolers or vanpoolers. In either instance, transit options would become more economically competitive with auto options.

A drawback to both transportation allowances and parking cash-out programs is that the federal tax code exempts employee parking from all payroll taxes if such parking is provided by the employer as a fringe benefit but not if the employee pays directly for it. As Shoup (1992) noted, this exemption from federal and state income taxes, social security taxes, unemployment insurance taxes, and other payroll taxes creates a strong bias in favor of employers providing employees "free" parking spaces. One dollar of employer-paid parking may be worth as much as two dollars in taxable cash income. The impacts of either a transportation allowance or a cash-out program are apt to be small as long as the Internal Revenue Service implicitly subsidizes employer-paid parking.

Develop a parking cash-out program. Similar to a transportation allowance, a parking cash-out program is based on providing employees greater flexibility in how they use their benefits and recognizes that not all employees need or want a free parking space. In cash-out programs, the monetary value of the space is determined and provided to the employee in cash as a monthly benefit. Employees can then

"purchase" a parking space for the same amount, use the money for other transportation purposes, or use it in other ways.

As has been noted by several analysts (e.g., RTA 1995), cash-out programs are most appropriate where employers lease parking for their employees. The cash value of the space can be fairly easily determined and the terms of the lease can be adjusted to lease fewer parking spaces if the program results in reduced parking demand. Employers who own parking may see little benefit in encouraging employees to make less use of what is essentially a sunk cost. As of 1993, California requires companies with 50 or more employees in areas that violate air quality standards to offer cash instead of subsidized parking if the parking is leased from a third party. Studies of the effects of this legal requirement will provide guidance to other states or regions considering such programs.

Impose parking taxes or surcharges. Taxes or surcharges can be used to increase the cost of parking to further TDM goals as well as to raise revenue. Taxes can be applied only to commercial facilities, while surcharges are related to the use of facilities and not to revenues derived from them. Thus, surcharges can be imposed on all types of parking facilities. Parking surcharges were promoted by the Environmental Protection Agency in the 1970s as a way to achieve air quality mandates, but the EPA withdrew its proposed policies in the face of Congressional opposition.

Increase long-term parking charges relative to short-term charges. The parking charge tactics described above would primarily affect commuters, who use parking spaces for the entire work day. In areas of mixed-use development, such as CBDs and shopping center/office complexes, parking requirements for other trips (primarily shopping) can overlap with commuter parking demand. If parking rates are low or nonexistent, commuters can monopolize available spaces and leave few or no places for shoppers to park.

If parking rates are varied by length of stay, they typically decrease as length of stay increases; the rate for parking for eight hours would be lower than the rate for one hour (although the overall cost would be higher). In areas where commuters and shoppers compete for relatively scarce spaces, parking rates could be increased over time to encourage short-term use of the parking spaces and discourage long-term use. As with most parking policies adopted as part of a TDM program, increasing long-term parking rates will be most successful if combined with other strategies, such as providing ample transportation alternatives.

A related strategy is to impose a peak period surcharge to encourage commuters to shift to other travel options. Madison, WI, adopted a one dollar surcharge at four of its municipal garages (Comsis Corporation and ITE 1993). Some travelers switched to transit; however, many more shifted parking location, underscoring the need to develop parking management strategies for a broad area. An increase in parking rates in Eugene, OR, resulted in a drop of monthly permit parking sales from 560 to 360

parkers. About one-half of former parkers shifted to carpools or to a free shuttle service, with the other half apparently changing parking location.

Parking Location

Managing parking supply and parking costs are the two parking strategies used most widely to implement TDM programs. A third strategy used by some agencies is to locate parking at some distance from the work site. The two ways in which this policy has been adopted are: 1) by applying fees in lieu of parking to off-site structures and 2) by encouraging or requiring employers to provide peripheral parking.

Fees in lieu of parking for off-site structures. A city can permit building developers or owners to meet their site parking requirements in ways other than providing on-site parking. For developments in constrained areas or if the city wishes to encourage site plans with little parking, developers can pay a fee in lieu of provision of the requisite number of spaces. The funds, paid to the city, are placed in a parking account used to fund the construction of a public parking facility to provide sufficient off-site parking to meet the needs of the developments contributing the funds. Although these parking structures are off-site, they usually are located close to the developments they are intended to serve; the maximum allowable distance between the parking spaces and the developments therefore can be specified in the parking section of the municipal ordinance.

Peripheral parking with shuttle buses. The deliberate aim of requiring or encouraging peripheral parking lots is to remove traffic congestion from a CBD or other activity center by providing parking at the edge of the congested area. Employees parking at these sites are transported to their destinations by shuttle buses. This allows employers to locate parking where land is cheaper, yet still provide a large number of spaces. The city avoids additional traffic congestion at the employer's site and has the option of pursuing urban design objectives without having to accommodate large amounts of on-site parking. If market prices are charged for parking, employee parking costs also drop. However, some inconvenience is created for employees who must transfer to a shuttle; and some cost is incurred in operating the shuttle bus. A survey from the late 1970s indicated that peripheral parking areas were used in 17 percent of surveyed cities, although this included an unknown number of peripheral lots from which access to destinations was made on foot rather than by transit (Parker and Demetsky 1980). As discussed in Chapter 2, this strategy is most often used or proposed in areas with large downtown concentrations or other centralized activity centers (e.g., universities), but it should also be evaluated for its effectiveness and possible application to other urban areas.

Other considerations

Many of the strategies mentioned above may encourage drivers to seek spaces off-site, particularly if parking supply is constrained or expensive. If developments exist

in or near residential or commercial neighborhoods, spillover parking can be a problem. Shoup (1995) develops an innovative proposal for allowing neighborhoods inconvenienced by long-term commuter parking to recapture some of the cost of losing their curbside spaces. If a market for such spaces is created, spillover parking might be much less of a problem.

Short of implementing a spillover parking market program, cities implementing parking management strategies will need to ensure that sufficient parking enforcement exists to keep spillover parking to a minimum. This is an important part of any plan to achieve the goals of the TDM program (modal shifts, trip reductions, air quality improvements, etc.), but is also important as a way of defusing potentially negative reactions from residents and business owners in the area targeted for TDM. Public perception of large amounts of spillover parking could create a backlash against the parking management program and perhaps the overall TDM program. Adequate enforcement should be a part of any parking management effort, particularly if spillover parking is likely to be a problem.

Parking strategies that allow reductions in numbers of spaces for new or redeveloped buildings are often tied to developer or employer actions assumed to reduce the demand for parking, such as ridesharing incentives, telecommuting programs, or transit-oriented policies. Both the parking reductions and the developer or employer actions should be explicitly stated in developer agreements. More important, such agreements should be established in covenants tied to the building itself, so that future building owners or lessees will be bound by original trip reduction policies. If such agreements are not made permanent and future owners/occupiers discontinue trip reduction policies, the city might end up with buildings that have inadequate parking.

APPLICABILITY TO IOWA CITIES

Although all of the above strategies have been implemented successfully in one or another urban area around the country, some strategies may be more useful than others in Iowa metropolitan areas. This section provides a recapitulation of the strategies and assesses their potential utility to Iowa metropolitan areas.

Restricting parking supply

Managing on-street parking. Management of on-street parking probably is the most common form of parking control in Iowa cities. Many cities prohibit parking on busy arterials and meter other curbside spaces, often reserving such spaces for short-term use. The extent to which on-street parking is controlled by local jurisdictions in Iowa can be seen by the reviews of the zoning ordinances described in Chapter 4; all ordinances require off-street parking for a variety of land uses, suggesting that on-street spaces are neither sufficient nor appropriate for accommodating all of the community's parking needs. Only in the smallest communities are on-street parking controls apt to be novel or controversial.

Preferential parking for ridesharers. As with several parking strategies, preferential parking is most relevant in combination with other TDM or trip reduction tactics. In the absence of other policies to promote ridesharing, preferential parking is likely to have very little effect. Such policies are apt to be instituted in larger urban areas with considerable congestion, conditions that do not apply in most Iowa cities. However, some preferential parking programs are in place in particularly congested areas, such as downtown Des Moines and the University of Iowa campus in Iowa City. Although this policy could be useful in combination with other ridesharing strategies, such as HOV lanes and carpool matching programs, it is likely to be of limited use in most Iowa urban areas for the foreseeable future.

Reducing off-street parking supplies. As development occurs on the urban fringe of Iowa metropolitan areas, relatively small municipalities may be faced with pressures for rapid growth. Implementing appropriate off-street parking standards is one means of assuring that such growth will be planned for in an efficient and orderly manner. As noted above, zoning ordinances often contain parking requirements mandating an excessive number of spaces. All Iowa communities, but particularly those in growth areas such as Des Moines, Cedar Rapids, and Iowa City, should examine their zoning ordinance parking requirements to ensure that the amount of parking required of new developments bears a rational relationship to the amount of parking likely to be needed. Chapter 4 provides a statistical summary of parking requirements for various land uses in Iowa cities.

Reductions in parking requirements can be aimed primarily at bringing parking supplies in line with demand, as demonstrated by the recent Iowa City study of neighborhood commercial developments, or can go beyond this goal to deliberately constrain parking options, thus encouraging shifts away from SOV use toward transit and ridesharing. Most Iowa metropolitan areas have relatively little congestion, even during peak periods, and except perhaps for downtown Des Moines, land use patterns are low density. Constraining parking to encourage a mode shift is not apt to be an appropriate strategy if employment and residential densities cannot support transit or ridesharing successfully. It could in fact reduce the competitiveness of an area by making business relatively less accessible. With the exception of major activity centers, such as downtown Des Moines, Iowa State University in Ames, and the University of Iowa, reducing parking supplies to effect a mode shift are not likely to succeed.

Reducing minimum parking requirements. High minimum parking standards result in oversupplies of parking in many communities, increasing the cost of development and resulting in an unnecessary loss of valuable urban land. Reducing minimum requirements is the easiest and most direct means of balancing parking supplies with parking demand. The extent to which parking supply and demand are out of balance is an empirical question that ideally should be determined for each community. Guidance from the state department of transportation, combined with some empirical studies in selected communities, can produce a set of up-to-date

standards that can be applied by other communities to reflect current parking supply and demand relationships.

Implementing area-wide parking caps. Although area-wide parking caps may be a successful strategy in certain areas, they are not likely to be a useful policy in Iowa cities at present. A lid on parking assumes the existence or development of other transportation options that are present only in large metropolitan areas.

Implementing maximum parking requirements. Unlike area-wide parking caps, maximum parking requirements can be adopted selectively, either for certain districts within a community or for certain categories of land uses. The success of maximum requirements in Bellevue, WA, suggests that under proper conditions, communities may benefit from less parking space than would typically be required by ordinance. If studies such as that done in Iowa City demonstrate a consistent pattern of excessive parking, a maximum parking requirement can reduce overbuilding and decrease the amount of pavement in the city. The Iowa City neighborhood commercial parking maximum should be periodically reviewed to determine its success and potential for application to similar conditions elsewhere.

Flexible parking requirements. Flexible parking requirements can be appropriate policy levers in any area implementing or considering a TDM or other program aimed at reducing vehicle trips. Although area-wide congestion is not a problem in most Iowa cities, rapidly growing or already congested corridors or subareas may be appropriate targets for a trip reduction program. Ordinances that permit flexibility in parking requirements can encourage developer and employer participation in such programs. However, as noted above, such programs should be developed with a clear understanding of existing parking demand and developer and lender preferences.

Shared parking. The Institute of Transportation Engineers (ITE) has stated that "the concept and application of shared parking should be part of every zoning code" (ITE 1992, p. 190). Shared parking options are appropriate for all Iowa cities, although not all cities will want to implement such options in all cases. Conditional permits can be required to allow the city control over when and where such parking arrangements are made. For the private sector, shared parking arrangements are voluntary, and should not be viewed as an imposition of additional city parking requirements. Under certain circumstances, shared parking has proven to be an effective means of reducing overall parking supplies.

Charging for parking

Implement or increase fees. The vast majority of Iowa commuters park for free; implementing parking charges can be a means of ensuring that the costs drivers incur bear a closer relationship to the true expense of operating an automobile. This can also be a successful technique for encouraging a shift to other modes, such as carpooling or transit, as noted above. Parking fees should only be implemented,

however, in cities with sufficiently strong transportation alternatives to offer commuters a choice. Parking increases or new fees are not politically popular under the best of circumstances, and commuters who perceive no transportation option other than to pay higher costs for driving alone may strongly oppose higher parking costs. The goal of any city that adopts or increases parking costs should be to bring such costs in line with market prices.

Implement parking discounts for ridesharers. In areas where parking is not free, ridesharing can be made more popular by offering free or discounted spaces for carpoolers or vanpoolers. This technique by itself, however, is unlikely to result in additional ridesharing. To make the greatest impact, it should be combined with other ridesharing tactics, as noted above. Any city might benefit from increased ridesharing through decreased congestion, more efficient use of arterials, and reduced auto emissions, but cities in which ridesharing programs are apt to have the greatest impact are those with at least moderate levels of congestion and relatively long journeys to work.[2] The University of Iowa has an active ridesharing program, as do some private employers in Des Moines. In Iowa cities with relatively dispersed employment centers, however, ridesharing is apt to be less utilized. If such cities implement a comprehensive ridesharing program, parking discounts for carpools and vanpools could be a significant contributing factor, as could preferential parking, but these policies alone are unlikely to have an impact on travel behavior.

Develop transportation allowance programs. Transportation allowances can be an effective means of providing employees greater flexibility in how they wish to spend their transportation dollars. Such strategies can be adopted by private employers, with no government involvement. In cities attempting to increase transit patronage or implement a ridesharing program, however, requiring employers to provide a transportation allowance to employees in lieu of a guaranteed parking space can be an important component of encouraging the use of other modes. Many Iowa cities might benefit from such a program, although it might be expected to have its greatest impact in larger areas where transit and ridesharing options are more prevalent.

Develop parking cash-out programs. As with transportation allowances, parking cash-out programs should be able to be successfully implemented in a variety of cities. Employees benefit from increased flexibility in how they can spend their "parking bonus," while those employers who lease parking spaces can reduce the number of spaces they lease based on how many employees choose not to repurchase a parking space. Employers who own all their own spaces, however, may be burdened by having to cash out spaces they then have no use for. As in the California legislation, cash-out programs at the city or state level in Iowa should target only those employers who lease spaces, at least at the outset. Still, it is

[2] The 1990 Census indicates that Iowa ranks 45th among the states in journey to work time, with a mean commute of 16.2 minutes. This undoubtedly contributes to its ranking of 39th in percentage of commuters who carpool (11.9 percent).

possible for cash-out programs that target employers who lease spaces to successfully reduce parking demand (at least to some extent) and provide greater employee choice.

Impose parking taxes or surcharges. Parking taxes and surcharges can raise additional funds for a city or county, but are unlikely to be politically acceptable if increased municipal revenues are the only justification. These strategies should be used to complement a TDM program or other effort to encourage a mode shift. Such programs typically are adopted in rapidly-growing areas to lessen traffic impact without substantially increasing transportation infrastructure. Few areas of Iowa are experiencing the types of growth pressure that have led to TDM programs in other parts of the country. In selected areas, such as West Des Moines, such programs may be appropriate, and a parking tax or surcharge might be a reasonable component of a broader strategy of dealing with anticipated traffic congestion.

Increase long-term parking charges relative to short-term charges. Increasing long-term parking charges relative to short-term charges is an effort to increase parking availability for shoppers and others who wish to use spaces for a relatively brief time, while encouraging a modal shift (or at least a shift to other parking facilities, perhaps further away) for workers and other long-term parkers. Such strategies can be used successfully in any area that may be facing a shortage of spaces for shoppers. If substantial displacement of commuters and other long-term parkers results, however, such policies should be adopted in conjunction with a broader strategy of providing additional commute options such as expanded transit services and ridesharing opportunities.

Parking location

Fees in lieu of parking for off-site structures. Fees in lieu of providing off-site parking spaces for individual developments may be appropriate in certain portions of cities in Iowa, with relatively high existing or desired densities, especially in commercial areas. Centralized parking facilities can prevent the checkerboard development patterns that often accompany mandates for on-site parking, with each building surrounded by its own lot. Although the immediate application of a "fee-in-lieu" option may be most appropriate in relatively high-density areas such as CBDs (assuming parking requirements apply to such areas), the long-term application of this strategy may be most notable in areas of new development, to provide opportunities for pedestrian-oriented, attractive mixed-use developments while providing sufficient parking to accommodate local businesses and commercial establishments.

Peripheral parking with shuttle buses. Peripheral parking with shuttle buses is only apt to be a useful strategy in areas of very high density with limited parking supplies. Such conditions exist at the University of Iowa Hospitals and Clinics in Iowa City, where a shuttle service connects the job sites with remote parking lots about a mile away. Other shuttle bus programs may be provided by private sector

employers, or groups of employers. Outside of the Des Moines CBD, however, peripheral parking programs would seem to have limited potential in Iowa cities, at least in the near future.

SUMMARY OF PARKING STRATEGIES FOR IOWA CITIES

Table 3–1 presents a summary of the parking strategies discussed in this section as they might apply to cities in Iowa. Three categories of parking policies are identified: those with potential applicability to any urban area; those applicable to areas of concentrated activity, such as central business areas of larger cities; and those not likely to be currently applicable in Iowa urban areas.

Table 3–1. Parking strategies for Iowa cities

Restricting parking supplies	
●	Managing on-street parking
●	Reducing off-street parking supplies
●	Reducing minimum parking requirements
●	Flexible parking requirements
●	Shared parking
◒	Preferential parking for ridesharers
○	Maximum parking requirements
○	Area-wide parking caps
Charging for parking	
●	Develop transportation allowance programs
●	Develop parking cash-out programs
●	Increase long-term parking charges relative to short-term charges
◒	Implement or increase fees
◒	Implement parking discounts for ridesharers
◒	Legislate parking taxes or surcharges
Parking location	
●	Fees in lieu of on-site parking
◒	Peripheral parking with shuttle buses
Key: ●	Potentially useful for all Iowa cities
◒	Potentially useful for areas of concentrated activity
○	Not currently useful

As indicated in the table, several strategies have the potential to be useful in any Iowa city. Most cities already manage on-street parking on major arterials; as cities grow, limiting or removing such parking often spreads to additional streets. Of

strategies not currently used in many Iowa cities, reducing off-street parking supplies and parking minimums, permitting or encouraging shared parking, providing for flexibility in parking requirements, and increasing long-term parking charges relative to short-term charges are all apt to be useful in the short-term. All of these strategies reflect modifications in municipal authority, most commonly expressed in zoning ordinances. Although Iowa municipalities have the authority to adjust such policies without state involvement, a statewide effort to provide guidelines and suggestions for modifying parking requirements in local ordinances likely would serve both an educational function and provide examples of possible ordinance modifications to cities looking for a way to proceed. Suggestions for state involvement in parking requirements are presented in the final chapter of this report.

Other strategies are likely to be most useful in areas of concentrated activity, such as the Des Moines CBD and university campuses. This is primarily due to the need for transportation alternatives to provide options for people no longer willing or easily able to drive their cars by themselves, especially for work trips. Preferential parking and discounts for ridesharers clearly assume a supporting physical and institutional infrastructure that further encourages carpool and vanpool development. By themselves, these policies would have almost no effect on mode choices. With complementary policies, however, they can be useful steps in encouraging modal shifts. In addition, areas of intense activity may be able to support increased parking fees or taxes, for two reasons: 1) land values in these areas are apt to be higher than in outlying areas, justifying the need to charge more for the use of land as parking space, and 2) the funds generated by these price increases can be used to provide other transportation alternatives, such as increased public transit service.

CHAPTER 4
PARKING REQUIREMENTS IN MIDWESTERN ZONING ORDINANCES

Parking requirements in local zoning ordinances often differ from observed levels of parking demand. Several recent studies such as Cervero (1989), Willson (1995), and City of Iowa City (1995), have noted the extent to which parking supply requirements often exceed parking usage at a variety of office, commercial, and residential sites.

A direct comparison of actual parking utilization with parking requirements is an extensive undertaking even for a single community; across several communities it would be extremely time- and resource-intensive. In order to provide useful information on parking policies, this study calculated parking requirements as expressed in municipal zoning ordinances from a number of cities across a range of land uses. These requirements were compared with estimates of parking demand as expressed in *Parking Generation* (ITE 1987), as well as with the results of other studies of parking requirements. Although no specific conclusions can be drawn as to the appropriateness of parking requirements for a particular community, the results indicate general tendencies in Iowa parking requirements, compare them with requirements from other areas, and examine them in light of general estimates of parking demand.

To accurately assess parking requirements in Iowa and nearby states, a sample of roughly 70 zoning ordinances was obtained from cities in Iowa, Minnesota, and Wisconsin. Cities contacted were those in each state with at least 20,000 residents. Local parking requirements were received from all such cities in Iowa, and from roughly 80 percent of cities over 20,000 in Minnesota and Wisconsin. Appendix A lists all cities from which we received zoning ordinance parking requirements.

The information contained in these requirements was used in two ways. First, information on the number of required spaces for different types of land uses was used to estimate parking requirements for various development types in each city; this information was aggregated to establish a quantitative measure of parking requirements for urban areas in these states. The results of this analysis are described in this section. Secondly, instances of shared parking options and flexible application of parking requirements were noted to provide a sense of the frequency of these policy alternatives, as well as to provide examples of such policies. The method of calculating required spaces for different land uses and the results of these calculations are described in this section. The next section contains a description of shared parking and flexible parking options.

PARKING SUPPLY REQUIREMENTS BY LAND USE TYPE

Two complications affect the measurement of parking supply requirements for different jurisdictions:

- Different amounts of parking are required for different land uses of the same size (e.g., an office building and a retail store).
- Measurement of the "size" of a particular land use varies by jurisdiction.

The first of these considerations simply means that different land uses need to be examined to obtain a more complete picture of ordinance parking requirements. For this study, office, commercial, and residential categories were selected as representing a sizable portion of new development in most communities. Other categories, such as restaurants, hotels, and hospitals, might be of interest to particular cities or in certain circumstances, but they typically account for less overall development and fewer total parking spaces.

The second consideration recognizes that parking requirements are typically expressed as a ratio of the number of required spaces based on some indicator of size, intensity of activity, or other measure of land use impact. Most but not all municipalities use thousands of square feet of floor area as the denominator for this ratio. Others use number of employees as the denominator, while still others combine thousands of square feet of floor area and numbers of employees.[3] In addition, some ordinances specifically apply parking requirements to gross *leasable* floor area, while others simply use gross floor area. Finally, several communities apply different ratios depending on the size of the development; for example, a large retail store might have a higher or lower ratio than a smaller retail store of the same type.

This made direct comparison of ratios across cities impossible. To compare the parking requirements in different jurisdictions, hypothetical land use scenarios were constructed, and the particular requirements of each community were applied to each scenario. The actual number of spaces required in each scenario thus became the basic measure of parking requirements for a community.

The scenarios that were developed fit into the three major land use categories noted above: office, commercial, and residential. Because ratios in some communities varied with the size of the development, scenarios of different sizes were developed for the office and commercial land uses. The specific scenarios used were:

- 10,000-square-foot[4] office building,
- 100,000-square-foot office building,

[3] Residential parking requirements are virtually always expressed in number of required spaces per unit, although the actual ratio will vary with the size of the unit and the type of residential development.

[4] All scenario sizes are in square feet of gross floor area.

- 10,000-square-foot retail store,
- 50,000-square-foot shopping center,
- 300,000-square-foot shopping center, and
- 50-unit multifamily residential complex (two-bedroom units).

These scenarios capture a range of likely development possibilities in most urban areas. The smaller shopping center was assumed to be oriented to neighborhood shopping opportunities, while the larger shopping center was assumed to be regional in nature (a necessary distinction for applying some parking requirements).

The estimation procedure for determining the number of spaces required for each scenario in each city is described in Appendix B. Once the number of spaces was calculated, they were averaged for the data set as a whole, and by each state. These averages are expressed in a ratio format for ease of comparison with other parking requirements and empirical demand estimates. For the office and commercial land uses, the ratios express the number of parking spaces required per thousand square feet of gross floor area. For the residential land use, the ratio expresses the number of parking spaces required per unit. Results from this procedure are described below.

RESULTS OF SCENARIO ESTIMATION PROCEDURE

Comparisons of derived parking ratios

The parking ratios derived from the municipal requirements for each scenario are presented in Table 4–1. The results follow a fairly consistent pattern: for each of the six scenarios, parking requirements are highest in Minnesota cities and, with one exception, are lowest in Iowa cities. Wisconsin cities require slightly less residential parking than do Iowa cities.

Table 4–1. Comparison of derived parking ratios, by scenario and state

	Iowa			Minnesota			Wisconsin			Total		
Scenario	N	Calc. spaces*	Sp/K sq ft†	N	Calc. spaces	Sp/K sq ft	N	Calc. spaces	Sp/K sq ft	N	Calc. spaces	Sp/K sq ft
10k office	18	34.8	3.48	30	43.4	4.34	23	38.7	3.87	71	39.7	3.97
100k office	18	332.6	3.33	30	417.3	4.17	23	377.2	3.77	71	382.8	3.83
50k shopping center	19	218.5	4.37	30	248.3	4.97	23	235.7	4.71	72	236.4	4.73
300k shopping center	19	1,293.3	4.31	30	1,486.5	4.96	23	1,416.5	4.72	72	1,413.2	4.71
10k retail	19	44.7	4.47	30	54.2	5.42	23	48.1	4.81	72	49.8	4.98
50-unit multifamily	19	87.5	1.75	28	99.4	1.99	25	83.2	1.66	72	90.6	1.81

*Calculated spaces
†Spaces per thousand square feet.

Creating scenarios of different sizes allows one to compare parking requirements by size of office and commercial development. For office developments, the differences are small but consistent: in each state, the smaller office building has a slightly higher parking ratio than the larger office building. This is due to the use of sliding parking scales in a few cities that apply lower parking ratios to larger office developments. Although these differences appear small, the savings in parking are not negligible. Using the overall parking ratios, a 100,000-square-foot office building would construct 14 fewer spaces using the lower ratio (3.83 vs. 3.97). As indicated previously, annual costs of surface parking lots commonly range from $600 to $900 per space. Using these cost estimates, 14 fewer parking spaces could result in an annual cost saving of $8,400 to $12,600. For particular cities, the amount of parking and costs saved might be considerably greater.

Differences among shopping centers are quite small. The smaller shopping center scenario results in a parking ratio of 4.73 spaces/thousand square feet, while the larger shopping center scenario produces a ratio of 4.71. However, both of these ratios are notably smaller than the 4.99 spaces required for the 10,000-square-foot retail store. These differences result primarily from the separate "shopping center" land use categorization existing in many cities. Such a categorization often applies smaller parking ratios as retail area increases.

DERIVED PARKING RATIOS COMPARED TO EMPIRICAL DEMAND ESTIMATES

As noted previously, the most complete estimate of parking demand by land use type was assembled by the Institute of Transportation Engineers (ITE) in their *Parking Generation* report. Comparisons of parking requirements in Iowa, Minnesota, and Wisconsin with the parking demand data compiled in *Parking Generation* show that the requirements are substantially higher than the estimated demand (Table 4–2). Although Iowa parking ratios are lower than those in Minnesota and Wisconsin, they are higher than the demand levels estimated by ITE. For example, demand is estimated to be 91 percent of Iowa shopping center parking requirements, 80 percent of office parking requirements, and only 63 percent of multifamily residential parking requirements. *Parking Generation* notes that shopping center demand is not based on peak usage, and therefore the demand figures should not be used to set design day standards. Taking higher seasonal parking needs into account, the average Iowa shopping center parking requirements probably are appropriate. However, both offices and multifamily housing are required to provide more parking than is likely to be needed in the large majority of cases.[5]

[5] *Parking Generation* does not contain a category approximating the retail scenario used in this study. The closest categories are "Hardware/Paint/Home Improvement Store," "Furniture/Carpet Store," "Supermarket," and "Convenience Market," each of which is too specialized to provide a good basis of comparison. Using the "Shopping Center" category of parking demand, demand is estimated to be 87 percent of Iowa retail parking requirements.

Table 4–2. Parking requirements of Midwestern and Southeastern cities and parking generation demand estimates

General office (10,000 sq. ft.)	Spaces per 1,000 sq. ft.	Sample size
Iowa ordinances	3.48	18
All Midwestern ordinances	3.97	71
Southeast ordinances	3.68	33
Parking generation demand estimates	2.79	207
Shopping center (50,000 sq. ft.)	Spaces per 1,000 sq. ft.	Sample size
Iowa ordinances	4.37	19
All Midwestern ordinances	4.73	72
Southeast ordinances	5.08	33
Parking generation demand estimates	3.97	178
Multifamily housing	Spaces per unit	Sample size
Iowa ordinances	1.75	19
All Midwestern ordinances	1.81	72
Southeast ordinances	1.67	33
Parking generation demand estimates	1.11	32

As noted earlier, the parking counts on which *Parking Generation* rates are based come primarily from stand-alone suburban sites with few non-auto trips. Thus, these demand figures should be considered as upper bounds of likely parking needs. Realistically, land uses that attract some trips by transit, carpooling, or walking (as is apt to be the case in a mixed-use area) are likely to require fewer, not greater, numbers of spaces than indicated in the ITE report. Most cities in this sample, however, required more spaces. This further suggests that most communities are requiring an excess of parking spaces, at least for office and residential developments.

A similar though smaller survey of parking requirements for Southeastern cities was conducted in 1990 by the North Carolina Section of the ITE (Polanis and Price 1991). Thirty-three municipalities with populations between 50,000 and 500,000 responded to a survey of off-street parking requirements for various land uses. Table 4–2 presents the average parking requirements obtained from this survey, along with ratios from the current study and empirical results from *Parking Generation*. The parking requirements are quite similar to each other, and consistently higher than ITE's measurement of parking demand.

CONCLUSION

As demonstrated through a comparison of municipal parking requirements in Iowa, Minnesota, and Wisconsin with estimates of parking demand, most cities require

excess parking for office and multifamily housing developments, and possibly for commercial land uses as well. This excessive requirement is consistent with the results of other studies, including examinations of demand at large mixed-use office complexes (Cervero 1989), office parks in Southern California (Willson 1995), and municipal requirements in Southeastern cities (Polanis and Price 1991). Although these requirements cannot be said to be inappropriate for any particular city, on average they suggest an oversupply of required parking in many communities. Lowering required parking minimums is one step a city can take to directly reduce the amount of unnecessary spaces. In addition, parking ordinances can permit shared parking, or provide other forms of flexibility that can reduce the amount of parking constructed for specific sites. Studies, such as that conducted by Iowa City (City of Iowa City 1995), are needed to relate adequacy of parking requirements to actual parking demand, in Iowa and elsewhere.

CHAPTER 5
SHARED PARKING AND FLEXIBILITY OF PARKING REQUIREMENTS

Rigid application of parking requirements can lead to an oversupply of parking for individual developments (or, in the case of parking maximums or caps, undersupplies). Two techniques that can reduce oversupplies of parking with more discretion than simply reducing parking standards across the board are shared parking and flexible parking requirements. Shared parking permits neighboring land uses that differ in their peak parking patterns to make use of each other's parking spaces. Flexible parking requirements allow a city council, planning or zoning commission, or city administrator to modify parking requirements for individual developments if certain conditions are met. This chapter describes these techniques in greater detail; in addition, it reports results from an analysis of zoning ordinances from cities in Iowa, Minnesota, and Wisconsin.

SHARED PARKING

Shared parking provisions stem from the long-recognized fact that different types of land uses attract their peak patronage at different times of the day, or different days of the week. If such land uses are in close proximity, the potential exists for the same parking space to be shared among the land uses.

Sharing of parking implies proximity of land uses. Thus, programs that encourage shared parking arrangements operate in areas of mixed land use: an area with only retail activities or only offices is not a candidate for shared parking. These mixed-land uses may be part of the same overall development, such as a theater in a shopping center, or individual developments, such as a mix of offices and shops in a downtown area. This mixing of land uses in areas with shared parking potential may permit a further reduction of parking spaces, as some trips that would be made by auto in an area of dispersed activities can be made on foot. As discussed below, this "market capture" element of shared parking can be difficult to measure, but may be substantial and should be considered in any shared parking program.

To effectively calculate the possible parking savings from a sharing of spaces, a planner must gather information on actual parking demand throughout the day to compare peaks for neighboring land uses. The most accurate method of ascertaining shared parking potential for any particular site is to collect data from a similar site in the same community, so that as many factors as possible can be held constant (e.g., trip generation characteristics unusual to the area, transit opportunities, amount of "walk-up" traffic). This will not always be possible, due to a lack of comparable

sites or limitations on resources for data collection. Information in the professional literature can be used to provide general estimates of shared parking potential for particular types of land uses.

Example of time-of-day and day-of-week shared parking methodology

For purposes of illustration, shared parking calculations will be made on a mixed use office/retail development. This combination of uses was selected because it represents two of the most common types of new development in most communities (excepting single-family residential, which cannot easily be included in a shared parking program). In addition, office and retail land uses were the two uses mentioned most often by municipalities responding to the question, "based on your experiences, which land uses do you feel are most appropriate for inclusion in mixed-use developments and offer the greatest potential for shared parking?" (ULI 1983). The following scenario illustrates the savings possible by taking into account different time-of-day and day-of-week parking peaks of a hypothetical office/retail development. The methodology for these calculations largely is drawn from an Urban Land Institute publication entitled *Shared Parking* (ULI 1983). Land use and parking characteristics for the scenario are listed in Table 5–1.

Table 5–1. Shared parking scenario: Land use and parking characteristics

Land use	
Office space	300,000 square feet (gross floor area)
Retail space	200,000 square feet (gross floor area)
Parking demand	
Office (weekday)	2.79 spaces/1,000 sq ft (from *Parking Generation*)
Office (Saturday)	0.50 spaces/1,000 sq ft (from *Shared Parking*[6])
Shopping center (weekday)	3.23 spaces/1,000 sq ft (from *Parking Generation*[7])
Shopping center (Saturday)	3.97 spaces/1,000 sq ft (from *Parking Generation*)
Parking requirements—office	
Iowa ordinance requirements	3.33 spaces/1,000 sq ft
All Midwestern ordinance requirements	3.83 spaces/1,000 sq ft
Parking requirements—shopping center	
Iowa ordinance requirements	4.31 spaces/1,000 sq ft
All Midwestern ordinance requirements	4.71 spaces/1,000 sq ft

[6] *Parking Generation* does not include office parking demand on Saturdays. The figure used in these calculations was taken from Exhibit 26 in *Shared Parking*.

[7] The shopping center parking ratios do not represent design-day parking demand estimates, but rather peak-period estimates during the time periods surveyed. Peak shopping center parking is generally found to occur on weekends before Christmas; using demand figures from these days would result in higher shopping center demand rates. However, on these days (as on other weekends), office parking demand would be very low; the total overlapping demand of office and retail would not equal a typical weekday combined demand unless retail was a very high proportion of the mixed use, or unless retail demand exceeded 5.5 spaces/1,000 sf (2.79 + 3.23 - 0.50 = 5.52). This equals or exceeds the ordinance requirements for virtually every community surveyed. For the purposes of these shared parking estimates, therefore, the design day estimates for retail space were not used.

Estimating parking demand for the two land uses separately based on averages in *Parking Generation* produces a total need of 1,483 spaces on weekdays and 944 spaces on Saturday.[8] This obviously does not take into account the daily difference in parking demand: office demand is highest during the week, while retail demand is highest on Saturday. This is one source of potential savings in parking spaces needed under a shared parking program. What is not as obvious is a second source of potential parking savings: reductions due to the different hourly peaking patterns of the two land uses on any given day.

Table 5–2 is derived from hourly parking estimates provided in *Shared Parking*, and is very similar to a table used in Alexandria, VA, to estimate potential parking savings using time-of-day percentages (Kuah 1991). The actual number of parked cars is presented for each hour, followed by a percentage, which expresses the number of vehicles present for each land use on a particular day, as a proportion of the highest peak hour parking demand for that day. For example, at 9:00 AM on a weekday, 93 percent of the peak-hour office parking is on-site, but only 42 percent of the peak hour retail parking has arrived. At 9:00 AM on a Saturday, 80 percent of the peak-hour office parking *for a Saturday* has arrived, compared with 30 percent of the peak hour retail parking. The "demand" columns reflect parking demand by hour, summed across the two land uses (office and retail).

The peak hour, as estimated for this scenario, occurs at 2:00 PM on a weekday. At this time, both office and retail approach, but do not quite reach, their maximum weekday parking demand, at 97 percent each. Although the number of vehicles attracted by either land use is greater at various times of the day, and for retail substantially greater on Saturdays, the greatest *overall* parking demand occurs at this time, with a total of 1,439 vehicles.

How does this demand estimate compare with other methods of determining parking demand, and with parking requirements calculated in this study? Without applying hourly percentages, the most accurate method of estimating demand is the method presented at the beginning of this section: calculating separate requirements for office and retail land uses and summing them together. This produced an estimated demand of 1,483 vehicles. This estimate is only slightly higher (approximately three percent greater) than the peak demand estimate using time-of-day percentages. This three percent nonetheless represents 44 parking spaces which, using cost estimates described previously, result in an annual cost of between $26,400 and $39,600. The advantages of using time-of-day estimates are clear (cost savings, aesthetic benefits, and lesser environmental impacts that result when unnecessary spaces are eliminated), even though the total amount of parking saved may be relatively small.

[8] Weekday Office: 2.79 spaces/1,000 sf * 300,000 sf = 837 spaces.
Weekday Retail: 3.23 spaces/1,000 sf * 200,000 sf = 646 spaces; 837 + 646 = 1,483 spaces.
Saturday Office: 0.50 spaces/1,000 sf * 300,000 sf = 150 spaces.
Saturday Retail: 3.97 spaces/1,000 sf * 200,000 sf = 794 spaces; 150 + 794 = 944 spaces.
Combined demand is highest on weekdays.

Table 5–2. Calculation of shared parking demand using time-of-day peaking factors

	Weekday					Saturday				
	Office		Retail			Office		Retail		
	No.	%	No.	%	Demand	No.	%	No.	%	Demand
AM										
6:00	25	3%	—	—	25	—	—	—	—	0
7:00	167	20%	52	8%	219	30	20%	24	3%	54
8:00	527	63%	116	18%	643	90	60%	79	10%	169
9:00	778	93%	271	42%	1,049	120	80%	238	30%	358
10:00	837	100%	439	68%	1,276	120	80%	357	45%	477
11:00	837	100%	562	87%	1,399	150	100%	580	73%	730
PM										
12:00	753	90%	627	97%	1,380	150	100%	675	85%	825
1:00	753	90%	646	100%	1,399	120	80%	754	95%	874
2:00	812	97%	627	97%	1,439	90	60%	794	100%	884
3:00	778	93%	614	95%	1,392	60	60%	794	100%	854
4:00	644	77%	562	87%	1,206	60	40%	715	90%	775
5:00	393	47%	510	79%	903	30	20%	596	75%	626
6:00	193	23%	530	82%	723	30	20%	516	65%	546
7:00	59	7%	575	89%	634	30	20%	476	60%	506
8:00	59	7%	562	87%	621	30	20%	437	55%	467
9:00	25	3%	394	61%	419	—	—	318	40%	318
10:00	25	3%	207	32%	232	—	—	302	38%	302
11:00	—	—	84	13%	84	—	—	103	13%	103

NOTE: Percentages derived from *Shared Parking* (ULI 1983). Absolute numbers based on *Parking Generation* (ITE 1987) demand estimates for scenario described in Table 5–1.

However, if the parking needs of office and retail uses are being considered separately, they typically would be calculated for their respective peak days: weekday for office and Saturday for retail. Using the estimated demand for these days from *Parking Generation* produces a total demand estimate of 1,631 spaces, approximately 13 percent over the time-of-day estimate calculated above.[9] This represents an additional 192 spaces, at an estimated annual cost of $115,200 to $172,800. As before, this estimate reflects amortized costs of land and parking lot construction for surface spaces, and annual operating and maintenance costs. Other costs, such as increased pollution due to storm water runoff or lost opportunities for more attractive landscaping (or perhaps even additional office or shopping space), are not included.

[9] Weekday Office parking demand of 837 spaces + Saturday Retail parking demand of 794 spaces.

If parking regulations were to utilize peak day demand estimates for each land use in a mixed use development and not permit shared parking, it would result in excess spaces being constructed: in this example, approximately 13 percent more spaces would be constructed than would be dictated by peak hour needs. As noted previously, however, zoning ordinances typically require greater numbers of spaces than estimated by parking demand counts, even in the absence of shared parking. As seen in the ordinances from Iowa, Minnesota, and Wisconsin (and similar ordinances from Southeastern cities), parking requirements typically are considerably higher than estimates of parking demand, either as measured in *Parking Generation*, or from other empirical sources. This results in oversupplies for many single-use developments; it results in even greater oversupplies for mixed-use developments or neighboring developments that could feasibly share parking.

Using average requirements from Iowa cities, approximately 1,861 parking spaces would be required for this office/retail mixed-use scenario if no sharing of parking spaces were permitted.[10] This is 29 percent greater than the amount of parking demand estimated at the busiest peak hour. The number of excess spaces is approximately 422; using previous estimates of parking space costs for surface lots, this results in an annual cost of $253,200 to $379,800 for unused parking spaces. Again, costs of environmental impacts, aesthetics, and lost opportunities for other land uses are not factored into these estimates.

Using average parking requirements from Minnesota and Wisconsin as well as Iowa produces even more excess parking. With these requirements, approximately 2,091 spaces would be required.[11] This is 45 percent higher than the 1,439 necessary spaces estimated for the busiest peak hour, and results in 652 excess spaces. The annual cost of these extra spaces ranges from $391,200 to $586,800.

Clearly, a considerable number of jurisdictions require far more parking in mixed-use developments than is ever apt to be needed. (Ordinance provisions permitting or prohibiting shared parking are discussed below.) A reasonable estimate of necessary parking based on demand figures should take into account some surplus in spaces, to "reduce the need to search an entire system for the last few available spaces, as well as provide for vehicle maneuvers, operating fluctuations and vacancies created by serving [sic] spaces for certain users, and losses due to misparked vehicles, snow cover, etc." (National Parking Association and Parking Consultants Council 1992, p. 5). The National Parking Association recommends an additional five to ten percent of spaces be added to the anticipated peak parking accumulation, to cover these and other exigencies. This cushion would slightly reduce the extent to which the parking requirement figures discussed above overstate the need for parking in the office/retail mixed use example. However, the *Parking Generation* demand figures

[10] Office: 3.33 spaces/1,000 sf * 300,000 sf = 999 spaces.
Retail: 4.31 spaces/1,000 sf * 200,000 sf = 862 spaces.

[11] Office: 3.83 spaces/1,000 sf * 300,000 sf = 1,149 spaces.
Retail: 4.71 spaces/1,000 sf * 200,000 sf = 942 spaces.

do not take into account arrival to the site by means other than automobile; for many developments, the modal split for transit, walking, and bicycling might reduce the necessary parking supply by about the same extent that the five to ten percent surplus increases it.

"Captive Market" Considerations

As mentioned previously, parking generation rates for particular land uses typically are derived from counts taken at isolated sites. This ensures that the traffic arriving at that site can be assumed to be destined to that land use, but it also results in parking rates that implicitly assume virtually all trips generated by a particular land use arrive by auto. This may not be true in many urban areas, particularly if two or more land uses are part of the same mixed-use development. Application of separate parking ratios for each of the land uses may result in excessive requirements of parking.

As stated in *Shared Parking*, "to accurately define parking requirements in a mixed-use development, the parking demand ratios of a component land use should be factored downward in proportion to the amount of market support received from an adjacent land use" (p. 39). To measure this factor, *Shared Parking* reports on a questionnaire that was distributed to employees in urban areas asking about their use of other facilities within their "building complex." Outside of CBDs, an average of 28 percent of employees in mixed-use sites patronized shops in the same development. At single-use sites, only 19 percent did so. The ranges of the survey responses were extremely high (from zero to 83 percent), and clearly factors for a particular development depend both on the mix of land uses and physical design features that facilitate or impede access between uses. Roughly, however, mixed-use facilities increase "captive market" effects over single-use facilities by 50 percent.

The impact of this effect on parking requirements for a particular development is dependent on many factors. The *Shared Parking* survey states that "walking distance or proximity is a major influence on the captive relationship. The sensitive distance is affected by local factors, including climate, the safety and convenience of pedestrian paths (for example, the amount of conflict with vehicles), and the general environment" (p. 40). In addition, as noted by Cervero (1986) and others, many mixed-use complexes are mixed-use in name only. These complexes often are composed of land uses separated by long distances and large expanses of parking.

The greatest captive market effect outside downtown areas is apt to be felt by complementary land uses (e.g., office and retail catering to office workers) located within the same building or immediately adjacent buildings. In such circumstances, well over half of the retail patronage may be "captive" office workers walking to the stores and restaurants. In such circumstances, requiring retail or restaurant parking amounts based on standard application of parking ratios derived from stand-alone sites could result in a substantial oversupply of parking.

At the other extreme, a large "mixed-use" complex with land uses separated by a quarter of a mile or more (such as an office complex and a regional shopping center, each surrounded by parking) would be apt to result in a very small "captive market" effect. The proportion of retail patrons from the adjacent office buildings would be very low relative to patrons from outside the complex, and even those shoppers from within the same complex might drive to the shopping center if the distance between land uses were great enough. This would negate any potential shared parking benefit from having a "captive market." The captive market adjustment factors for such situations would be quite small, and might well be dropped altogether.

Considerably more research is needed before any general statements can be made about the likely effects of captive markets for parking requirements in various situations. In the meantime, local jurisdictions should recognize the potential for captive market effects to reduce the necessary amount of parking for various developments, perhaps substantially, and provide the flexibility within municipal codes to permit reductions of parking supply if a high proportion of site arrivals are expected to be made on foot.

Prevalence of Shared Parking Language in City Ordinances

As part of the review of municipal ordinances described in the previous section, parking requirements were read for statements regarding the acceptability of shared parking. Ordinance provisions regarding shared parking were classified three ways, as "expressly prohibited," "expressly permitted," or "not mentioned," and are summarized in Table 5–3 by state. Overall, shared parking is explicitly permitted in 42 percent of the cities surveyed, although not all of these ordinances indicate the procedures for determining shared parking. Thirty-six percent of the ordinances permit shared parking and indicate where and how such programs can operate. Shared parking is explicitly prohibited in 23 percent of the ordinances. In over a third of the ordinances, shared parking is not mentioned, making it an open question as to whether a developer proposal to reduce parking costs and impacts by sharing spaces would be accepted or rejected, by either the city or the courts.

Table 5–3. Shared parking in zoning codes

State	Prohibited	Not mentioned	Permitted	Total
Iowa	4	6	9	19
Minnesota	5	13	14	32
Wisconsin	9	8	9	26
Total	18	27	32	77

The most common shared parking parameters indicate the types of land uses that are able to share parking (such as "daytime" and "nighttime" uses), and the maximum

percentage reduction in required parking that may be achieved. Daytime and nighttime uses are usually (but not always) spelled out in the ordinances. The maximum percentage reduction is generally 50 percent, although churches and school auditoriums often may be reduced 100 percent (i.e., they need not supply any of their own parking). Some ordinances require evidence that the parking demands of the proposed land uses would not overlap, though most do not. St. Paul was the only city in the sample to explicitly model its ordinance after the procedures described in *Shared Parking*.

In the ordinances reviewed, shopping centers and retail outlets were not generally considered "nighttime" uses, this term being reserved primarily for activities such as theaters, nightclubs, and bowling alleys. Therefore, a mixed use office/retail development of the type described above would not be eligible for a reduction in parking spaces in most of the cities that permit some type of shared parking. Very few ordinances explicitly mention the shared parking issues that arise in mixed-use developments, and most would seem to require separate calculations of parking supply. Thus, although some type of shared parking is permitted in over 40 percent of the cities, the percentage of cities that would permit shared parking in all practical instances is much lower.

FLEXIBLE PARKING REQUIREMENTS

As with any effort to develop a standard that will apply to a variety of specific situations, the establishment of parking ratios for different land use types will occasionally result in inappropriate or unreasonable requirements. Flexibility can be added to zoning ordinance language to permit either a staff administrator or a planning or zoning commission to modify parking requirements in particular situations. Such flexibility can be applied in a variety of different circumstances, including the following:

Evidence of lower or higher parking demand than assumed in the ordinance. Parking ratios are based on assumptions of similarities of parking requirements for similar land uses, and these assumptions are correct in most circumstances. However, specific buildings that fit into a particular land use category may generate more or less parking demand than other buildings in that classification. Parking ordinance flexibility can permit reductions or mandate increases in required numbers of spaces based on empirical evidence that a particular development will be likely to generate an unusually high or low level of demand.

Presence of complementary land uses nearby. As indicated in the discussion on shared parking, neighboring land uses may result in some level of market capture by a particular land use; a relatively high proportion of customers, visitors, or clients may arrive on foot, and thus not need a parking space. Although the actual reduction in the number of required spaces cannot be determined in the absence of a particular building and neighborhood, flexibility in the zoning ordinance can permit reductions in required spaces based on a demonstration by the developer that a significant

number of patrons will be persons living or working in the immediate area. This typically would be done as part of a market evaluation for a new development, and would not require significant extra work by either the developer or city staff.

Involvement of developer or building tenants in TDM or trip reduction programs. As the goal of many TDM and trip reduction programs is to shift solo auto users to other modes of transportation, it is reasonable to assume that, to the extent such programs are successful, participating employers would not need as many parking spaces as the code might dictate. Permitting reductions in parking spaces can be an incentive to encourage participation in such programs. Whether participation in such programs is voluntary or mandatory, ordinances can reduce the number of unnecessary parking spaces by specifying a flexible determination of parking needs based on program participation and the likely modal shift. Kuah (1991) provides a methodology for determining parking supply for mixed-use developments under transportation systems management ordinances.

Location along a bus route or near a rail station. Buildings located close to transit may have higher transit mode shares for employees and patrons than buildings located elsewhere. As parking ratios typically assume very low transit mode shares, flexible parking requirements can take account of likely reductions in parking demand generated by such buildings. A general percentage reduction can be specified in the ordinance to apply to all land uses located within a certain distance of transit, or the reductions can be applied on a case-by-case basis, typically based on transit usage estimates provided by the developer and verified by city staff.

Each of these techniques was employed by at least one surveyed jurisdiction. Table 5–4 presents information on the number and percentage of communities that provided some type of flexibility in their parking code. Overall, only 32 percent of ordinances (25 jurisdictions) mention some type of flexible parking requirements. Of these 25 ordinances, 21 permit some type of reduction in parking requirements, although in some cities these reductions are available only for specific land uses (e.g., high-density residences in Mason City and "low-income well-elderly housing" in Marshalltown). Eight of these communities require some demonstration or evidence of lower parking demand; the rest do not, generally providing no explanation of the circumstances under which a reduction might be warranted or granted.

Table 5–4. Flexibility of parking requirements in zoning codes

State	Flexible parking not mentioned	Flexible parking permitted	Total
Iowa	13	6	19
Minnesota	18	14	32
Wisconsin	21	5	26
Total	52	25	77

The most common qualification in ordinances permitting parking space reductions is that the developer or building owner must set aside an amount of land equivalent to the amount of land saved by not constructing the full complement of spaces. This practice, commonly called "land banking," reserves land that could be converted to parking spaces at a future date. Land banking provides assurances to cities that the developments granted parking space reductions will be able to accommodate greater-than-anticipated parking demand, up to the amount specified by the ordinance without the reduction. Of the 21 cities permitting parking reductions in at least some circumstances, 12 required land banking, eight did not, and one indicated that land banking could be required in certain circumstances. The eight cities that permitted reductions without land banking were more likely to permit reductions only for specified land uses (e.g., high-density residential or public assembly). The large majority of communities that provided opportunities for parking reductions irrespective of land use type tied such reductions to land banking requirements.

Land banking is a reasonable compromise between requiring significant oversupplies of parking and allowing substantial development with insufficient parking. Land that is banked instead of converted to parking reduces the cost of development. Although the land cannot be built upon, it can be landscaped or left as open space, perhaps enhancing the attractiveness of the development. From an environmental perspective, it reduces the paved surface area and has less impact on storm water runoff and water pollution. The city reserves the ability to require additional parking in the future, if estimates of parking demand are too low or trip reduction program forecasts too optimistic. In addition, land banking provides flexibility in parking supplies for changes in tenants or more general shifts in land uses. Cities may be reluctant to reduce parking requirements for a site not because of concerns of greater parking needs for the current tenant, but because of uncertainty regarding future tenants on the site. If the land saved through a parking reduction is developed, changes in land use intensity may result in insufficient parking capacity and overflow problems on city streets and adjacent property. Setting aside sufficient land to meet future potential parking needs, should they arise, can ensure that site-generated traffic can be accommodated on-site.

In addition to permitting parking reductions based on evidence of lower demand, several other types of flexible parking requirements were described in various ordinances:

- four cities allowed reductions for land uses near transit lines (Blaine and Burnsville, MN; Eau Claire and New Berlin, WI),
- two cities allowed reductions if bicycle parking was provided (St. Paul, MN and Eau Claire, WI),
- one city allowed reductions for participation in vanpool programs (Roseville, MN),

- one city permitted fees in lieu of parking to be used for construction of public facilities, in a specified zoning district (Cedar Falls, IA),
- one city permitted public parking spaces to supplement part or all of the required number of private spaces (Cedar Rapids, IA), and
- six cities reserved the right to require additional spaces if warranted by anticipated demand.

CONCLUSION

Both shared parking and flexible parking requirements can be useful tools in tailoring general parking standards to particular developments. Shared parking in particular seems to be an underutilized option in the ordinances examined in this study. Although a number of ordinances permit some type of shared parking among land uses, they typically define the permissible conditions for shared parking to exclude many worthwhile opportunities. A more inclusive description of shared parking is necessary to encourage communities to take better advantage of the reductions in parking requirements that can result from full application of shared parking principles. This description should emphasize the opportunities for shared parking among land uses such as offices, shopping centers, hotels, and restaurants, which may not have completely distinct times of operation, but which nevertheless have substantially different peaking patterns in their typical daily traffic generation.

This chapter presented examples of flexible parking policies drawn from the ordinance review, and described several that likely would be most useful in many cities. Proscribing specific flexible parking policies, however, would negate much of the value of such policies, namely their ability to be tailored to the needs of a specific community or a particular zoning district. Rather than adopting a particular flexible policy, a city should consider what conditions would be most likely to lead to an oversupply (or undersupply) of parking in its own community, and adopt those policies most likely to bring parking supplies in line with demand.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

This report examined parking policies in regional transportation plans and local zoning ordinances, and also reviewed literature on parking in TDM programs and trip reduction ordinances. Parking requirements were calculated based on zoning ordinances from approximately 70 cities in Iowa, Minnesota, and Wisconsin; these requirements were compared to estimates of parking demand for various land uses. The report also used these data to illustrate the potential benefits of a shared parking program, and reviewed local ordinances for policies on shared parking and flexible parking requirements.

The breadth of the materials reviewed—local parking ordinances, traffic engineers' estimates of parking demand, regional transportation planning documents, and evaluations of TDM and trip reduction programs—reflects the dispersed nature of planning for parking. The three primary sources of information (municipal ordinances, trip reduction and TDM programs, and regional plans) all address parking policies from very different perspectives. Decisions about parking, like other land use decisions in the United States, are primarily made at the local level. Parking policies can be, and often are, established only to accommodate local needs and concerns. Yet the impacts of parking policies extend far beyond municipal boundaries, as indicated by the impact parking has in most TDM programs. Plentiful free parking can counteract the total benefits achieved by virtually all other trip reduction tactics, frustrating efforts to mitigate transportation problems through such programs. This can contribute to increasing air pollution, traffic congestion, and auto dependence in many urban areas.

Such impacts indicate the need for considerations of parking policies at a broader level, such as the region or the state. This need is reinforced by other potential impacts of localized parking decisions:

- If such decisions lead to oversupplies of parking, they can contribute to regional problems with storm water runoff and water pollution.
- Requirements for large amounts of parking, particularly if shared parking is prohibited, encourage development at the urban edge, where land is relatively inexpensive and plentiful. This can impede efforts to develop a more compact and efficient urban form.
- Readily available parking can draw potential riders away from transit systems. Parking has two primary impacts on transit:

  - convenient and "free" (i.e., subsidized) parking is a significant incentive for using an automobile as opposed to transit;
  - a large amount of parking between a building and a major arterial acts as a barrier to transit users destined to the building, serving as a further disincentive to transit use.

- Large amounts of parking can prevent the development of an attractive and pedestrian-oriented community. A parking lot typically devotes 300 to 315 square feet to each auto parked in it (including the space itself, access aisles, and internal circulation). If the land use provides more than 3.3 parking spaces per thousand square feet of building area, it is providing more area for parking than building space. This is borne out by various studies, including a recent study from the City of Olympia, WA, which found in a survey of shopping centers that approximately twice the amount of land was devoted to parking as to the shopping centers themselves (City of Olympia 1995). Such an overabundance of parking taxes the skills of the most talented landscape architect or shopping center designer, and results in retail (and other) land uses surrounded by a sea of asphalt.

These impacts indicate that parking policies should be part of transportation planning efforts at all levels of government. Ultimately, much of the decision-making authority regarding parking rests at the local level, but state and regional agencies also can participate significantly in raising parking issues and developing mitigation strategies. The recommendations that follow are targeted toward state and regional transportation agencies, and are divided into two broad categories: those that can or should be undertaken at the state or regional level, and those that should be undertaken at the local level, with opportunities for state or regional assistance.

RECOMMENDATIONS FOR PARKING POLICIES AT THE STATE OR REGIONAL LEVEL

1) ***Explicitly recognize parking as an important part of the transportation system in statewide and regional planning.***

   The specific issues surrounding parking will vary from state to state and region to region; a typical set of issues that a state or region might want to draw on include:

   - the relationship between parking and mode choice, particularly parking's impact on transit ridership;
   - the role of parking in achieving TDM or trip reduction goals;
   - the regional or statewide impacts of parking on water pollution;
   - parking as a tool to achieve air quality mandates;
   - providing transportation allowances or cash-out programs;
   - reducing or eliminating parking subsidies through taxes or surcharges.

The particular issues discussed may not be as important as simply raising the issues in a public forum, and providing recognition that parking policies are of significant importance beyond a local level.

2) ***Link parking policies to federal and state requirements.***

For example:

- emphasize the role of parking in TDM and trip reduction strategies;
- recognize parking's impact on transit ridership;
- discuss ways to increase the efficiency of parking policies through reviews of parking requirements and opportunities for shared parking and flexible parking programs;
- discuss the environmental impacts of parking, particularly with respect to water pollution and, through its impact on mode choice, air pollution;
- view parking as an appropriate means of linking transportation and land use concerns.

3) ***Gather sufficient empirical data to validate the application of nationwide parking demand estimates to Iowa developments.***

4) ***Support nationwide efforts (through ITE, AASHTO, or other appropriate bodies) to develop a more extensive parking demand data base.***

In particular, such a data base should advance our understanding of parking demand levels and needs at mixed use centers, and should increase our knowledge of "captive market" effects, both at mixed-use centers and at single-use sites.

5) ***Require inclusion of parking policies in any TDM or trip reduction program receiving state support.***

Examples of appropriate parking policies include 1) implementing flexible parking policies to support other TDM strategies, 2) increasing parking charges and/or reducing parking charges for ridesharers, 3) reducing off-street parking supplies or minimum parking requirements, 4) providing reserved parking spaces for ridesharers, and 5) providing peripheral parking lots with shuttle connections to major employment sites and activity centers. The particular parking policies to be implemented will depend both on the overall goals of the TDM program and the other strategies being implemented.

RECOMMENDATIONS FOR PARKING POLICIES AT THE LOCAL LEVEL

1) ***Disseminate information about potential oversupplies of parking to Iowa's cities and counties.***

This information should discuss both possible causes of such oversupplies (e.g., outdated requirements, lack of flexibility in accommodating reduced parking needs at particular sites, or inflated private sector expectations of parking needs) and the potential costs of requiring or allowing excess parking.

2) ***Communicate potential benefits of parking reductions and the costs of existing policies to the development community.***

3) ***Encourage communities to adopt shared parking regulations.***

   Information on shared parking policies could provide examples of appropriate opportunities for shared parking, model ordinance language, and potential cost savings.

4) ***Promote examples of parking flexibility that may be useful in particular circumstances.***

   Examples of potentially useful flexible parking policies include allowing reductions in parking for proximity to transit, participation in a trip reduction program, development of a fee-in-lieu program, or demonstration by the developer of reduced parking needs due to high "captive market" patronage, an active ridesharing program, or other appropriate considerations.

Different aspects of parking call for planning by different levels of government, as well as contributions by the private sector. The current transportation policy environment favoring increased intermodalism and communication across both functional transportation categories and levels of government presents considerable opportunities for raising the visibility of parking as a transportation issue and explicitly planning for its proper role in the transportation system. No one agency, body, or level of government can plan for parking; plans that recognize and utilize appropriate parking policies must be developed by state, regional, and local agencies. Much can be done separately by each agency but, as with many transportation issues, a successful parking strategy must ultimately be the product of a combined effort from a broad range of transportation interests, as well as from land use, air quality, and other groups concerned with solving urban problems.

APPENDIX A

MUNICIPAL ZONING ORDINANCES USED IN PARKING REQUIREMENT CALCULATIONS AND SHARED PARKING/FLEXIBLE REGULATION REVIEW

Iowa			
Ames	Clinton	Fort Dodge	Sioux City
Bettendorf	Council Bluffs	Iowa City	Urbandale
Burlington	Davenport	Marshalltown	Waterloo
Cedar Falls	Des Moines	Mason City	West Des Moines
Cedar Rapids	Dubuque	Ottumwa	
Minnesota			
Apple Valley	Cottage Grove	Lakeville	Roseville
Austin	Crystal	Mankato	St. Cloud
Blaine	Duluth	Maple Grove	St. Paul
Bloomington	Eagan	Maple Wood	South St. Paul
Brooklyn Center	Eden Prairie	Minnetonka	White Bear Lake
Brooklyn Park	Fridley	Moorhead	Woodbury
Burnsville	Golden Valley	Richfield	
Coon Rapids	Inver Grove Heights	Rochester	
Wisconsin			
Appleton	Janesville	New Berlin	Waukesha
Beloit	Kenosha	Oshkosh	Wausau
Brookfield	LaCrosse	Racine	West Allis
Eau Claire	Madison	Sheboygan	West Bend
Fond du Lac	Manitowoc	South Milwaukee	
Franklin	Milwaukee	Stevens Point	
Green Bay	Neenah	Superior	

APPENDIX B

METHODOLOGY FOR ESTIMATING PARKING REQUIREMENTS

As described in Chapter 3, six scenarios were developed to determine parking requirements for different land use categories in roughly 70 cities in Iowa, Minnesota, and Wisconsin. The scenarios were:

- 10,000-square-foot office building;
- 100,000-square-foot office building;
- 10,000-square-foot retail store;
- 50,000-square-foot shopping center;
- 300,000-square-foot shopping center; and
- 50-unit multifamily residential complex of two-bedroom units.

All scenario sizes for office and commercial use are in square feet of gross floor area.

STEP 1: SELECT PARKING CATEGORIES

The first step was to select the applicable parking category in each municipal ordinance for each scenario. The office and multifamily residential scenarios corresponded well to office and residential land use categories present in most zoning ordinances. Not all communities differentiated retail and shopping center categories; in such cases, the parking requirements for the most appropriate existing commercial category were used for both the retail and shopping center scenarios.

It was assumed for the purposes of this categorization that the scenarios existed outside of a city's central business district (CBD). Cities often require lesser amounts of parking in their CBD, or no privately-provided parking at all. Because most commercial, office, and residential development currently taking place in Iowa and elsewhere occurs outside established CBDs, the use of parking requirements for land uses outside a CBD was expected to result in more realistic and useful estimates.

At times, the same land use might be subject to differing parking requirements in different districts (excluding the CBD). In such cases, the ordinance was studied to determine in which district a particular type of development (e.g., a 50-unit multifamily housing complex) would be most likely to be located, and the parking

requirements for that district were used. If no clear-cut decision could be reached, the parking standards for a suitable district were used (e.g., a primarily office district for the office scenarios).

STEP 2: CALCULATE NUMBER OF SPACES, WITH ADJUSTMENTS

The second step was to calculate the number of spaces required by each municipality for each scenario. This was straightforward if the parking ratio was expressed in terms of spaces required for 1,000 square feet of gross floor area (e.g., 3.3 spaces/thousand square feet of gross floor area for office uses). However, this step could become more complicated in three ways. Adjustments and assumptions were made for each of these situations to permit the computation of the number of spaces required for each scenario. These adjustments and assumptions are described below.

Parking requirements expressed in terms of building space less than total floor area. Many zoning ordinances express parking ratios in terms of leasable floor area, net floor area, useable floor area, or some other subset of the total floor area. Ordinances sometimes, but not always, define these terms and rarely indicate the percentage of total floor space that is considered to be leasable or usable.

A review of real estate literature suggests that leasable or usable space usually comprises roughly 80 percent of the total floor space of an office or commercial development (National Retail Federation 1995). Although this percentage varies depending on the size of and number of stories in the building, the age of the building, and other factors, 80 percent was assumed to be a reasonable estimate for an *average* office or commercial development.[12] This figure was used as the basis for parking space calculations in those cities that linked parking ratios to leasable or usable floor space and did not indicate a particular percentage in the ordinance.

Use of employee numbers to determine parking ratios. Some ordinances related the number of required spaces to the number of employees. As the scenarios were developed based on gross square feet of office or commercial development, estimates had to be made of the likely number of employees working in each scenario. Various empirical studies have calculated the average square footage for office employees. The results are presented in Table B–1.

Averaging the results of these six studies produces an estimate of 339 square feet per office employee. The figure from Cervero (1989) was least consistent with the other estimates, primarily because it was based on information from large mixed-use suburban centers, which may be atypical of current office development in the U.S. Dropping this estimate produced a figure of 308 square feet per employee. This was

[12] Note that this estimate does not indicate the percentage of space devoted to *retail* floor area, which in commercial developments is frequently a very small percentage of the total shop floor area. No reliable estimates of retail floor area as a percentage of gross floor area could be obtained; however, this only affected the parking ratio calculations of one city.

rounded off to 300 square feet per employee, producing an estimated 33 employees in the 10,000-square-foot office building and 333 employees in the 100,000-square-foot office building.

Table B–1. Average amount of space per office employee, as cited in various empirical studies

Source	Amount of space per employee
Gruen Gruen and Associates (1986)	347 square feet
Cervero (1986)	380 square feet (gross floor area)
Cervero (1989)	492 square feet (gross floor area)
Kuah (1991)	286 square feet (gross floor area)
Shoup and Pickrell (1978)	250 square feet
Willson (1992)	278 square feet

Only one city expressed retail parking requirements in terms of spaces per employee. As no reliable figures could be found for amount of floor space per retail employee, parking requirements for this city's three retail scenarios were not calculated.

Square feet versus number of spaces. A few cities did not specify number of spaces per unit of development, but instead directly tied the area to be devoted to parking to the area of the building (in square feet of floor area). This made it necessary to estimate the average size of a parking space to convert the required amount of parking area to an estimated number of spaces. Three references were in general agreement on this figure: Weant and Levison (1990) indicated a typical parking space is 300 square feet, including room for maneuvering; the National Parking Association et al. (1983) reported an average of 300 to 315 square feet; and Vuchic and Hessami (1978) reported an average of 300 to 320 square feet. 300 square feet per parking space was used for these calculations, resulting in 3.33 spaces per thousand square feet of parking lot. (In other words, if the parking ordinance required the area of parking to be 100 percent of the floor area of the building, this was translated to 3.33 spaces per thousand square feet of floor area.)

STEP 3: DETERMINE OVERALL PARKING RATIO

Following the adjustments made in step two, the amount of parking required for each scenario by each city was summed and averaged to produce an overall parking ratio for each scenario, as described in Chapter 3. This was done for the overall sample, and by state.

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