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CONTENTS

ACCESS Magazine reports on research at the University of California Transportation Center and the University of California Center on Economic Competitiveness in Transportation. The goal is to translate academic research into readable prose that is useful for policymakers and practitioners. Articles in *ACCESS* are intended to catapult academic research into debates about public policy and convert knowledge into action.

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Politics ain't worrying this country one-tenth as much as where to find a parking space.
—Will Rogers

This issue of *ACCESS* considers the most controversial topic in transportation: parking. When it comes to parking, rational people quickly become emotional, and staunch conservatives turn into ardent communists. Critical and analytic faculties seem to shift to a lower level when people think about parking. Some people strongly support market prices—except for parking. Some vehemently oppose subsidies—except for parking. Some abhor planning regulations—except for parking. Some insist on rigorous data collection and statistical tests—except for parking. This parking exceptionalism has impoverished discussions about parking policies. The authors in this issue have taken a more rational and rigorous approach.

Andrew Fraser, Mikhail Chester, Juan Matute, and Ram Pendyala found that, as of 2010, Los Angeles County had 18.6 million parking spaces, including 15 million off-street parking spaces and 3.6 million on-street spaces. This amounts to more than 200 square miles of parking, equivalent to 14 percent of the county's incorporated land area. Even though Los Angeles has one of the densest road networks of any metropolitan area in the US, the area dedicated to parking is 43 percent larger than the area dedicated to roads.

Zhan Guo examines what happened when London switched from minimum parking requirements to maximum parking limits. With the previous minimum but no maximum, most developments did not provide more than the minimum required, whereas with the maximum but no minimum, most developments provided less than the maximum allowed. The supply of parking in new developments is only 52 percent of the previous minimum required and only 68 percent of the currently allowed maximum.

Michael Manville and Daniel Chatman examine the results of SF*park,* San Francisco's pilot program that adjusts on-street parking prices to ensure parking availability. They find that the average parking occupancy rate is not the best way to measure parking availability. Instead, they argue that cities should aim for a high share of each time period with one or two vacant spaces on every block because drivers search for vacancies, not average occupancies.

Adam Millard-Ball, Rachel Weinberger, and Robert Hampshire also examine the results of SF*park*. They find that extending meter hours into high-demand times in the evenings and on Sundays, or pricing parking on unmetered residential streets, can provide higher benefits than simply adjusting rates where meters already exist.

Richard Willson explains why getting the prices right for parking are necessary but not sufficient for parking management. He shows how cities can both shrink the demand for parking and better manage all the parking they have.

And in the final article, I argue that charging market prices for on-street parking and spending the revenue for local public services can be a cheap, fast, and simple way to improve cities and create a more just society, one parking space at a time.

Donald Shoup
Editor of *ACCESS*

Do Cities Have Too Much Parking?

ANDREW M. FRASER, MIKHAIL V. CHESTER, JUAN M. MATUTE, AND RAM PENDYALA

Minimum parking requirements create more parking than is needed. This in turn encourages more driving at a time when cities seek to reduce congestion and increase transit use, biking, and walking. After nearly a century of development under these requirements, parking now dominates our cities.

To counter the problem of excessive minimum parking requirements, academics and practitioners have advocated a new suite of parking policies, including reduced parking requirements and demand-based prices for on-street parking. These policies aim to better manage parking and reduce driving, but too much parking works against these goals by spreading the destinations and making the cost of driving artificially low. To more effectively address the issues caused by minimum parking requirements, planners and policymakers should focus not only on future development, but also on the existing parking oversupply.

Relatively little information exists, however, on the amount and location of parking in cities, limiting our understanding of how that parking contributes to land and automobile use patterns. To address this knowledge gap, we developed a case study to estimate where parking infrastructure exists in Los Angeles and how it has evolved over time.

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Parking in Los Angeles County

Most cities in the United States, have required off-street parking spaces in their zoning and building codes since the 1950s. They require developments to provide specified amounts of off-street parking based on land use and project size. What makes Los Angeles unique and well suited for our case study is that 1) a majority of the buildings were erected following the adoption of minimum parking requirements, 2) the pace of construction has slowed dramatically in recent decades, largely due to spatial constraints, and 3) the region is unlikely to see extensive new development.

With a building stock and parking supply that are largely "locked-in," even drastic changes to parking requirements are likely to have little impact on the total number of spaces in the region. To understand how this parking may affect policies intended to curb the use of automobiles, city planners need information on where current parking exists and how much of it there is.

Los Angeles is widely recognized for its automobile dependence and associated issues with traffic congestion. Covering 4,700 square miles, Los Angeles County includes 88 incorporated cities. To evaluate the impact of minimum parking requirements in the county, we estimated the number, location, and year of construction for off-street residential, off-street non-residential, and on-street parking over the past century.

To develop these estimates at a scale that will be useful for policy decisions, we combined models of building and roadway growth, land use and building types, and historical minimum-parking requirements covering 55 types of zones. Because there was significant consistency from one city's parking ordinances to another's, we used the median parking requirements from a sample of 19 incorporated cities. Estimates of the on-street parking supply excluded portions of the roadway that would not have on-street parking, such as driveways, bus stops, fire hydrants, and intersections.

With a building stock and parking supply that are largely "locked-in," even drastic changes to parking requirements are likely to have little impact on the total number of spaces in the region.

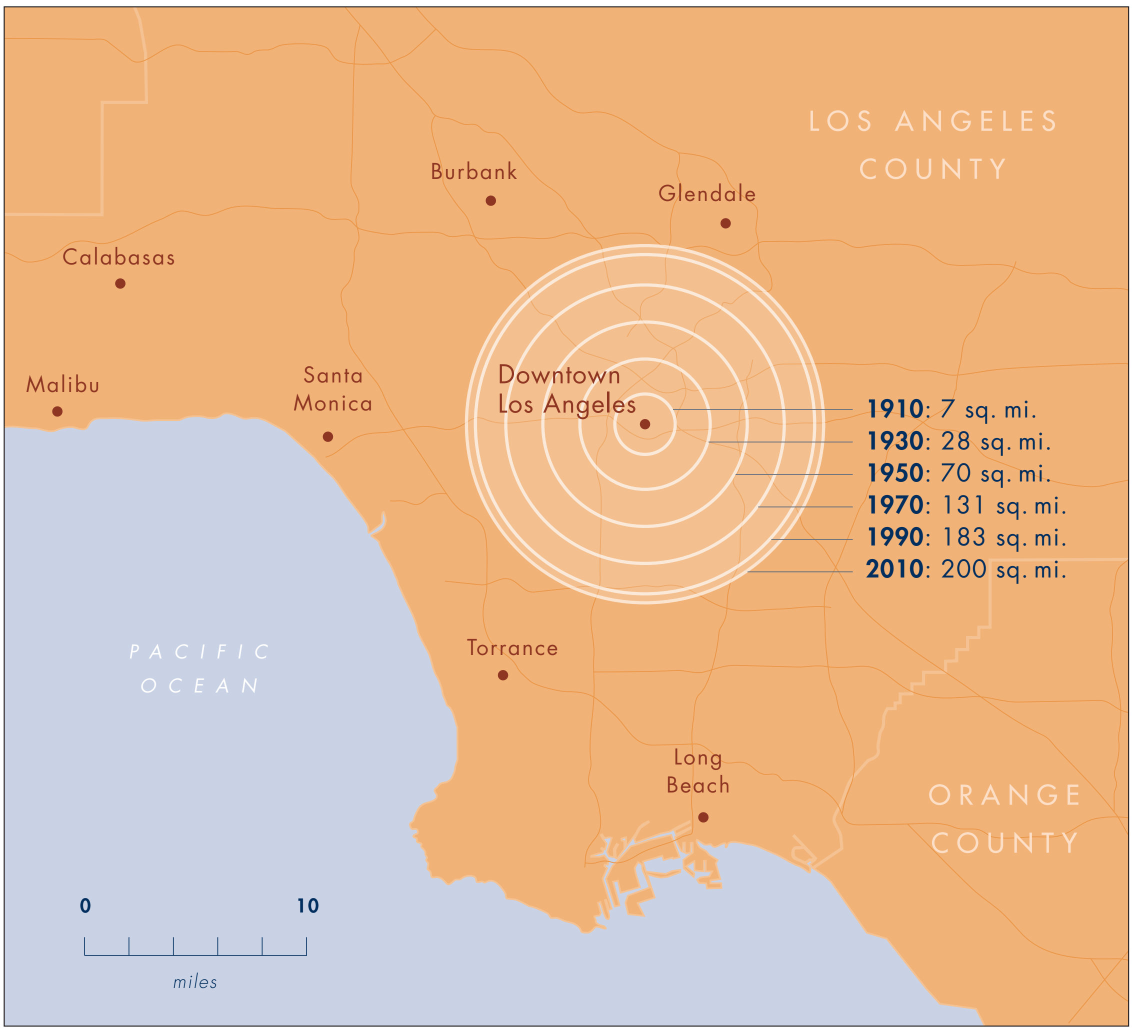
Parking Quantity

As of 2010, Los Angeles County had 18.6 million parking spaces, including 5.5 million residential off-street, 9.6 million non-residential off-street, and 3.6 million on-street spaces. This amounts to more than 200 square miles of parking spaces, equivalent to 14 percent of the county's incorporated land area (Figure 1). Even though Los Angeles has one of the densest road networks of any metropolitan area in the US and is recognized worldwide for its expansive freeway system, the total area dedicated to on- and off-street parking is 40 percent larger than the 140 square miles dedicated to the roadway system.

While perceived parking shortages are often used to defend minimum parking requirements in metropolitan areas, there are 3.3 spaces for each of the 5.6 million vehicles in the county (1.0 residential off-street, 1.9 non-residential off-street, and 0.6 on-street spaces per vehicle). Although certain areas of Los Angeles do struggle with an imbalance between parking supply and demand, these results show that the indiscriminate application of uniform parking requirements has led to a large oversupply of parking in many areas.

FIGURE 1

Los Angeles County's Total Parking Footprint, 1910–2010



Parking Growth

Los Angeles is a relatively young region, and a majority of its parking infrastructure was built during the second half of the 20th century. Between 1950 and 2010, the city added 12 million of its 18.6 million total spaces. The greatest rate of growth in total spaces occurred between 1950 and 1980, when an average of 310,000 spaces were added annually. During this time period, parking grew faster than the number of road lane miles, contributing to increased auto use and resulting congestion. Average space additions slowed to 190,000 per year from 1980 to 2010. By 1990, the growth of residential and roadway infrastructure also slowed. More recent increases in parking spaces across the county have mainly been the result of additional non-residential parking spaces.

The total area dedicated to on- and off-street parking is 40 percent larger than the 140 square miles dedicated to the roadway system.

Parking and the Automobile

The automobile was ascending to modal dominance in Los Angeles when minimum parking requirements were codified. As a result, parking spaces grew faster than cars, leading to a significant oversupply of parking. The rate of car ownership, however, soon caught up, and surpassed the growth or parking spaces. By 1975, the number of vehicles in the county equaled the number of off-street residential spaces. Since then, this ratio of vehicles to off-street spaces has remained consistent, approaching one to one in 73 percent of the census tracts in Los Angeles County. Residential off-street space requirements may be effective at preventing cruising for street parking in neighborhoods, but the results indicate that they incentivized vehicle adoption, ultimately contributing to additional vehicle miles traveled and congestion.

Parking Density

The growth of parking has varied across the county. Since 1950, much of the growth in parking occurred outside the urban core in low-density residential and commercial developments. Neighborhoods *within* the urban core, however, have the greatest parking space densities (Figure 2). The central business district has the highest density of parking spaces, most of which are associated with nonresidential development. This abundance of parking in areas with high-quality transit and dense mixed-use limits transit use, cycling, and walking. While we did not directly assess how the parking supply affects congestion, we suspect that high parking density contributes to localized congestion on nearby roads. Reforming existing parking requirements may limit parking additions in the future but is unlikely to address existing congestion issues.

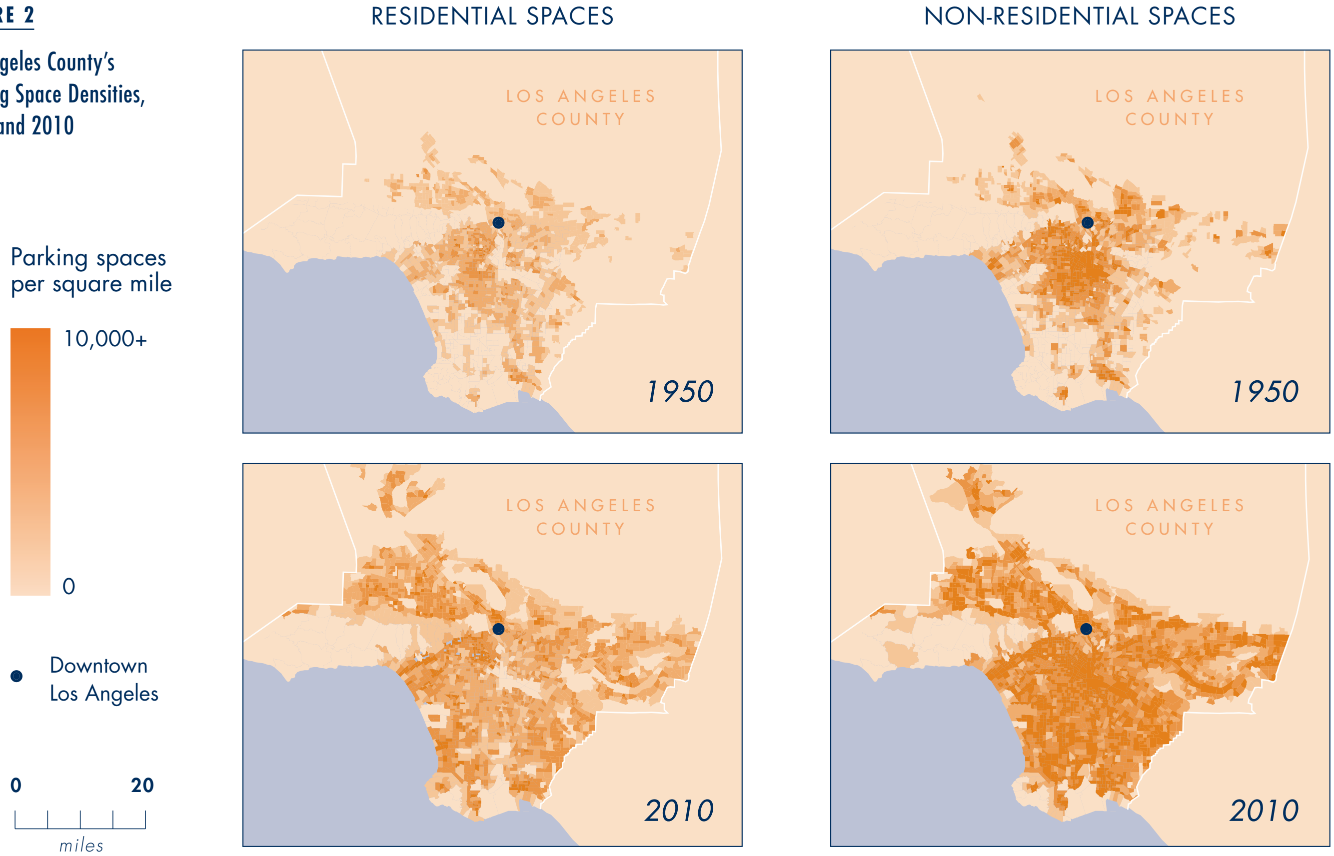
Reducing the Parking Supply

Our findings suggest that cities should reduce the existing oversupply of parking, which encourages automobile travel and deters alternative modes. It may be necessary to reduce the number of existing parking spaces to fully realize the positive impacts of these policies.

There is also a substantial opportunity to redevelop our cities by transitioning existing parking to alternative land uses. Space for development is limited in urban areas, but our findings show that a significant portion of developable land in Los Angeles is dedicated to parking. While repurposing parking lots or structures may offer the greatest opportunity for

FIGURE 2

Los Angeles County's Parking Space Densities, 1950 and 2010



large redevelopment projects, planners should also consider the benefits of transitioning residential parking, especially home garages, toward other uses. Converting residential parking spaces to additional dwelling units, for example, could help alleviate the housing shortage in Los Angeles.

Reducing the existing parking supply will likely meet strong resistance in a region that is largely car dependent and, in the short-term, could increase cruising for parking and congestion. In order to reduce car dependency and its associated problems in the long term, however, existing parking should be repurposed.

Conclusion

Reforms need to go beyond reducing or removing minimum parking requirements. Cities can encourage converting parking to other uses. While parking may dominate urban landscapes today, new uses for this land and capital can provide a path to a brighter future. ◆

This article is adapted from "Parking Infrastructure: A Constraint on or Opportunity for Urban Redevelopment? A Study of Los Angeles County Parking Supply and Growth," published in the *Journal of the American Planning Association*.

FURTHER READING

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Cruising for Parking

LESSONS FROM SAN FRANCISCO

ADAM MILLARD-BALL, RACHEL WEINBERGER, AND ROBERT C. HAMPSHIRE

Parking management has been a vexing problem for cities since the invention of the automobile. Among the concerns are traffic congestion, air pollution, and greenhouse gas emissions caused by drivers searching for available parking—an activity colloquially known as *cruising*. Cruising for parking in a 15-block business district in Los Angeles has been estimated to produce 3,600 miles of excess travel each day—equivalent to two round trips to the Moon each year.

Many cities try to reduce cruising by increasing the supply of parking. They require private developers to provide off-street spaces to accommodate the expected demand for [free] parking, and they provide public garages to make up for shortages at the curb. These minimum parking requirements have been standard practice in US cities since the 1950s.

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Although cities have increased the supply of off-street parking, they have neglected to manage on-street spaces. Because they seem unable or unwilling to properly price scarce curb spaces and enforce restrictions, cities suffer from cruising, double parking, and illegal parking in bus stops and other restricted zones. If the price of off-street parking is higher than the price of parking at the curb, drivers will rationally choose to cruise.

Recently, a wave of interest in more effective curb parking management, particularly through performance-based pricing, has arisen in cities as diverse as Seoul, Mexico City, New York, Seattle, Los Angeles, and Budapest. The movement is exemplified by San Francisco, which introduced variable priced parking to improve space availability and reduce cruising.

Here we evaluate the effectiveness of the pilot San Francisco initiative, SF*park*. We ask whether it succeeded in reducing cruising and examine how to set performance targets to achieve a given level of parking availability.

About SF*park*

One of the defining features of SF*park* is that it adjusts parking meter rates based on occupancy levels observed over the previous weeks or months, with the aim of achieving a per-block occupancy rate between 60 and 80 percent. The city increases meter prices by 25 cents per hour if the occupancy on a block exceeds 80 percent, and reduces the price if the occupancy is less than 60 percent. By adjusting the price, the city expects to redistribute parking demand from very crowded blocks to less crowded ones.

By adjusting the price, the city expects to redistribute parking demand from very crowded blocks to less crowded ones.

A system of parking sensors tracked occupancy levels in both pilot areas where meter prices changed, and in control areas where meter prices remained unchanged. The sensors provided detailed occupancy data, which the city used to adjust rates about every six weeks. The six-week frame was selected to allow users to become accustomed to the new prices before making additional changes. The sensors, which have a limited lifespan, were disabled at the end of 2013. Since then, SF*park* has adjusted meter rates using meter payment data to estimate occupancy.

Our study of SF*park* uses the sensor data. We obtained occupancy snapshots every five minutes over a six-week period, and average hourly occupancy rates over a two-year period. We used the five-minute snapshots to model the likelihood that a space would be available, given the block size and an hourly average occupancy. We then developed a simulation model to estimate the amount of cruising by calculating the distance a driver must travel before finding an available space.

Setting a Parking Occupancy Target

Any occupancy target represents a tradeoff. The lower the occupancy, the easier it becomes for drivers to find a space and the less they will cruise to find a vacant spot. A lower occupancy, however, also means that curb spaces are idle more of the time, which wastes the space and deprives the city of revenue from parking meters.

One rule of thumb that has gained wide policy traction is to use an average occupancy rate of 85 percent to eliminate cruising. This rate would ensure that at least one parking space is available on every block at all times. To achieve this 85 percent occupancy rate, parking prices should vary throughout the day and across different blocks. The 60–80 percent target occupancy under SF*park*, by contrast, is slightly lower than the widely accepted rate of 85 percent. The rationale of SF*park* is the variability in parking demand. An occupancy rate of 60–80 percent averaged over a period of time may include moments where occupancy exceeds 85 percent and even reaches 100 percent.

Any occupancy-based goal, however, is somewhat arbitrary. More importantly, it does not relate directly to public policy goals of improving availability and reducing cruising. Driver behavior is not guided by average occupancy on a block. Rather, it is guided by price and availability. Knowing that the *average* occupancy is 85 percent is little comfort if a block is full.

Moreover, more people try to park at high-demand times and are therefore exposed to crowded parking conditions. For example, take a block that is empty half the time, fills up very rapidly, and then remains full. When full, drivers will continue to arrive but be forced to seek parking elsewhere. Objectively, this block has an average occupancy rate of about 50 percent, yet only one user experiences it as 50 percent full. The vast majority of parkers, or would-be parkers, arrive after the block is full and experience it at 100 percent occupancy. While the average occupancy target may thus be met, the user experience still leaves something to be desired.

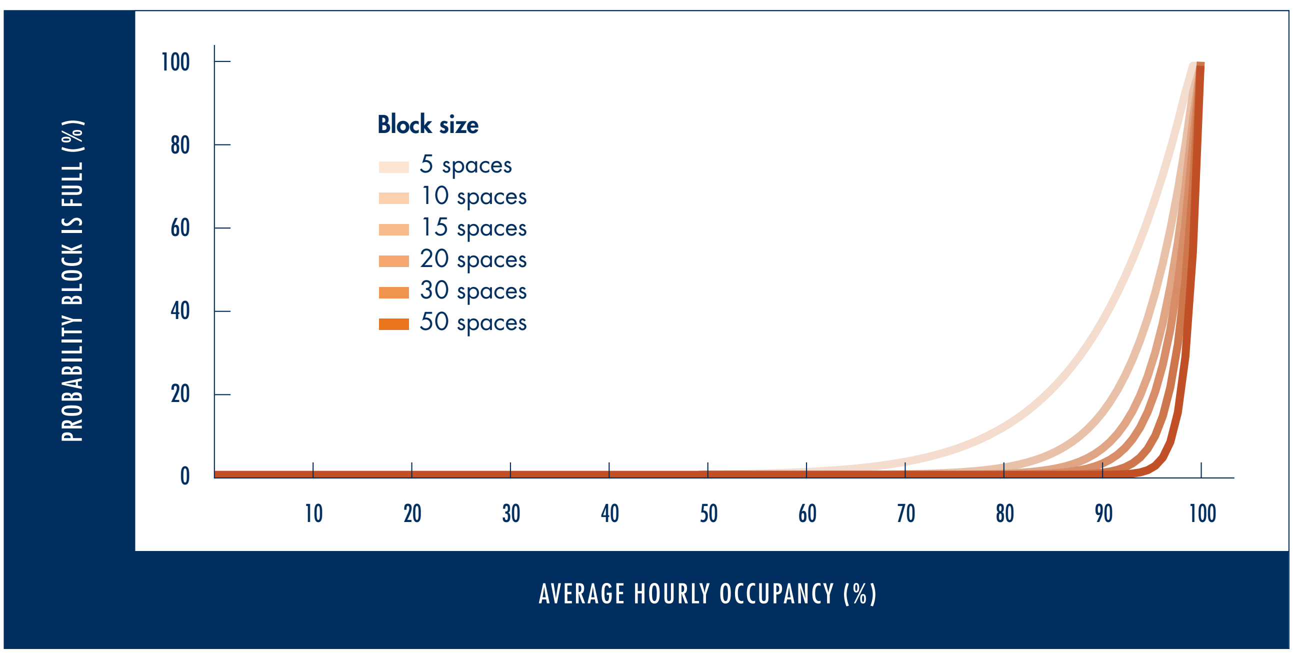
Therefore, the variable relevant to policy is the demand-weighted *probability that a block is full*. We use the sensor snapshot data to calibrate the relationship between this measure and the average occupancy. We find that block size and the length of the averaging period are important practical factors to consider when measuring the performance of the 85 percent rule of thumb.

The size of the block is important.

The relationship between block size (number of spaces) and the probability of unavailable parking is shown in Figure 1. For any given occupancy level, the probability that a block is full decreases as the size of the block increases. This makes intuitive sense and suggests that a uniform occupancy target across all block sizes may be inappropriate from a policy perspective. For very large blocks, a parker has a good chance of finding a space even when more than 90 percent occupied. In this case, the occupancy target could be increased to 90 or 95 percent.

FIGURE 1

Probability of a Block Being Full for Different Block Sizes



Our simulations suggest that SF*park* worked.

The rate of observations and the period over which the average occupancy is measured matter. Consider, for example, a block with 85 percent average occupancy. If the average is based on five observations in a five-minute period (i.e., one observation per minute), then it is highly unlikely that the block is ever full during this time. At the other extreme, if the average is computed over a 24-hour period with one observation made every hour, the chances are much greater that the block was actually full over some periods and quite low during others. Therefore, if a two-week period of averaging is used, as in the case of SF*park*, then a lower occupancy target may be appropriate to ensure parking availability and reduce cruising.

The takeaway message: the fewer spaces on the block and the longer the period of averaging, the lower the occupancy target needs to be to achieve parking availability.

Does SF*park* Reduce Cruising?

Our simulations suggest that SF*park* worked. Occupancy levels moved towards the 60–80 percent target range. In addition, cruising fell by more than 50 percent over a two-year period in the SF*park* pilot areas compared to the control neighborhoods.

The two years of our data occurred during a rebounding local economy, when parking pressures would be expected to intensify. In fact, there was little change in occupancy in the pilot areas—reflecting the success of SF*park*—while parking availability and cruising worsened in the control areas.

Success, however, did not happen overnight. On average, each individual rate adjustment brought a block 0.1–0.2 percentage points closer to the 60–80 percent target range (Figure 2). It took nearly two years for these small changes to grow into a larger and statistically significant cumulative effect, with an average difference of 1–2 percentage points after ten rate adjustments. For example, a typical block with 84 percent occupancy fell to 82–83 percent occupancy over two years, while a block with 50 percent occupancy rose to 51–52 percent.

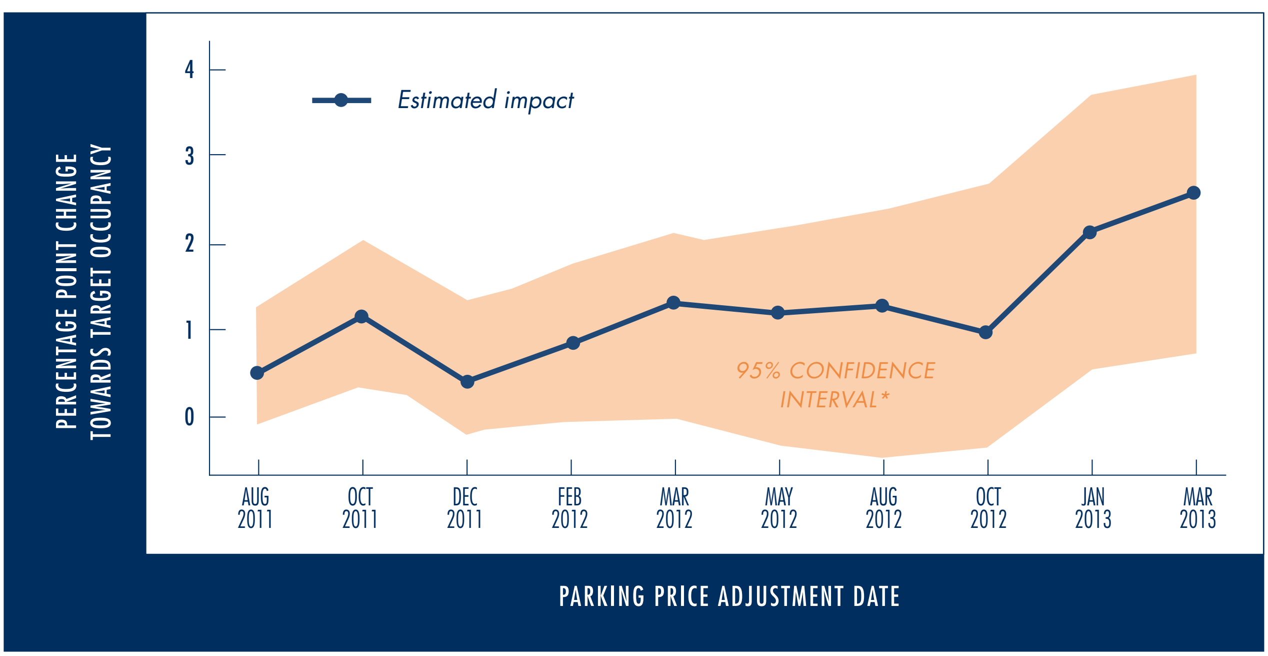
That SF*park* took time to influence behavior should come as no surprise. Almost all rate adjustments were just 25 cents, up or down. Drivers are presumably reluctant to forgo the first available space in the hope of saving a quarter and finding a space on a neighboring block. Only when rate differentials between neighboring blocks grew larger over time did the incentive to seek out cheaper parking increase substantially. Moreover, it is unclear how many motorists were aware of the differential rates and the opportunity to save money by choosing a space on a more distant block. Some hold disabled placards and can park for free at meters by state law. According to City of San Francisco surveys, about 20 percent of metered spaces are occupied by disabled placard holders.

SF*park* effects on cruising were smaller—but still encouraging—compared to its effects on occupancy. In pre-SF*park* baseline simulations, the average motorist could find parking within just 0.13 blocks—equivalent to about 50 feet, or just a few seconds. (This does not include the distance driven partway along the block where the driver ultimately finds a space.) Our simulations suggest that each rate adjustment reduced the average search for parking in the SF*park* pilot by about a hundredth of a block (roughly four feet) compared to the control areas. The cumulative impact after the tenth rate change was between 0.07 and 0.17 blocks (roughly 30 to 70 feet).

This reduction in cruising seems small but is more than 50 percent less than our baseline. In other words, SF*park* produced a small absolute but large relative reduction in cruising.

FIGURE 2

Impacts of Rate Changes on Occupancy over Time



Sample: 311 blocks with sensor data; metered hours. *Combined confidence interval for three alternative models.

Differences in Perception and Data Collection

Almost any resident or visitor to San Francisco can regale you with stories of their parking miseries. Self-reported survey data also indicates that cruising is a major problem. How is it we have data suggesting an average distance cruised of just 50 feet but perceptions of much longer times?

Two separate pieces of data from the San Francisco Municipal Transportation Agency (SFMTA) provide useful points of comparison. Parkers interviewed on the street reported an average search time of more than six minutes (albeit down from more than 11 minutes before SF*park* was implemented). Meanwhile, bicycle surveyors, who followed a predetermined route in certain neighborhoods, found that average search time for an available space ranged from just over 30 seconds in the early mornings, to nearly two minutes at lunchtimes.

The face-to-face SFMTA surveys show markedly more cruising than both the bicycle surveyors and our own results. Thus, cruising may partly be a problem of perception. Differences between the reported cruising times may also arise if some of the interviewees searched for a zero-cost space on a residential street, passing up an available metered space.

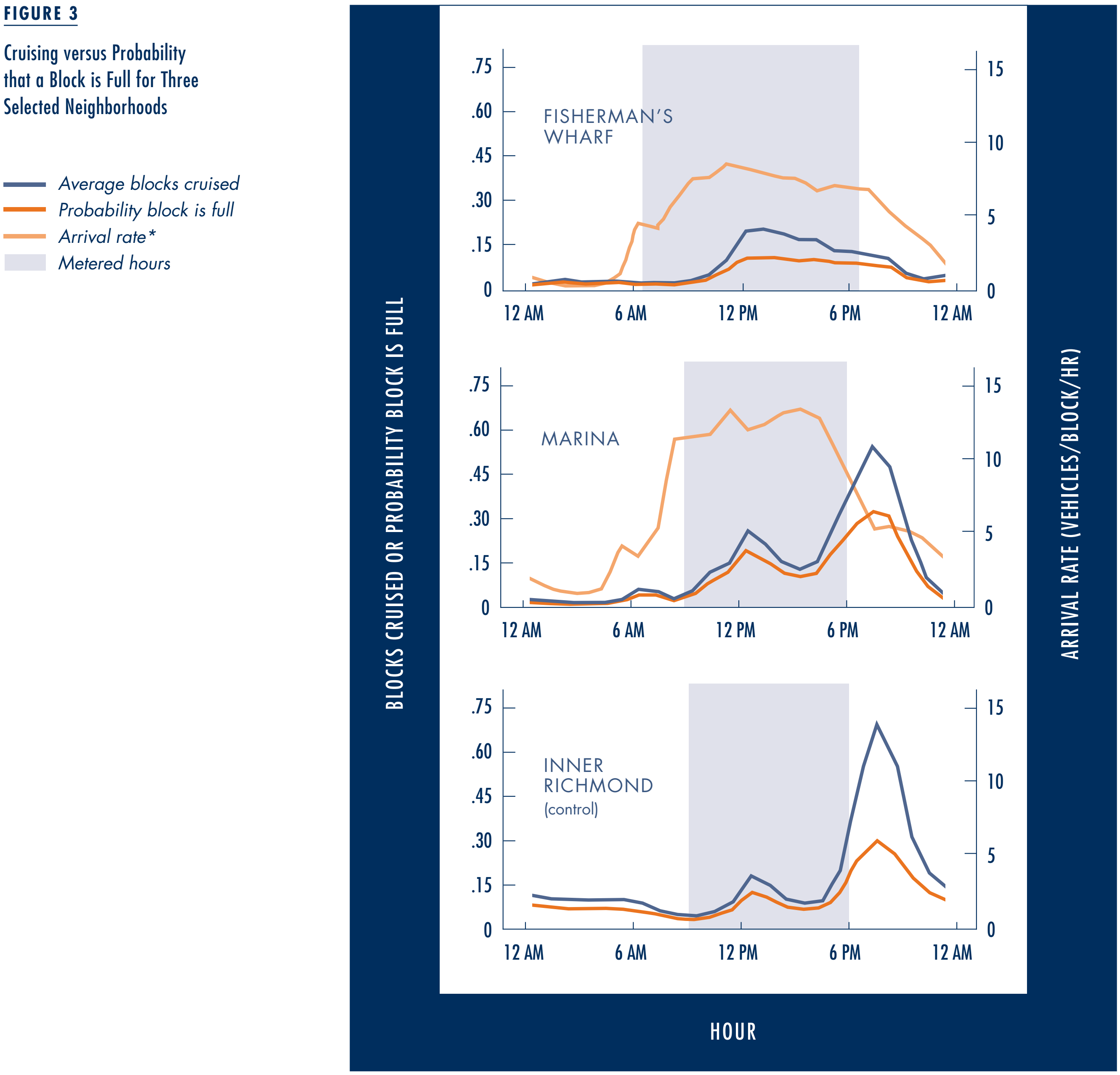
The contrast between our own results and the bicycle surveys may be due to methodological differences. For example, we do not count the distance traveled on the block where a driver ultimately finds a space. If parking were available on the first block, we would register zero cruising, while the SFMTA surveyors would count up to the length of the block, typically 400 feet. We also sample all blocks in sensor-equipped neighborhoods, while the SFMTA's predetermined survey routes tend to start on the busier commercial streets and ignore vacant parking spaces that may be visible on side streets.

Metering: Locations and Times

Our interpretation is that cruising may indeed be a problem, both before and after SF*park*, but mainly on blocks without meters or in the evenings after meters have switched off. (The analysis described above only considers metered blocks during metered hours.) Motorists cruising for a parking space during the daytime may forgo a readily available metered spot in the hopes of finding a no-cost parking space (or one with a longer time limit) on a residential side street. In the evening, our data show that cruising increases markedly in many neighborhoods around 5 pm, an hour before parking becomes free at 6 pm. A driver arriving at 5 pm will be able to pay for just one hour and park until the next morning.

FIGURE 3

Cruising versus Probability that a Block is Full for Three Selected Neighborhoods



Sample: 262 blocks with continuous sensor record; weekdays only. Note: meter hours may vary within district; modal hours are shown.
*No arrival rate for control districts.

Figure 3 illustrates the patterns of parking and cruising over the course of an average weekday in three distinct neighborhoods. Fisherman's Wharf is a tourist-oriented destination and part of the SF*park* pilot. The Marina is a mixed-use commercial district and an SF*park* pilot neighborhood. Inner Richmond is a similar commercial district, but in a control area where meter rates remained unchanged.

In both commercial districts (the Marina and Inner Richmond), cruising remains low for most of the day, with a small peak around lunchtime. Cruising then rises dramatically around 5 pm as the rush of restaurant goers and returning residents begins, and peaks around 8 pm. The evenings show much less cruising in Fisherman's Wharf, a neighborhood where there are fewer local residents and neighborhood-oriented businesses. Given the apparent effectiveness of pricing, a possible next step for SF*park* to reduce cruising would be to extend the hours of meter operation to all periods of excess occupancy.

Conclusions

San Francisco's parking experiment, SF*park*, is the first large-scale experiment with performance-based management of on-street parking. Judged by its impact—improved parking availability and reduced cruising—it has been a success.

Several lessons can be taken from the San Francisco experiment. First, small changes in meter rates, such as 25 cents per hour, are unlikely to have much impact on driver behavior. There is only a discernible effect on occupancy and cruising after individual meter rate changes combine to form much larger price differences between nearby blocks, and after drivers have time to adjust to the patterns of prices. Cities that want to change parking availability or cruising will need to consider more substantial price changes that are immediately noticeable, or have a long-term strategy of small-but-frequent rate adjustments.

Second, few cities will be able to replicate the expansive (and expensive) network of in-street sensors that San Francisco used to monitor occupancy and make rate adjustments. Fortunately, similar results may be possible with simpler methods, such as using transaction data or occasional manual surveys.

Third, sensors provide a precise estimate of average occupancy, but that measurement only loosely relates to cruising, driver frustration, and the probability that a block is full.

Finally, while a performance-based strategy such as SF*park* can succeed, most of the gain occurs simply from pricing parking in the first place. For a city such as San Francisco, extending meter hours into high-demand times in the evenings and on Sundays, or pricing parking on unmetered residential streets, would provide a bigger win than adjusting rates where meters already exist. At least in San Francisco, cruising does not appear to be a major problem when there are meters in operation. Rather, the fabled scarcity of parking in urban neighborhoods results primarily from drivers searching for a *free* parking space. ◆

This article is adapted from "Is the Curb 80% Full or 20% Empty? Assessing the Impacts of San Francisco's Parking Experiment," published in *Transportation Research Part A: Policy and Practice*.

Further Reading

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Market-Priced Parking in Theory and Practice

MICHAEL MANVILLE AND DANIEL G. CHATMAN

One of the first lessons of economics is that price controls lead to shortages, and shortages lead to queues. Street parking vividly illustrates this principle. Many cities keep valuable street spaces free or underpriced, and as a result they fill up quickly, creating shortages at busy times. These shortages then create moving queues as drivers circle the block, or "cruise," searching for spaces. Cruising, in turn, creates congestion and pollution.

The textbook answer to this problem is simple: remove the price control and let the market set the price for curb parking. The "right" price will keep one or two spaces open but no more. Just as a private firm wants its inventory to sell briskly without being exhausted, so too should cities keep parking spaces well-used but never completely full. With most but not all spaces occupied, any driver willing to pay can find a spot, reducing cruising without creating underuse.

This approach to street parking is sometimes called performance pricing, because instead of choosing a price and seeing what happens to occupancy, the city chooses a performance standard (e.g., one or two spaces always open) and lets the price adjust to achieve it.

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Performance pricing for parking is similar to congestion pricing for roads: both use prices to "clear the market" and prevent the overuse of scarce infrastructure. Like road congestion pricing, performance-priced parking is rare. Most cities prefer to keep roads and parking free, even though cities that have experimented with congestion tolls have seen remarkable results. When London implemented congestion pricing in 2004, the price of driving into central London went from 0 to £5. Traffic volumes fell 25 percent the very first day of tolling. Results were similar in Singapore, where traffic volumes fell 44 percent in the first year of tolling, and in Stockholm, where traffic fell over 10 percent. Vehicles in toll lanes on California's performance-priced State Route 91 zip along unencumbered by congestion, even as vehicles in the nearby free lanes sit mired in traffic. In all cases, as the price goes up, congestion goes down. Could market-priced parking do the same thing?

In 2011, San Francisco decided to find out, by creating a market-priced parking pilot program, called SF*park,* in its downtown. SF*park*'s explicit goals were to reduce cruising (its slogan was "live more, circle less"), increase the speed and reliability of transit, and make walking and cycling safer. For researchers, SF*park* provided a real-world test of performance pricing. Would raising the price for parking nudge occupancy down and vacancy up in one of America's densest and most congested cities?

About SF*park*

Prior to SF*park*, meter rates in San Francisco were like those in most cities. They varied by neighborhood, but not by time of day or day of week. Prices were rarely high enough to generate turnover, and often much lower than off-street rates. In the downtown, the highest on-street price was $3.50 an hour, while the median off-street price was $10 an hour. This disparity created curb shortages and gave drivers strong incentives to cruise. The San Francisco Municipal Transportation Agency (SFMTA) compounded this problem by rarely changing the rates. And when the SFMTA did raise prices, it usually did so to raise revenue, not to improve parking. There was no fixed timetable for reviewing meter rates, nor any formula for changing them. And, of course, increasing rates was rarely popular and often laborious, because most of the meters were older, coin-operated devices.

SF*park* changed these conditions. Using modern equipment, the program made prices more responsive to demand, and made price changes more transparent and predictable. And unlike many public initiatives, which get launched with fanfare and then fade from view before anyone can scrutinize them, SF*park*'s planners displayed an admirable commitment to openness and analytical rigor. The SFMTA selected eight "treatment" neighborhoods and four control neighborhoods. In both areas, it replaced thousands of coin-operated meters with digital "smart" meters that allowed credit card and remote payment. The agency also placed magnetic sensors in the pavement to measure parking occupancy. Together the sensors and meters relayed information wirelessly to the SFMTA, allowing the agency to correlate prices with occupancy. All these data were available to the public.

Once the new equipment was installed, the city began gathering data and also relaxed the parking time limits. On some blocks the city allowed parking for up to four hours, and on the remaining blocks it eliminated time limits altogether. Finally, in late spring 2011, the SFMTA used its new data to set meter rates in the treatment neighborhoods. The new rates varied by block, by time of day (morning, midday, and afternoon "timebands"), and by day of the week (weekday versus weekend). The price adjustments were based on the average occupancy for each timeband on each block over the course of six to eight weeks' worth of sensor data. Prices for any of the three timebands on a block could rise or fall depending on the calculated occupancy levels (Table 1). Thus if a block was congested in the morning but vacant in the afternoon, the morning rate rose while the afternoon rate fell.

In short, SF*park* replaced an opaque system of rates that changed infrequently and by whole neighborhoods with a more transparent system where prices changed over smaller units of time and space. It also provided something close to an experiment in priced parking. SF*park* gave researchers the classic "before-and-after, within-and-without" research design: we could examine conditions on blocks that received variable priced parking before and after SF*park*, and compare these to conditions on similar blocks that were never "treated" with variable pricing.

TABLE 1

Criteria for Parking Rate Changes, SF*park*

AVERAGE BLOCK-SIDE OCCUPANCY	RATE CHANGE PER HOUR
Under 30%	–$0.50
30–60%	–$0.25
60–80%	No change
80–100%	+$0.25

Did SF*park* Work?

Performance pricing is intended to reduce cruising, and cruising is notoriously difficult to measure—it is hard to look at a car moving in traffic and know if it is searching for parking. However, cruising is caused by a shortage of street parking, and shortages *can* be measured, through occupancy and vacancy rates (which are simply the share of spaces that have vehicles in them, and the share that don't). Thus one way to evaluate SF*park* is to see if shortages became less common on treated blocks—if these blocks were more likely to have at least one open space.

Here is where things get tricky. SF*park*'s meters and sensors can measure average occupancy. Drivers, however, can respond to price increases in ways that may not change average occupancy. As prices rise, more vehicles could park for shorter periods of time. This higher turnover could help local businesses, but need not alter average occupancy (and might even increase local traffic). Drivers could also respond to higher prices by carpooling. Carpooling would change *vehicle* occupancy but not necessarily change *parking-space* occupancy. And, of course, some drivers might respond to higher prices by choosing not to pay. When subway fares rise, some people pay more, some people ride less, and some people jump the turnstile. Drivers may be no different. If higher prices just encourage meter evasion or double parking, then price changes may have little impact on occupancy or vacancy.

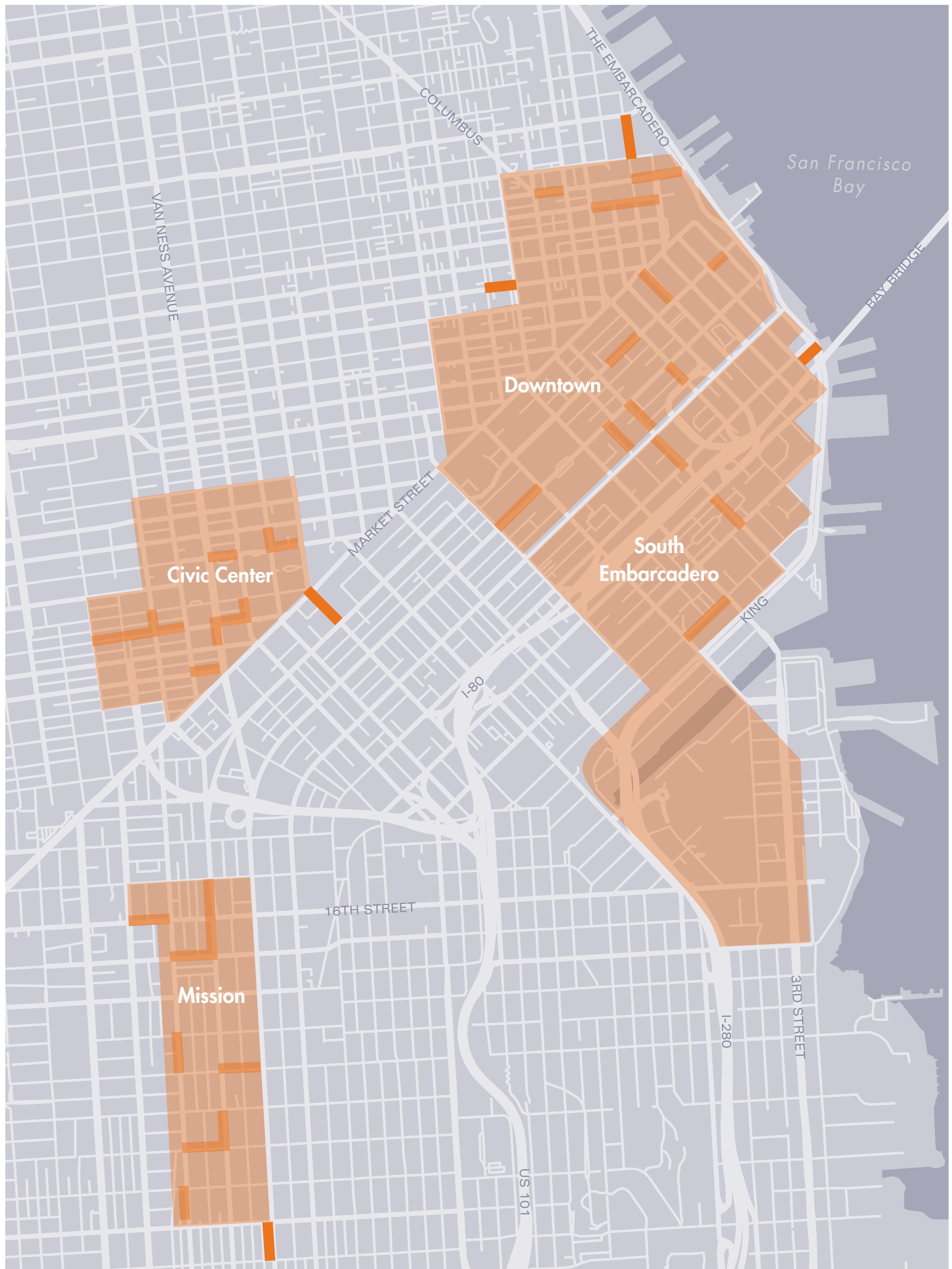
SF*park*'s meters and sensors could not track many of these changes. The SFMTA could not rely on its meter and sensor data to calculate vehicle turnover or the parking duration. Sensors also cannot tell if drivers are double-parking or carpooling, and cannot distinguish between types of nonpayment. Some nonpaying drivers are simply scofflaws, while others have credentials, such as disabled placards or government tags (acquired legally or illegally) that let them avoid payment.

Evaluating SF*park*'s Price Changes

In our study of SF*park*, we wanted to observe all of these behaviors. The best way to do so was to pay research assistants to stand on the streets all day and have them watch drivers park. (Yes, it was tedious; we paid well.) We selected about 40 block sides in the treatment zones and 9 “control” block sides nearby (Figure 1). Because we were interested in pricing’s impact on cruising, we concentrated on blocks where occupancy was often high. We then observed each block three different times, usually a week or two after SF*park* announced price changes. Student surveyors watched and recorded cars parking while pricing was in effect, typically from 7 or 9 am until 6 pm. This continuous observation allowed us to collect not only arrival and departure times for vehicles at individual meters,

FIGURE 1

Map of Pilot Zones, Rounds 1 and 3



SF*park* charging areas

Observed blocks

Control groups

0 0.5 miles

but also data on vehicle occupancy, double parking, and nonpayment. We observed 13,431 parking sessions during three rounds of observation over one year.

We found that when prices rose on a block its average occupancy rate fell. This result was encouraging—exactly as SF*park* had intended. Average occupancy, however, is only one way to measure parking availability, and may not be the best one, particularly if the average occupancy gets measured over the course of many weeks (as it did in SF*park*). A potentially better metric is minimum vacancy: the share of minutes that a block has at least one space open. When we analyzed minimum vacancy rates, we found that price changes had no effect. We also found no statistical association between price changes and carpooling, or price changes and vehicle turnover.

How can we make sense of these results? Nonpayment seems to be part of the answer, but not a huge part. The larger issues, we think, are twofold. First is the crucial difference between average occupancy and minimum vacancy. SF*park* raised prices only if the average occupancy was over 80 percent. Our favorite way to think about this, which we described for CityLab when we first conducted this analysis, is as follows: suppose you have a block with ten spaces and observe it for three hours, meaning there are 1,800 total possible minutes of parking on the block. If 1,200 of those minutes are occupied, the average occupancy rate is 67 percent, and the price should not change. But this figure indicates nothing about how those 1,200 minutes are distributed. They could be spread evenly across the three hours, implying that three spaces are always empty, or they could be two straight hours of zero vacancy followed by one hour of complete vacancy.

Now think about how this disparity between average occupancy and minimum vacancy could widen as occupancy gets calculated over longer periods of time. A block with an average morning occupancy of 67 percent for the month could contain hundreds of hours with no vacancies at all. The pricing mechanism can achieve the "right" average occupancy without attaining a consistent minimum vacancy. This is a problem, because drivers search for vacancies, not average occupancies.

The pricing mechanism can achieve the "right" average occupancy without attaining a consistent minimum vacancy. This is a problem, because drivers search for vacancies, not average occupancies.

The second problem is that SF*park* was not an example of "true" congestion pricing, in that prices did not closely match changes in demand. Compared to standard approaches for pricing parking, SF*park* was certainly using a market mechanism. Compared to most other markets, however, SF*park* remained tightly controlled. Look back at Table 1: the SFMTA limited the size and frequency of price changes. Rates changed once every eight weeks, and rates could neither increase by more than 25 cents per hour nor decrease by more than 50 cents per hour each time. Finally, the agency imposed a price floor of 25 cents, and a price ceiling of $6.00 per hour. So a block that started out $1.00 below its optimum level would take eight months to reach its market-clearing price (assuming nothing else changed) and blocks where the price should have been $6.50, or zero, would never reach their correct prices.

SF*park*, in short, was an example of price-controlled performance pricing. Because the price had a cap, it may not have risen enough to actually create consistent vacancies in some areas. On blocks with high parking demand, rather than "clearing the market," rising prices might have simply attracted drivers who were willing to pay more. As a result, in high-demand areas, rising prices may have changed the composition of parkers rather than created more vacancies. In principle this problem could be solved over time, if the price catches up to demand. But because there are caps on both the price level and the size of price changes, that is a big *if*. We cannot measure the queue on blocks without vacancies, but if they are large, prices may not be able to rise to clear them.

We do not fault the designers of SF*park* for these decisions. It is always easier to criticize a program after the fact than it is to design and deliver that new program in the first place. And trying to overcome the obstacles we list certainly has its own challenges. For example, winning permission to let prices truly float would have been difficult, perhaps even impossible. Nor is it obvious that more frequent or larger price changes would be administratively possible, or even desirable. A price that truly keeps at least one space vacant might fluctuate a lot. With more frequent or larger price changes, the benefits of increased vacancy might be outweighed by the unpredictability such a system could create for drivers. Drivers who arrive at their regular spots and find that the price had doubled might get discouraged and circle the block looking for a better deal—exactly the behavior SF*park* was designed to prevent.

The primary takeaway from our research is that performance pricing will always have to navigate a tension between the effectiveness of a price (does it actually create vacancies?), the stability of a price (how often does it fluctuate?), and the political acceptability of the price (is it so high that the public revolts, leading to no pricing at all?). Because this balance is most difficult to strike in the highest-demand areas, which are the areas most likely to generate cruising, the benefits of pricing programs may not be as large as were originally hoped. Nevertheless, the benefits *are* large, and SF*park* was a beginning, not an end. Policymakers and academics alike should work to expand and improve upon San Francisco's valuable work. ◆

This article is adapted from "Theory versus Implementation in Congestion-Priced Parking: An Evaluation of SF*park*, 2011–2012," published in *Research in Transportation Economics.*

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Parking Management *for* Smart Growth

RICHARD WILLSON

Parking is the sacred cow of land uses. It claims privileged status in zoning codes and there is simply too much of it in cities. Previous *ACCESS* articles reveal problems with minimum parking requirements; show how excess parking harms livability, sustainability, and equity; and explain how pricing can manage its use. This article demonstrates that progress requires more than code reforms and better pricing; it requires coordinated, comprehensive parking management. We need to shift from building parking to managing it.

Figure 1 shows the result of parking's privileged status: vast heat islands seldom used for their intended purpose. Future social trends and technological advances will disrupt the private vehicle ownership model, making these empty spaces even *less* justified. The question is how do we transition from too much parking to efficient use of a smaller parking supply? The answer is parking management.

FIGURE 1

Ontario Mills Mall Parking Lot, Ontario, CA

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FIGURE 2

No Parking

Parking management uses a wide range of tools—parking sensors, pricing, regulations, and information systems—in an effort to use parking efficiently. Efficiency occurs, for example, where the most convenient spaces serve many different parkers per day and different land uses share all spaces. Said another way, parking management prevents spaces from seldom or never being used.

Every community that has a two-hour time limit for downtown curb parking is engaged in parking management. The problem is that parking management is ad hoc, infrequently adjusted, and uncoordinated. In most communities, parking management is a "set it and forget it" enterprise. Figure 2 shows a locale where this set-it-and-forget-it mentality has been in place so long that a tree grew around the parking sign. Even in America's largest cities, a baffling, arbitrary, and non-optimal set of practices often manage on- and off-street parking spaces located in both private and public facilities.

As with any critique, the skeptic rightly asks, "how could this be?" There are three reasons for America's lack of proper parking management. First, our cultural ideals embed the notion that parking should be a free and available right in front of any destination. The introduction of parking management can signify broader, highly charged social changes as communities become denser and traffic increases.

Second, the responsibility for parking is extremely fragmented. Cities, transit agencies, property owners, employers, commercial facilities, and parking operators all play important roles. Even *within* governments, parking responsibility is divided between the departments of public works, planning, economic development, finance, as well as the police. Few cities think about the big picture in a comprehensive way.

Finally, the oversupply of parking means that we have not had to manage it well. When there is too much parking everywhere, there is no need to efficiently direct parkers to a space that suits the length of their stay. Most zoning codes have forced up the parking supply, which creates artificially low prices that do not create an incentive for better management.

Parking management shifts thinking about parking spaces from objects to services. While two parking spaces may have identical dimensions, one may seldom be used while the other serves many users and many trips per day. The first space is practically useless; the second effectively supports automobile access to a district.

The best way to measure parking use is by measuring the share of total hours a space is occupied (during a day, week, or year). Better parking use means we need fewer parking spaces to provide a given number of parking space-hours. Thus, as communities grow, the parking supply can grow more slowly or even shrink.

Figure 3 shows how parking perceptions differ from reality. The first, largest circle represents the number of parking spaces that stakeholders *think* they need when there is no management. Transportation demand management (TDM) allows a district to function successfully with fewer parking spaces. The second, smaller circle represents the number of parking spaces needed after conventional TDM. This reduction in spaces occurs, for example, when cities charge for parking and some drivers shift to carpooling, walking, biking, or transit. The third, smallest circle represents the number of spaces needed when better parking management more efficiently uses the spaces we already have.

Fortunately, there has been an explosion of techniques and technologies that facilitate parking management. Sensors can determine parking occupancy. This real-time information can reduce search times, allow sophisticated pricing schemes, and support efficient enforcement. Parking meters can vary price by time of day and parking duration to encourage space turnover. Meters that accept credit cards or smartphone payments eliminate the hassle of finding quarters to pay for parking.

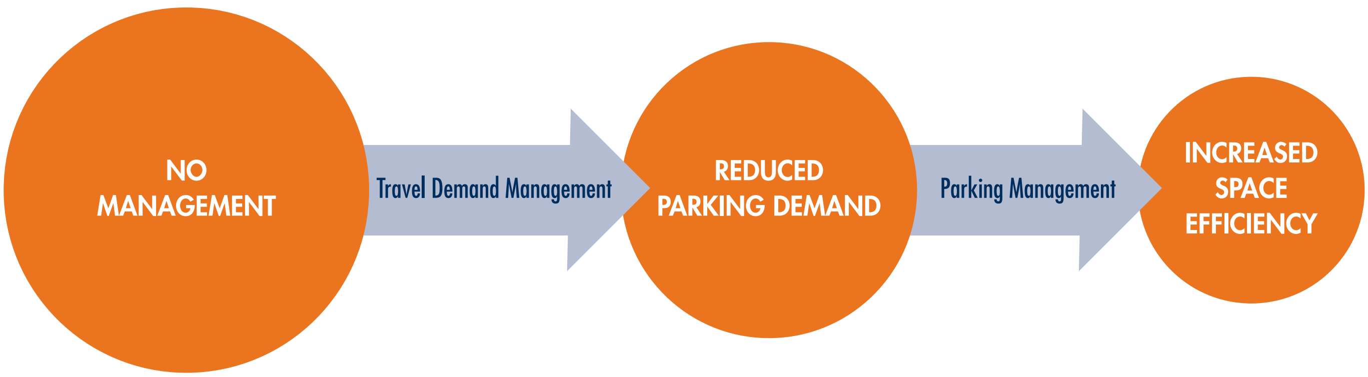
The other piece of good news is that cities are increasingly adopting parking pricing for on- and off- street spaces. This aligns the drivers' costs with the broader social costs of accommodating cars. Parking pricing encourages the use of alternative travel modes and can achieve space occupancy goals by dynamically varying prices to achieve space availability on every block. Dynamic pricing projects in Los Angeles and San Francisco use time-of-day pricing and frequent price adjustments to achieve space occupancy goals.

Combining parking pricing with new technologies will help resolve the parking management issue. Unfortunately, these tools alone are not enough. We need collective

Parking is the sacred cow of land uses.

FIGURE 3

Strategies to Reduce the Number of Parking Spaces Needed at a Site



action when markets don't function properly, such as when landowners don't respond to price signals because they are unaware of profit opportunities from sharing their parking. Planners may need to persuade property owners about the benefits of parking management, or give assistance in managing their parking.

The best solution is comprehensive and coordinated parking management. Improved management maximizes shared parking, uses parking prices to allocate spaces to parkers, and provides choices, predictability, and reduced search time for parkers.

Parking management requires a strategic plan that goes beyond traditional planning for parking. Plans must call for policy makers to engage with multiple organizations, not just one. These organizations must collaborate, design operating protocols, and perform assessments. Strategic plans should also include elements that are programmatic, which means that they can start as pilot projects and be adjusted in response to conditions. Changing meter prices or "loading zone" dedications is much easier than building or tearing down a parking structure.

Stakeholders often think of parking management options in ways that align with their background or expertise. Someone trained in economics is likely to think of pricing strategies. Someone trained in education and marketing may think about information systems. In Figure 4, Box 1 provides examples of strategies that an engineer might envisage, such as advanced parking equipment. Box 2 presents the pricing techniques used by an economist. Box 3 displays parking rules that reflect a regulatory approach. Finally, Box 4 contains education and marketing strategies.

Parking managers should consider all four approaches. They may not all apply, but a multi-pronged approach in which strategies are coordinated will be more successful than any one strategy. There may also be connections (and tradeoffs) between approaches. For example, dynamic pricing (Box 2) requires advanced parking equipment to support the pricing algorithm (Box 1). This equipment works best if parkers have apps that guide them to the location and price they want (Boxes 2 and 4). Rules about who gets to park in what space are likely still required for special parking uses, such as locations where curb parking is permitted (Box 3). Education is also essential to avoid the negative perception that this is just a money grab by the city (Box 4).

FIGURE 4

Parking Management Strategies

	DIRECT STRATEGIES	INDIRECT STRATEGIES
MONETARY ($)	1 "The Engineer" **Provide** parking for public use **Purchase** advanced parking equipment **Program** alternative transportation schemes	2 "The Economist" **Tax** parking spaces **Price** on-street parking **Subsidize** alternative modes
NON-MONETARY (RULES, CONVINCING, AGREEMENTS)	3 "The Regulator" **Require** parking cash out **Prohibit** bundled parking **Allow** shared parking	4 "The Educator/Marketer" **Inform** drivers about other options **Implore** people to walk **Facilitate** parking apps

Portland-based parking consultant Rick Williams argues that an integrated management entity can best coordinate parking strategies. Some cities create a parking authority and achieve a high level of coordination between private and public parking. Other cities form joint authorities with transit agencies to cooperatively manage parking resources as well. Williams outlines the following steps for creating a managed, integrated, and financially sustainable parking district.

1. Establish management principles
2. Create organizational structure
3. Define roles for on- and off-street parking
4. Establish rate-setting protocols
5. Measure performance
6. Communicate how the integrated parking system works
7. Evaluate new technologies
8. Conduct financial analysis for ongoing management

As cities consider a future economy that emphasizes use rather than ownership, and services rather than facilities, many are innovating in parking management. In addition to Los Angeles and San Francisco, cities representing a full spectrum of sizes and locations are following suit: Redwood City, CA; Pasadena, CA; Boulder, CO; Washington, DC; Portland, OR; Seattle, WA; and Tacoma, WA.

Meanwhile, several emerging trends suggest that parking use rates will decrease in the future. This shift is due to new services (such as shared-ride mobility), alternative arrangements to owning a car, and improved transit, walking, and bicycling options. Land use changes such as mixed-use developments will have a similar effect, while preferences for an auto-free lifestyle may reduce parking use as well. Furthermore, technology can reduce driving (such as online shopping), and self-parking cars reduce the space needed per parked vehicle.

The best strategy for creating a managed, integrated, and financially sustainable parking district is to start with an appeal to broader community goals. Show how parking management supports revitalization. Educate stakeholders, especially by showing them how parking management works in communities that are similar to theirs. Appeal to people's self-interest, such as when parking pricing produces revenue for street improvements or public amenities. Finally, find allies, like multimodal transportation advocates, infill and affordable housing developers, small businesses, and historic preservationists. All of them can help strengthen the case for parking management.

Parking management is the key to smart growth. As we shift toward providing parking as a service rather than as an object, so must we shift from building parking to managing it. We can manage parking more efficiently by ensuring that its price aligns with the value it provides. Parking management is right on time for this new era. ◆

This article is adapted from the book, *Parking Management for Smart Growth,* published by Island Press.

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FROM PARKING MINIMUMS TO PARKING MAXIMUMS IN LONDON

ZHAN GUO

Minimum parking requirements create too much parking, reduce the supply of housing, and increase traffic congestion. Without parking requirements, the market would provide fewer parking spaces, resulting in fewer cars and more housing units. Evidence to support this argument is inconclusive, however, in part because few local governments have removed their parking requirements. Even when they do adjust parking requirements, the changes are usually quite minor, often targeting small areas (e.g., near a rail station) and including only a few development types.

One exception is London. In 2004, London reversed its parking requirements, eliminating the previous minimums and putting new maximums on parking supply for all developments in the metropolitan area (Figure 1). No other major city has reformed its parking requirements on such a radical, comprehensive scale. Examining the effects of this reform provides much-needed empirical evidence of how parking reforms can affect cities.

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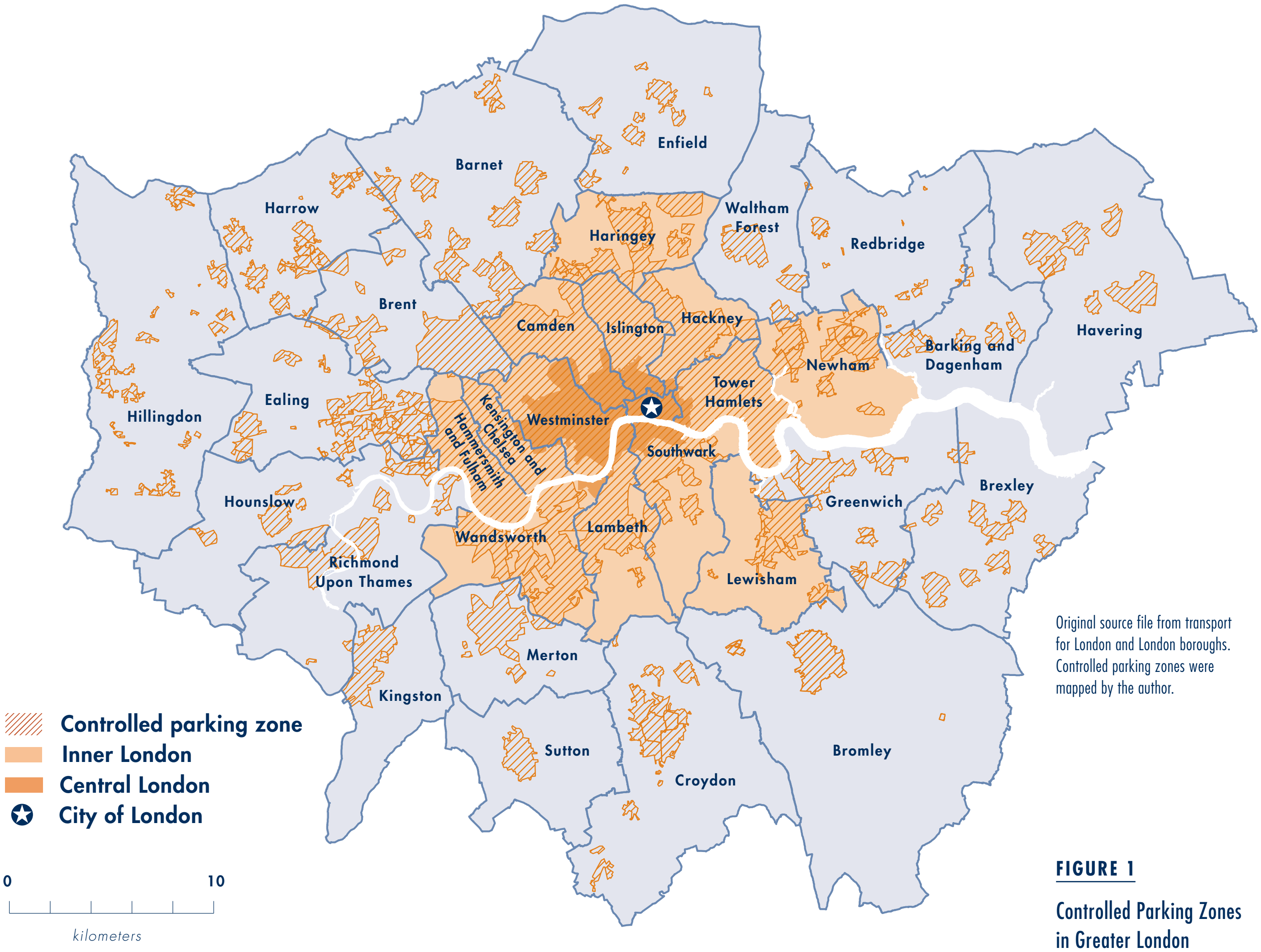


Original source file from transport for London and London boroughs. Controlled parking zones were mapped by the author.

FIGURE 1

Controlled Parking Zones in Greater London

London Parking Reform

The London parking reform was part of a national agenda to transform transportation policy in the United Kingdom that began years earlier. In March 2000, the UK government published *Planning Policy Guidance 3: Housing* which explicitly stated that "developers should not be required to provide more parking than they or potential occupiers might want," and that local parking standards should not result in developments with more than an average of 1.5 off-street parking spaces per dwelling.

In 2001, the government then published *Planning Policy Guidance 13: Transport*, which stated, "There should be no minimum standards for development, other than parking for disabled people," and that "maximum standards should be designed to be used as part of a package of measures to promote sustainable transport choices."

Following these national policies, the Greater London Authority (GLA), the regional government for the metropolitan area, passed the London Plan in February 2004, requiring local authorities to shift from parking minimums to maximums. As a result of the national and regional policy changes, London's 33 boroughs updated their local plans to replace parking minimums with maximums and used these standards in the review process for planning applications.

With the minimum but no maximum, most developments did not provide more than the minimum required, whereas with the maximum but no minimum, most developments provided less than the maximum allowed.

Data

In our research, we focused on residential developments because residential parking accounts for 71 percent of all off-street parking spaces in London. We used two sources of data. First, we used the application decision reports from residential developments built between 1997 and 2000. This dataset includes 216 residential developments with 2,666 housing units in 30 boroughs. Second, we used the London Development Database (LDD), containing records of all new development permits in London between 2004 and 2010.

Because information on the previous minimum standards was available for only 22 boroughs, we used a smaller subsample of only these boroughs, which included 8,257 developments with 204,181 units. This filtering ensured our study included only boroughs with information on the previous minimum and new maximum parking standards.

Large developments supplied the majority of new housing stock in our sample. Although developments with more than 30 housing units only accounted for 10 percent of new projects, they accounted for 81 percent of all new units.

With our new subset, we compared the number of parking spaces supplied under the new maximums to the number of spaces that would have been supplied under the previous minimums.

Parking Supply Changes

Our sample of the pre-reform developments provided 2,994 parking spaces, or 1.1 spaces per unit (Table 1). Because some planning exceptions were allowed, the sample provided only 94 percent of the minimum 3,197 spaces required (Table 2).

Our sample of the post-reform developments provided 128,350 parking spaces (0.63 spaces per unit), much lower than both the previous minimum of 248,628 spaces and the

	DEVELOPMENTS	HOUSING UNITS	PARKING SPACES	SPACES PER UNIT
Pre-Reform	216	2,666	2,994	1.1
Post-Reform	8,257	204,181	128,350	0.63

TABLE 1

Spaces per Unit, Pre- and Post-Reform

	PARKING SPACES	REQUIRED SPACES BASED ON OLD MINIMUM STANDARD	PERCENT OF SPACES PROVIDED BASED ON OLD MINIMUM STANDARD	ALLOWED SPACES BASED ON NEW MAXIMUM STANDARD	PERCENT OF SPACES PROVIDED BASED ON NEW MAXIMUM STANDARD
Pre-Reform	2,994	3,197	94%	N/A	N/A
Post-Reform	128,350	248,628	52%	188,592	68%

TABLE 2

Total Parking Spaces Supplied versus Minimum and Maximum Required

post-reform maximum of 188,592 spaces. Therefore, the overall supply is only 52 percent of the previous minimum requirement and only 68 percent of the currently allowed maximum (Table 2). In other words, after the reform, the parking supply fell from 94 percent to 52 percent of the previous minimum requirements.

Before the 2004 parking reform, roughly half of the 216 developments provided parking at exactly the minimum required level, and only 26 percent provided parking above that level. After 2004, only 17 percent provided parking at the previous minimum required level, and 67 percent provided parking below the previous minimum level. With the minimum but no maximum, most developments did not provide more than the minimum required, whereas with the maximum but no minimum, most developments provided less than the maximum allowed.

After the switch to parking maximums, one-quarter of all the developments provided no parking at all. Under the previous minimums, these developments would have been required to provide at least 30,154 parking spaces. Twenty-two percent of developments provided parking at the maximum cap level, but these developments account for only 4.2 percent of the housing units. In other words, the new maximum was not preventing many parking spaces from being built, but the previous minimum required many parking spaces that would not have been built.

Effects of Density and Transit Accessibility

Because density and transit accessibility are integral to parking policy, we examined how the parking requirements and actual supply vary in relation to these factors using the post-reform dataset. We calculated the average actual supply, the maximum allowed supply, and the minimum required supply of parking spaces per unit for nine density levels (Figure 2) and eight transit-accessibility levels (Figure 3). Some developments exceed the maximum parking standards because each application is approved case by case.

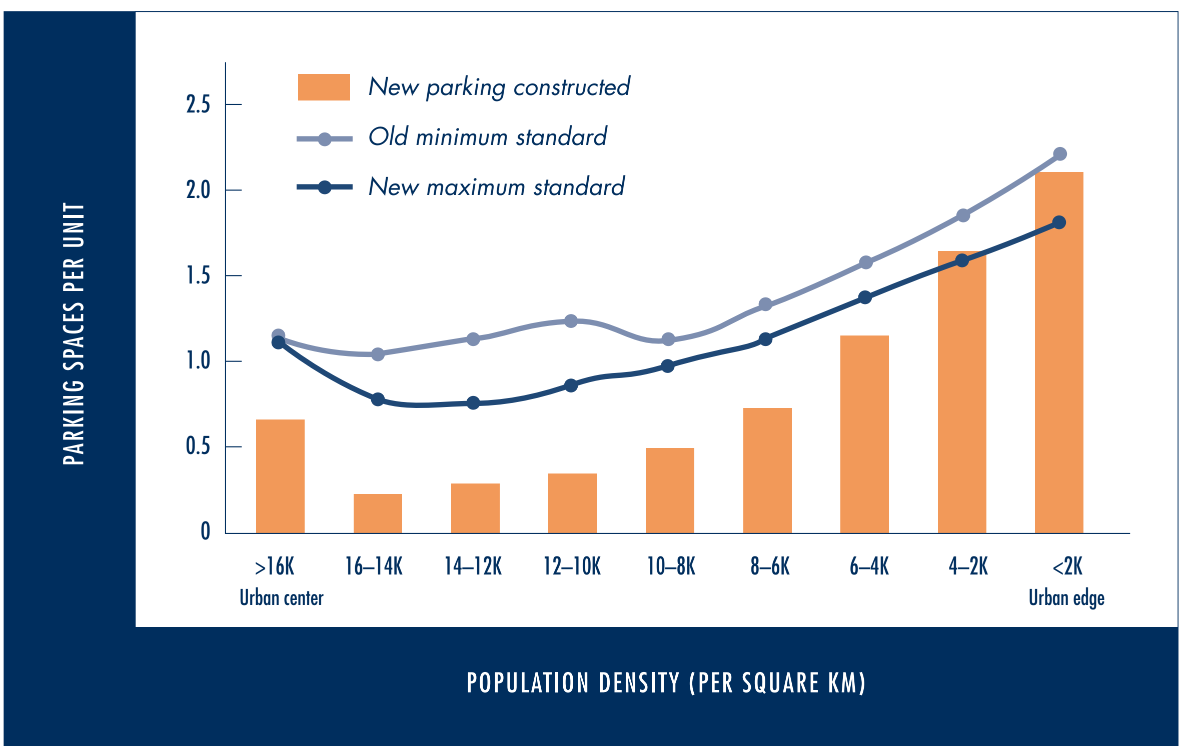
Both figures reveal considerable differences among the parking minimums and maximums applied to the 8,257 developments built between 2004 and 2010. The new maximums allowed per unit are consistently *below* the previously required minimums. The differences between the two are greatest in the areas surrounding Central London, which have a very high density and transit accessibility. Although the required minimums increased as density and transit accessibility decline, the allowed maximums exhibit an unexpected "U-shaped" curve, declining as developments move inward from Outer London but increasing again in the city center. Areas with the highest levels of density and transit accessibility actually have *higher* parking caps compared to the immediately surrounding areas.

There are two possible explanations for this finding. The first is that housing units tend to be larger in Central London than in adjacent areas, which might necessitate more parking. Indeed, the average unit size in the densest area is 2.4 bedrooms, which is 30 percent larger than the unit size in the second-densest area. Similarly, the average unit size in areas with the highest levels of transit accessibility is 2.3 bedrooms, which is approximately 13 percent greater than the next-most-transit-accessible area.

Parking congestion requires effective regulation of on-street parking, such as residential parking permits and properly priced parking meters.

FIGURE 2

Post-Reform Parking Supply Compared to Population Density



A second possible explanation is that local boroughs are reluctant to reduce the parking maximums in central areas because they are concerned about parking spillover on already crowded local streets. One planning officer in Westminster, the only Central London borough with significant residential development, expressed this concern in our interview:

"[Borough council] members, in respect of new private residential developments, will normally be seeking car parking provision as close to the maximum standards. [They] do not accept car-free developments. In general, given the high levels of car ownership in the Borough and the pressure that existing on-street spaces experience, new developments should incorporate parking."

This attitude contrasts starkly with the Inner London boroughs immediately adjacent to Central London, such as Camden, that actively advocate for parking-free housing developments. Parking-free developments accounted for only 44 percent of developments in the highest-density areas but approximately 69 percent in the second-highest-density areas.

Parking Supply

The actual parking supply exhibits a U-shaped curve similar to the maximum standard curve and—apart from Outer London—is consistently below the maximum allowed levels. The highest-density areas consistently outpace the second-highest-density areas when it comes to parking. The highest-density areas provide three times as many parking spaces per dwelling unit as the second-highest-density areas (0.66 spaces versus 0.22 spaces). More developments in the highest-density areas provide parking than in the second-densest areas (56 percent compared to 31 percent). Developments that do provide parking also provide more spaces per unit (1.17 spaces compared to 0.71 spaces).

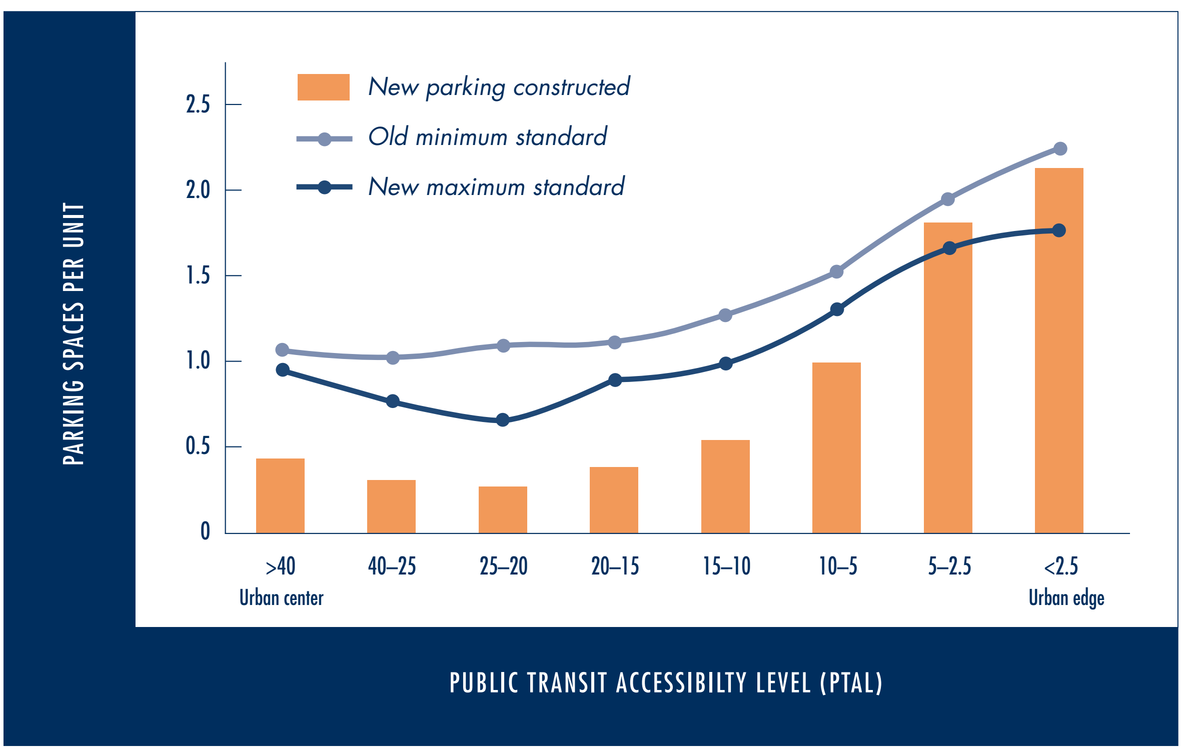


FIGURE 3

Post-Reform Parking Supply Compared to Transit Accessibility

PTAL is an index used by Transport for London to measure the accessibility level of public transit. The higher the value the better access to transit.

Similar differences are found for transit accessibility. The most transit-accessible areas provide 0.43 spaces per unit. This amount is 43 percent more than the second-most-accessible (Figure 3). Although 36 percent of developments in both areas provide parking, developments in areas with the highest level of transit accessibility provide more parking per unit (1.19 spaces compared to 0.82 spaces).

Differences in housing size might explain some, but not all, of these differences. Another possible explanation for the differences may be purely market-based. The benefits of providing parking might exceed construction and opportunity costs in areas with the highest levels of density and transit service. Developers might actually obtain a higher premium by allocating some floor space to parking instead of to living space. This possibility is plausible for Central London because households in this area have the highest median income in the metropolitan area. In addition, the cost of one off-street parking space in Central London could equal the cost of a single-family home in other regions. This type of market does not exist in the areas outside Central London.

Conclusion

The number of parking spaces supplied after the 2004 parking reform fell by approximately 40 percent when compared to the number of parking spaces that would have been supplied with the previous minimum parking requirements. This means that from 2004 to 2010, the new parking requirements led to a total of 143,893 fewer spaces. No other alternative explanations (car ownership saturation, development constraints, congestion charging, oil price spike, etc.) account for such a dramatic decline. Furthermore, almost all the reduction in parking supply was caused by eliminating the minimum standards, declining only 2.2 percent due to adoption of the maximum standards.

We also found that the market actually provided more parking in areas with the highest density and best transit service than in the immediately adjacent areas with lower density and poorer transit service. Therefore, parking caps may still be necessary for an efficient parking market because the deregulated market appears to provide more parking in the densest and transit-richest areas, and does not take into account the high social cost of driving in these areas, which are often congested.

Elected officials may oppose parking caps because of concerns about parking spillover in dense areas. But solving on-street parking congestion doesn't require higher off-street parking requirements. Instead, parking congestion requires effective regulation of on-street parking, such as residential parking permits and properly priced parking meters. Minimum parking requirements only cause a maximum amount of problems. ◆

This article is adapted from "From Minimum to Maximum: The Impact of Parking Standard Reform on Residential Parking Supply in London from 2004–2010," published in *Urban Studies*.

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Parking Benefit Districts

DONALD SHOUP

If it is feasible to establish a market to implement a policy,
no policy-maker can afford to do without one.
—J.H. Dales

Most drivers seem to think that charging for parking on a residential street is like charging children to play in a public park. But if on-street parking is crowded, drivers will congest traffic, pollute the air, and waste energy while they hunt for free parking like hawks circling for prey.

Researchers who interviewed drivers stopped at traffic signals on Prince Street in Manhattan found that 28 percent were searching for curb parking. In another study, observers found that drivers hunting for curb parking on 15 blocks in Manhattan traveled 366,000 miles and created 325 tons of CO_2 in one year. Free parking on a crowded street gives a small, temporary benefit to a few drivers who are lucky on a particular day, but it creates large social costs for everyone else every day.

If cities charge the right price for curb parking—the lowest price that will produce one or two open parking spaces on each block—all drivers will have great parking karma and no one will need to circle for parking.

To create local support for right-priced parking in commercial areas, some cities have created Parking Benefit Districts that spend meter revenue for public services in the metered areas. These cities offer each neighborhood a package that includes both priced parking and better public services. Everyone who lives, works, visits, or owns property in a Parking Benefit District can then see their meter money at work.

Residential Parking Benefit Districts

Can Parking Benefit Districts work in purely residential neighborhoods? Many cities have already established Residential Parking Permit districts where they charge a nominal price (or nothing, as in Boston) for the permits, but they can be freewheeling about the number of permits they issue. For example, a political storm erupted in San Francisco when journalists discovered that romance novelist Danielle Steel had obtained 26 residential parking permits for her house in Pacific Heights.

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If cities charge the right price for curb parking—the lowest price that will produce one or two open parking spaces on each block—all drivers will have great parking karma and no one will need to circle for parking.

In residential neighborhoods, a Parking Benefit District resembles a conventional Parking Permit District except for three key features. First, drivers pay the market price rather than a nominal price for the permits. Second, the number of permits is limited to the number of curb spaces. Third, the permit revenue pays for neighborhood public services. In neighborhoods where most residents park off-street or do not own a car, the desire for better public services can outweigh the desire to park free on the street.

Market prices for curb parking do not mean that only the rich will be able to park on the street. Most cities are segregated by income, so the rich will compete mainly with each other for parking and will drive up the permit prices only in their own neighborhoods.

Because parking prices will be higher in richer neighborhoods, market prices for residential permits will act like an income tax for drivers who park on the street. In contrast, nominal prices for the permits act like a flat tax, which is less fair.

Setting the Right Prices

A uniform-price auction, which is often used when many identical items are sold, is the simplest way to discover the market price for residential parking permits. Consider how this would work on a block with 20 on-street parking spaces reserved for residents. Any resident can bid for a permit. The bids are ranked in descending order and the highest 20 bidders receive permits. In a uniform-price auction, all the winning bidders then pay the same price: the lowest accepted bid. All but the lowest successful bidder thus pay less than what they bid. A few curb spaces can also be reserved as metered parking for drivers without permits.

Permit parking revenue can pay to clean and repair sidewalks, plant street trees, remove grime from subway stations, and provide other public services. Few will pay for curb parking but everyone will benefit from the public services.

Parking Benefit Districts can also eliminate the hated requirement for on-street parkers to move their cars from one side of the street to the other on street-cleaning days. Permit revenue can pay for vacuum equipment to clean around and under parked cars so drivers won't have to move their cars back and forth and the city won't give parking tickets for street-cleaning violations.

Residents who don't store a car on the street may begin to eye crowded curb spaces as a potential source of public services and view free parking the way landlords view rent control. Free curb parking is like rent control for cars. Randomly giving free curb parking to a few lucky drivers and nothing to people who cannot afford a car, or choose not to own one, is unfair.

Parking Benefit Districts should be especially popular wherever most people park off-street or do not own a car. Consider Manhattan, where only 22 percent of households own a car. Car owners in Manhattan also have almost double the income of the carless. Charging for curb parking and spending the revenue for public services will therefore transfer income from richer to poorer families.

Power-Equalization

If richer neighborhoods have higher parking prices, they will earn more money for public services. How can a city avoid this inequality yet still provide the local incentive to charge for curb parking? One option is to use what in public finance is called *power equalization*. Suppose the citywide permit revenue per curb space is $2,000 a year ($5.50 a day). In this case, the city can offer to spend $1,000 a year per space for added public services in every Parking Benefit District and spend the other $1,000 a year for citywide public services. All neighborhoods that charge market prices for curb parking will receive equal revenue for public services.

If a block has 20 parking spaces and could earn $40,000 a year to pay for public services, for example, free parking subsidizes drivers by $40,000 a year. Is providing hard-to-find free parking for a few cars more important than providing better public services for everyone? If the city were already charging market prices for curb parking and spending an extra $40,000 a year for public services, few would say the city should reduce public services for everyone to subsidize parking for 20 cars.

Affordable Housing

Finally, Parking Benefit Districts can also increase the supply of affordable housing. Almost every proposal for new housing now comes bundled with a dispute over scarce curb parking. As a result, cities require new housing to provide enough off-street parking to prevent new residents from crowding the curb. These parking requirements increase the cost and reduce the supply of housing. But if permits restrain parking demand to fit the available supply, new residents will not crowd the curb. Cities will be then able to eliminate their off-street parking requirements, which will allow developers to provide less parking and more housing.

Turning a Problem into an Opportunity

Diverse interests across the political spectrum can support a Parking Benefit District. Liberals will see that it pays for public services. Conservatives will see that it relies on market choices rather than government regulations. Drivers will see that it guarantees curb parking and removes the requirement to shift their cars for street cleaning. Residents will see that it improves the neighborhood. Environmentalists will see that it reduces energy consumption, air pollution, and carbon emissions. And elected officials will see that it depoliticizes parking, reduces traffic congestion, and pays for public services without raising taxes.

If cities manage their curb parking as valuable real estate, they can stop subsidizing cars, congestion, pollution, and carbon emissions. Instead, they can provide better public services. Parking Benefit Districts with power equalization can fairly manage public land used for private parking. This simple reform can be a cheap, fast, and simple way to improve cities and create a more just society, one parking space at a time. ◆

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