Parking Plan Supplemental Materials

Princeton Parking Strategy

Municipality of Princeton, New Jersey

NELSON NYGAARD

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PERFORMANCE-BASED PRICING ORDINANCES

EXAMPLES

Seattle, WA

Rate-Setting Authority

11.16.121 - Director of Transportation—Rate setting for parking payment devices.

A. Parking rates to be charged at parking payment devices, including parking meters, for parking in city rights-of-way and other city-controlled parking areas under the jurisdiction of Seattle Department of Transportation shall be within rate limits established by this section. Rates may vary according to location, time of day, maximum parking time allowed, the capabilities of available parking payment devices, and any other factors the Director determines are pertinent. In setting rates, the Director is not subject to Chapter 3.02 of the Seattle Municipal Code.

B. The Director of Transportation is authorized to set parking rates up to $5.00 per hour ("Maximum Hourly Rate"). When parking rates are in effect, parking rates shall be set no lower than $0.50 per hour ("Minimum Hourly Rate").

C. The Director shall establish on-street parking rates and shall adjust parking rates higher (up to the Maximum Hourly Rate) or lower (as low as the Minimum Hourly Rate) in neighborhood parking areas based on measured occupancy so that approximately one or two open spaces are available on each block face throughout the day in order to:

1. Support neighborhood business districts by making on-street parking available and by encouraging economic development;

2. Maintain adequate turnover of on-street parking spaces and reduce incidents of meter feeding in commercial districts;

3. Encourage an adequate amount of on-street parking availability for a variety of parking users, efficient use of off-street parking facilities, and enhanced use of transit and other transportation alternatives; and,

4. Reduce congestion in travel lanes caused by drivers seeking on-street parking.

(Ord. 125210, § 1, 2016; Ord. 123462, § 1, 2010; Ord. 122852, § 2, 2008; Ord. 122274, § 1, 2006; Ord. 121420, § 6, 2004; Ord. 121330, § 2, 2003.)

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Redwood City, CA

Sec. 20.133. - PERIODIC ADJUSTMENT OF DOWNTOWN METER ZONE METER RATES:

Under the authority of California Vehicle Code section 22508, the following process for adjusting Downtown Meter Zone meter rates from time to time to manage the use and occupancy of the parking spaces for the public benefit in all parking areas within the Downtown Meter Zones is hereby established.

A. To accomplish the goal of managing the supply of parking, including the use and occupancy of parking spaces for the public benefit, and to make it reasonably available when and where needed, a target occupancy rate of eighty-five percent (85%) is hereby established as the goal sought to be achieved with the rate structure for parking meters within the Downtown Meter Zones...

B. At least biennially and not more frequently than quarterly, the City Manager shall survey the average occupancy for each parking area in the Downtown Meter Zone that has parking meters and recalculate the parking rates for parking meters in both Downtown Meter Zones A and B using the criteria and calculations established below:

1. In the Downtown Meter Zone A:

   a. The hourly parking rate in Downtown Meter Zone A shall at all times be between twenty-five cents ($0.25) per hour and two ($2.00) dollars per hour.

   b. If the average occupancy within Downtown Meter Zone A between the hours of eleven o'clock (11:00) A.M. and one o'clock (1:00) P.M. on two (2) representative days are over 85%, the then existing hourly meter rate shall be increased by twenty-five cents ($0.25) provided, however, the hourly parking rate shall in no event exceed the approved maximum rate.

   c. If the average occupancy within Downtown Meter Zone A between the hours of eleven o'clock (11:00) A.M. and one o'clock (1:00) P.M. on two (2) representative days are between seventy percent (70%) and eighty-five percent (85%), the then existing hourly meter rate shall remain the same.

   d. If the average occupancy within Downtown Meter Zone A between the hours of eleven o'clock (11:00) A.M. and one o'clock (1:00) P.M. on two (2) representative days are below seventy percent (70%), the then existing hourly meter rate shall be reduced by twenty-five cents ($0.25), provided, however, the hourly parking rate shall in no event go below the approved minimum rate.

2. In the Downtown Meter Zone B:

   a. The hourly parking rate in Downtown Meter Zone B shall at all times be between fifty cents ($0.50) per hour and three ($3.00) dollars per hour.

   b. If the average occupancy within Downtown Meter Zone B between the hours of eleven o'clock (11:00) A.M. and one o'clock (1:00) P.M. on two (2) representative days are over eighty-five percent (85%), the then existing hourly meter rate shall be increased by fifty cents ($0.50), provided, however, the hourly parking rate shall in no event exceed the approved maximum rate.

   c. If the average occupancy within Downtown Meter Zone B between the hours of eleven o'clock (11:00) A.M. and one o'clock (1:00) P.M. on two (2) representative days (Tuesday, Wednesday, or Thursday) are between seventy percent (70%) and eighty-five percent (85%), the then existing hourly meter rate shall remain the same.

d. If the average occupancy within Downtown Meter Zone B the hours of eleven o'clock (11:00) A.M. and one o'clock (1:00) P.M. on two (2) representative days are below seventy percent (70%), the then existing hourly meter rate shall be reduced by fifty cents ($0.50), provided, however, the hourly parking rate shall in no event go below the approved minimum rate.

C. The new rates shall become effective upon the programming of the parking meter for that rate. The current schedule of meter rates shall be available at the City Clerk's office.

(Ord. No. 2406, § 4, 6-9-14)

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PERFORMANCE-MONITORING PROGRAM

OVERVIEW

Effective performance-based pricing requires performance monitoring—tracking the availability of parking spaces, continuously or via "spot checks" during peak-demand conditions. To ensure a desired level of space availability – often a formally identified target measure, such as 15% of spaces being unoccupied – parking managers must strategically monitor parking occupancy conditions. This should prioritize, but not necessarily be limited to, locations and times that consistently experience peak-demand conditions.

The primary objective of performance monitoring is to inform parking rates and rate-adjustments, and/or other management/regulation adjustments, and to document the impact of such on performance/availability.

A performance-monitoring program in support of performance-based pricing should center on the following sequential steps.

1. Define performance to be measured.
2. Define success (performance target/s).
3. Monitor conditions.
4. Evaluate performance & adjust rates.

PROGRAM STEPS

Define Performance to be Measured: Availability

The primary performance measure should be "availability" – the proportion of viable parking spaces that remain vacant and available for parking at a given point in time. Achieving optimal availability conditions can bring about several parking-management objectives. The two most significant and transformative are:

- Improved customer experiences, as more parking options are more consistently available, more of the time; and

- Reduced traffic congestion and vehicle emissions, as drivers simply park once they have arrived at/near their destinations, or at their first-choice parking option.

Define Success: Modest but Consistent Availability

Performance-based pricing success can be broadly described as resulting in a modest, but obvious and consistent, level of availability among all primary parking options—just enough so that the empty spaces are apparent to drivers seeking out a space – particularly during peak-demand conditions.

On-Street Availability Targets

The most widely-adopted target measure for on-street availability is 15% of spaces—just enough so that empty spaces are quickly perceivable to drivers upon approaching a blockface. This is an ideal performance measure for any location, and at any time. Achieving it, however, will be most challenging, and therefore essential, during times of peak parking demand.

Off-Street Availability Targets

Performance targets for off-street parking are less standardized as they should be dependent upon facility programming and design, which can be highly variable compared to on-street parking. In general, availability targets should be at least moderately lower than the 15% target for on-street parking. There is little risk of lower availability conditions generating "search traffic," as the travel patterns of drivers in off-street facilities is largely determined by the facility layout – drivers essentially drive in a fixed pattern until a suitable space is found. For most drivers, the first space found is likely to be preferred over any space that a continued search might offer, reducing the propensity for drivers to circle back to repeat search patterns.

However, at some point, very low levels of availability will reduce the functionality of an off-street facility. For these facilities, efficiency and maximized utility require an optimal balance between maximum occupancy and internal circulation efficiency (getting vehicles into the facility as quickly as possible). Too few empty spaces can slow internal circulation, reducing the turnover process that is especially important to commercial operators and any operator serving hourly customer markets. Suboptimal internal circulation conditions can also reduce the appeal of a parking facility, as drivers consistently find themselves stuck in entry/exit congestion.

As such, the performance target can be qualitatively defined as the highest level of occupancy that a facility can accommodate without congesting internal circulation. Typically, 85% occupancy is a too-modest target for this; 90% - 95% is much more common. Facility characteristics that can most significantly determine optimal occupancy levels include the following.

- Hourly vs. Monthly customer balance – Target occupancy levels can be set close to 100% in facilities that primarily cater to monthly customers, but have sufficient hourly-parking demand to fill spaces that remain empty after the morning peak.
- Facility design – Facility design and layout can affect circulation efficiency, as can entry and exit processing procedures and technologies. The more efficient the facility is in either or both aspects, the higher its occupancy target can be.
- Real-time information system – This can increase internal circulation efficiency, by reducing the need for drivers to attentively scan facilities for empty spaces. This is especially true for systems that identify availability by floor, and even more so for systems that visually identify empty spaces individually.

Monitor Conditions

Measure and Track Availability Levels

Performance monitoring requires a program of regularly collecting measures of occupancy. This is typically executed through one of three approaches: manual field surveys, digital sensors, or the use of meter-transaction data to estimate occupancy conditions. Commercial services, such as Smarking, which is currently supporting performance-based pricing for off-street parking managed by the City of Grand Rapids, uses a version of the latter of these approaches to monitor on-street conditions as well, as they have done in support of seasonal on-street meter rates in Aspen, Colorado.[1]

Manual-Count Surveys

Field surveys continue to be used to document occupancy/availability levels among curbside parking inventories, particularly in small cities, many of which were early adopters of performance-based pricing programs. Frequent and/or expansive surveys, however, are labor intensive to complete with staff, and costly to outsource. This approach can be highly reliable, and remains a standard for checking the reliability of technology-enabled, labor-saving approaches, including those outlined below. Further, license-plate-recognition devices can increase the processing speed, and reduce the labor requirements, of "manual" counts.

Meter-Transaction Data

Many cities that have grown wary of the downsides to digital-sensor systems have begun to use meter-transaction data to estimate curbside occupancies. This offers a similarly robust "stream" of data as sensor systems, without the cost and complications of dedicated technology. It allows parking managers to "measure" occupancy from any previous date, at any particular time; a distinct advantage over relying on manual field surveys. This approach is not without challenges, as meters will occasionally be "over-paid" while others will be "under-paid." The latter occurs in particular where there is parking placard use and/or abuse. An emerging trend is to combine meter payment data with observed occupancy surveys. By merging these data streams, cities are developing models to support performance-based parking strategies, as there is a strong positive relationship between payment rates and occupancy rates.

This method is evolving, most notably as part of the SFpark program.[2]

Commercial Services Option

Smarking is a data analytics software platform for parking systems. The software can collect transactional data from on-street meters and/or off-street facilities to provide customized data reports and analytics. It can also sync with garage entry/exit data for a more direct estimate of occupancy over time. This is highly useful for estimating occupancy in metered areas and for off-street facilities, but Smarking cannot provide measures of parking demand where or when pricing is not in effect.

Smarking relies on meter payment status and garage access control or payment data to estimate occupancy. It is important to note, this is not the same as occupancy data. The difference between meter payment status and occupancy will differ in various cities and neighborhoods. Spot checks

[1] https://www.dropbox.com/s/wlx1ce4a1dq9vqn/Aspen%20Smarking%20Case%20Study.pdf?dl=0

[2] http://sfpark.org/wp-content/uploads/2014/05/SIRA-methodology-and-implementation-plan_2014_05-14.pdf

should be used to check the accuracy of Smarking data and analytics, and to work with Smarking representatives to adjust the model to ensure it is responding to local conditions/contingencies.

Evaluate Performance & Adjust Rates

Following is an overview of steps for establishing a process of collecting and analyzing data, and making rate adjustments in response to findings (and in pursuit of defined availability targets).

On-Street Parking

Collect Data: Spot Counts

At a minimum, monthly counts during identified peak-demand periods (likely weekday midday + Friday night)

Collect Data: Transaction-Based/Smarking Data

- Define the base data set.
  - Occupancy counts are only needed for "general parking meters" – the typical, regulated spaces available to all.
  - Data sets should not include special meter types, such as loading zones or short time limits.
- Filter out any blocks that have high non-payment levels.
- Pull a two-week sample of data from Smarking, every month, formatting it to fit time buckets.
  - Exclude Mondays, Friday, holidays – so Tues-Thurs.

Adjust Rates

- Set parameters for triggering rate adjustments, such as the following.
  - When occupancy is 85-100%, the hourly rate is increased by $0.25
  - When occupancy is 60-86%, the hourly rate is not changed.
  - When occupancy is 30-60%, the hourly rate is lowered by $ 0.25.
  - When occupancy is less than 30%, the hourly rate is lowered by $0.50.
- Adjust rates no more than twice per year
  - Generally, annual rates are preferred, except in larger city centers and/or during the first year of performance-based pricing.
  - Allow at least two weeks after rate adjustments to pull new data for evaluation.

Off-Street Parking

- Conduct occupancy counts around the 1PM hour, or pull peak-occupancy data where available, at least every quarter, preferably monthly.
  - The more days, the better, to provide a running average
  - Exclude Mondays, Friday, holidays.
- Follow guidelines for permit and hourly parking, as outlined below.

Monthly/Annual Permits

Quarterly Assessments:

- If the average peak-utilization measure is below 80%, issue more permits for that facility.
  - # of new permits sold should roughly equal 1% of the facility's capacity, multiplied by the difference between the peak-utilization average and 90%.
    - For example, if the average weekly-peak measure for a 200-space garage is 70%, issue 40 more permits (20% of 200 = 40) for that facility.
    - This is a conservative increase in permit issuance, as it would push the 85th percentile measure up to 90% only if all 40 new cardholders use the facility at a 0% "absentee" rate.
- If the average peak-utilization measure is at or above 95%, raise the monthly permit rate by 10-20%.
- Continually invest parking revenues in mobility programs, services, and infrastructure, as well as programs to help reduce drive-alone commute rates, and subsequently help avoid permit-rate increases.

Hourly

- Apply a process similar to the on-street process outlined above, but with the following thresholds.
- Set parameters for triggering rate adjustments, such as the following.
  - When occupancy is 90-100%, the hourly rate is increased by $0.25
  - When occupancy is 60-90%, the hourly rate is not changed.
  - When occupancy is 30-60%, the hourly rate is lowered by $0.25.
  - When occupancy is less than 30%, the hourly rate is lowered by $0.50.
- Adjust rates no more than twice per year
  - Generally, annual rates are preferred, except in larger city centers and/or during the first year of performance-based pricing.
  - Allow at least two weeks after rate adjustments to pull new data for evaluation.

Monitor and Calibrate Model Performance

- Periodically spot check proxy (Smarking, transaction-based, etc.) data with field-collected data via manual/LPR counts.
- Calibrate the in-house mode, or work with model vendor, to address any significant inconsistencies.

CASE STUDY: *SF*PARK

San Francisco's Municipal Transportation Agency (MTA) created the *SFpark* project to pilot a citywide, robust implementation of performance-based pricing for on-street parking. The program established different rate periods for weekdays and weekends based on observed parking demand. Rates were then adjusted gradually and periodically based on demand. Rates changed no more often than once per month.

Performance-Based Pricing

Rates were set with the goal of maintaining no more than 80% occupancy on any single block.[3] For each block, prices can vary by weekday and weekend and by time of day (divided into three to four "time bands" for simplicity; e.g., "9 a.m. to noon"). The example below shows all time bands and recent rates for the 100 block of Berry Street, where the meters operate from 9 AM to 10 PM. On this block, demand is highest on weekdays, somewhat lower on weekends, and substantially lower in the evening. Rates vary accordingly.

Figure 1 Time of Day Parking Rates in San Francisco – An Example

Day Type	From Time	To Time	Rate
Weekday	9 AM	12 PM	$4.25
	12 PM	3 PM	$4.25
	3 PM	6 PM	$4.25
	6 PM	10 PM	$0.75
Weekend	9 AM	12 PM	$3.50
	12 PM	3 PM	$3.75
	3 PM	6 PM	$3.75
	6 PM	10 PM	$0.75

Monitoring & Evaluation

Occupancy rates were *initially* determined using data from wireless in-ground parking occupancy sensors and were calculated by dividing the total number of seconds the block was occupied by the sum of total occupied seconds and total seconds the block was vacant. Occupancy rates were calculated on whole hour increments – the total number of occupied seconds, divided by 3,600.

Rate Adjustments

The program's original approach to performance-based rate adjustments is outlined below.

- When occupancy is 80-100%, the hourly rate is increased by $0.25
- When occupancy is 60-80%, the hourly rate is not changed.
- When occupancy is 30-60%, the hourly rate is lowered by $ 0.25.
- When occupancy is less than 30%, the hourly rate is lowered by $0.50.[4]

In the first two year of the program, the MTA implemented 13 rate adjustments using occupancy calculated from parking sensor data.

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[3] San Francisco Municipal Transportation Agency, *SFpark: Putting Theory into Practice* (San Francisco: SFMTA, August 2011), p. 25.

[4] Ibid. p. 26. Recently, the City found that after numerous rounds of performance-based price adjustments, rates very rarely needed to be lowered by $0.50, and for the sake of simplicity, eliminated this rate adjustment band.

From Sensors to SIRA

At the end of 2013, when the project's federally funded parking sensors reached the end of their useful lives, they were deactivated and not replaced. *SFpark* staff decided not to purchase and operate new sensors, due to a variety of problems experienced with this emerging technology, including problems with reliability, accuracy, cost, and replacing sensors removed without warning due to construction projects.

To replace the data these sensors provided, staff developed a new methodology to estimate parking occupancy using meter payment data, which it subsequently named the Sensor Independent Rate Adjustment (SIRA) methodology. [5] This approach was developed using the sensor data accumulated over 2+ years of operation (supplemented by manual counts for quality assurance), and compared it to estimated occupancy measures using revenue data from parking meters over the same time period. The SIRA model was found effective, and since June 2014, the City has used the model to continue making regular performance-based rate adjustments to on-street parking. The model allows the City to continue performance-based pricing, without needing sensors.

SIRA Overview

The Sensor Independent Rate Adjustment (SIRA) model was developed to estimate occupancy from transactional data in the absence of physical sensors.

The model uses meter payment rates to estimate occupancy rates on each block. At any snapshot in time, the meter payment rate is the share of total spaces available that are also paid. The parking occupancy rate is the share of total spaces available that are also occupied. The occupancy rate is usually higher than the payment rate because not everyone who parks pays (sometimes because a driver is not required to pay, and sometimes because the motorist parked illegally).

Using a statistical regression analysis model, San Francisco developed the following simple linear model equation:

Occupancy Rate =
29.283 + 0.808 * (Payment Rate)

As one example, using this model, a payment rate of 50% yields an occupancy rate of about 70%. *SF*park's Sensor Independent Rate Adjustments (SIRA) Methodology & Implementation Plan[3] provides extensive detail on the development of the model and important additional information on how to use it. The document also describes two slightly more accurate model equations, which customize the model for different San Francisco districts.

[5] San Francisco Municipal Transportation Agency. "Sensor Independent Rate Adjustments (SIRA) Methodology & Implementation Plan," May 14, 2014. http://sfpark.org/wp-content/uploads/2014/05/SIRA-methodology-and-implementation-plan_2014_05-14.pdf. Accessed February 28, 2016.

PAYMENT TECHNOLOGIES

Pay station technology provides several potential advantages over traditional, single-space meters, including:

- Reduced visual clutter as a single pay station can replace 8-10 traditional meters;
- Expanded payment options, including smart card, credit card, and paper bills;
- Expanded data collection and distribution options; and
- Expanded options to increase revenue, compliance rates, and enforcement efficiency.

Rather than paying for parking at a meter that is assigned specifically to a parking space, customers pay their parking fees at a pay station which can accept payments for some or all parking spaces in the area. One or two pay stations are typically located on each block and evenly distributed to reduce walking distances from parking spaces. Payments made at stations are connected to customer vehicles via one of three methods:

5. Each payment is recorded in conjunction with a stall-identification code entered by the customer to coincide with his or her stall;
6. A payment receipt is dispensed at the station to be placed on the dash of the parked vehicle; or
7. Each payment is recorded in conjunction with the license plate ID code of the customer's vehicle.

Enforcement of payment-compliance is handled in various ways with pay station technology, depending upon the specific payment system that is used in coordination with this technology. Specifics of enforcement are detailed for each payment system in the following section.

Pay-by-Space

Pay-by-Space (PBS) systems utilize space identification codes to track customer payments across the on-street inventory. Typically, spaces are marked either directly via paint on the street, or through a series of posts located on the side-walk.

How it Works

When drivers park in a PBS space, they must note the identification code assigned to their space, proceed to the nearest pay station, and enter the code in conjunction with their payment. The system is capable of providing immediate payment information and interfaces with many other parking management technologies designed to internally monitor utilization patterns and externally broadcast real-time information on space availability.

Enforcement

There are two ways for Parking Enforcement Officers (PEO's) to enforce Pay-by-Space meters:

1. The PEO links up to the system network or Pay-by-Space meter via wireless communication to verify if the occupied space is paid.
2. The PEO can also manually run a report through the Pay-by-Space meter that shows all paid versus unpaid parking stalls.

Key Elements

- Makes use of tokens, coins, bills, stored value cards and credit cards
- Transactions are completed at the Pay-by-Space meter, eliminating the need for the customer to return to their vehicle
- Provides an excellent communication platform to obtain occupancy and payment information when dynamic real-time data is the primary goal
- Interfaces with Pay-by-Cell transactions by working in conjunction with the main office database, eliminating the need for enforcement staff to carry extra hardware and accessories
- Supports two-way communication to allow the operator to:
- receive payment transaction and trouble alarm information
- perform rate and time changes
- provide real-time credit card transaction processing
- Capable of operating utilizing solar power
- The system can be networked so the parking customer may extend time from any of the Pay-by-Space meters, provided they know their parking stall number.

Potential Drawbacks

- Because Pay-by-Space requires a parking stall number to be entered into the meter, all parking spaces will be required to be 20 feet in length, as outlined in the "Manual on Uniform Traffic Control Devices" (MUTCD). Not all vehicles require 20 feet, and because of this, the system is not capable of maximizing all available parking on a block.
- Pay-by-space meters also require curbside parking stall numbers to identify each parking space. Given the area's winter conditions, elevated markers from the sidewalk will be required. This adds to additional curbside clutter.
- Often parking customers neglect to make note of the parking space number, and this is even more likely for a visitor, who is required to complete a parking transaction. The customer then has to make a return trip to their vehicle to obtain this information, often resulting in frustration with the experience.

Pay-and-Display

Like Pay-by-Space meters, Pay-and-Display meters are usually installed one per blockface. The key distinction from Pay-by-Space systems is that Pay-and-Display systems eliminate the need to mark or identify parking stalls by providing customers with a receipt of payment to display on the dash of their vehicle.

How it Works

After parking, the customer pays for a selected amount of parking time, and then displays the valid receipt on the dash of their vehicle. This provides proof of payment to the enforcement officers.

Enforcement

There is really only one efficient way to enforce Pay-and-Display meters, and that is on foot. The receipt, which acts as proof of payment, is displayed on the dash, and there is no way to electronically communicate payment information to enforcement staff.

Key Features

- Makes use of tokens, coins, bills, stored value cards and credit cards
- Supports two-way communication to allow the operator:
  - to receive payment transaction and trouble alarm information
  - to perform rate and time changes
  - to provide real-time credit card transaction processing
- No need to stripe parking spaces or display space numbers. Receipts indicate proof of payment, not stalls, which can result in a 5 to 10% gain in parking spaces.
- The same space can be sold multiple times in the same time period due to the user taking the time with them; any unused parking time is on the display receipt and not on the meter, increasing revenue potential
- The customer benefits by being able use the same receipt in multiple parking spaces, provided the receipt is still valid, and the parking rates and restrictions are the same
- In most cases, one unit can cover an entire block face.
- Capable of operating by utilizing solar power

Potential Drawbacks

- While Pay-and-Display is capable of live communication technology, because there is no assigned parking space or stall number required for this technology, the system is not capable of giving real-time occupancy data.
- This system requires the user to return to their vehicle and place the purchased receipt on the dash after the transaction is complete.
- Pay-by-cell does not interface with a Pay-and-Display meter, but still may be used as a payment option. A separate monitoring system is required to be used by the Parking Enforcement Officer.

Pay-by-Plate

Pay-by-Plate (PBP) systems are the newest and least used among pay station systems. Some cities are requesting information regarding this technology, and while there is interest, it is not a preferred technology.

How it Works

As with Pay-by-Space and Pay-and-Display, the pay station is typically located mid-block and covers multiple parking spaces. Once a parking customer parks and locates a meter, they enter their vehicle license plate identity. The plate identity is linked with a digital record of payment and recorded in a central database.

Enforcement

Enforcement of Pay-by-Plate does require some form of a live communication device in the field. This is normally done using live hand held units or Licenses Plate Recognition vehicles.

Key Elements

- Makes use of tokens, coins, bills, stored value cards and credit cards
- Supports two-way communication to allow the operator:

  - to receive payment transaction and trouble alarm information
  - to perform rate and time changes
- No need to stripe parking spaces or display space numbers. Receipts indicate proof of payment, not stalls, which can result in a 5 to 10% gain in parking spaces.
- Capable of operating by utilizing solar power
- Pay-by-license is the only pay station technology, at this time that can be enforced using license-plate-recognition systems

Potential Drawbacks

- The system does require the customer to enter the vehicle license plate number. For first time users and visitors this will require a significant learning curve as well as a very detailed marketing and education component.
- While Pay-and-Display is capable of live communication technology, because there is no assigned parking space or stall number required for this technology, the system is not capable of giving real-time occupancy data.
- If street sensor technology is required then 20 foot stripped parking stalls will be required.

SINGLE SPACE SMART METERS

Many of the capabilities and amenities that were once exclusive to Pay Station products are being offered in single-space, "smart meter" products. More expensive than a typical, single-space meter, but less expensive than a pay station, these meters essentially function as pay stations, while providing the payment-location convenience of a traditional meter. Another emerging advantage of these meters is the capacity to add "occupancy sensors" to the meter, providing real-time occupancy data at much lower costs compared to "in-street" sensor systems.

Key Elements:

- Makes use of tokens, coins, stored value cards and credit cards
- The parking customer is not required to return to their vehicle to display a receipt.
- Capable of operating on solar power
- The meter is located at the parking stall, so there is no need for the customer to walk any distance to make a transaction.
- Optional vehicle detection built into the meter.
- Offers a reset mode. When a paid vehicle leaves, the meter will zero out remaining time.
- Pay-by-Cell can still be used as a payment option
- Retrofits into most existing meter housings/poles.

Potential Drawbacks

- This system still requires a meter and pole at every parking stall.
- Size limitations of coin canisters will keep current single space parking meter collection procedures and associated costs.

- All parking spaces will be required to be 20 feet in length, as outlined in the "Manual on Uniform Traffic Control Devices" (MUTCD). Not all vehicles require 20 feet, and therefore, this system is not capable of maximizing all available parking on a block.
- Each meter requires its own communication account, which results in an increased cost over pay station technology.

PAY BY PHONE

Mobile-phone payment, or pay-by-phone (PBP), technology has recently evolved as one of the most innovative advances in parking payment technology, and one of the most popular options for paying parking costs. The convenience it offers helps drivers avoid dealing with change and has been shown to increase compliance and reduce resistance to demand-based parking rates.

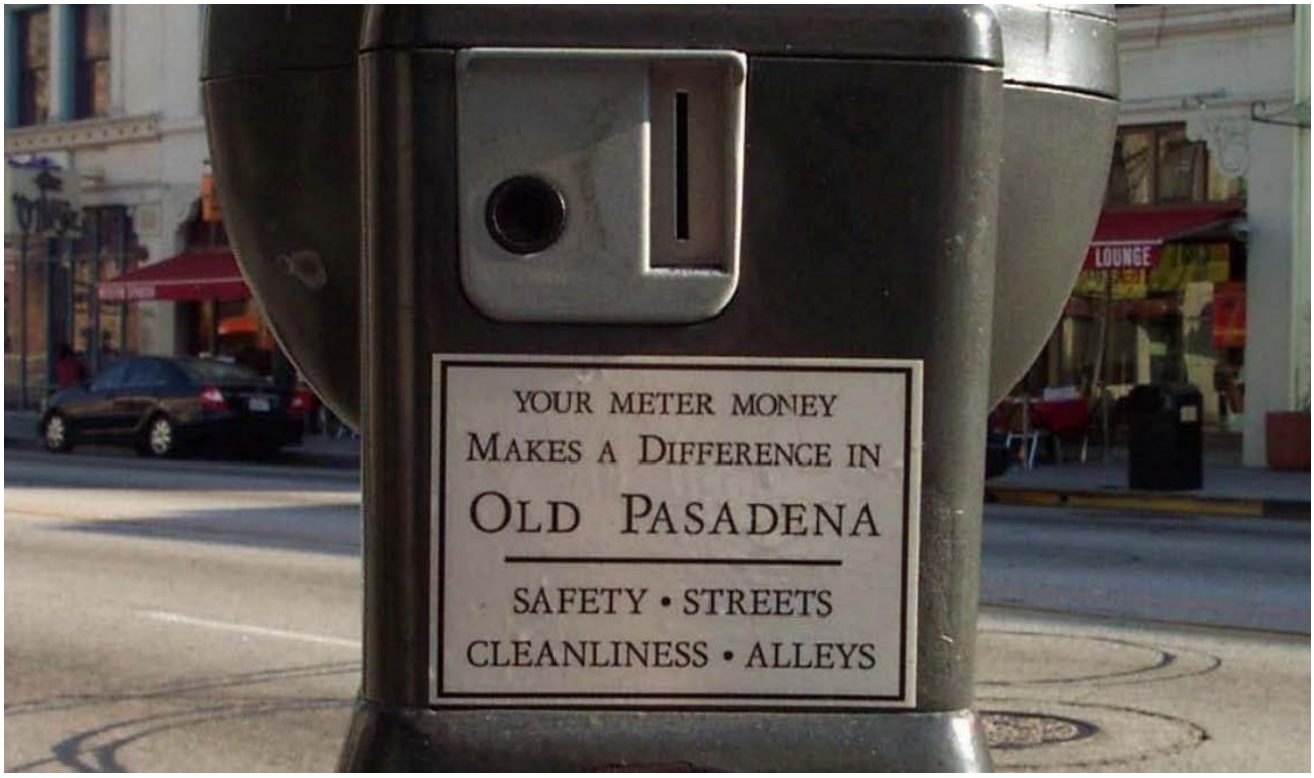
Using a mobile phone application, parking purchases are made by dialing, texting, or scanning the ID number or QR code for the parking space or zone, and purchasing the amount of time desired. First-time users must set up an account, including license plate and credit card information. Once registered, subsequent parking sessions can be paid for with a few taps on the phone. One of the most popular features of PBP is the benefit of receiving text messages when the time one has paid for is about to expire, followed by the option to add more time with a few taps of the screen. Additionally, systems can be set up so that drivers only pay for the time they actually parked.

The convenience of PBP for both the customer and the parking provider is a significant factor when considering implementation. Users do not have carry coins or walk back and forth between destinations and meters when their time is nearing expiration. For providers, PBP will eliminate the need to install new credit-card capable revenue collection infrastructure on the street, as well as the cost of labor, maintenance, and collections for these systems. PBP providers typically charge a small fee for each transaction. This fee can either be passed on to customers or paid for by the parking provider.

PARKING BENEFIT DISTRICTS

A key, complementary strategy for Performance-Based Pricing is returning some or all resulting parking revenue to fund local improvements. This approach is known as a Parking Benefit District (PBD). Parking Benefit Districts underscore and formalize management policies that parking-rate adjustments will be made based on performance criteria like space availability during peak-demand conditions, rather than revenue generation opportunities. By ensuring that revenue gains from strategic rate adjustments will captured for shared, local benefits, a PBD program creates stakeholders with a vested interest in well-managed, and appropriately-priced parking resources. This stakeholder relationship can be further enhanced by allowing local stakeholders to influence or determine what investments are made with PBD funds.

Figure 2 Meters Promote the Benefits Funded by Parking Revenues in Pasadena, CA



OBJECTIVES & BENEFITS

- Increase stakeholder support for well-managed and appropriately-priced parking.
- Promote the connection between parking revenues and local improvements.
- Make Performance-Based Pricing (see separate Strategy Sheet, "Performance-Based Pricing") policies more transparent, while making the benefits of such policies more conspicuous.
- Use revenue to offset the impact of increasing parking demand on parking costs, by expanding and improving driving alternatives and other cost-saving benefits.

- Investing parking revenues in mobility improvements and demand-management benefits can create a virtuous circle, in which increased parking revenue helps to shift demand to other modes, or non-peak times, thereby easing parking demand and preventing further rate increases.
- These investments can also produce significant co-benefits, while extending the effectiveness of existing parking resources, by facilitating:
  - Greater mobility choice,
  - Reduced commuting costs,
  - More active sidewalks and public spaces, and
  - Expanded access to safe active-mobility networks.

Figure 3 Parking Revenues Provide Enhanced Downtown Transit in Grand Rapids

KEY ELEMENTS

- **Parking Enterprise Fund** – Capture all parking revenue, or at least revenue gains provided by rate adjustments made following the establishment of the PBD program, or parking, mobility, and demand-management investments.
- **Stakeholder Engagement** – Make sure area parking stakeholders, including all parking users, are aware of the program, and its capacity to convert parking fees into public improvements.
- **Investments** – Ensure that investments are made, in line with stakeholder priorities and parking-management objectives.

- **Promotion** – Ensure that the program's activities and benefits are known in order to further build a stakeholder base for effective parking management, even when that requires rate increases.

IMPLEMENTATION APPROACHES

PBD and similar programs vary based on the following approach elements.

- **Level of stakeholder involvement in program-revenue investments** – Not all PBDs directly involve stakeholders in the selection of public improvements to be funded; though the most effective programs ensure that investments support broad stakeholder priorities and objectives.
- **Formality of the program** – Many cities have parking enterprise funds, and invest in public improvements, without a formally-recognized or branded PBD program; they simply capture parking revenues for investment in public parking, mobility, and/or demand-management resources as a matter of effective parking management.
- **Range of investments** – The most traditional version of a PBD is a public parking program that captures parking fees to ensure that the system is self-supporting. While not as innovative as other PBD iterations, this ensures that parking is not subsidized, thus reducing the risk of over-supplying parking as an "economic development" strategy. Other PBD programs must limit investments to parking, mobility, or demand-management investments. Others can invest in a much wider range of improvements, including sidewalk cleaning and public art.

ENFORCEMENT & MONITORING TECHNOLOGY: LICENSE PLATE READERS

OVERVIEW

Parking enforcement vehicles equipped with LPR technology can provide highly efficient time-limit monitoring, parking-meter payment status, and residential permit parking (RPP) enforcement, while also providing a stream of data on vehicle occupancies that can be used to monitor utilization/availability conditions across downtown. LPR also provides visual evidence for infractions, when it occurs and when a citation is issued, which can be invaluable for adjudication purposes.

LPR technology has evolved into a core enforcement, permit-management, and scofflaw-mitigation tool for cities. LPR increases efficiency in several ways, including the automation of vehicle-location and parking-duration monitoring. This can significantly increase payment and time-limit compliance. LPR technology can also enforce RPP regulations, by validating the permit status of parked vehicles, if permits are linked to license plates.

KEY USES

Permit Enforcement

Many LPR vendors provide specialized technology for parking enforcement purposes and have developed the software to integrate with most citation, permit-management, and technology-hardware vendors.

Time Limit Enforcement

For time-limit enforcement, LPR provides digital chalking that can track the location of a vehicle, how long it was parked in a specific location/designated area, to track parking durations against posted time limits. This helps provide a more transparent, consistent approach to time-limit management, while reducing labor costs associated with traditional "tire chalking" systems.

Performance Tracking

LPR data can be used to measure parking occupancy, track availability, and monitor parking demand patterns, over time, in support of a Performance-Based management program. A daily data collection route could be incorporated into normal enforcement duties and routines. The information gathered from this routine procedure will provide an invaluable resource for analysis and ongoing assessment. This will also provide a substantial long-term cost savings since the City should not need to retain future occupancy study support services because the information will be systematically collected.

INTEGRATION

Integration requirements must be clearly defined in any vendor solicitation or new contract for citation, permit, and metering technologies. This will allow PEOs to link vehicle occupancies to payment/permit requirements and/or time-limit restrictions. Integration requirements and the cost of any software development should be the burden of the parking technology vendors. Data integration must be addressed during the solicitation and contracting stage with each vendor and the City should have a standard application programming interface (API) requirement that is included with any parking solicitation. Integration with the enforcement handheld is imperative to maximize the efficiency of the PEOs and minimize the burden of equipment that they are required to carry.

COST

The approximate cost to support the installation of LPR equipment on an existing vehicle is approximately $50,000-$65,000, inclusive of training and infrastructure needs, the installation of the cameras on the outside of the vehicle, wheel-imaging camera, the processing unit in the trunk, and the in-vehicle PC and navigator set-up in the front seat.

BROKERING SHARED PARKING & SUPPORTING TECH

BROKERING SHARED PARKING

Shared parking is the co-location of off-street parking in a single location that serves the parking demand for multiple land uses in a mixed-use context. Shared parking is particularly valuable in walkable, mixed-use centers in which small, private lots tend to be overwhelmed with demand when their associated land uses are busy, and significantly under-utilized much of the rest of the time. Fortunately, such districts also present two distinct, cross-supportive shared-parking opportunities that can reduce parking supply needs while providing more destinations with "overflow" parking resources.

Staggered Peaks

The first shared parking opportunity offered by mixed-use development comes from the staggered demand peaks associated with each use. Different land uses generate unique levels and patterns of parking demand. Parking supplies at mixed-use locations accommodate these demand fluctuations more efficiently than segregated supplies by accommodating peaking uses with spaces left vacant by other uses. Thus, the same parking lot that was full of workers' vehicles during the day can be used for residents at night.

Because parking demand for different land uses fluctuates throughout the day, each land use within a mixed-use development has a variable parking demand rate by time of day. Shared parking does not reduce parking demand per se. Rather, it reduces the number of spaces needed to meet the parking demand. These efficiencies allow for a much smaller "parking footprint", and thus reducing the space between buildings, while lowering the cost of development, housing, goods and services in urban districts.

Internal Capture

Mixed-use projects allow for parking efficiencies through "internal capture" trips. Such trips are made by patrons who, having already parked, travel between uses without accessing their vehicle. Restaurants and retail services are common generators of internal capture trips in mixed-use developments, as they serve both employees and residents within the same development. Not only does this proximity of uses present an opportunity to conserve land area from parking uses, but it reduces localized congestion as local employees and residents can easily access everyday goods and services within walking distance.

Some cities have maximized shared parking by facilitating the public use of private parking during a given building's off-peak hours (i.e. the evening in a parking lot associated with an office building). Increasing the share of parking in a given area that is open to public use can also help justify reduced accessory parking requirements, which can in turn ensure that more land is reserved for active uses.

Contextual Considerations

Shared parking is particularly valuable in walkable, mixed-use centers in which small, private lots tend to be overwhelmed with demand when their associated land uses are busy, and significantly under-utilized much of the rest of the time. In cities with effective municipal parking systems, this is typically the result of a legacy of parking requirements and/or development patterns that sought to ensure adequate parking at each destination, despite the typical physical constraints of development sites in walkable urban districts. As a result, the developed uses tend to never have enough parking when they need it most, and far too much at most other times. While it is essential to address any codes or developer tendencies that might continue this practice into the future, arrangements to share these parking capacities among affected developments can provide significant relief.

Implementation Barriers

Viable sharing arrangements often fail to materialize due to a lack of initiative among those seeking more capacity, or to liability concerns among those with excess capacity. Cities can play a vital role in realizing these potential capacity gains by engaging these parties, actively exploring the following options.

- Liaise between business, property, and lot owners with recognizable opportunities for mutually beneficial arrangements.
- Initiate negotiations by providing an independent perspective on issues and opportunities, identifying shared-benefit opportunities, and helping to address common concerns.
- Negotiate agreements, including identifying strategic agreement components, as necessary, such as:
  - Compensation in the form of increased lot maintenance, lot improvements, added security, etc.
  - Restricting access to the shared parking, via permits, to area employees to reduce risk and increase accountability.
  - Defining any added security or enforcement measures necessary to ensure that the primary uses of the lot are prioritized.
- Stepping in to remove stubborn barriers to viable arrangement, when feasible.
  - This commonly includes assuming added liability-insurance costs related to the sharing agreements.

SUPPORTING TECHNOLOGY & INNOVATION

Below are two case studies presenting innovative approaches to optimizing shared-parking potential in downtown districts, both incorporating pay-by-phone technology.

Case Studies

Asheville, NC

Drivers in downtown Asheville can pay for the City's on-street parking using the Passport Parking App. Signage denotes the parking zone and provides instructions to pay for parking using a cell phone. If users do not have a smartphone, they can still pay using their phone by calling a number and specifying the zone or by texting a code (after registration).

Recently, private lot owners approached Passport, the third-party provider of Asheville's parking app, to become part of the same payment system. Passport assigns the lot a "Zone," and incorporates the lot into the app with the other Asheville parking resources. The lot owner posts signage describing the rates and regulations for the lot (see Figure 4). Some lots maintain their private parking for periods of the day and convert to public parking in off-hours. Others operate as privately-owned, public parking throughout the entire day. Either way, private lot owners are able to take advantage of the city's easy-to-use parking system without giving up control of the lot itself.

The Asheville example highlights how cities themselves may not need to convince private lot owners once pay-by-cell programs have become established in a city. Sometimes, the ease and simplicity offered by the app is enough of an incentive to motivate lot owners to seek out participation themselves.

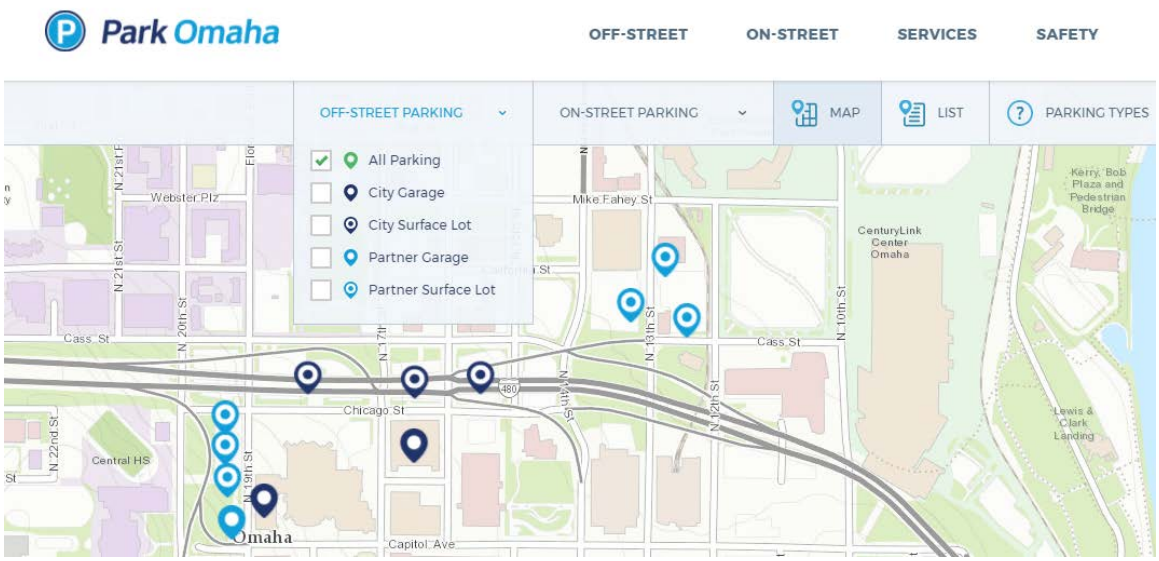
Figure 4 Private Lot with Public Payment after 5pm – Asheville, NC

Omaha, NE

The City of Omaha recently branded the Parking Division of its Public Works Department as Park Omaha to signal a commitment to provide coordinated and strategic management of its on- and off-street parking resources. A key component of the Park Omaha mission was to set up a system to incorporate private parking facilities as a means to avoid building more City facilities. "We want to maximize efficiency, minimize frustrations and develop an extensive shared parking network."[6]

[6] https://parkomaha.com/about/

Figure 5 Park Omaha map showing City & Partner Off-Street Parking



Source: https://parkomaha.com/map/

The result of these efforts is the highly successful, Park Omaha Partners program.

Park Omaha Partners

Park Omaha launched the Park Omaha Partners program to "boost the number of public parking spaces and help visitors easily locate them in the popular downtown area".7 The program provides a user-friendly, online process for property owners to offer their unused spaces, at a specified schedule, to the Park Omaha network through a shared parking agreement. The process begins with an online application – see below.

Accepted Partner locations are added to the Park Omaha interactive map. An expanded map view also provides information on rates, hours of operation and payment options. Park Omaha identifies these facilities, as "partner" facilities, and distinguishes them from Park Omaha facilities, in its maps and information materials. As Partner facilities, private lots are given official (copyrighted) signage/iconography with a distinct logo that identifies them as part of the City parking system, while indicating that hours of access, rates, and other regulations may vary from standard Park Omaha facilities. The copyrighted branding helps to prevent unapproved private lots from using the same design and calling themselves Park Omaha Partners.

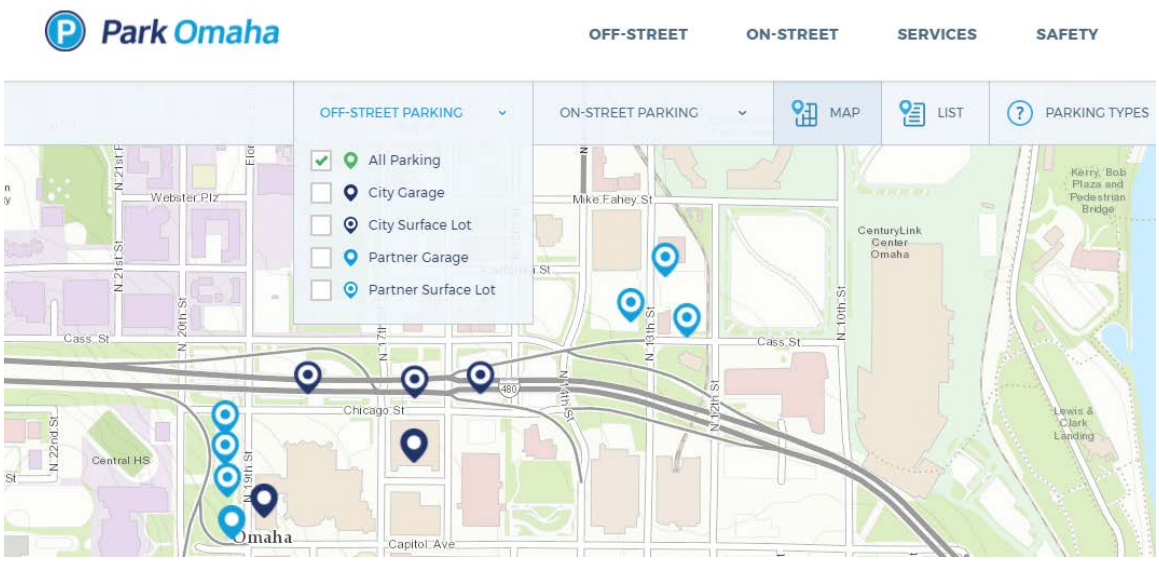
One of the key tools to make this work has been facilitating payment via the Park Omaha App. Partner facilities are given a unique payment-zone designation to use this mobile-payment system, allowing drivers to pay for parking exactly as they would in a City facility. Payment revenue goes directly to the facility owners, thus allowing private facility owners to monetize their excess parking without having to set up payment systems. This has been a critical component in recruiting new Partners to the program.

7 https://parkomaha.com/about/park-omaha-partners/

Figure 6 Partners Application Portal

Source: https://parkomaha.com/about/park-omaha-partners/

Figure 7 Park Omaha map showing City & Partner Off-Street Parking



Source: https://parkomaha.com/map/

Program Collaborators

- The City's Planning and Public Works departments, with the guidance of the Mayor's Office, have partnered with Park Omaha to ensure that parking is part of the downtown trailblazing system – signs that lead visitors to popular venues.
- Park Omaha contracts with Republic Parking to operate and administer the parking system, provide professional customer service, make parking upgrades, and oversee a Parking Ambassador program.
- A parking advisory committee – comprised of representatives from city staff, retailers, developers and business leaders – provides guidance on parking improvements, rates and makes recommendations.

Keys to Success

The City initiated private lot participation in the Partners program by giving presentations to local lot owners and operators. Park Omaha has seen the prospects of the Partners program become increasingly attractive to private facility owners, especially as the approach proves viable and profitable, and the technology has successfully incorporated private facilities to handle demand, even from large events, seamlessly.

Challenges

While the proliferation of smartphones and mobile payments offers distinct benefits for cities that wish to incorporate privately owned parking into their systems, there are challenges to consider associated with this strategy. For one, some private owners may fear the added liability associated with opening up the lot/structure to the public. In addition, incorporating private resources means choosing to standardize or not standardize pricing, hours, and regulations across available parking resources. This could cause confusion or work against shared parking management goals, and should be considered as part of any partnering processes.

RESIDENT PERMIT PARKING (RPP)

CONCEPT OVERVIEW

Residential permit parking (RPP) programs can improve on-street parking availability for local residents within a specific neighborhood/district, typically by issuing permits to local households and restricting parking for non-permit-holders during selected hours, and/or on selected days. RPP programs originated as a means to keep parking-demand from adjacent commercial business districts or nearby transit stations from "spilling over" into residential areas. In some more densely urbanized locations, they have been implemented as a means of managing resident parking demand, and bringing resident-vehicle curbside occupancy levels more in line with available supplies.

Figure 8 Resident Permit Parking in Medford, MA

OBJECTIVES & BENEFITS

- Ensure parking availability for local residents, particularly during times of high demand within a specific neighborhood or district.
- Help maintain the value of homes in urban districts, particularly where homes have minimal or no off-street parking, by ensuring consistent and convenient parking opportunities.
- Reduce public concerns about "spillover" impacts from strategic parking management (pricing, restrictions, etc.) and zoning (reduced minimum parking requirements, parking maximums, etc.) practices.

GOALS & PRINCIPLES

- Prioritize parking for residents and their guests.
- Make clear that affected streets remain public resources, with particular preference given to residents only where and when access to housing would otherwise be constrained by drivers with more suitable parking options.
- Maintain public parking access when resident demand is more modest.
- Make clear that the purchase of a permit does not guarantee the permit holder a space on any given block, parking lot or particular location.
- Control the number of issued permits to ensure that the on-street spaces are not overwhelmed.
  - This is generally only an issue in higher-density neighborhoods in which most households lack access to dedicated off-street parking options.
  - The City of Toronto, for example, caps the number of permits issued to the curbside-parking capacity within each zone, and limits households to single permits until all eligible households have secured or declined to purchase a permt.
- Incorporate clear signage and user-friendly technology options so the program is easy to understand for motorists and simple to enforce for staff.

KEY ELEMENTS

Core elements of an RPP program include the following.

- **Zones**: Assign permits to appropriately-sized residential areas/neighborhoods.
- **Petition-initiation**: Consider new zones in response to a petition signed by representatives from households that would be affected.
  - Most cities with an RPP require a minimum number of residential units in the proposed RPP area to sign a petition of support and that a majority of their residents approve of program implementation.
  - Required majority levels range from 50% (Boston, MA and Portland, OR) to 80% (Chicago, IL).
- **Hardship**: Confirm conditions of reduced resident access to neighborhood street parking before final approval.
- **Fees**: Ensure that these cover the cost of administering the program, if not the cost of maintaining the affected streets. Some cities have adopted more strategic pricing approaches, particularly to address locations where resident permit demand is significantly higher than curbside capacities.
- **Schedule:** Customize enforcement hours to respond to local demand conditions, breaking from the initial tendency to set hours around the workday. This has become a more common practice, and city-center neighborhoods have continued to attract "24/7" activity.
- **Visitor Parking**: Typically accommodated through visitor permits, a small amount of which is commonly provided with a resident permit with the option to purchase more. Some cities have begun to meter high-demand neighborhood blocks, exempting resident-permit holders, as a means of accommodating visitor parking needs without having to administer visitor permits.

Figure 9 Arlington County, VA Parking Permit Types

Zone Permit Flex Pass Visitor Pass

AREAS OF INNOVATION

More innovative practices in managing RPP programs include the following.

- **Limiting Permits:** Cap the number of permits based on supply, to ensure consistent availability for permit holders. Toronto is the only city in North America that currently has a cap.
- **Limiting Household Permits:** Limit the number of permits a household can purchase, to seek more consistent availability for permit holders. Providence, RI, and Sacramento, CA, limit permits to 2 per residence; Seattle, WA, limits permits to 4 per residence.
- **Graduated Permit Rates:** Discourage overuse of curbside parking in high-demand areas, by charging households an escalating rate for multiple permits. Arlington County, VA was an early adopter of this approach, and continues to use it to manage demand for permits in its more walkable urban districts.

CONTEXTUAL CONSIDERATIONS

RPP programs are particularly useful and sought after in residential areas near a transit station, a commercial/employment center, or any destination that generates significant parking demand. RPP can also help reduce resistance to effective curbside management efforts in commercial and mixed-use areas, by reducing the risk that pricing/restrictions in these area will shift parking demand into nearby areas. Similarly, an effective RPP program can reduce public pressure to maintain minimum parking requirements for new development, which many established residents consider the only effective means of preserving their curbside parking from the impacts of growth.

CASE STUDIES IN INNOVATION

RPP + Daytime Business/Employee Permits: Aspen, CO

The City of Aspen established Residential Permit Parking zones to prevent overflow parking from the city's downtown, which implemented paid parking in 1995. Residents are provided with parking permits and visitors are allowed to park for free for up to 2 hours in an 8-hour period. To increase utilization of on-street parking facilities towards 85% occupancy, the city sells 1-day visitor passes to park for more than 2 hours in RPP zones. Any visitor may purchase day passes

without involvement of a resident for $7 at a local grocery store, via pay-by-phone, or at one of 15 neighborhood pay stations.

Businesses in RPP zones are allowed to purchase business vehicle permits, which are non-transferable and cost $1,000 per year. Lodges within RPP zones can purchase parking permits for guest use. After lodge employees were found using guest permits for personal parking, the City implemented a "two strikes" program that banned lodges from purchasing permits when employees are caught twice abusing the program. Parking availability in residential neighborhoods is regularly monitored by the City and rates are increased when average occupancy in the neighborhood exceeds 85% over a 1-year period.

RPP zones are enforced using license plate recognition (LPR) technology, which allows the 3,000 residential-zone parking spaces to be checked 2-3 times per day. Enforcement vehicles identify cars that park in RPP zones for more than 2 hours in an 8-hour period without purchasing a day pass or holding an RPP. Physical passes are unnecessary as enforcement vehicles access a database with information on all residential pass holders.[8]

Visitor Parking: Charleston, SC

The City of Charleston established its first residential permit parking district in 1975 to minimize the number of non-residential and commercial vehicles competing for parking in residential neighborhoods. Currently, there are 11 parking districts, ranging in size from a few blocks to several dozen, which cover much of downtown Charleston. Each residence within a Resident Permit Parking district is allowed up to two on-street parking permit decals for their specific district, and more than 8,000 permits are issued annually.

The City offers homeowners the option to purchase the following guest passes to accommodate their individual need for long term visitor parking:

- Single day pass
- Two week pass
- A booklet of 30 single-day passes at a discounted rate

Guest passes must be filled out and initialed by the homeowner and placed on the vehicle dashboard.[9]

[8] *Contemporary Approaches to Parking Pricing: A Primer*, USDOT-FHWA, 2012
[9] "Charlotte Curb Lane Management Study." Charlotte Department of Transportation. charmeck.org/city/charlotte/Transportation/Parking/Pages/CurbLaneManagementStudy.aspx).

REDEFINING PARKING REQUIREMENTS

BACKGROUND

Minimum Parking Requirements

Parking requirements defined within municipal zoning codes are a powerful tool for shaping a city's transportation and development character. For several decades, zoning codes across the United States have emphasized minimum requirements for on-site, tenant-reserved parking spaces to protect local street-parking capacities from parking activity generated by new development. The concern was that without these requirements, developers would save money and developable land area by not building any parking, relying instead on nearby street parking to accommodate their project's parking needs. In response, cities began to require sufficient accessory parking at each new development — enough to ensure that a space would always be available for anyone who needed one.

For this to work, not only must developers provide enough parking to meet peak demand, but they need to provide it for free to prevent drivers from parking on-street to save money. The result of this approach is the common practice of requiring far more parking than is consistently needed at new development projects. There are, of course, exceptions, but aerial images of most downtowns and commercial centers attest to the fact that most have been inundated with low-cost parking facilities that are mostly empty, most of the time.

This is not only a waste of some of the best real estate in the country, it depresses development densities and undermines walkable, bike-friendly, and transit-accessible development patterns.

Trend Toward Reduced or Eliminated Requirements

Today, governments are increasingly questioning the merits of minimum parking requirements in urban centers — particularly as traditional urban forms and transportation options have regained considerable market favor. In many of these areas, requirements have been reduced or eliminated in recognition of the potential for minimum requirements to be counter-productive. Increasingly, many are proposing full-scale reviews of their standards, and even considering removing parking requirements altogether.

Minimum parking requirements are not the only reason projects end up "over-parked". Developers who are unfamiliar with walkable, transit-accessible urban centers often bring assumptions and formulas built from experience gained in highly auto-dependent environments. As often, lenders bring the same assumptions and formulas to downtown projects, insisting upon levels of parking that go beyond zoning code requirements, and well beyond the highest peak levels of demand generated by realized development. [10] [11] As a result, in many contexts, removing

[10] http://www.planetizen.com/node/56296

[11] http://www.washingtonpost.com/wp-dyn/content/article/2009/10/07/AR2009100703996.html

minimum parking requirements is not enough to address the many problems created by a glut of private, free parking in urban areas, as outlined above.

The Emerging-Mobility Disruption

The cost of over-requiring parking is set to become even greater, as disruptive technologies and service innovations, primarily in the arena of "Shared Mobility", push US travel preferences toward what many expect to be a profound paradigm shift, and potentially a significant drop in personal-auto parking demand. While the exact impact is still to be determined, some experts estimate that self-driving vehicles predominantly utilized through on-demand, shared-mobility services, could eliminate the need for up to 90% of the current parking supply over the next two decades.[12] Services like Uber and Lyft are already significantly reducing auto-dependency, allowing more commuters to shift their primary mode away from driving by providing a nimble, affordable, and increasingly-familiar, non-driving "rainy day" commute option.

This relatively recent mobility phenomenon has good company in several, more-established Shared Mobility elements, such as car-share, bike-share, and computer-matched ridesharing. Where access to these options is consistent, one-car and carless households are becoming far more common,[13] further increasing the share of trips taken by modes that require a fraction of the parking necessary for private autos.[14] Into this ever-expanding mix of mobility options, driverless autos can be expected to bring a new level of disruption and opportunity. Put simply, driverless ride services will combine the distinctly appealing components of car-sharing (privacy and autonomy) and TNCs (Transportation Network Carriers: door-to-door service, no driving or parking necessary) services at a fraction of the cost for either.[15]

A NEW APPROACH

Require Access Accommodation, Keep Parking in the Mix

Ensure that most parking, whether provide on-site at new development or via In Lieu Fees, provides access benefits that go beyond the development site, and to allow for private and public investments to shift away from parking where and when mobility and TDM become more relevant and effective. By keeping parking as a primary option, this approach will allow municipalities to focus on parking solutions in the near-term, as downtown parking facilities are redeveloped and replacement capacities remain a priority. Five years from now, the same code will allow municipalities to jointly-develop a mobility hub, or expand a bike-share system should replacement capacities no longer be a necessary part of repurposing downtown parking garages. At the same time, the approach provides a unique range of options for developers to meet requirements that are no longer framed tightly around parking.

3. Provide on-site parking, which will be credited toward (or increase) requirements, depending on how it is managed and how broadly accessible the spaces are.
4. Provide on-site mobility and TDM amenities, which will non-driving travel to the site more viable and appealing.

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[12] http://www.motherjones.com/environment/2016/01/future-parking-self-driving-cars

[13] https://escholarship.org/uc/item/5k56406d#page-6

[14] https://www.apta.com/resources/reportsandpublications/Documents/APTA-Shared-Mobility.pdf (page 6)

[15] https://www.morganstanley.com/ideas/car-of-future-is-autonomous-electric-shared-mobility

5. Provide funding for district-level investments, which will provide public parking, mobility, and TDM benefits, as befitting context and circumstance at the time.

Parking Requirements become Access Management Requirements

Using the existing framework for calculating minimum parking requirements, the "requirement" is shifted away from parking toward a requirement to manage the project's access needs and impacts, measured as Access Management Requirement (AMR) points.

Figure 10 Examples of Access Management Requirements (in AMR points)

Land Use	Minimum Requirement
Multi-Family Housing	1 to 3 per dwelling unit, increasing by # of bedrooms
Offices	1 per 200 SQ FT FA - 1 per400 SQFT FA
Medical Facilities	1 per 4 Planned Bed sites, or 300 SQ FT.
Standard Restaurant	1 per 4 seats, plus 1 per employee on largest shift
Retail Trade	1 per 150 SQ FT FA
Drinking & Entertainment	1 per 4 persons based on building's maximum capacity

Three Options to Satisfy AMR

Developers can meet a project's AMR through any combination of the following three options.

1. On-site parking,
2. Bonus TDM measures, and
3. In Lieu Fee payments.

Case Study: Aspen, CO[16]

The proposed approach, while novel, is not without precedent. The City of Aspen, Colorado very recently adopted a similar approach for their downtown district (the Aspen Infill Area).

The City of Aspen is preparing for a future into which it is becoming increasingly tenuous to predict rates of parking-demand generation, particularly in walkable, urban centers. It is seeking to integrate parking regulations and TDM into a Mobility Requirement, which will replace all parking requirements in its downtown. To satisfy the Mobility Requirement, developers will have three primary options.

1. Provide on-site parking.
2. Commit to on-site mobility amenities and/or TDM programs, beyond the minimum required for the project's Transportation Impact Analysis.[17]
3. Contribute funding to the provision of public parking, mobility, and TDM programs.

[16] http://aspenpublicradio.org/post/aspen-looks-mobility-not-parking-way-future#stream/0

[17] http://www.aspenpitkin.com/Business-Navigator/Get-Approval-to-Develop/Transportation-Impact-Analysis-Guidelines/

This is designed to generate *direct provision of private amenities and programs*, while also allowing developers to, instead *fund the provision of public amenities and programs*. The latter of these options, provided via a Cash in Lieu option, will generate revenue for the City to invest in parking, mobility improvements/expansions, or TDM, according to existing and anticipated needs. This allows the City to respond to changes in parking demand, mobility preferences, and transportation/sustainability objectives by shifting resources toward "right fit" solutions, as those options emerge and evolve.