SF*park*

Pilot Project Evaluation

The SFMTA's evaluation of the benefits of the SF*park* pilot project

SFMTA
Municipal Transportation Agency

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EXECUTIVE SUMMARY

The SFMTA conducted a thorough evaluation of SF*park*. As a federally-funded demonstration of a new approach to managing parking, the SF*park* project collected an unprecedented data set to enable a thorough evaluation of its effectiveness.

SFMTA evaluation results

An overview of the benefits of the SF*park* pilot project

The SFMTA evaluated the SF*park* pilot project to see how effectively this approach to managing parking delivered the expected benefits. This section outlines what the SFMTA learned from this evaluation and provides transportation managers in other cities an overview of how parking management can help achieve their goals.

Rate change summary

Over the course of the SF*park* pilot project, the SFMTA lowered the average hourly rate at meters by 11 cents from $2.69 to $2.58 and average hourly rates at SF*park* garages by 42 cents from $3.45 to $3.03.

Hourly parking rates in SF*park* areas

Before vs after (10 rate changes)
On- and off-street rates

SF*park* improved parking availability

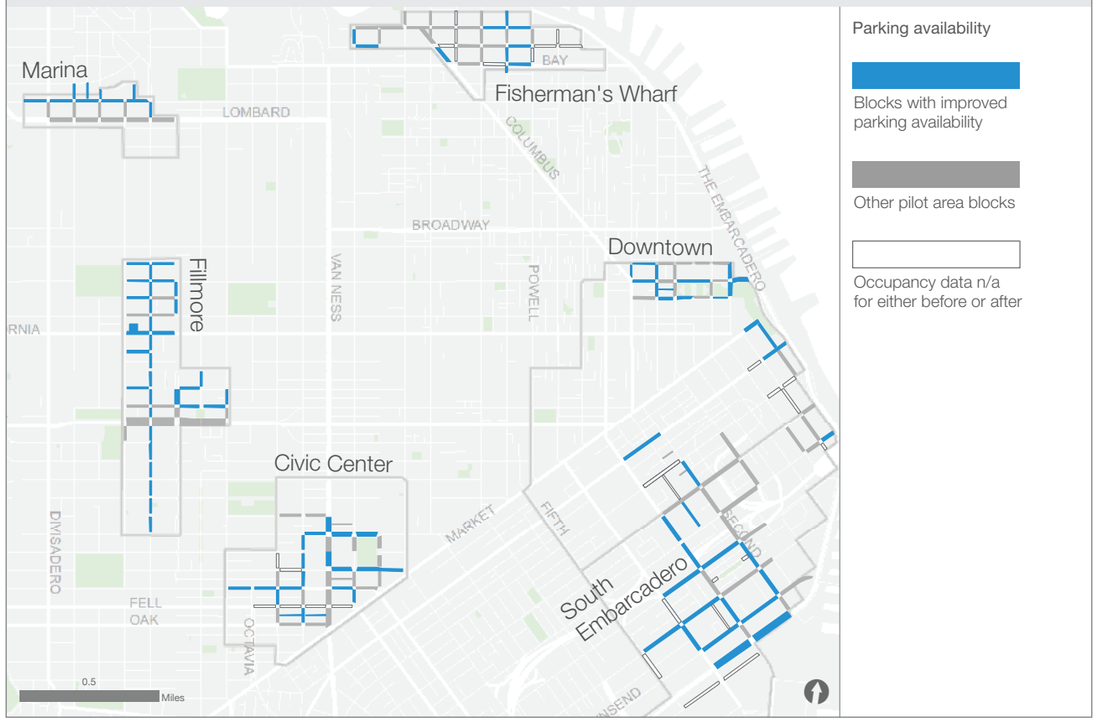
While the SF*park* pilot project had many goals, its primary focus was to make it easier to find a parking space. More precisely, the goal was to increase the amount of time that there was parking available on every block and improve the utilization of garages. Besides helping drivers, making it easier to park more of the time was expected to deliver other benefits (e.g., reducing circling, double parking, greenhouse gas emissions, etc.).

Even as the economy, population, and overall parking demand grew, parking availability improved dramatically in SF*park* pilot areas. The amount of time that we achieved the target parking occupancy (60 to 80%) increased by 31% in pilot areas, compared to a 6% increase in control areas. On blocks where people paid the meter most of the time (in high payment compliance or "HP" pilot areas) where we would expect pricing to be most effective, achievement of the 60 to 80% target occupancy rate nearly doubled.

Even more importantly, the amount of time that blocks were too full to find parking decreased 16% in pilot areas while increasing 51% in control areas. In other words, SF*park* made it easier for drivers to quickly find parking spaces. In areas where people pay at the meter most of the time, the impacts were even more notable, with a 45% decrease.

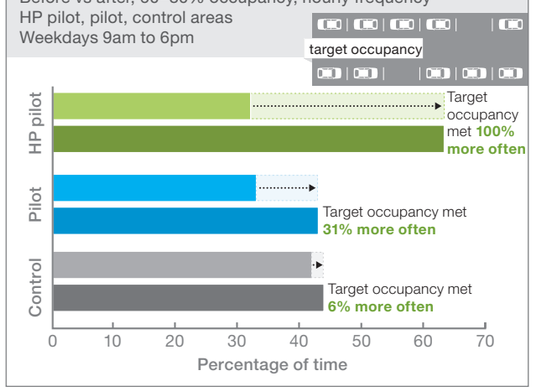
Improved parking availability

Blocks where frequency of 90–100% hourly occupancy rates decreased from spring 2011 to spring 2013 | Weekdays 9am to 6pm



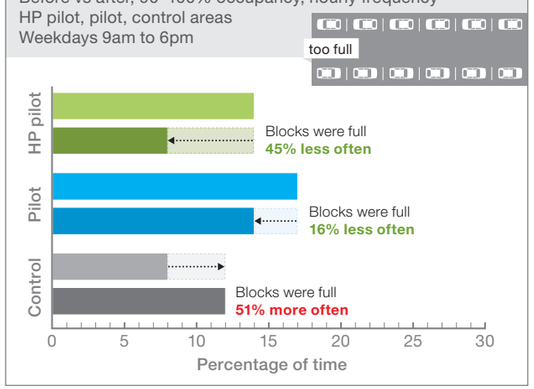
How often do blocks meet target occupancy?

Before vs after, 60–80% occupancy, hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm



How often are blocks too full?

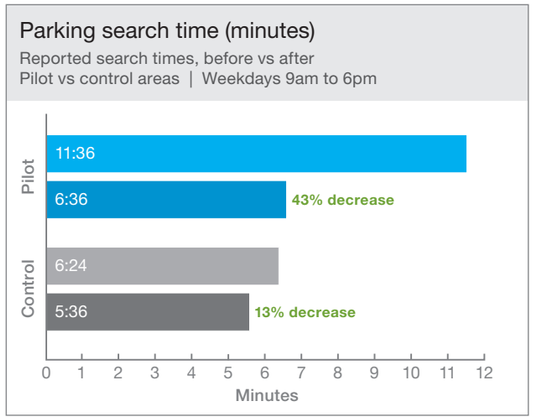
Before vs after, 90–100% occupancy, hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm



Secondary benefits

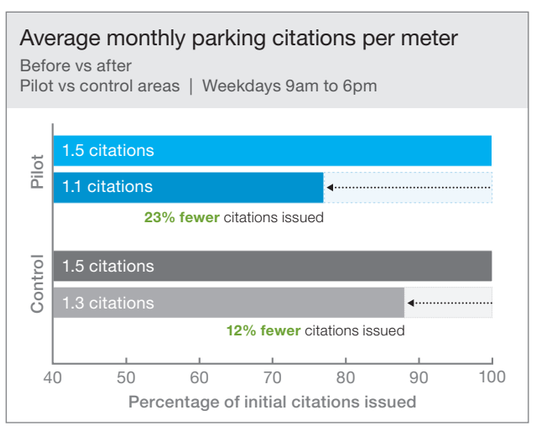
This section outlines the benefits of meeting occupancy goals and making sure that there are open parking spaces.

It is easier for drivers to find a parking space. In SF*park* pilot areas, the amount of time most people reported that it took to find a space decreased by 43%, compared to a 13% decrease in control areas.

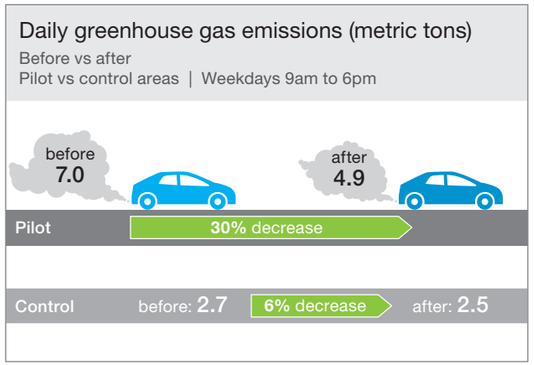


It is easier to pay and avoid citations. SF*park* also sought to create a parking experience that is simple, consistent, easy to use, and respectful. The pilot project improved the experience of parking by lengthening time limits and making it much easier to pay. Drivers surveyed before and after SF*park* were asked to rate their parking experience; after SF*park*, the likelihood of reporting that it was somewhat or very easy to pay for parking increased in pilot areas by 75%, or twice as much as in control areas that did not receive new meters or longer time limits.

Making it easier for drivers to pay for parking also made it easier to avoid parking tickets; in SF*park* areas, the SFMTA gave 23% fewer parking meter-related citations per meter than before the pilot.



Greenhouse gas emissions decreased. Drivers generated 7 metric tons of greenhouse gas emissions per day looking for parking in pilot areas. This dropped by 30% by 2013, compared to a decrease of 6% in control areas.

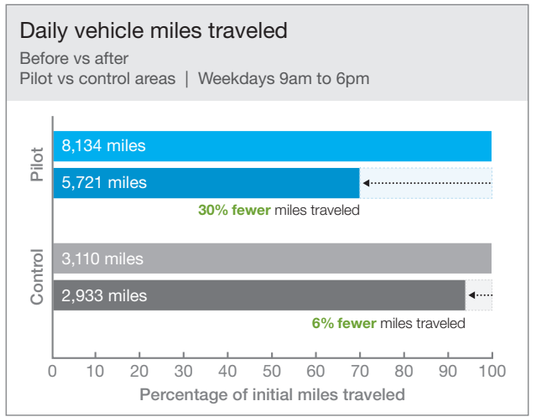


Peak period congestion decreased. SF*park* encouraged people to drive at non-peak times and improved parking availability when it mattered most. On-street parking availability improved by 22% during peak periods, compared to 12% during off-peak. In SF*park* garages, morning peak entries rose 1% while off-peak entries rose 14%, and evening peak exits rose 3% while off-peak exits rose 15% This suggests that SF*park* helped to reduce peak-period congestion, which makes the roads flow more smoothly for drivers and transit.

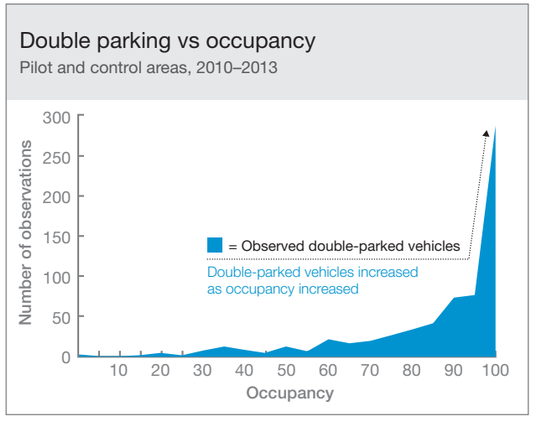
Traffic volume decreased. In both pilot and control areas, where parking availability improved, traffic volume decreased by approximately 8%, compared to a 4.5% increase in areas where parking availability worsened.

Traffic speed improved. While overall traffic speed decreased, it decreased by 3% in areas with improved parking availability, compared to a decrease of 6% in areas with worsened parking availability.

Vehicle miles traveled decreased. As a result of less circling, pilot areas saw a 30% decrease in vehicle miles traveled from 8,134 miles per day in 2011 to 5,721 miles per day by 2013. Control areas saw a 6% decrease.



Double parking decreased when parking availability improved. Double parking increases as parking gets harder to find, and it increases dramatically as parking occupancy exceeds 80% In pilot areas, double parking decreased by 22% versus a 5% decrease in control areas.



Transit speed improved where double parking decreased. Transit speed increased 2.3% from 6.4 to 6.6 mph along corridors with reduced double parking, and it decreased 5.3% from 7.1 to 6.7 mph along corridors with increased double parking. Besides helping to increase transit speed, fewer unpredictable delays help transit operate more reliably.

Net parking revenue increased slightly. Though the purpose of SF*park* was to deliver transportation, social, and environmental benefits, it also appears to have, in total, increased SFMTA net parking revenues by approximately $1.9M per year. In comparing the pilot areas to citywide trends, the installation of credit card enabled parking meters and longer time limits in SF*park* areas appears to have increased net annual revenues from meters by approximately $3.3M from FY2011 to FY2013. In the same period, annual citation revenues appear to have decreased by approximately $0.5M in SF*park* pilot areas (a decrease 10% greater than the citywide trend of declining citation issuance). SF*park* appears to have slightly slowed the growth of revenue for garages, accounting for about $0.9M in annual revenue that may have been earned had SF*park* garage revenue grown at the same pace as non-SF*park* garage revenue, though revenue from SF*park* garages increased at a faster rate since FY2012. Annual parking tax collected in pilot areas increased by $6.5M, or 43%, during the same period, compared to a 3% increase in the rest of the city, but it is unclear what portion of that is attributable to SF*park*.

Improved availability supports economic vitality. While available data does not allow us to confirm a causal relationship, the SFMTA assumes that improving parking availability improves customer access to commercial districts and therefore supports economic vitality.

Safer streets because of reduced vehicle miles traveled and less distracted driving. The SFMTA assumes that reducing circling by distracted drivers looking for parking helps to reduce collisions with pedestrians, cyclists, and other cars.

Case study: Fillmore

The Fillmore pilot district illustrates how demand-responsive pricing improved both parking availability and parking utilization. Prices decreased on blocks that were underused, which increased use, and prices increased on blocks that were too full, which tended to lower occupancy into the target range.

With each data-driven rate adjustment, SF*park* followed this set of rules:

- When occupancy was 80–100%, the hourly rate increased by $0.25
- When occupancy was 60–80%, the hourly rate was not changed
- When occupancy was 30–60%, the hourly rate decreased by $0.25
- When occupancy was less than 30%, the hourly rate decreased by $0.50

In the Fillmore pilot area, the average hourly cost of metered parking increased during the pilot period from $2.00 per hour to $2.37 per hour.

Fillmore
Pricing and occupancy summary
Weekdays 9am to 6pm | Average weekday rate change: $0.37

45/45 blocks = 100% of blocks in Fillmore participated in all 10 rate adjustments

50% of blocks with rate increase[1]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$3.63	$1.63	86	70	(16)
Noon to 3pm	$2.00	$3.58	$1.58	83	70	(13)
3pm to close	$2.00	$3.61	$1.61	84	71	(14)

42% of blocks with rate decrease[2]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$0.67	($1.33)	61	65	4
Noon to 3pm	$2.00	$1.28	($0.72)	68	61	(7)
3pm to close	$2.00	$1.11	($0.89)	62	64	2

8% of blocks with no change overall[3]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$2.00	$-	76	66	(10)
Noon to 3pm	$2.00	$2.00	$-	73	75	2
3pm to close	$2.00	$2.00	$-	75	62	(13)

*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

*2 These blocks may have seen a price increase mid-way through but by rate adjustment 10 were at a lower price than they were before SF*park

*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after
Hourly rate for "After" shown

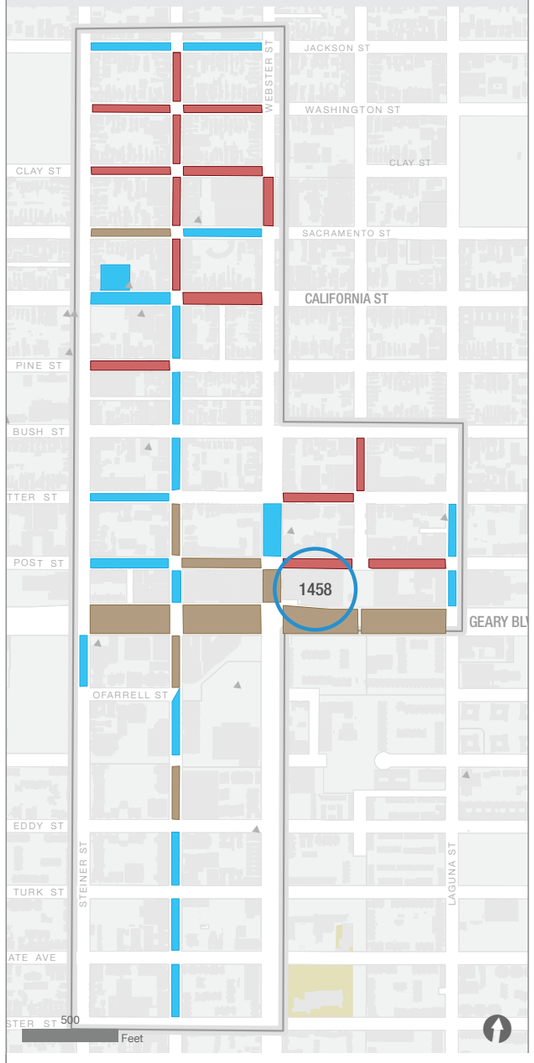
Hourly garage rates

- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

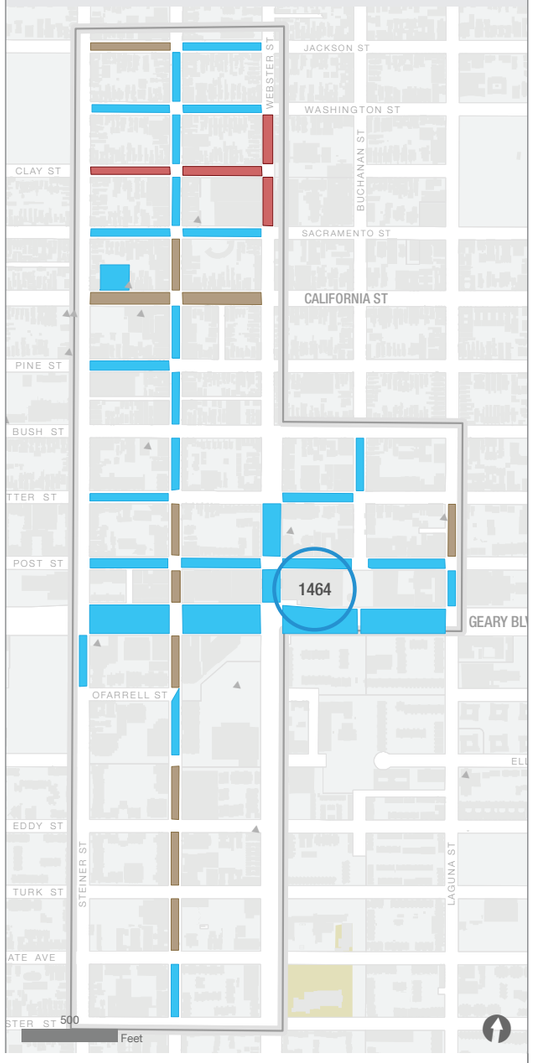
Hourly meter rates

- $0.25 to $3.25 decrease
- $0.25 to $0.01 decrease
- $0.01 to $0.25 increase
- $0.26 to $2.50 increase
- No overall rate change

Average occupancy: before
Weekday average, 9am to 6pm



Average occupancy: after
Weekday average, 9am to 6pm



Occupancy[1]

- 0 – 30%
- 30 – 60%
- 60 – 80%
- 80 – 100%

SF*park* garage usage[2]

Other garages/lots

[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period
[2] Garage usage shown for weekdays and weekends, all operating hours

About the evaluation

The SFMTA's evaluation of the SF*park* pilot project was predicated on effective study design, an unprecedented amount of data collection, careful data management, significant staff resources, and support from consultants, leading experts in the transportation and parking management fields, and a federal evaluation team.

An evaluation of this nature and magnitude has inherent limitations and challenges for the study design, data collection, and evaluation. For example, it is not possible to do purely "apples to apples" comparisons between pilot and control areas because every neighborhood is unique. The Downtown and Civic Center pilot areas have no analog that can be used for comparison or benchmarking. While the level of data collection for this project is unprecedented, that cannot overcome the fact that countless (and often immeasurable) factors affect travel behavior and parking demand. In other words, while parking pricing and information are critical factors, they were not the only variables to change in these San Francisco neighborhoods over the course of a two year pilot project.

As a result, one must use considerable sophistication, care, and judgment when evaluating this data, and use caution when trying to definitely establish causality (i.e., that SF*park* was or was not responsible for a particular outcome), especially when trying to evaluate the effect of SF*park* on more complex and nuanced secondary outcomes.

One of the largest confounding factors for the project evaluation is the fact that the two-year SF*park* pilot began as San Francisco was emerging from the economic recession of 2008–2010. This is in addition to other possible confounding factors such as the unknown variations in the level of parking enforcement, the increase in bicycling and ride sharing, improvements to transit service, capital projects impacting San Francisco's streets, and other changes to the built environment. This evaluation incorporates our best effort to address these challenges and accurately assess the effects of SF*park*.

Additional findings: meters are effective parking management tools

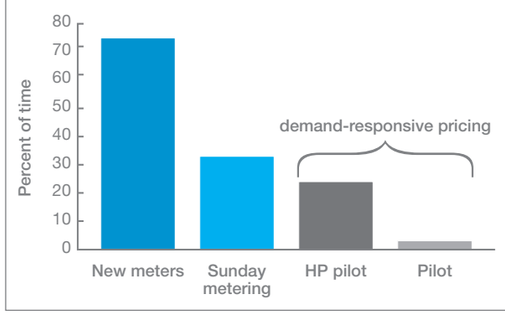
Demand-responsive pricing helps to improve parking management and optimize outcomes, but the starkest improvements come from whether or not (or when) parking meters are used as parking management tools. Though not the purpose of the SF*park* pilot project, one of the clearest findings of this evaluation is that parking meters are extremely effective at managing parking demand, helping to achieve parking occupancy goals, and thereby achieving other goals such as reducing circling and greenhouse gas emissions.

For example, starting to enforce meters on Sundays in January 2013 resulted in improved parking availability, parking search time, and parking turnover on Sundays. Additionally, the SFMTA introduced new meters on many blocks in 2011, resulting in improved parking availability. Prior to installing meters, parking was too full 90% of the time. After installing meters, this dropped to just 15% of the time.

Evenings provide additional evidence; parking occupancy spikes approximately 30 minutes before the SFMTA stops operating meters (typically around 6pm) making parking often hard to find in the evening in San Francisco's commercial areas.

Change in percent of time parking was available

Change in percent, before to after, occupancy less than 90%
New meters, Sunday metering, and demand-responsive pricing



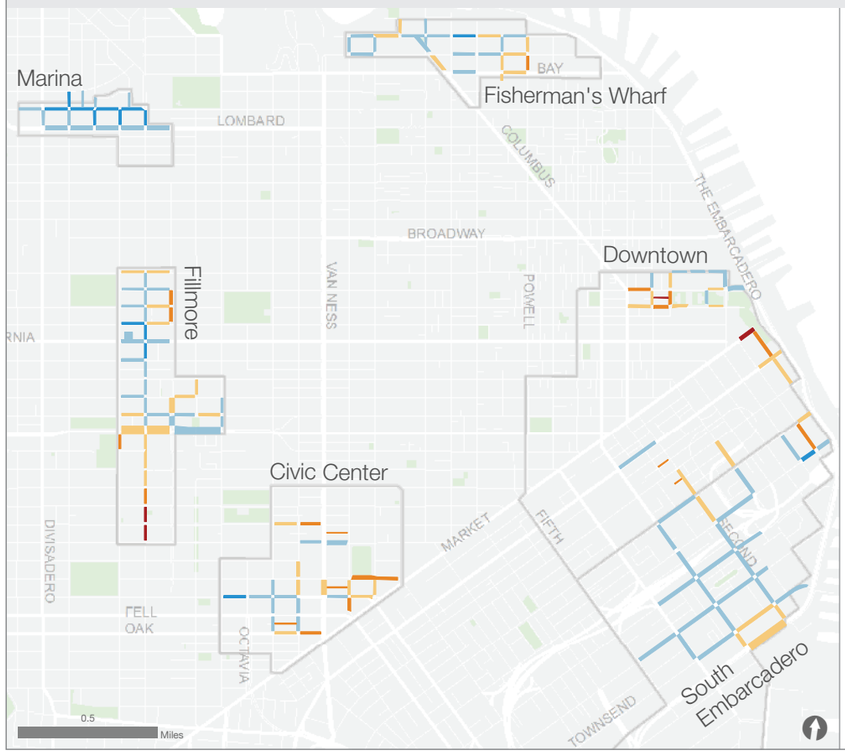
Payment compliance: findings and challenges

While demand-responsive pricing delivers the benefits we expected, those benefits are more pronounced when most people pay at the meter. Data from this evaluation confirmed that many blocks consistently had low payment compliance, which is when cars are parked without paying the meter.

HP blocks, or blocks with high payment compliance where at least 85% of occupied time was paid for, saw the biggest improvements in several indicators. This suggests that improving parking enforcement to increase compliance rates has the potential to increase the social and transportation benefits of parking management. This also highlights why it is desirable for cities to strive to ask all drivers to pay at the meter; the more drivers that are exempted from paying the meter, the less that demand-responsive parking pricing will deliver benefits.

Payment compliance rates

Share of paid time to occupied time, July 2011 – June 2012
Blocks that participated in the first 10 rate adjustments



Data not available for control areas (smart meters are not located in control areas). Pilot areas include blocks that participated in the first 10 rate adjustments.

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OVERVIEW OF SF*PARK*

SF*park* was a federally-funded demonstration of a new approach to managing parking that tested better information, including real-time data where parking is available, and demand-responsive parking pricing to help make parking easier to find.

Overview of SF*park*

A summary of the policies, technologies, and evaluation of the SF*park* pilot project

This section summarizes the policies behind the SF*park* pilot project, the different strategies and technologies that were implemented, and how the project study design enabled a thorough evaluation.

Why manage parking?

How cities manage parking really matters, as how we manage parking can help us be more successful as a city. When parking is difficult to find, many people double park or circle to find a space. This circling doesn't just waste time and fuel—it's also dangerous. Circling drivers are distracted drivers making lots of right and left turns who are more likely to hit someone crossing the street, a cyclist, or another car.

Muni (San Francisco's public transit system) is sometimes stuck in the middle, negotiating double parked cars or waiting for circling cars to turn, which is part of why Muni isn't as fast or reliable as it could be. Parking also affects economic competitiveness—if very few spaces are available, fewer people can access our commercial districts. The reality or even just the perception that it is hard to find a parking space in a particular area can hurt its economic vitality.

The SF*park* pilot projects were a demonstration of a new approach to managing parking intended to make it easier to park. As one part of dramatically improving the experience of parking in San Francisco, SF*park* focused on improving parking availability by better managing demand for existing parking supply. In other words, SF*park* was a demonstration of how we could manage our existing parking as intelligently as possible to maximize its benefit for the city. SF*park* was intended to make parking more convenient for drivers while also delivering wider benefits such as improving transit speed or reducing greenhouse gas emissions.

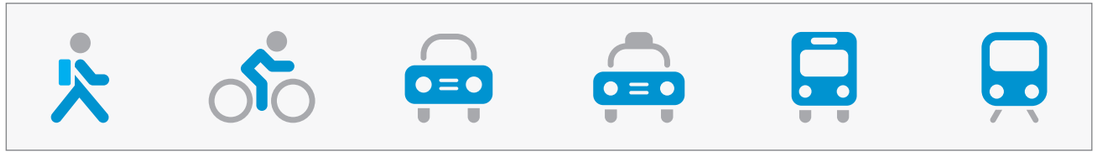
Besides addressing the parking problems we see today, SF*park* was intended to enable the city to grow more gracefully into the future.

Project context

In San Francisco, the San Francisco Municipal Transportation Agency (SFMTA) plans, manages, and operates the city's transportation network, including local public transit (Muni), walking, biking, roads, on-street parking, parking enforcement, and a significant portion of the city's off-street parking supply: 19 garages and 19 parking lots (see SFMTA.com to learn more).

Prior to SF*park*, the San Francisco Board of Supervisors managed paid parking much like it is managed in most other North American cities. Parking rates and fines were used to achieve turnover goals through short time limits as well as, often, to increase revenues to balance budgets. Rates were not tied to transportation policy goals, and rates at on-street meters were the same all day every day, regardless of demand. Meter rates were set lower than the rates at municipal garages, giving drivers financial incentive to circle to find on-street parking.

The historical approach to parking management that emphasizes flat meter rates and short time limits to achieve turnover has been reasonably effective, but it is not convenient for drivers, nor does it explicitly manage towards creating parking availability and thereby achieving broader goals for the city or its transportation system.



What is SF*park*?

SF*park* is the brand for SFMTA's approach to parking management. SF*park* was a demonstration project funded through the Department of Transportation's Urban Partnership Program. For the SF*park* pilot project, the SFMTA used several strategies to make it easier to find a space and improve the parking experience, including:

- Demand-responsive pricing.
- Making it easier to pay at meters.
- Longer time limits.
- Improved user interface and product design for touch points with the parking system.
- Improved information for drivers, including static directional signs to garages and real-time information about where parking is available on- and off-street.
- Highly transparent, rules-based, and data-driven approach to making changes to parking prices.

SF*park* piloted and/or cultivated several emerging technologies, including smart meters, parking sensors, and a sophisticated data management tool. This data

San Francisco Mayor Lapham operating the first parking meter installed in San Francisco in 1947

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management tool and how it is used by the SFMTA is also an instance of "smart cities" actively using data to make smarter decisions and achieve more with the same resources. The data management system developed for SF*park* allowed the SFMTA to use data to manage contracts more effectively, make highly data-driven decisions to adjust parking prices, provide a real-time data feed, increase the efficiency and capabilities for parking operations, and enable a new level of analytical rigor for this evaluation as well as ongoing reporting and ad hoc analysis.

SF*park* yielded an unprecedented amount of data to support a rigorous evaluation. To isolate and measure the effects of these policy changes, the SFMTA designated seven parking management districts (PMDs) as pilot areas, which included 6,000 metered spaces, or a quarter of the city's total metered parking spaces, and 12,250 spaces in SFMTA-administered garages, or 75% of the off-street spaces managed by the SFMTA. The SFMTA implemented SF*park* strategies in the pilot areas, with two additional areas serving as control areas where no changes to parking management or technology were implemented. The SFMTA collected "before", "mid-point", and "after" data in both pilot and control areas.

Demand-responsive pricing

At the heart of the SF*park* approach is demand-responsive pricing, whereby the SFMTA gradually and periodically adjusted rates at meters and in garages up or down. The goal was to achieve a minimum level of availability so that it was easy to find a parking space most of the time on every block and that garages always have some open spaces available. Furthermore, meeting target availability also means improving utilization of parking so that spaces—on-street or off—would not sit unused.

In this approach, the SFMTA was obligated to find the lowest rates possible to achieve its goals. As a result, average rates at garages and meters decreased over the course of the pilot period.

On-street

For on-street parking, the SF*park* used occupancy data from in-ground parking sensors in each space to adjust rates at meters up or down to help achieved the target occupancy rate of 60–80%. Each data-driven rate adjustment used the following rules. When average occupancy was:

- 80–100%, the hourly rate increased by $0.25
- 60–80%, the hourly rate was not changed
- 30–60%, the hourly rate decreased by $0.25
- Less than 30%, the hourly rate decreased by $0.50

Hourly rates were not allowed to exceed $6.00 per hour or go below $0.25 per hour. SF*park* adjusted on-street rates about every eight weeks starting in August 2011. Over the course of the two year pilot evaluation period (i.e., through June 2013), the SFMTA made ten on-street rate adjustments.

SFpark rate adjustments and evaluation periods

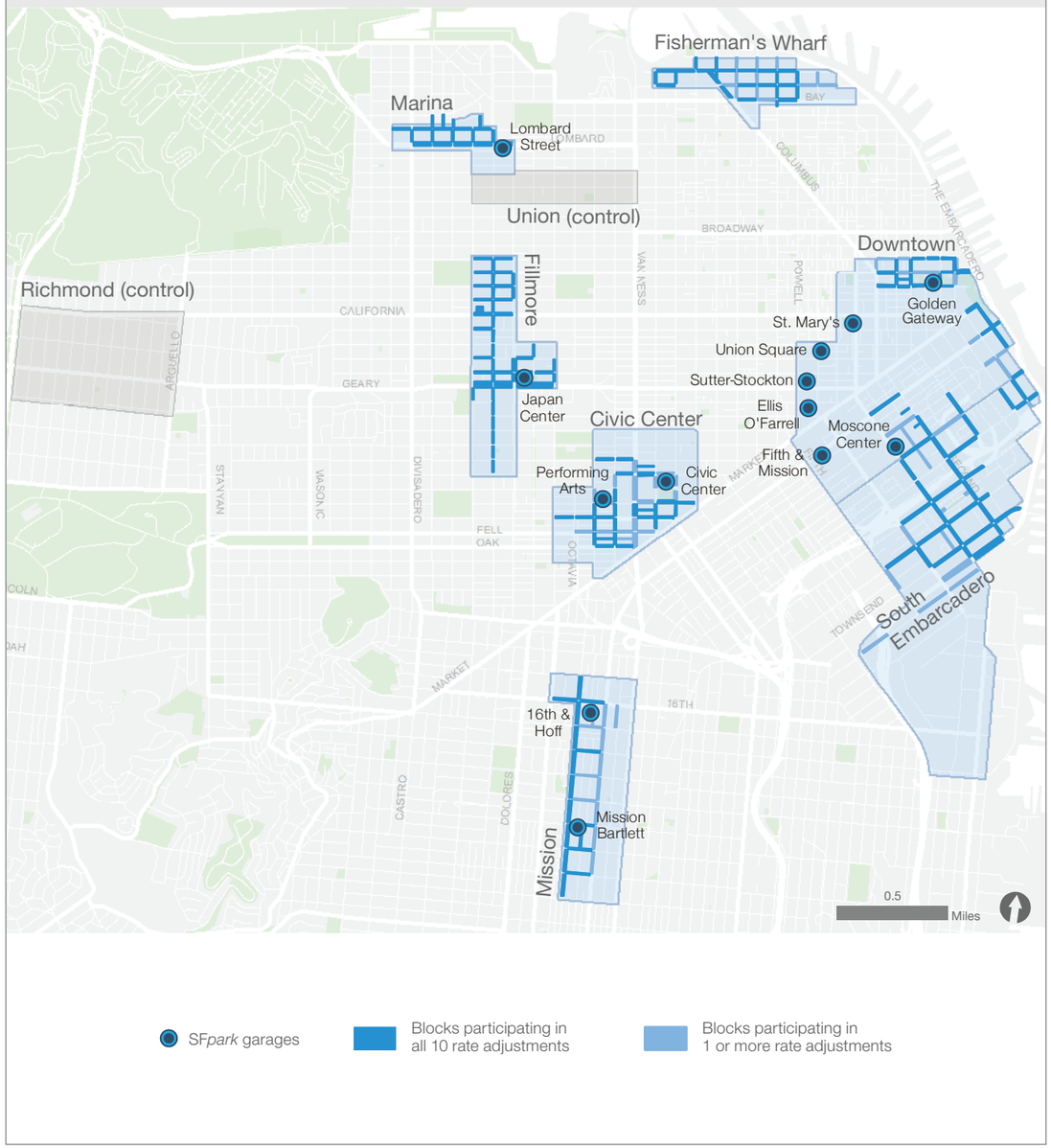
Period	Month/Day	Year
Before SF*park*	April to June	2011
Rate adjustment 1	August 1st	2011
Rate adjustment 2	October 11th	2011
Rate adjustment 3	December 13th	2011
Rate adjustment 4	February 14th	2012
Rate adjustment 5	March 28th	2012
Rate adjustment 6	May 8th	2012
Rate adjustment 7	August 29th	2012
Rate adjustment 8	October 31st	2012
Rate adjustment 9	January 16th	2013
Rate adjustment 10	April 3rd	2013
"After" SF*park*	April to June	2013
Rate adjustment 11	August 21st	2013
Rate adjusment 12	November 20th	2013
Rate adjustment 13	February 12th	2014

Off-street

As parking garages were converted to the SF*park* approach, the SFMTA simplified rate structures, reduced the discount implied by commuter-oriented rates (e.g., early bird, daily, monthly), and moved to time-of-day pricing to match the approach at the meters, make sure rates between meters and garages were easy to compare, and to make it easier for customers to understand what they would be charged. Thereafter the SFMTA changed hourly rates quarterly according to the following rules. When average occupancy was:

SF*park* pilot, control areas and garages

Blocks and garages participating in rate adjustments



- 80–100%, the hourly rate was raised by $0.50
- 40–80%, the hourly rate was not changed
- Less than 40%, the hourly rate was lowered by $0.50

In addition to demand-responsive pricing, SF*park*'s garage pricing policies aimed to minimize garage entries and exits during peak traffic times. Time-of-day pricing made parking at peak times more expensive and off-peak times cheaper. Off-peak discounts provided a discount for drivers who entered the garage before the morning rush hour or left after the evening rush hour. Before SF*park*, early bird parking typically required drivers to be "in by 10am, out by 6pm," essentially forcing them to be on the streets during the morning and evening rush hours. By tightening the morning time requirement (to "in by 8:30am") and eliminating the evening time requirement (so that drivers could leave after the evening rush hour and still receive the early bird discount), SF*park* provided financial incentives for drivers to be off the streets at peak times.

2010

7/2 Smart meter installation begins

9/1 Sensor installation begins

2011

January Smart meter installation completed

April Formal launch of the SF*park* pilot project (longer time limits implemented and real-time data available)

4/1 Special event rates and hours launched for Port of San Francisco meters near baseball stadium

8/1 First SF*park* meter rate adjustment

9/15 SF*park* text message service for garage parking availability launched

10/11 2nd meter rate adjustment

11/7 SF*park* Android app launched

Fall SF*park* pricing implemented at most garages

11/15 App source code made available to public and other developers

12/11 3rd meter rate adjustment

12/14 PayByPhone launched citywide, beginning in non-SF*park* areas

Timeline

In November 2008, the SFMTA Board of Directors approved the legislation that enabled the SF*park* pilot project. It defined the SF*park* pilot areas and policies and empowered the SFMTA Director of Transportation to set rates—within ranges determined by the SFMTA Board—for on-street metered spaces and SFMTA-managed lots and garages in SF*park* pilot areas.

For the SF*park* pilot project, the SFMTA has also worked closely with the Port of San Francisco, which has jurisdiction through state legislation for the over 1,400 metered on-street spaces along the city's waterfront. The Port has contracted the SFMTA to operate, maintain, and enforce its parking operation, and it adopted the SF*park* enabling legislative language to define its parking management policies.

2012

2/14 4th meter rate adjustment

April PayByPhone available at meters citywide

3/28 5th meter rate adjustment

5/8 6th meter rate adjustment

5/23 MTC launches parking availability and pricing information via 511 phone service

6/1 SF*park* text message service for garage parking availability discontinued

8/29 7th meter rate adjustment

10/31 8th meter rate adjustment

11/26 MTC launches parking availability and pricing information via 511 web service

2013

1/16 9th meter rate adjustment

1/7 Sunday parking meter operation implemented citywide

3/4 Special event rates and hours initiated at SFMTA parking meters near baseball stadium

4/3 10th meter rate adjustment

6/30 SF*park* pilot project data collection and evaluation period ends

Evaluating SF*park*

The SFMTA used data gathered during the pilot period to evaluate how effectively the SF*park* approach delivered the expected benefits.

Data collection, parking census, and study design

As part of the SF*park* pilot project, the SFMTA collected an unprecedented data set to evaluate the pilot, including some never-before available data sources. The majority of the data are linked to a specific geography or location (for example, a parking event, meter payment, and citation all happen at a particular point in time and space), which facilitated sophisticated analysis and mapping of the data.

Data type	Sample data sets
Parking sensors	Parking session start/stop, sensor downtime
Motorcycle occupancy	Manually collected occupancy data (sensors were not used at motorcycle spaces)
Parking meters	Payment session/time, type, amount; meter downtime
Parking citations	Type, location, time, Parking Control Officer (PCO) badge number
Parking garage	Parking garage usage data by hour and by type of parker (hourly v. monthly)
Parking tax	All publicly available parking facilities in San Francisco pay a 25% parking tax. Parking tax receipts, aggregated to prevent identification of individual facilities, was provided by the City Assessor, to help evaluate changes in parking demand in private parking garages and lots.
Manual surveys	Manually collected data includes surveys of double parking, disabled placard usage, parking search time, parking occupancy in residential areas, and intercept surveys of people on street
Roadway sensors	Roadway sensors were installed at approximately 60 locations in the pilot and control areas. They provide traffic counts, average speed, and vehicle density.
Local public transit (Muni)	Data from automatic passenger counters (APCs) fitted on ~30% of the rubber-tired fleet.
Regional travel demand	Besides data from the Muni system, SFMTA gathered data from the region's highways (PEMS) and regional rail systems (BART)
Sales tax	Sales tax data from the City Controller.
Safety	Collision data from the state's SWITRS reporting system
Exogenous factors	Fuel price, CPI, unemployment, and weather data

Additionally, for the SF*park* project, the SFMTA collected comprehensive data about San Francisco's publicly available parking supply, both on- and off-street, including existing parking regulations. This data, which was the first citywide parking census of its kind, was critical for the planning, implementation, and evaluation of the SF*park* pilot project.

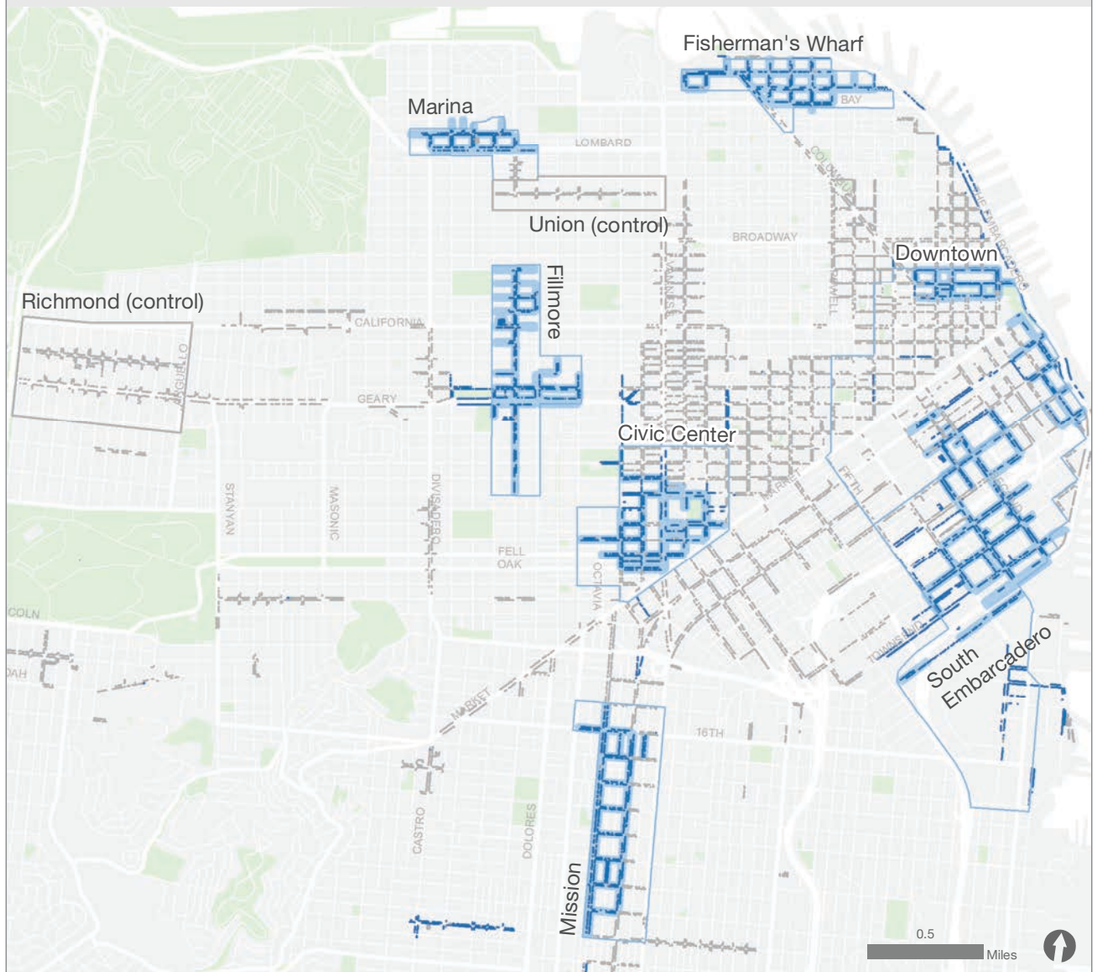
The SF*park* pilot project was planned to provide extensive empirical data that the SFMTA, the US Department of Transportation, researchers, and other cities needed to evaluate this approach to parking management, and the project will also support transportation research more generally. This document contains the SFMTA's evaluation of the SF*park* pilot project.

This document, as well as the appendices containing the full methodologies, are available on SFpark.org.

Download the evaluation at:
SFpark.org/docs_pilotevaluation

Smart meters, legacy meters and SF*park* areas

Location of smart meters and blocks participating in rate adjustments



2. EFFECTIVENESS OF PARKING PRICING

The SF*park* pilot project demonstrated that demand-responsive pricing is an effective way to improve both parking availability and utilization.

Effectiveness of parking pricing

An overview of how demand-responsive pricing improved parking availability and made it easier to find parking

Demand-responsive pricing is at the heart of the SF*park* approach to managing parking, and the extent to which it helped to make it easier for drivers to find a parking space (especially during peak times) and improve how well parking spaces are utilized is a central question for the evaluation.

Key findings

Even as car ownership, population, economic activity, and overall parking demand increased from 2011 to 2013, and even after lowering the average cost of parking, the SF*park* pilot project achieved parking occupancy goals for both on- and off-street parking. To summarize key findings:

- Overall, as a result of demand-responsive rate adjustments, SF*park* decreased rates on half of all blocks and increased rates on the other half, with average meter rates falling 4% from $2.69 to $2.58 during the pilot. At garages, the average hourly rate fell from $3.45 to $3.03.
- Parking availability at meters improved by 16% in pilot areas, while falling 50% in control areas, making it easier to find parking.
- Achievement of the target occupancy rate increased by 31% in pilot areas, compared to a 6% increase in control areas, improving parking utilization significantly.
- Parking availability and utilization improved even more on blocks in pilot areas that had high payment compliance (i.e., where most occupied spaces were paid): parking availability increased 45% and there was a 100% increase in achievement of target occupancy rate.
- SF*park* maintained consistent parking availability while increasing utilization of SF*park* garages. Utilization grew by 11%, far exceeding non-SF*park* garages. The greatest increase (14%) occurred during off-peak periods. This improved the utilization of these city assets, and helped to reduce parking demand on the street.
- SF*park* decreased the number of daily commuters parking in SFMTA garages and increased the number of short-term hourly parkers, supporting the goals of reducing commuting by car and improving economic vitality.

Citywide trends

While parking demand in SF*park* pilot and control areas is affected by pricing, it is also determined by larger economic and social trends. From 2011 to 2013, San Francisco's population, employment, travel demand, and economic activity grew considerably as the city recovered from the 2008 to 2010 recession.

Citywide trends, 2006 to 2013

	2006	2007	2008	2009	2010	2011	2012	2013
Citywide population	800,000	812,000	835,000	846,000	805,000	809,000	816,000	825,000
Regional population	3,290,000	3,320,000	3,367,000	3,407,000	3,286,000	3,302,000	3,328,000	3,363,000
Employment	399,000	415,000	434,000	419,000	413,000	426,000	443,000	456,000
Sales tax (x1000)	115,531	123,639	127,770	117,699	111,715	121,935	135,096	140,649
Fuel price	$2.79	$3.17	$3.56	$2.69	$3.11	$3.83	$4.04	$3.97
Auto ownership	379,000	382,000	380,000	382,000	382,000	381,000	385,000	397,000
Inbound commuters	260,000	273,000	289,000	291,000	306,000	322,000	n/a	n/a
Citywide VMT (x1000)	324,915	316,885	321,133	339,855	424,875	451,823	452,042	411,074
Regional VMT (x1000)	3,359,782	3,495,162	3,654,070	3,740,696	4,236,226	4,323,820	4,416,776	4,495,791

- *Citywide VMT and regional VMT are weekday peak period freeway only*
- *"Regional" includes San Francisco and adjacent counties: Alameda, Marin and San Mateo*

Citywide trends, 2011 to 2013

	2011	2013	Net change	% change
Citywide population	809,000	825,000	16,000	2.0%
Regional population	3,302,000	3,363,000	61,000	1.8%
Employment	426,000	456,000	30,000	7.0%
Sales tax (x1000)	121,935	140,649	18,714	15.3%
Fuel Price	3.83	3.97	0.14	3.7%
Auto ownership	381,000	397,000	16,000	4.2%
Parking tax	16,813	18,851	2,038	12.1%
Citywide VMT (x1000)	451,823	411,074	(40,749)	-9.0%
Regional VMT (x1000)	4,323,820	4,495,791	171,971	4.0%
BART Ridership	256,000	291,000	35,000	13.7%

Citywide trends: annual growth rate

	2006–08	2008–10	2011–13
Citywide population	2.2%	-1.8%	1.0%
Regional population	1.2%	-1.2%	0.9%
Employment	4.3%	-2.4%	3.5%
Sales tax	5.2%	-6.5%	7.4%
Fuel price	13.0%	-6.5%	1.8%
Auto ownership	0.1%	0.3%	2.1%
Inbound commuters	5.4%	2.9%	n/a
Citywide VMT	-0.6%	15.0%	-4.6%
Regional VMT	4.3%	7.7%	2.0%

- *BART ridership is weekday daily ridership, into and out of San Francisco stations*

Almost all of the contextual trends for the city suggest that overall parking demand increased during the SF*park* pilot period. From 2011 to 2013, there were more people living and working in San Francisco, with employment increasing 3.5% per year. Another indicator of increased overall parking demand is the 12% increase in citywide parking tax revenue, which comes from all publicly-available off-street lots and garages.

Transportation trends suggest that the source of parking demand may have shifted somewhat, with more demand possibly coming from San Franciscans and less demand from those living in surrounding counties. From 2011 to 2013, vehicle miles traveled to and from

San Francisco decreased by almost 5% per year, while daily weekday BART ridership to and from San Francisco increased by 7% per year. This suggests that regional commuters took BART more and drove less than in the past, which may have reduced work-related parking demand in San Francisco. Another factor is that from 2011 to 2013 auto ownership in San Francisco increased twice as much as citywide population growth. During that time the city added 16,600 cars after showing almost no change from 2006 to 2011, suggesting that San Francisco's newest residents have significantly higher car ownership rates than existing residents. While commuters that have shifted toward BART may have reduced demand for parking in San Francisco, higher car ownership rates in San Francisco may be the primary source of the increase in overall parking demand.

Regardless of a possible change in the source of parking demand, the increase in parking tax revenue confirms that the SF*park* pilot project took place during a period of increasing overall parking demand. The effectiveness of demand-responsive parking pricing is evaluated within this context.

SFpark rate adjustments and evaluation periods

Period	Month/Day	Year
Before SF*park*	April to June	2011
Rate adjustment 1	August 1st	2011
Rate adjustment 2	October 11th	2011
Rate adjustment 3	December 13th	2011
Rate adjustment 4	February 14th	2012
Rate adjustment 5	March 28th	2012
Rate adjustment 6	May 8th	2012
Rate adjustment 7	August 29th	2012
Rate adjustment 8	October 31st	2012
Rate adjustment 9	January 16th	2013
Rate adjustment 10	April 3rd	2013
"After" SF*park*	April to June	2013
Rate adjustment 11	August 21st	2013
Rate adjusment 12	November 20th	2013
Rate adjustment 13	February 12th	2014

Did it work? Parking pricing and availability

*After ten SF*park *rate adjustments, parking availability and utilization for both on- and off-street parking improved significantly.*

During the pilot project, on-street parking availability in pilot areas improved by 16%, and by 22% during peak periods, while parking availability in control areas went down by over 50%. In SF*park* garages, utilization increased by 11% overall and by 14% during off-peak periods. In other words, both on-street parking availability and off-street parking utilization improved when it mattered most to help reduce circling for on-street parking: during peak periods. Data from after the 10th rate adjustment is not included as part of this evaluation because those rate changes were made after the end of the formal SF*park* evaluation period.

On-street pricing and occupancy

SF*park* adjusted parking prices at meter rates to achieve a 60–80% target occupancy rate (parking occupancy as averaged over three hours). Rates were adjusted gradually and periodically according to the following rules; when average occupancy was:

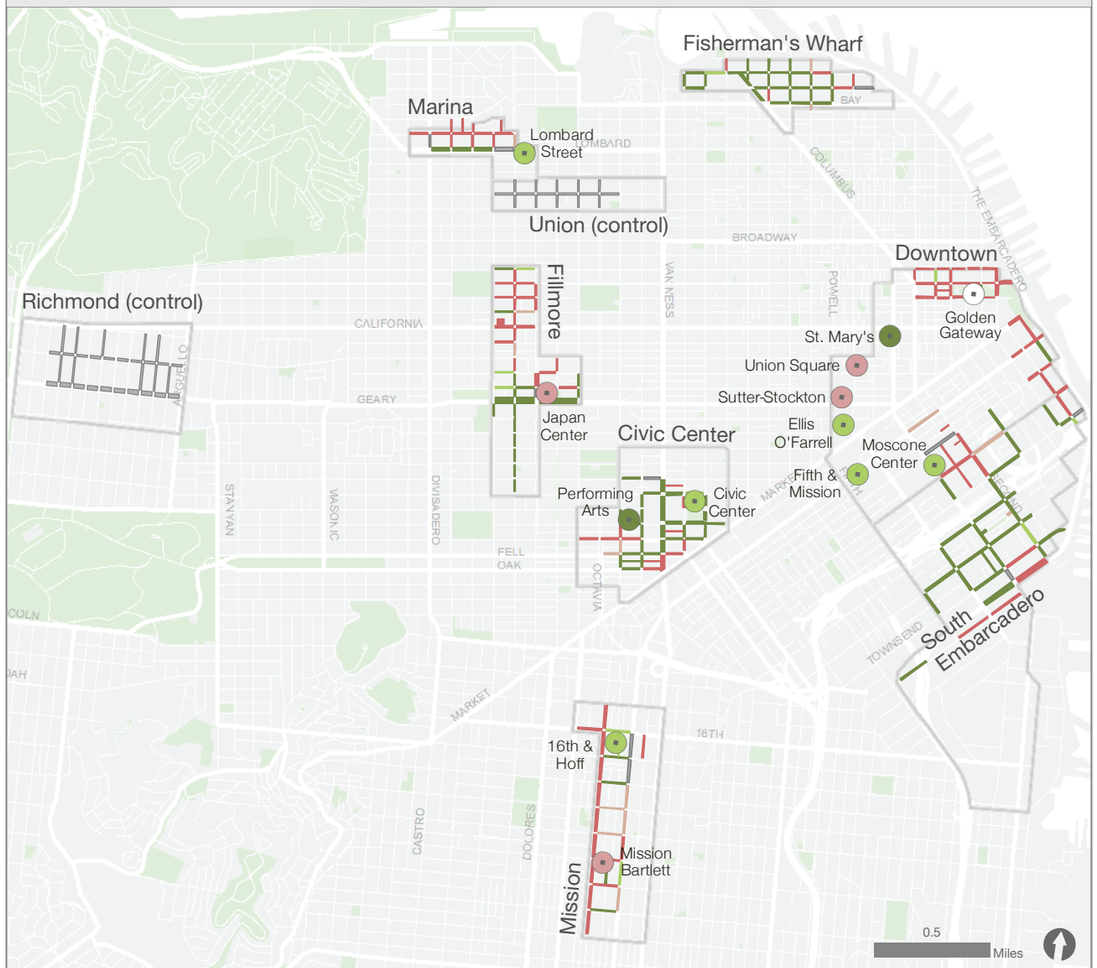
- 80–100%, the hourly rate increased by $0.25
- 60–80%, the hourly rate did not change
- 30–60%, the hourly rate decreased by $0.25
- Less than 30%, the hourly rate decreased by $0.50

The SFMTA adjusted on-street rates about every eight weeks starting August 2011, and hourly rates could not exceed $6.00 per hour or go below $0.25 per hour. Over the course of the two year pilot, the SFMTA completed ten rate adjustments. For the evaluation of SF*park*, "before" refers to spring 2011 and "after" refers to spring 2013, several weeks after the tenth rate adjustment.

During the first ten rate adjustments nearly half of all blocks experienced an average weekday rate increase, while the other half experienced a decrease. This varied by area; rates increased more in the Downtown, Marina, and Mission areas, and decreased more in the Civic Center, Fisherman's Wharf, and South Embarcadero areas. In the Fillmore area rates increased slightly. During this time, meter rates in control areas remained at $2.00 per hour.

Pricing: net change

Net change in average hourly rates at SF*park* garages and blocks participating in rate adjustments
Weekdays, 9am to 6pm | Before vs after



Hourly garage rate change, overall

$1.00 or more decrease | $0.01 to $1.00 decrease | No change | $0.01 to $1.00 increase

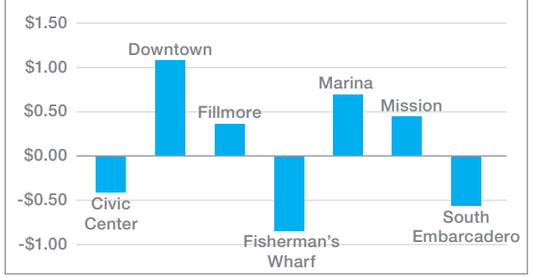
Hourly meter rate change, overall

$0.25 to $4.00 decrease | $0.25 to $0.01 decrease | $0.01 to $0.25 increase | $0.25 to $2.50 increase | No overall rate change

Map shows meter rate changes for blocks with parking sensors

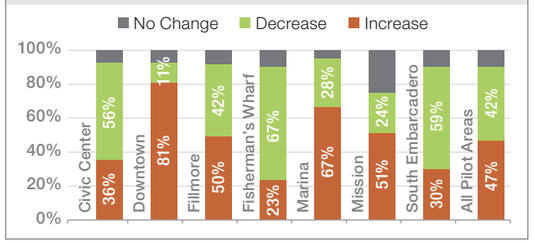
Average hourly price change per block

Blocks that participated in the first 10 SF*park* rate adjustments
Based on changes to average weekday hourly rates
Before vs after



Percent of blocks with: increase, decrease, or no change in rates

Blocks that participated in the first 10 SF*park* rate adjustments
Based on changes to average weekday hourly rates
Before vs after (i.e., "before" rates compared with rates after 10 rate adjustments)



Payment compliance

As rates changed, occupancy changed as well; occupancy typically decreased where rates were raised and increased where rates were decreased. Over the course of the pilot project, an increasing number of blocks achieved the target occupancy rate and did not require additional rate adjustments. Some blocks experienced both rate increases and decreases.

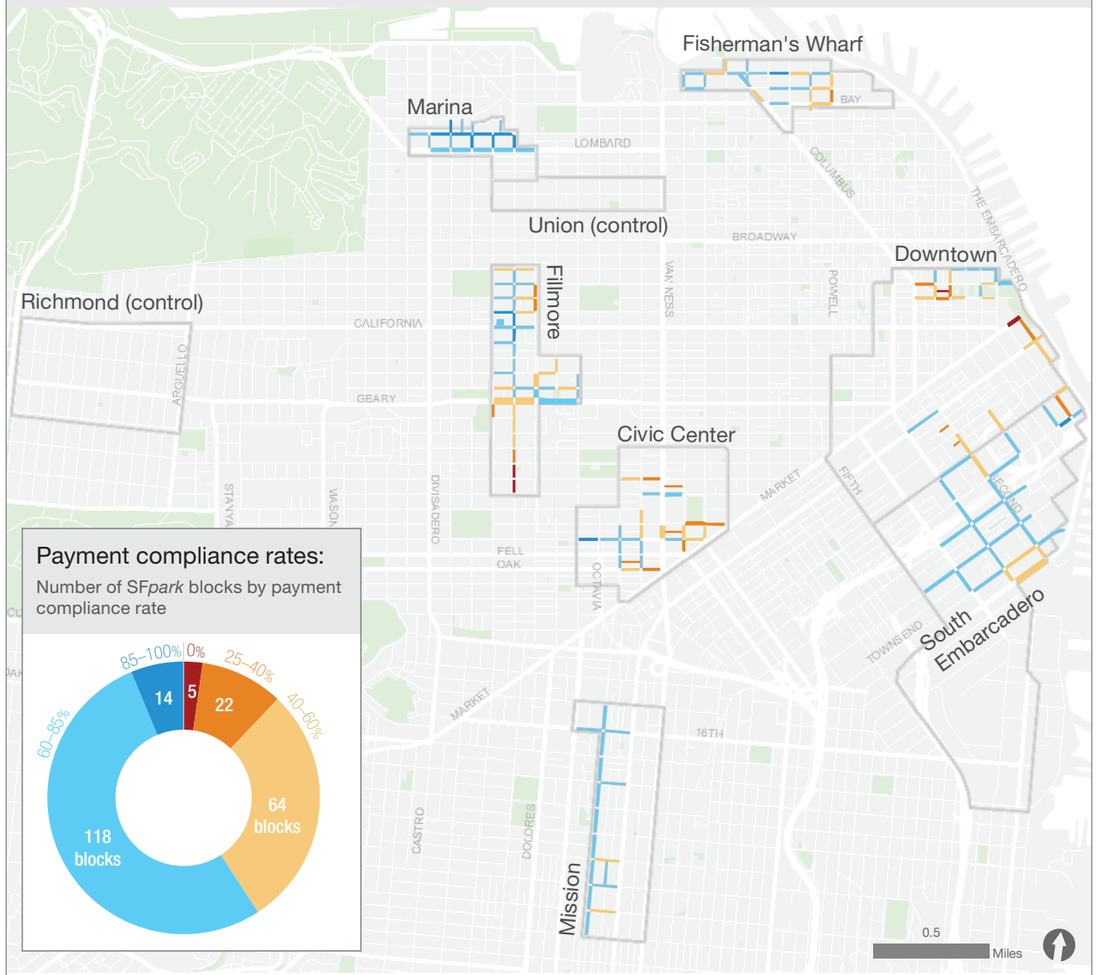
Overall, demand-responsive rate adjustments have been effective in achieving occupancy goals, but a small portion of blocks have a lower price elasticity, meaning that some blocks were not as responsive to parking pricing.

While rates on those blocks simply may not yet have changed enough, data from pilot areas show that parking pricing was less effective on blocks with low payment compliance (payment compliance is the share of paid time to occupied time). And this is sensible; parking prices can only be expected to be effective if drivers feel (or are) obligated to pay either via policy or effective enforcement. Of the nearly 200 blocks that were included in all ten SF*park* rate adjustments, only 14 have high payment compliance rates, defined as having at least 85% of occupied time paid for.

Because one of the primary purposes of the SF*park* pilot project is to better understand how parking pricing affects parking occupancy, this evaluation often considers these 14 high payment compliance or HP blocks separately because those blocks are where demand-responsive rate adjustments would be expected to be most effective. HP blocks show the potential of demand-responsive rate adjustments most clearly.

High payment compliance blocks

The 14 "HP" blocks are those with payment compliance rates over 85%. Calculated as paid time/occupied time. Average payment compliance rates calculated for 2011–2012. Other blocks shown for comparison purposes.



Map shows blocks that participated in the first 10 rate adjustments that also had high quality payment compliance data.

Meter rate change table: Percent of total meter operating hours

Rate	Initial meter rates	Meter rate adjustment #1	Meter rate adjustment #2	Meter rate adjustment #3	Meter rate adjustment #4	Meter rate adjustment #5	Meter rate adjustment #6	Meter rate adjustment #7	Meter rate adjustment #8	Meter rate adjustment #9	Meter rate adjustment #10	Meter rate adjustment #11*	Meter rate adjustment #12*	Meter rate adjustment #13*	Meter rate adjustment #14*	Rate
$0.25					0.0%	0.4%	1.9%	4.7%	6.1%	7.5%	16.4%	16.7%	16.9%	16.1%	16.5%	$0.25
$0.50					0.4%	0.9%	2.7%	1.6%	2.5%	3.2%	4.3%	4.9%	4.0%	4.1%	5.5%	$0.50
$0.75				0.2%	0.3%	2.7%	2.5%	3.1%	4.0%	5.2%	2.7%	3.1%	4.4%	4.3%	3.7%	$0.75
$1.00				0.3%	3.4%	3.3%	3.2%	4.0%	4.1%	2.7%	3.8%	4.0%	4.5%	4.5%	4.7%	$1.00
$1.25			0.2%	3.8%	2.8%	3.3%	3.9%	4.6%	3.5%	4.2%	3.2%	3.3%	3.4%	3.2%	4.0%	$1.25
$1.50		0.0%	4.7%	4.0%	4.0%	4.6%	6.4%	5.1%	6.1%	4.0%	4.5%	4.9%	4.0%	4.3%	4.2%	$1.50
$1.75		5.6%	6.1%	5.6%	7.0%	8.9%	5.9%	6.7%	4.1%	5.6%	5.4%	4.1%	4.2%	3.2%	3.5%	$1.75
$2.00	40.5%	20.1%	14.5%	14.5%	16.2%	11.4%	13.2%	10.8%	9.8%	8.9%	6.7%	6.4%	5.8%	6.3%	5.0%	$2.00
$2.25		14.8%	8.6%	13.1%	9.0%	9.8%	5.8%	5.6%	5.4%	4.9%	4.0%	5.0%	4.6%	4.9%	5.1%	$2.25
$2.50		2.2%	21.3%	8.5%	10.1%	7.8%	5.6%	5.8%	5.9%	5.5%	5.1%	3.4%	3.8%	4.0%	4.3%	$2.50
$2.75		12.8%	6.7%	18.1%	6.6%	5.6%	7.0%	4.6%	4.4%	4.2%	3.1%	3.7%	3.1%	3.1%	3.6%	$2.75
$3.00	29.3%	11.9%	11.0%	6.3%	14.2%	8.7%	7.2%	7.3%	6.0%	4.9%	4.5%	4.3%	5.0%	4.2%	4.3%	$3.00
$3.25		13.9%	6.6%	5.0%	4.7%	11.1%	5.2%	5.1%	5.9%	4.7%	4.7%	4.2%	4.1%	4.3%	4.9%	$3.25
$3.50	30.2%	13.1%	13.4%	10.1%	9.4%	7.1%	14.1%	10.1%	8.7%	9.0%	6.0%	5.7%	5.5%	5.8%	4.0%	$3.50
$3.75		5.7%	2.8%	5.0%	4.0%	4.0%	3.8%	8.4%	5.3%	4.6%	5.2%	4.0%	2.9%	3.2%	3.9%	$3.75
$4.00			4.1%	2.2%	3.9%	3.5%	2.7%	2.7%	7.7%	5.2%	4.8%	5.3%	5.1%	4.5%	3.8%	$4.00
$4.25				3.3%	1.4%	3.6%	2.8%	2.1%	2.2%	6.8%	4.3%	4.4%	5.0%	5.3%	4.9%	$4.25
$4.50					2.6%	1.0%	3.3%	2.3%	1.6%	1.6%	4.7%	3.6%	3.4%	3.8%	3.1%	$4.50
$4.75						2.4%	0.9%	3.0%	2.1%	1.4%	1.3%	3.4%	3.2%	2.9%	2.6%	$4.75
$5.00							2.1%	0.7%	2.6%	2.2%	1.4%	1.2%	2.7%	2.5%	2.0%	$5.00
$5.25								1.8%	0.7%	2.0%	1.1%	1.2%	0.8%	2.6%	2.2%	$5.25
$5.50									1.5%	0.8%	1.7%	1.2%	1.1%	0.5%	1.3%	$5.50
$5.75										1.0%	0.5%	1.1%	1.0%	0.9%	1.8%	$5.75
$6.00											0.6%	0.9%	1.6%	1.6%	1.2%	$6.00
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	Total

** Rate adjustments 11 through 14 occurred after the official pilot period and are not included in this analysis.*

Parking availability

The metric "how often are blocks too full?" can be used to compare parking availability before and after SF*park*.

Parking availability improved considerably in pilot areas compared to control areas on weekdays as well as Saturdays. On weekdays, prior to SF*park* blocks in control areas were too full 8% of the time, increasing to 12% of the time after SF*park*—a 51% increase. During this same period, pilot areas dropped from 17 to 14% of the time—a 16% decrease. On high payment compliance blocks there was a 45% decrease— three times as much as core pilot areas. Saturdays show similar trends.

Improvements to parking availability in pilot areas occurred over the course of ten SF*park* rate adjustments. The progressive decrease in the highest payment compliance areas stands out: a drop from blocks being too full 24% of the time after the first rate adjustment to 8% of the time by the tenth rate adjustment. A small spike occurs after the eighth rate adjustment in both high payment compliance areas as well as control areas, suggesting a temporary increase in parking demand.

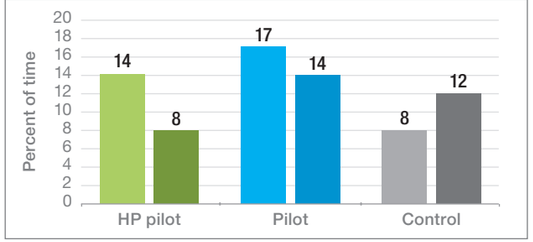
How often are blocks too full? By rate adjustment

90-100% occupancy—hourly frequency
HP pilot, pilot, and control areas, 2011 to 2013
Weekdays, 9am to 6pm

Rate adjustment	HP pilot	Pilot	Control
Before (Spring 2011)	14	17	8
Rate adjustment 1	24	19	9
Rate adjustment 2	20	20	8
Rate adjustment 3	19	16	9
Rate adjustment 4	18	18	8
Rate adjustment 5	17	19	10
Rate adjustment 6	13	18	12
Rate adjustment 7	10	19	14
Rate adjustment 8	16	19	20
Rate adjustment 9	6	13	15
Rate adjustment 10	8	14	12
Net change	(6)	(3)	4
% change	-45%	-16%	51%

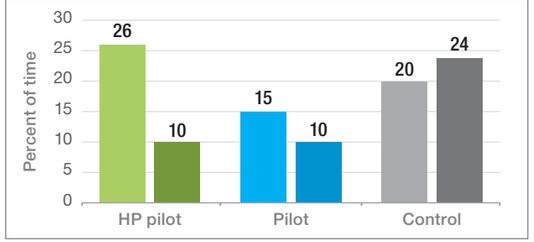
How often are blocks too full? Weekdays

90 – 100% occupancy – hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm | Before vs. after SF*park*



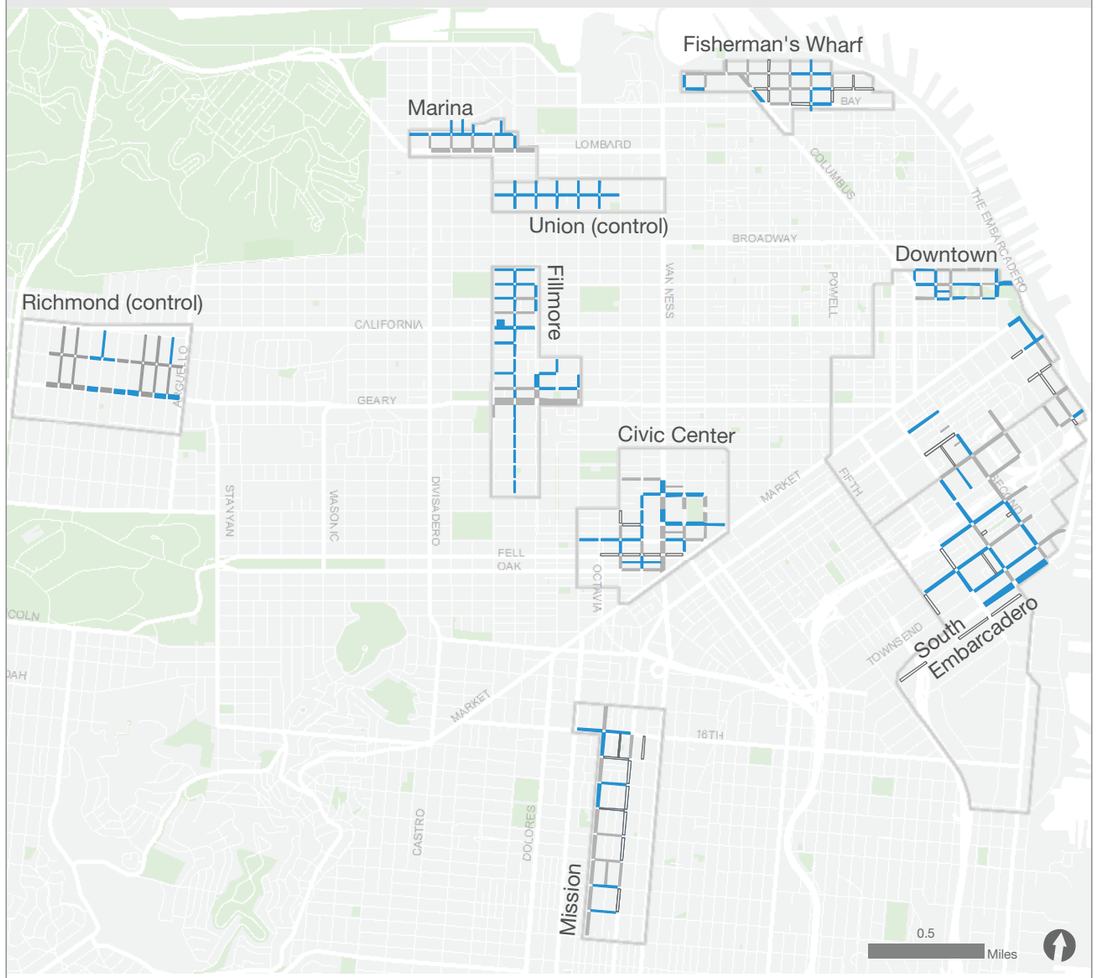
How often are blocks too full? Saturdays

90 – 100% occupancy – hourly frequency
HP pilot, pilot, control areas
Saturdays 9am to 6pm | Before vs. after SF*park*



Improved parking availability

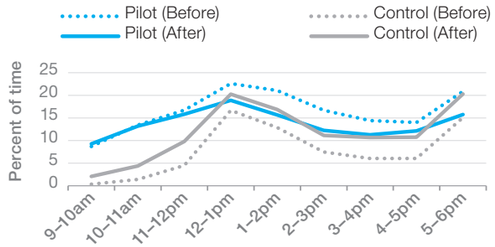
Blocks where frequency of 90–100% hourly occupancy rates decreased from spring 2011 to spring 2013
Weekdays, 9am to 6pm



Over the course of an average weekday in core pilot areas, the biggest improvements to parking availability occurred during the lunch hour peak period when it is most difficult to find parking. Parking availability worsened in control areas over the course of an average weekday from before to after.

How often are blocks too full? By time of day

90 – 100% occupancy – hourly frequency
Pilot and control areas | Before vs after
Weekdays 9am to 6pm

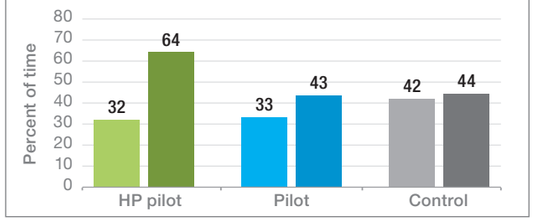


Target occupancy

Achievement of the target 60 to 80% occupancy rate improved in pilot areas on weekdays as well as Saturdays. Prior to SF*park*, blocks in control areas achieved the target occupancy rate 42% of the time, slightly increasing to 44% of the time after SF*park*—a 6% increase. During this same period, pilot areas increased from 33 to 43% of the time—a 31% increase. The highest payment compliance blocks increased by 100%—over three times the increase in pilot areas and 17 times the increase in control areas. Saturday show similar trends.

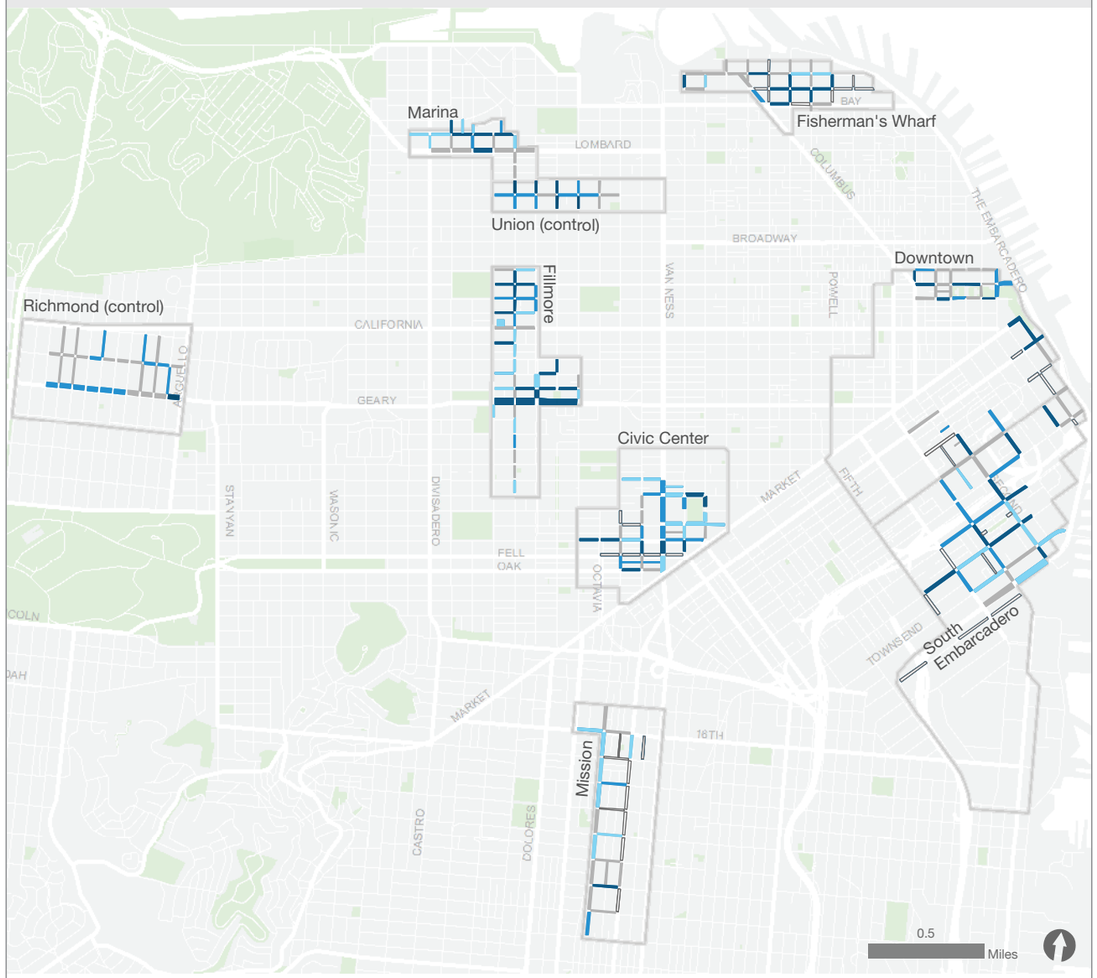
How often do blocks meet target occupancy? Weekdays

60 – 80% occupancy – hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm | Before vs after SF*park*



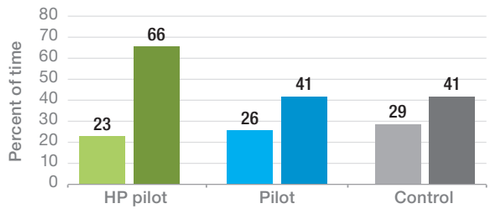
Target occupancy achievement

Blocks reaching 60–80% target occupancy rate from spring 2011 to spring 2013
Weekdays, 9am to 6pm



How often do blocks meet target occupancy? Saturdays

60 – 80% occupancy – hourly frequency
HP pilot, pilot, control areas
Saturdays 9am to 6pm | Before vs after SF*park*



How often do blocks meet target occupancy? By rate adjustment

60–80% occupancy—hourly frequency
HP pilot, pilot, and control areas, 2011 to 2013
Weekdays, 9am to 6pm

Rate adjustment	HP pilot	Pilot	Control
Before (Spring 2011)	32	33	42
Rate adjustment 1	27	30	39
Rate adjustment 2	27	31	40
Rate adjustment 3	31	34	37
Rate adjustment 4	28	33	40
Rate adjustment 5	30	33	41
Rate adjustment 6	42	36	45
Rate adjustment 7	49	37	46
Rate adjustment 8	39	36	43
Rate adjustment 9	63	43	44
Rate adjustment 10	64	43	44
Net change	32	10	2
% change	100%	31%	6%

Increased achievement of target occupancy in pilot areas occurred over the course of ten SF*park* rate adjustments. The progressive increase in the amount of time blocks met the target occupancy in the highest payment compliance areas stands out: a jump from 27% of the time after the first rate adjustment up to 64% of the time by the tenth rate adjustment. Compare the progressive increase to control areas, which fluctuated throughout the two year pilot and peaked around rate adjustment 7.

Case study:
Three high payment compliance blocks

Rate adjustments and occupancies for 3 of the 14 blocks with high payment compliance are summarized here: the 500 block of Hayes Street, the 2100 block of Fillmore Street, and the 2200 block of Chestnut Street. Each of these blocks show notable increases in achievement of target occupancy and decreases in the amount of time they were too full, and appear to have achieved price equilibrium in the later part of the pilot period (e.g., rates on the 500 block of Hayes Street settled at $3.33/hr after the eighth rate adjustment). On these blocks, it is clear how it became much easier to quickly find a parking space.

Parking availability & target occupancy: case studies

Percent of time that occupancy reached 60–80% (target) or 90–100% (too full)
Weekdays 9am to 6pm
Three of the 14 highest payment compliace (HP) blocks

	HAYES ST 500		Civic Center	FILLMORE ST 2100		Fillmore	CHESTNUT ST 2200		Marina
Rate Adjustment	Meter Rate	Too Full	Target	Meter Rate	Too Full	Target	Meter Rate	Too Full	Target
Before (Spring 2011)	$ 2.00	6	37	$ 2.00	14	36	$ 2.00	13	27
Rate adjustment 1	$ 2.25	12	35	$ 2.25	32	7	$ 2.25	26	29
Rate adjustment 2	$ 2.50	16	39	$ 2.50	26	15	$ 2.50	11	32
Rate adjustment 3	$ 2.67	9	42	$ 2.75	27	24	$ 2.75	16	30
Rate adjustment 4	$ 2.75	6	38	$ 3.00	14	29	$ 3.00	13	25
Rate adjustment 5	$ 2.92	13	27	$ 3.25	20	24	$ 3.25	15	27
Rate adjustment 6	$ 3.08	7	45	$ 3.50	5	36	$ 3.50	2	68
Rate adjustment 7	$ 3.17	3	47	$ 3.58	13	42	$ 3.50	3	53
Rate adjustment 8	$ 3.33	3	38	$ 3.83	8	38	$ 3.50	2	63
Rate adjustment 9	$ 3.33	-	69	$ 3.92	1	72	$ 3.50	-	80
Rate adjustment 10	$ 3.33	-	80	$ 3.92	-	39	$ 3.50	-	82

Case study: Fillmore

The Fillmore pilot district illustrates how demand-responsive pricing improved both parking availability and parking utilization. Prices decreased on blocks that were underused, which increased use, and prices increased on blocks that were too full, which tended to lower occupancy into the target range.

With each data-driven rate adjustment, SF*park* followed this set of rules:

- When occupancy was 80–100%, the hourly rate increased by $0.25
- When occupancy was 60–80%, the hourly rate was not changed
- When occupancy was 30–60%, the hourly rate decreased by $0.25
- When occupancy was less than 30%, the hourly rate decreased by $0.50

In the Fillmore pilot area, the average hourly cost of metered parking increased during the pilot period from $2.00 per hour to $2.37 per hour.

Fillmore
Pricing and occupancy summary
Weekdays 9am to 6pm | Average weekday rate change: $0.37

45/45 blocks = 100% of blocks in Fillmore participated in all 10 rate adjustments

50% of blocks with rate increase[1]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$3.63	$1.63	86	70	(16)
Noon to 3pm	$2.00	$3.58	$1.58	83	70	(13)
3pm to close	$2.00	$3.61	$1.61	84	71	(14)

42% of blocks with rate decrease[2]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$0.67	($1.33)	61	65	4
Noon to 3pm	$2.00	$1.28	($0.72)	68	61	(7)
3pm to close	$2.00	$1.11	($0.89)	62	64	2

8% of blocks with no change overall[3]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$2.00	$-	76	66	(10)
Noon to 3pm	$2.00	$2.00	$-	73	75	2
3pm to close	$2.00	$2.00	$-	75	62	(13)

*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

*2 These blocks may have seen a price increase mid-way through but by rate adjustment 10 were at a lower price than they were before SF*park

*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after
Hourly rate for "After" shown

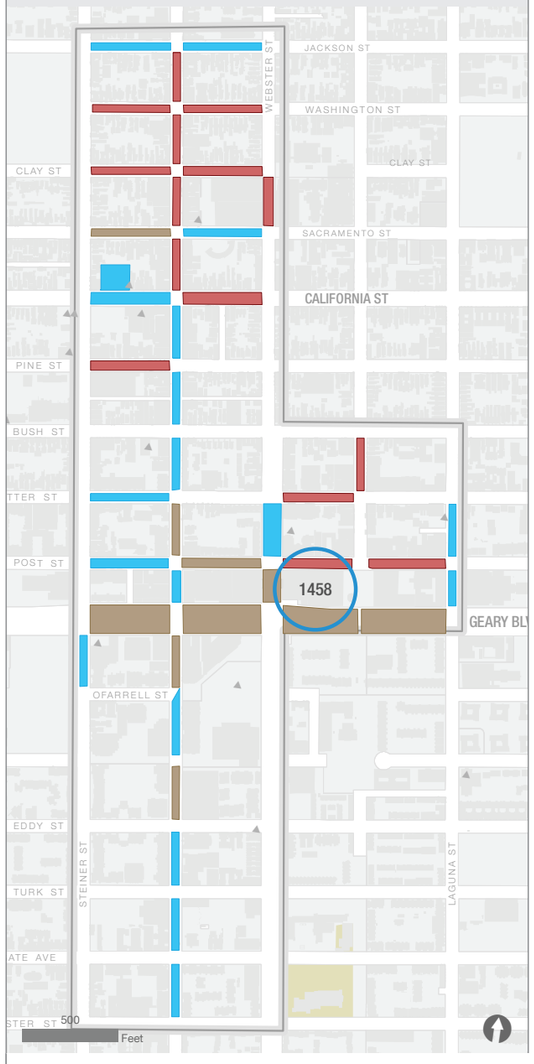
Hourly garage rates

- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

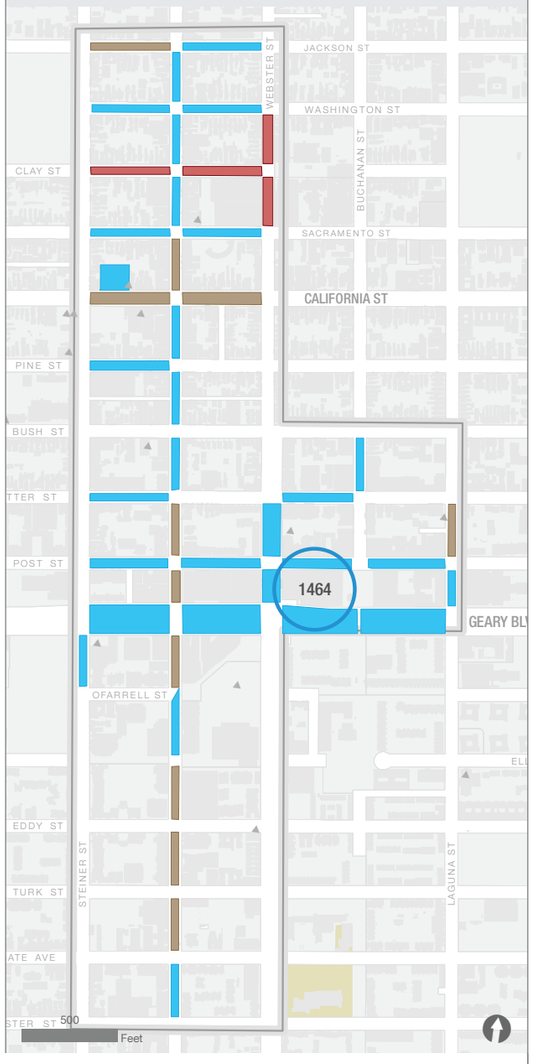
Hourly meter rates

$0.25 to $3.25 decrease	$0.25 to $0.01 decrease	$0.01 to $0.25 increase	$0.26 to $2.50 increase	No overall rate change

Average occupancy: before
Weekday average, 9am to 6pm



Average occupancy: after
Weekday average, 9am to 6pm



Occupancy[1]

0 – 30%	30 – 60%	60 – 80%	80 – 100%

SF*park* garage usage[2]

Other garages/lots

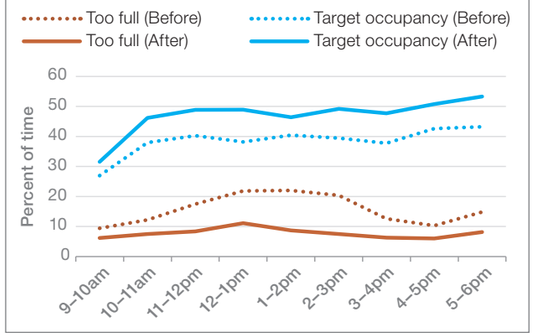
[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period

[2] Garage usage shown for weekdays and weekends, all operating hours

Improvements to parking availability and target occupancy achievement can be seen over the course of an average weekday in Fillmore. Consistent with larger trends, the biggest improvements to parking availability occurred over the lunchtime peak period, with a 55% drop in how often blocks were too full.

Parking availability and target occupancy: Fillmore

Percent of time blocks in Fillmore were too full & percent of time they achieved target occupancy
Before vs after | Weekdays 9am to 6pm



Area profiles: pricing and occupancy

While Fillmore serves as a example of how getting the price right can improve both parking availability and utilization, each of the pilot areas tells a similar story.

During the first ten rate adjustments, nearly half of all blocks experienced an average weekday rate increase, typically resulting in a decrease of average occupancy into the target 60–80% occupancy rate. Over 40% of blocks experienced a decrease in rates, typically resulting in an increase of average occupancy into the target 60–80% occupancy rate. About 10% of blocks did not experience a rate change overall and typically hovered within the 60–80% target occupancy rate.

On some blocks, occupancy rates continue to be too high or too low. In many of these cases, low payment compliance obstructs the effectiveness of demand responsive pricing. However, in other cases, some blocks haven't yet reached their price point. SF*park* rate adjustments continue to be implemented every 6–8 weeks in pilot areas, moving blocks closer and closer to their price point and therefore target occupancy.

The following pages illustrate how this general pattern affected each pilot area. Tables provide average prices before and after for each timeband, as well as net change in average price for each timeband, for each group of blocks: those that experienced an overall rate increase, overall rate decrease, or no change overall. The same is shown for average occupancy rates before and after SF*park*.

Pricing and occupancy summary: All pilot areas

Weekdays 9am to 6pm

203/256 blocks = 79% of blocks in all pilot areas participated in all 10 rate adjustments

47% of blocks with rate increase[1]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.68	$3.77	$1.08	79	75	(4)
Noon to 3pm	$2.67	$4.07	$1.40	80	76	(4)
3pm to close	$2.59	$4.06	$1.47	80	75	(5)

42% of blocks with rate decrease[2]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.73	$1.10	($1.63)	52	63	11
Noon to 3pm	$2.68	$1.48	($1.20)	54	64	11
3pm to close	$2.81	$1.64	($1.18)	54	63	9

10% of blocks with no change overall[3]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.42	$2.42	$-	73	72	(0)
Noon to 3pm	$2.81	$2.81	$-	64	73	9
3pm to close	$2.67	$2.67	$-	66	69	3

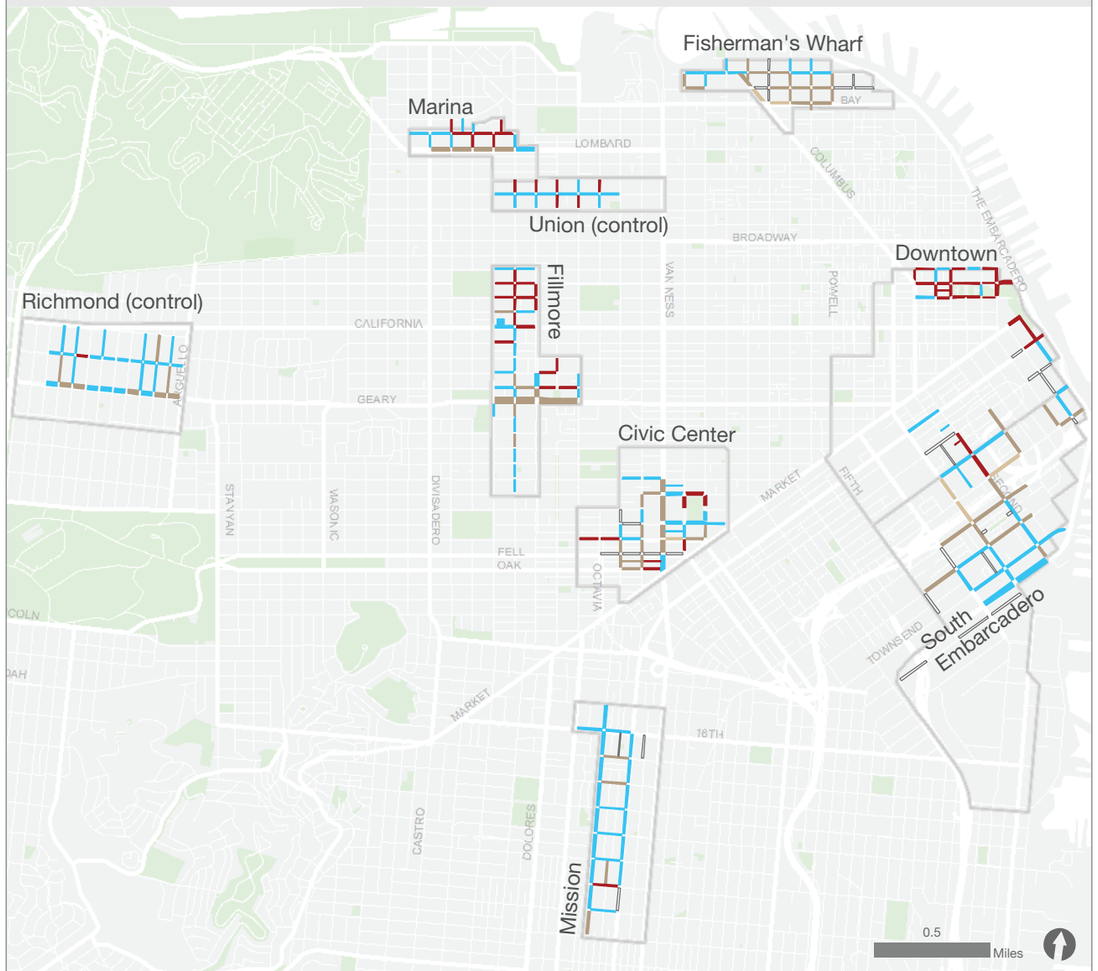
*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

*2 These blocks may have seen a price increase mid-way through but by rate adjustment 10 were at a lower price than they were before SF*park

*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Occupancy: before

Average weekday occupancy by block, spring 2011
Weekdays, 9am to 6pm | Before

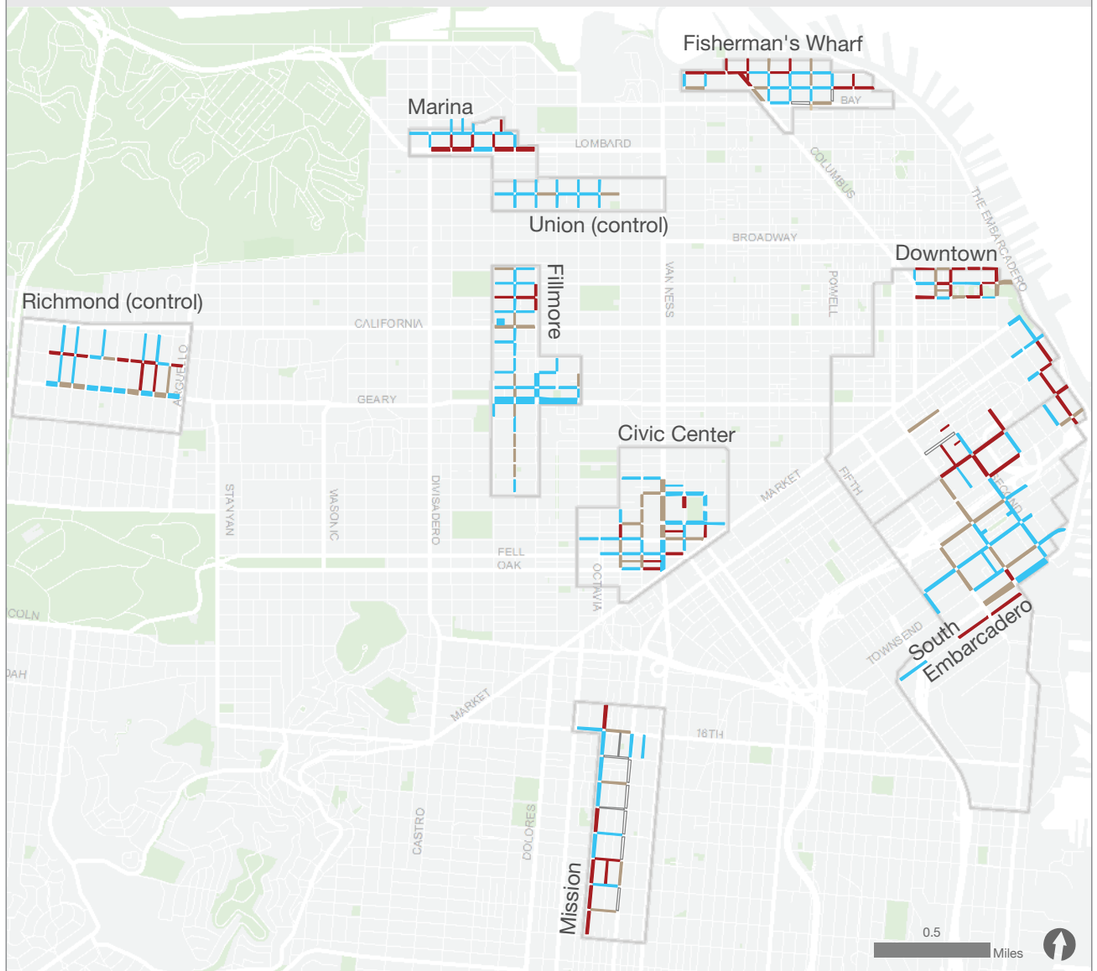


Average occupancy, spring 2011

- 0 – 30% occupancy
- 30 – 60% occupancy
- 60 – 80% occupancy (target)
- 80 – 100% occupancy
- Occupancy data n/a

Occupancy: after

Average weekday occupancy by block, spring 2013
Weekdays, 9am to 6pm | Before



Average occupancy, spring 2011

- 0 – 30% occupancy
- 30 – 60% occupancy
- 60 – 80% occupancy (target)
- 80 – 100% occupancy
- Occupancy data n/a

Area profile: Civic Center

Pricing and occupancy summary: Civic Center

Pricing and occupancy summary
Weekdays 9am to 6pm

Average weekday rate change: ($0.45)

36/44 blocks = 82% of blocks in Civic Center participated in all 10 rate adjustments

	36% of blocks with rate increase[1]						56% of blocks with rate decrease[2]						8% of blocks with no change overall[3]					
	Price			Occupancy			Price			Occupancy			Price			Occupancy		
	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net
Open to noon	$2.63	$3.28	$0.66	77	76	(1)	$2.79	$1.04	($1.75)	53	62	8	$3.00	$3.00	$-	81	87	5
Noon to 3pm	$2.75	$4.05	$1.30	76	76	0	$2.71	$1.14	($1.57)	48	55	8	$3.00	$3.00	$-	62	67	5
3pm to close	$2.54	$3.77	$1.23	77	77	(0)	$2.86	$1.65	($1.20)	55	58	3	$3.00	$3.00	$-	57	73	17

*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

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*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after

Hourly rate for "After" shown
Weekday average, 9am to 6pm

Hourly garage rates

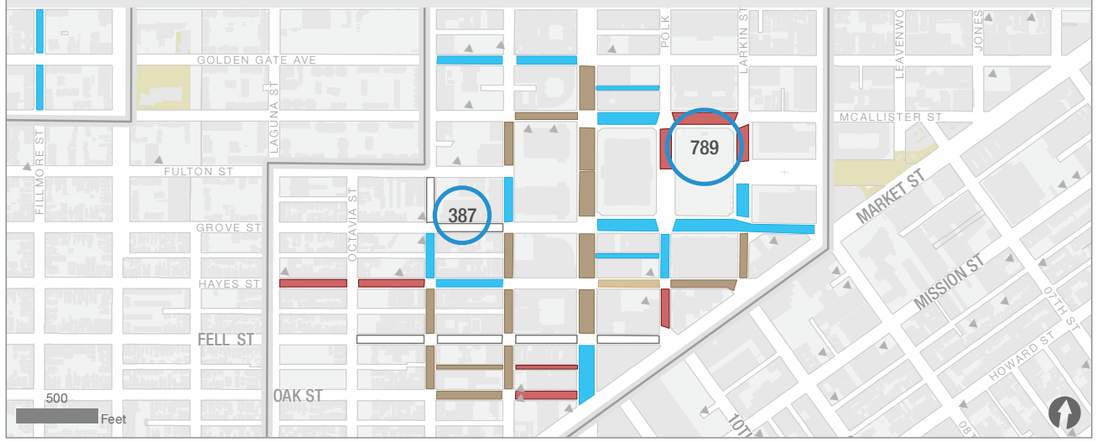
- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

Hourly meter rates

- $0.25 to $3.25 decrease
- $0.25 to $0.01 decrease
- $0.01 to $0.25 increase
- $0.26 to $2.50 increase
- No overall rate change

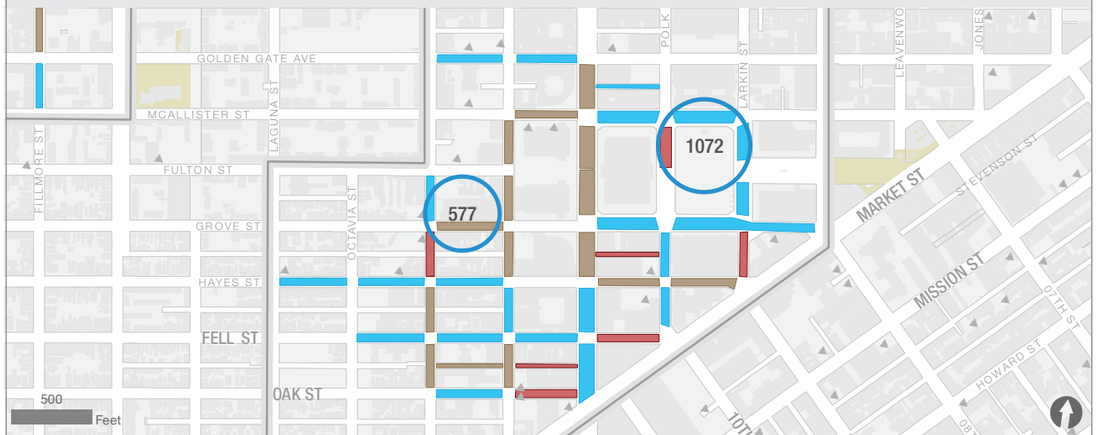
Average occupancy: before

Weekday average, 9am to 6pm



Average occupancy: after

Weekday average, 9am to 6pm



Occupancy[1]

- 0 – 30%
- 30 – 60%
- 60 – 80%
- 80 – 100%
- Occupancy data n/a

SF*park* garage usage[2]

Other garages/lots

[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period

[2] Garage usage shown for weekdays and weekends, all operating hours

Area profile: Downtown

Pricing and occupancy summary: Downtown

Pricing and occupancy summary
Weekdays 9am to 6pm

Average weekday rate change: $1.13

32/40 blocks = 80% of blocks in Downtown participated in all 10 rate adjustments

	81% of blocks with rate increase[1]						11% of blocks with rate decrease[2]						8% of blocks with no change overall[3]					
	Price			Occupancy			Price			Occupancy			Price			Occupancy		
	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net
Open to noon	$3.40	$4.49	$1.09	84	76	(7)	$3.50	$2.79	($0.71)	69	71	2	$3.33	$3.33	$-	88	86	(1)
Noon to 3pm	$3.40	$5.02	$1.62	86	77	(9)	$3.50	$3.25	($0.25)	65	68	3	$3.50	$3.50	$-	73	82	9
3pm to close	$3.39	$5.02	$1.63	85	76	(8)	$3.50	$3.00	($0.50)	62	65	3	$3.50	$3.50	$-	68	80	12

*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

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*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after

Hourly rate for "After" shown
Weekday average, 9am to 6pm

Hourly garage rates

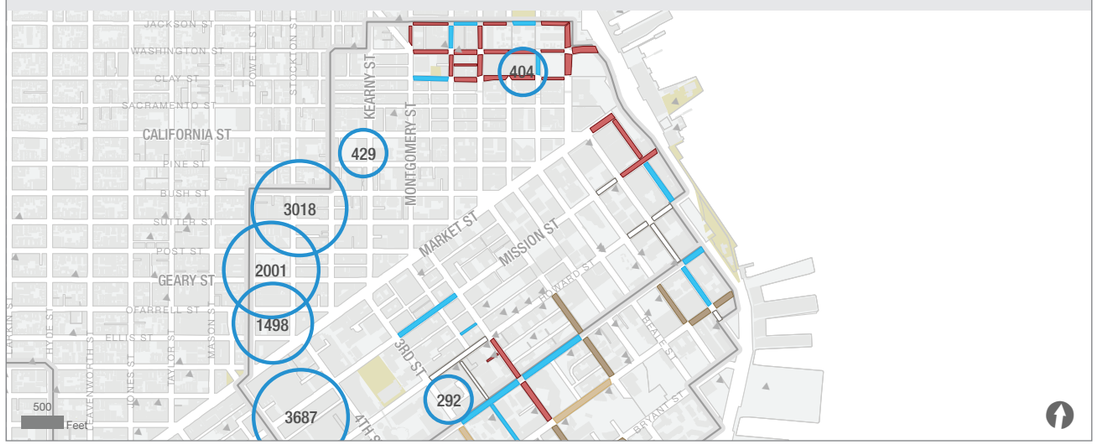
- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

Hourly meter rates

- $0.25 to $3.25 decrease
- $0.25 to $0.01 decrease
- $0.01 to $0.25 increase
- $0.26 to $2.50 increase
- No overall rate change

Average occupancy: before

Weekday average, 9am to 6pm



Average occupancy: after

Weekday average, 9am to 6pm

Occupancy[1]

- 0 – 30%
- 30 – 60%
- 60 – 80%
- 80 – 100%
- Occupancy data n/a

SF*park* garage usage[2]

Other garages/lots

[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period

[2] Garage usage shown for weekdays and weekends, all operating hours

Area profile: Fisherman's Wharf

Pricing and occupancy summary: Fisherman's Wharf

Pricing and occupancy summary
Weekdays 9am to 6pm

Average weekday rate change: ($1.04)

25/37 blocks = 68% of blocks in Fisherman's Wharf participated in all 10 rate adjustments

	23% of blocks with rate increase[1]						67% of blocks with rate decrease[2]						10% of blocks with no change overall[3]					
	Price			Occupancy			Price			Occupancy			Price			Occupancy		
	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net
Open to noon	$3.00	$3.25	$0.25	64	65	1	$2.97	$0.71	($2.26)	47	66	19						-
Noon to 3pm	$2.92	$3.81	$0.88	73	73	(0)	$3.00	$1.50	($1.50)	47	67	20	$3.00	$3.00	$-	55	85	30
3pm to close	$2.86	$3.61	$0.75	72	66	(6)	$3.00	$1.56	($1.44)	49	67	17	$3.00	$3.00	$-	64	74	10

*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

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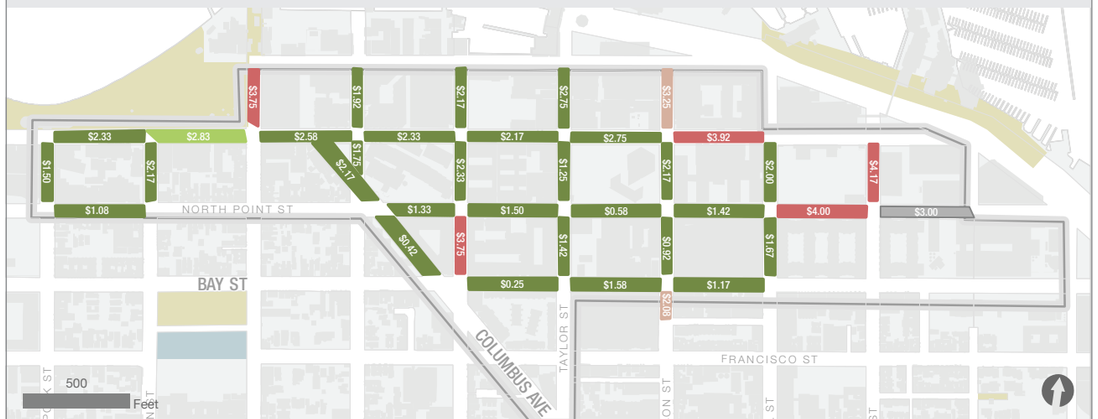
*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after

Hourly rate for "After" shown
Weekday average, 9am to 6pm



Hourly garage rates

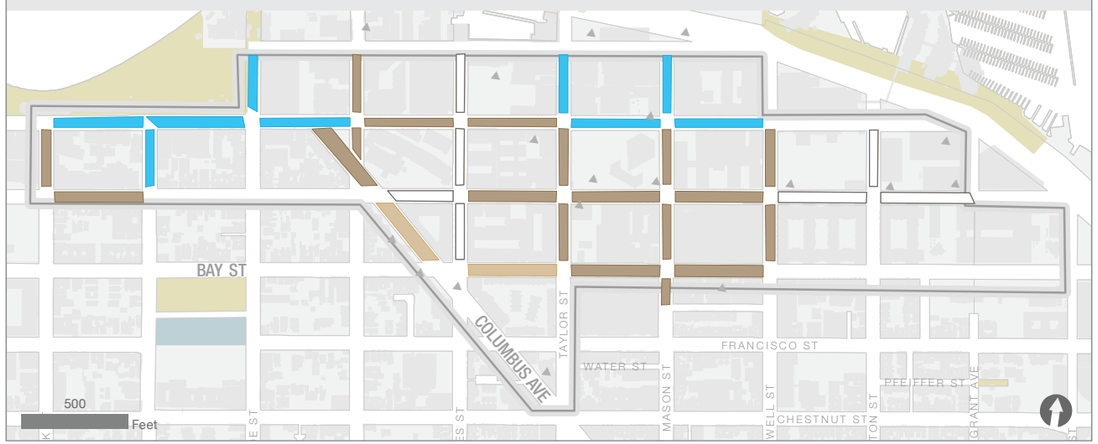
- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

Hourly meter rates

- $0.25 to $3.25 decrease
- $0.25 to $0.01 decrease
- $0.01 to $0.25 increase
- $0.26 to $2.50 increase
- No overall rate change

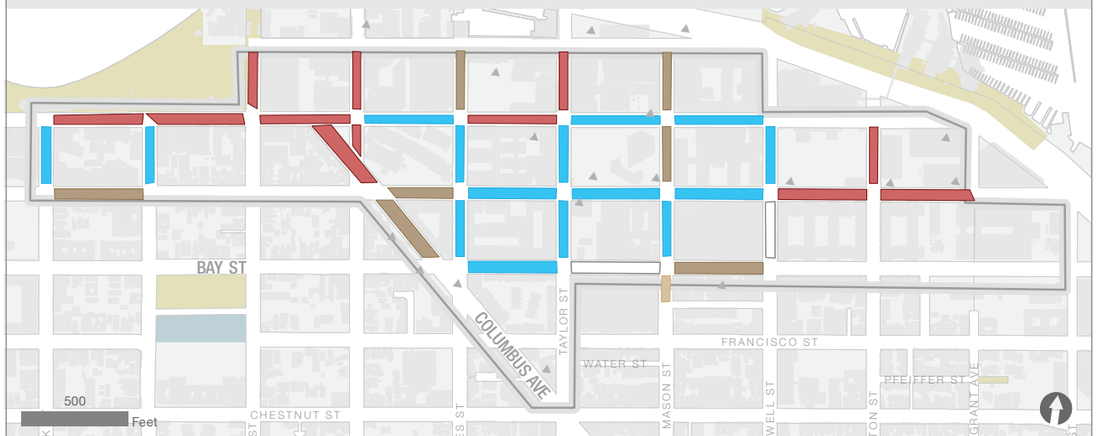
Average occupancy: before

Weekday average, 9am to 6pm



Average occupancy: after

Weekday average, 9am to 6pm



Occupancy[1]

- 0 – 30%
- 30 – 60%
- 60 – 80%
- 80 – 100%
- Occupancy data n/a

SF*park* garage usage[2]

Other garages/lots

[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period

[2] Garage usage shown for weekdays and weekends, all operating hours

Area profile: Marina

Pricing and occupancy summary: Marina

Pricing and occupancy summary
Weekdays 9am to 6pm

Average weekday rate change: $0.70

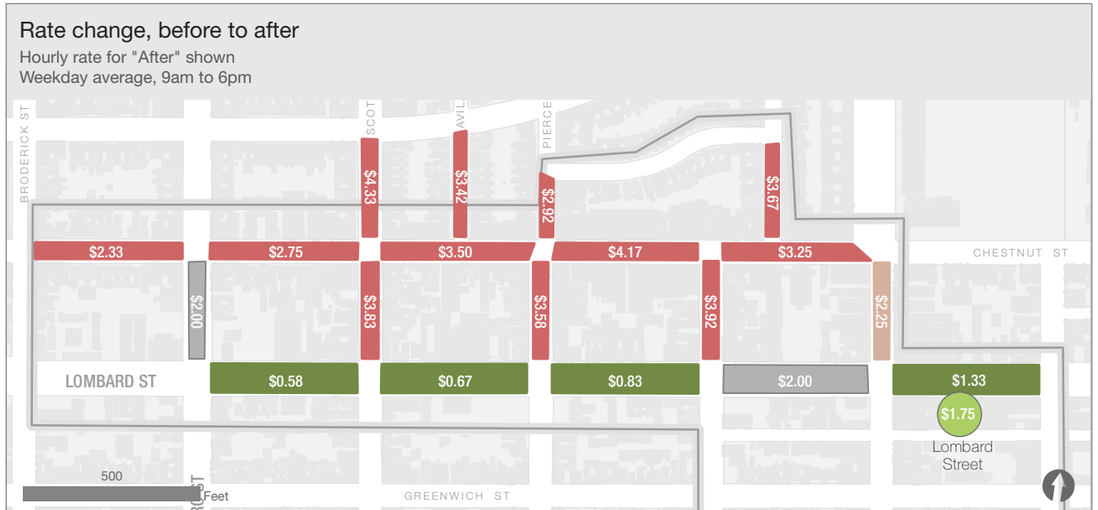
19/19 blocks = 100% of blocks in Marina participated in all 10 rate adjustments

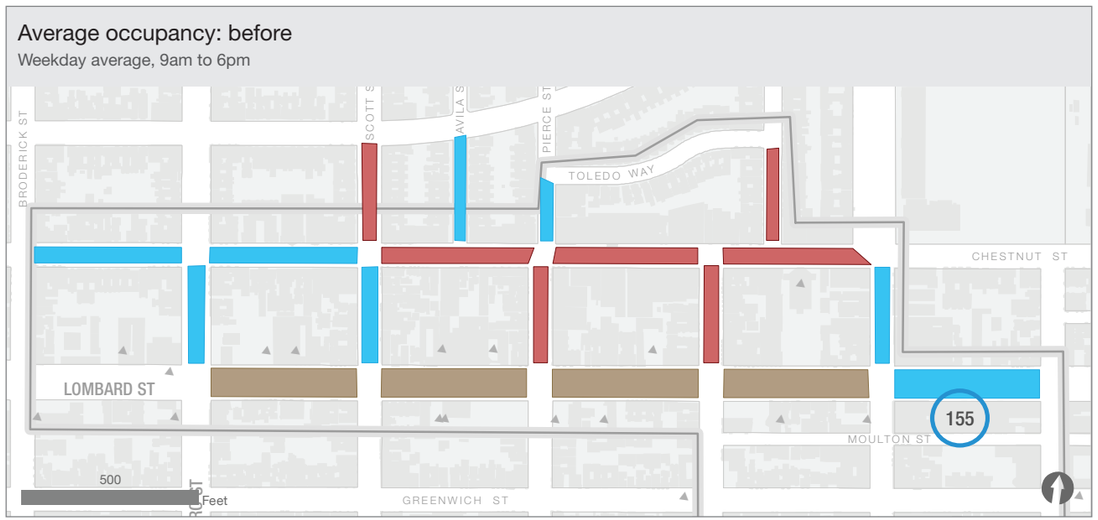
	67% of blocks with rate increase[1]						28% of blocks with rate decrease[2]						5% of blocks with no change overall[3]					
	Price			Occupancy			Price			Occupancy			Price			Occupancy		
	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net
Open to noon	$2.00	$2.92	$0.92	76	73	(3)	$2.00	$0.91	($1.09)	54	76	22	$2.00	$2.00	$-	68	81	14
Noon to 3pm	$2.00	$3.60	$1.60	82	78	(4)	$2.00	$1.25	($0.75)	60	87	26						-
3pm to close	$2.00	$3.71	$1.71	82	77	(5)	$2.00	$0.88	($1.13)	60	85	25	$2.00	$2.00	$-	79	56	(22)

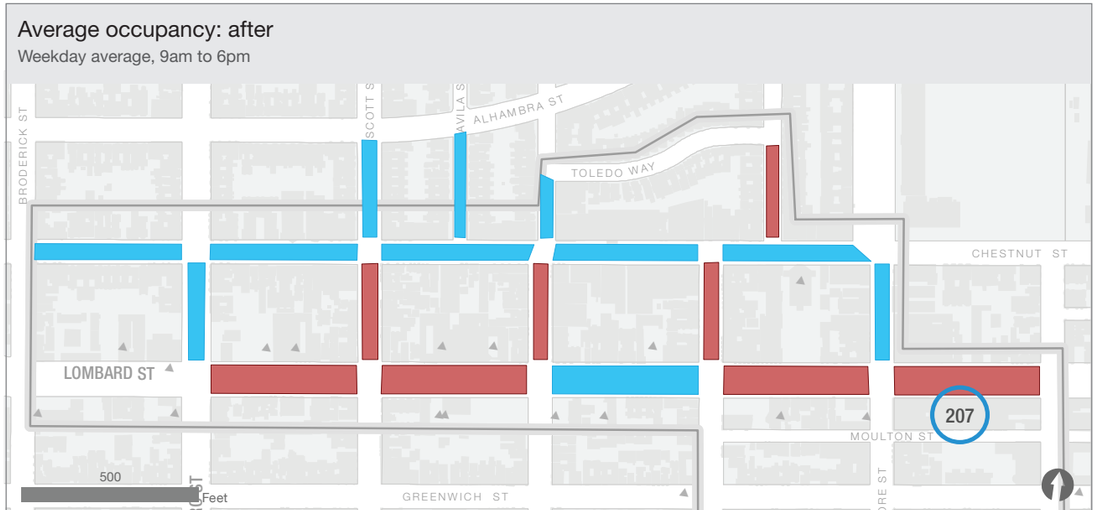
*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

*2 These blocks may have seen a price increase mid-way through but by rate adjustment 10 were at a lower price than they were before SF*park

*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park







[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period

[2] Garage usage shown for weekdays and weekends, all operating hours

Area profile: Mission

Pricing and occupancy summary: Mission

Pricing and occupancy summary
Weekdays 9am to 6pm | Average weekday rate change: $0.49

16/28 blocks = 57% of blocks in Mission participated in all 10 rate adjustments

51% of blocks with rate increase[1]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$2.75	$0.75	70	78	8
Noon to 3pm	$2.00	$3.34	$1.34	77	80	3
3pm to close	$2.00	$3.58	$1.58	79	81	2

24% of blocks with rate decrease[2]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$1.10	($0.90)	57	60	3
Noon to 3pm	$2.00	$1.25	($0.75)	67	62	(5)
3pm to close	$2.00	$1.63	($0.38)	64	70	6

25% of blocks with no change overall[3]

	Price			Occupancy		
Timeband	Before	After	Net	Before	After	Net
Open to noon	$2.00	$2.00	$-	64	67	4
Noon to 3pm	$2.00	$2.00	$-	67	66	(1)
3pm to close	$2.00	$2.00	$-	70	61	(9)

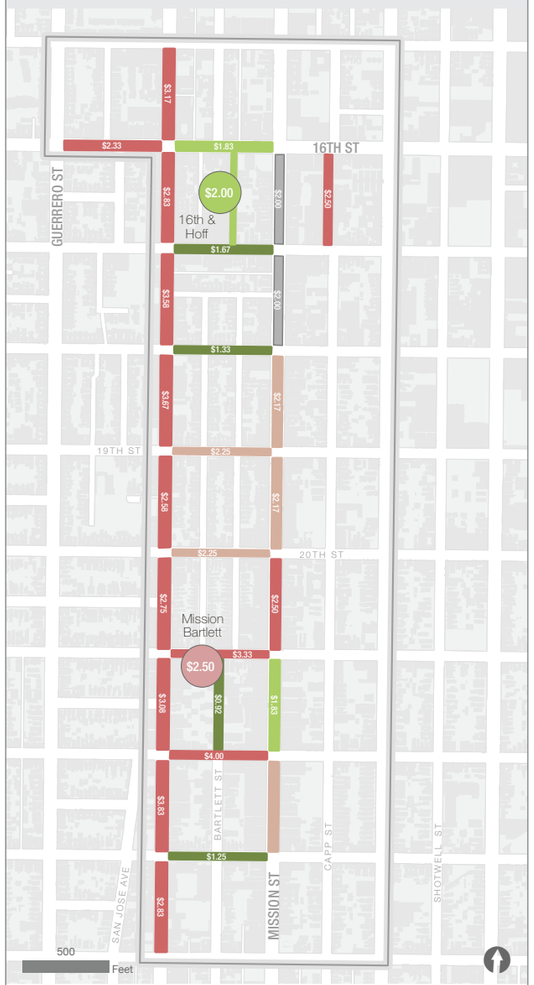
*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

*2 These blocks may have seen a price increase mid-way through but by rate adjustment 10 were at a lower price than they were before SF*park

*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after

Hourly rate for "After" shown



Hourly garage rates

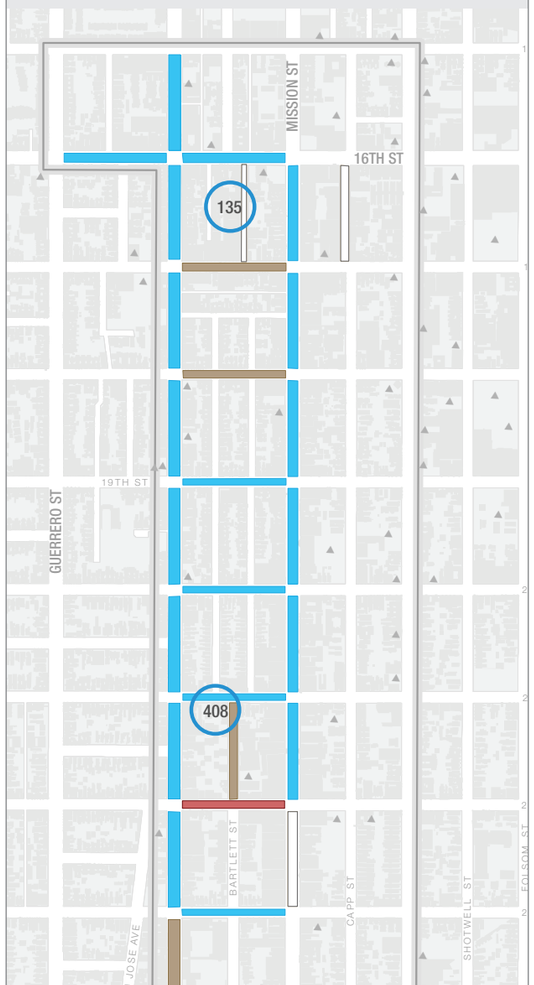
- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

Hourly meter rates

- $0.25 to $3.25 decrease
- $0.25 to $0.01 decrease
- $0.01 to $0.25 increase
- $0.26 to $2.50 increase
- No overall rate change

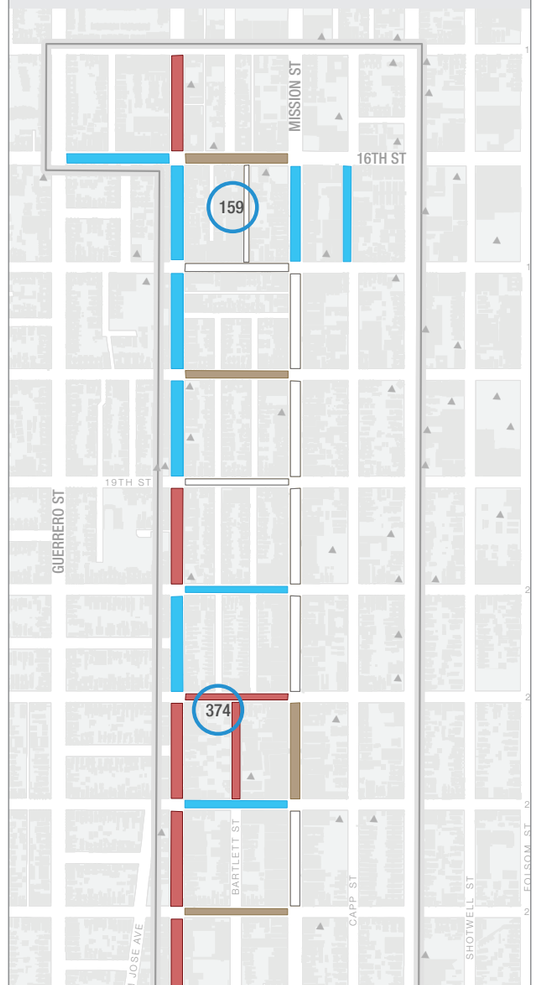
Average occupancy: before

Weekday average, 9am to 6pm



Average occupancy: after

Weekday average, 9am to 6pm



Occupancy[1]

- 0 – 30%
- 30 – 60%
- 60 – 80%
- 80 – 100%

SF*park* garage usage[2]

Other garages/lots

[1] Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period
[2] Garage usage shown for weekdays and weekends, all operating hours

Area profile: South Embarcadero

Pricing and occupancy summary: South Embarcadero

Pricing and occupancy summary
Weekdays 9am to 6pm

Average weekday rate change: ($0.66)

30/43 blocks = 70% of blocks in South Embarcadero participated in all 10 rate adjustments

	30% of blocks with rate increase[1]						59% of blocks with rate decrease[2]						10% of blocks with no change overall[3]					
	Price			Occupancy			Price			Occupancy			Price			Occupancy		
	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net	Before	After	Net
Open to noon	$3.50	$4.29	$0.79	72	83	11	$3.48	$1.61	($1.86)	45	60	15	$3.50	$3.50	$-	79	73	(6)
Noon to 3pm	$3.50	$4.55	$1.05	72	75	3	$3.46	$1.98	($1.48)	45	67	22	$3.50	$3.50	$-	65	72	6
3pm to close	$3.50	$4.34	$0.84	72	74	3	$3.48	$2.15	($1.32)	48	60	12	$3.50	$3.50	$-	63	75	12

*1 These blocks may have seen a price decrease mid-way through but by rate adjustment 10 were at a higher price than they were before SF*park

*2 These blocks may have seen a price increase mid-way through but by rate adjustment 10 were at a lower price than they were before SF*park

*3 These blocks may have seen a price change mid-way through but by rate adjustment 10 were at the same price as they were before SF*park

Rate change, before to after

Hourly rate for "After" shown
Weekday average, 9am to 6pm

Hourly garage rates

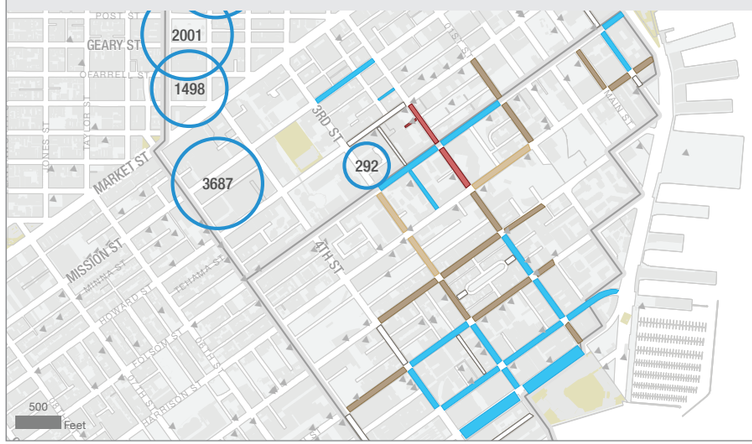
- $1.00 or more decrease
- $0.01 to $1.00 decrease
- No change
- $0.01 to $1.00 increase

Hourly meter rates

- $0.25 to $3.25 decrease
- $0.25 to $0.01 decrease
- $0.01 to $0.25 increase
- $0.26 to $2.50 increase
- No overall rate change

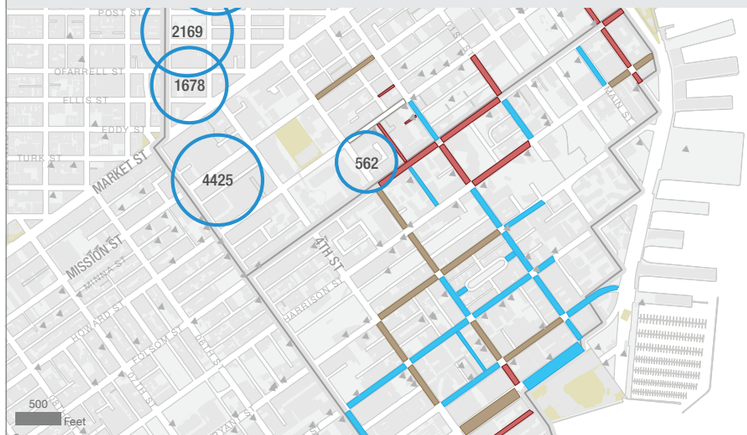
Average occupancy: before

Weekday average, 9am to 6pm



Average occupancy: after

Weekday average, 9am to 6pm



Occupancy[1]

- 0 – 30%
- 30 – 60%
- 60 – 80%
- 80 – 100%
- Occupancy data n/a

- SF*park* garage usage[2]
- Other garages/lots

1 Occupancy not shown for blocks with poor quality parking sensor data for the "Before" or "After" period

2 Garage usage shown for weekdays and weekends, all operating hours

Off-street parking pricing and occupancy

Demand-responsive pricing was also used in 13 SFMTA-administered parking garages in SF*park* pilot areas to improve utilization and to further minimize the amount of time, however infrequent, that garages are full. The demand-responsive approach to pricing in garages was complemented by other garage-specific pricing policies such as time-of-day pricing, off-peak discounts, and de-emphasizing early-bird commuter parking. All of these strategies were aimed at minimizing garage entries and exits during peak traffic times to help reduce congestion:

- Time-of-day pricing makes parking at peak times more expensive, and parking at off-peak times cheaper.
- Off-peak discounts provide a discount for drivers who enter the garage before the morning rush hour or leave after the evening rush hour.
- Before SF*park*, early bird parking typically required drivers to be "in by 10am, out by 6pm," essentially forcing them to be on the streets during the morning and evening rush hours. By tightening the morning time requirement (to "in by 8:30am") and eliminating the evening "out by" time requirement (so that drivers could leave after the evening rush hour and still receive the early bird discount), SF*park* provides financial incentives for drivers to be on the streets at off-peak times.

Demand-responsive pricing at garages complements SF*park* on-street policies by helping to pull some parking demand off the street, discouraging commuting by car, improving availability of garage parking for short-term trips (e.g., for shopping) by using prices to discourage commuting, and giving economic incentives not to enter or exit a city garage during peak times. During the SF*park* pilot, this overall approach to parking pricing in garages helped meet these goals. Average daytime garage occupancy increased from 51 to 59%—a 14.5% increase. Even as occupancy increased, SF*park* garages maintained parking availability[1] at least 97% of the time.

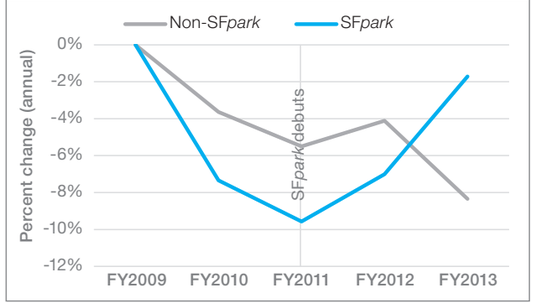
1 *at least 5% of spaces open*

Garage utilization

Parking garages in SF*park* pilot areas saw significant increases in usage over the course of the SF*park* project, while SFMTA-managed garages outside of SF*park* pilot areas saw substantial usage declines. At all SF*park* garages, total entries increased 9% from FY2011 to FY2013.

Total garage usage (percent change)

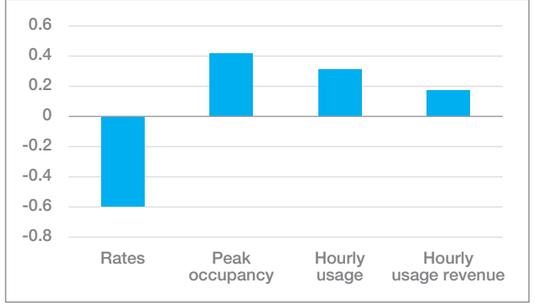
FY2009 to FY2013
SF*park* vs non-SF*park* garages



Since decreasing rates at the Performing Arts garage at the beginning of FY2013, usage and revenue are up significantly from pre-SF*park* levels.[2] At Civic Center, where fewer changes were made as a result of demand-responsive pricing, usage is up and revenues have remained relatively flat:

Off-street case study: Performing Arts garage

Percent changes in rates, hourly usage and revenue
Before vs after SF*park*



A specific example of the effect of demand-responsive pricing on garage usage can be seen at the two garages in the Civic Center Pilot Area, where the Performing Arts Garage and Civic Center Garage are located approximately five blocks apart. As SF*park* garages, both have demand-responsive hourly rates, early bird rates, and are similar in size. Because of very low occupancy during peak times, Performing Arts Garage daytime hourly rates dropped 60% (from $2.50 to $1.00 per hour) by July 2012. Rates at Civic Center dropped about 20%.

Garage Comparison	Performing Arts	Civic Center
Capacity	600	843
Pre-SF*park* daytime hourly rate	$2.50	$3.00
July 2012 daytime hourly rate	$1.00	$2.00 – $2.50

Peak entries and exits

Since SF*park* was implemented, overall garage usage increased significantly. All things being equal, one might expect that an increase in overall usage would result in an equivalent increase in peak entries and exits. But in fact, while usage at SF*park* garages increased significantly, there was no increase in peak-time entries and exits.[3] At all SF*park* garages, total entries are up 11% in FY2013 over FY2011.[4] Off-peak entries are up 14%, while peak entries rose only 1%. Exits show a similar trend: total exits are up 11%, off-peak exits are up 15%, while peak exits are up only 3%.

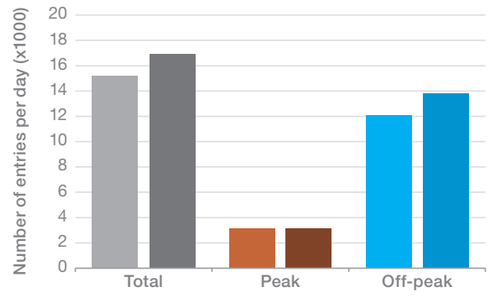
2 *For an accurate picture of the impact of July 1, 2012 rate changes at Performing Arts Garage, this analysis compares data from October 2012 (three months after the July 1 rate changes, to allow the public to respond) to June 2013 (FY2013) against to October 2010–June 2011 (FY2011).*

3 *"Peak" entries are entries between 7am and 10am on weekdays. "Peak" exits are exits between 4pm and 7pm on weekdays. All other weekday entries and exits are considered "off-peak." Because this analysis concerns traffic and congestion during weekday rush-hours, only non-holiday weekdays are included in this analysis.*

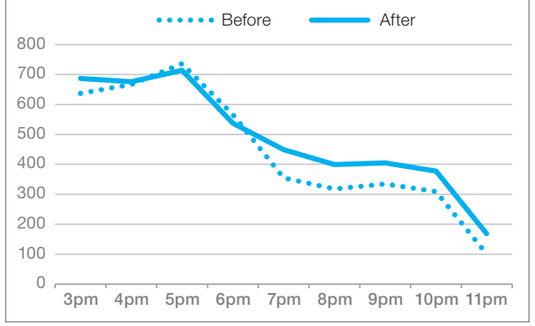
4 *This analysis compares January 1–April 20 of 2013, 2011, and 2009, in order to compare conditions well before SF*park*, just before the debut of SF*park*, and two years into the SF*park *program. The SF*park *rate structure debuted at the first garage, Moscone Center, on April 21, 2011.*

Average daily SF*park* garage entries

Before vs after
Total, peak, off-peak

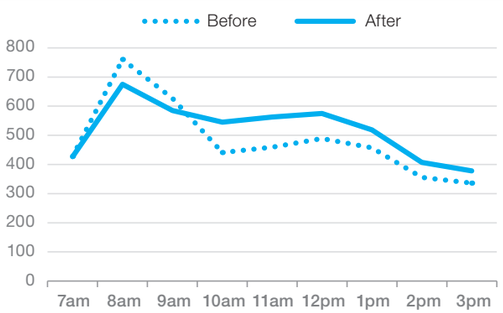


Weekday exits at early bird garages



This flattening of the demand curve by redistributing entries and exits from peak to off-peak traffic times also can be seen when observing average entries and exits over the course of a day. Under SF*park*, the only reductions in entries and exits were during the 7am–10am and 4pm–7pm peak traffic periods; all other times of day saw significant growth in usage.

Weekday entries at early bird garages



Shifting garages toward short-term rather than commute-oriented parkers

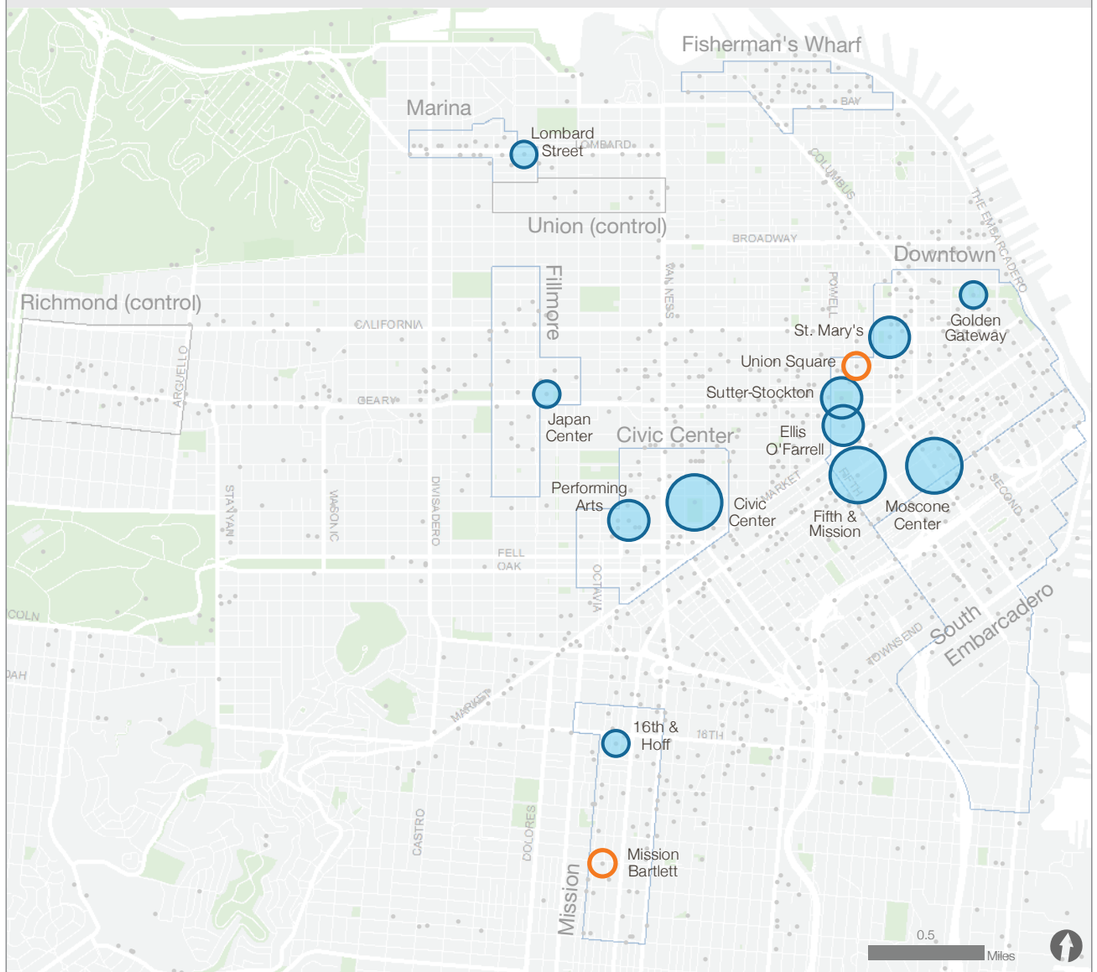
The SFMTA and City of San Francisco have long had a policy of discouraging commuting by single occupant automobile. In addition to demand-responsive time-of-day pricing, SF*park* also reduced the discount implied in daily, early bird (for garages that offered that discount), and monthly parkers to help support this goal by making garages relatively more expensive for commuters—who use the garages mostly for vehicle storage—and relatively cheaper for short-term hourly parkers—who use the garages to access the businesses in the area. This helps return parking garages to their original intent, which was to support the economic vitality in their surrounding areas.

The SF*park* pricing approach appears to have been successful: at SF*park* garages, early-bird and monthly usage declined while hourly usage increased. Between FY2009 and FY2011, transient (combined hourly and early bird) usage at SF*park* garages declined by nearly 600,000 customers, or 10%. Transient usage rebounded significantly in FY2012 and FY2013 at SF*park* garages, after the introduction of SF*park*. During this time, parking availability remained high at all SF*park* garages as usage and occupancy increased.

When hourly and early bird usage are examined separately, the effect of SF*park* is clearer. In FY2013, hourly usage was up approximately 575,000 customers over FY2011, and now exceeds FY2009 levels. Early bird usage since the debut of SF*park* declined significantly, down about 43% from FY2011 levels:

Off-street usage, net change

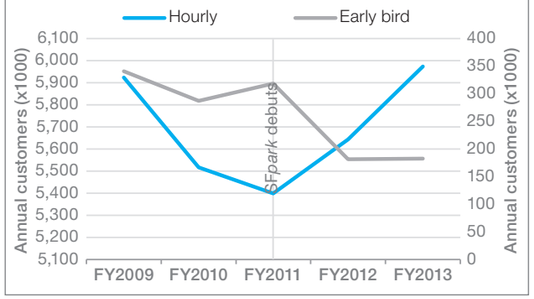
Changes in off-street usage, measured as net change in number of hourly parkers per day
Before vs after



Off-street usage for all days, all times of day

SF*park* garage usage

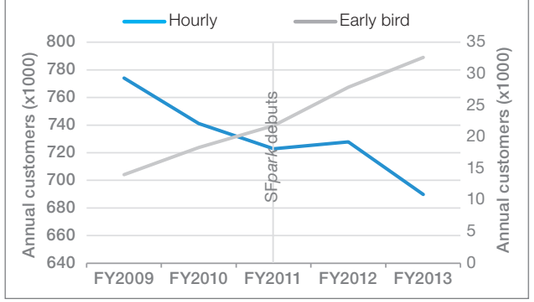
Total number of customers per year
Weekdays and weekends, all operating hours



In contrast, non-SF*park* garages have continued the trend of encouraging early bird parking while hourly parking declines:

Non-SF*park* garage usage

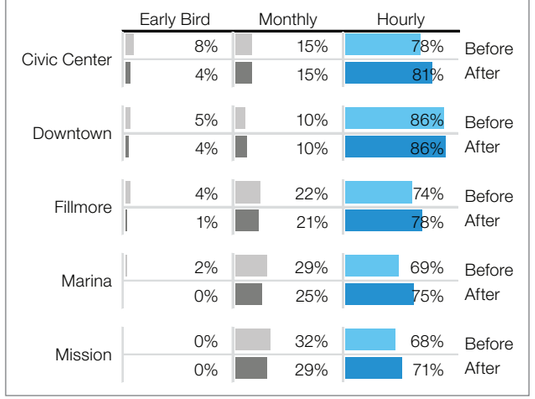
Total number of customers per year
Weekdays and weekends, all operating hours



Hourly parkers now make up a larger share of total parkers at garages than they did before SF*park*, while the share of early bird and monthly parkers has decreased. This trend indicates that more drivers are using garages for shorter trips rather than daily commutes.

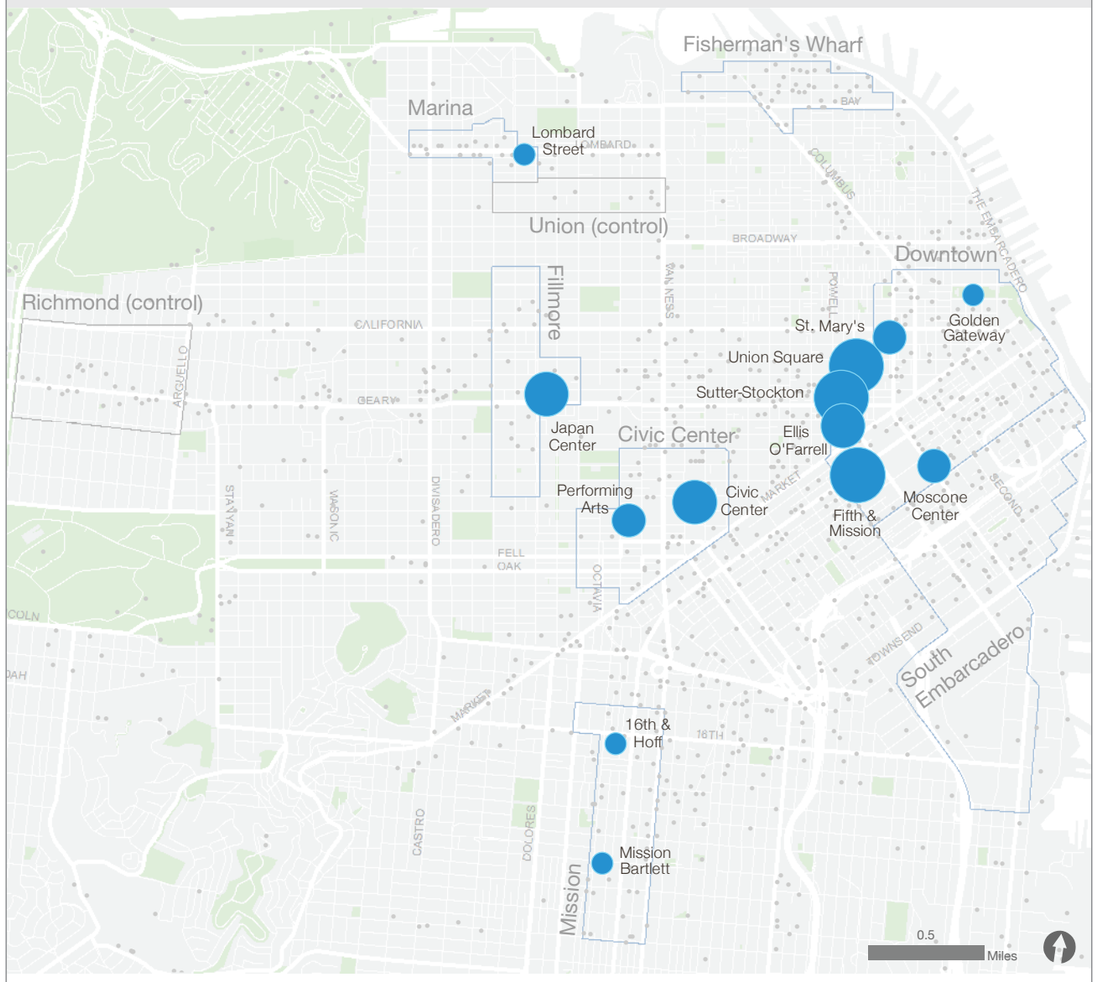
Proportion of early bird, monthly and hourly parkers

All SF*park* garages | Weekdays and weekends, all operating hours
Before vs after



SF*park* garages: daily usage

Number of hourly parkers per day (weekdays and weekends), spring 2013

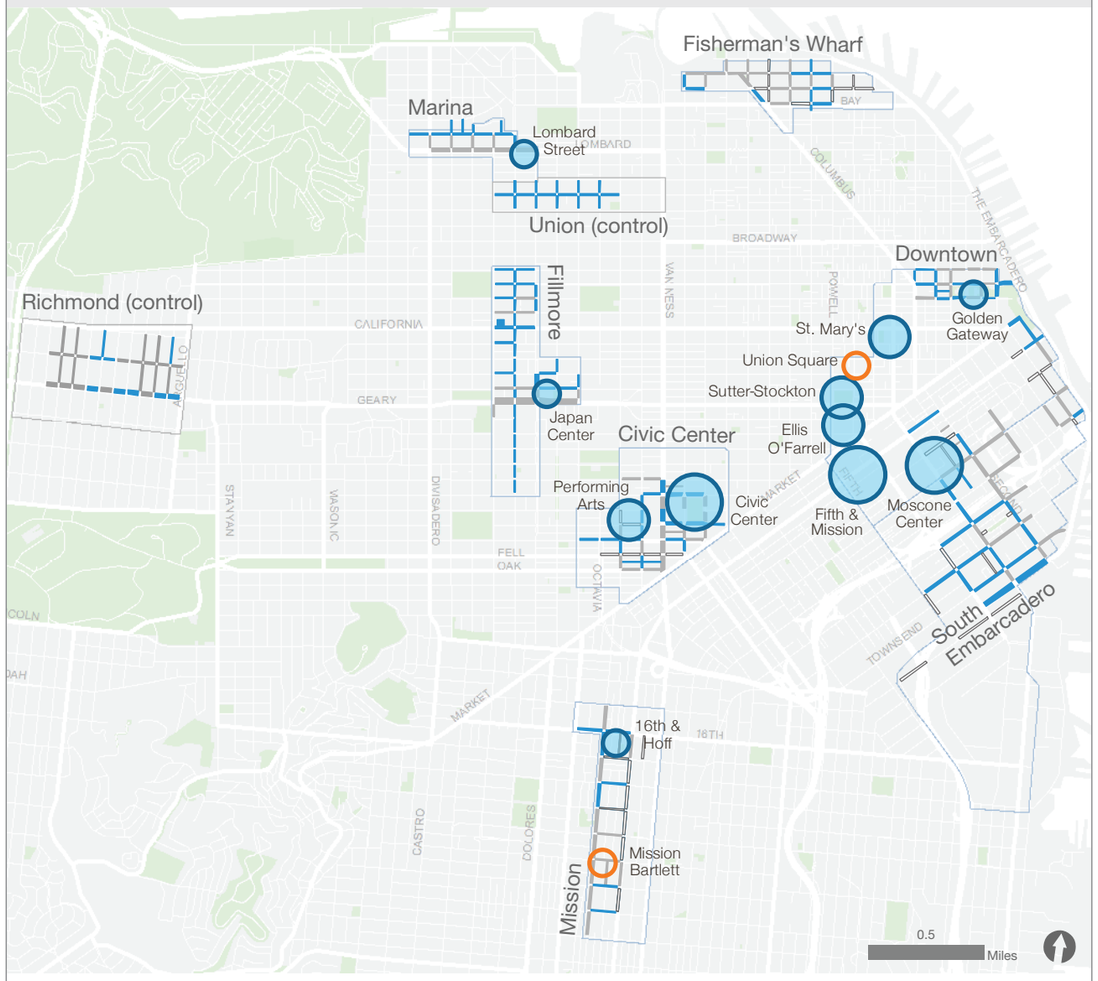


Off-street usage for all days, all times of day

On and off-street summary

On-street parking availability and off-street usage, before vs after

Changes in on-street parking availabiltiy and off-street usage. On-street parking availability improved where frequency of 90–100% hourly occupancy rates decreased. Off-street usage measured as net change in number of hourly parkers per day.



On-street availability
- Blocks with improved parking availability
- Other pilot and control area blocks
- Occupancy data n/a

Off-street usage, net change
- 0 to -100
- 0 to 100
- 100 to 200
- 200 to 800

On-street availability for weekdays 9am to 6pm. Off-street usage for all days, all times of day.

3. EFFECTIVENESS OF PARKING MANAGEMENT

Parking meters are effective at managing parking demand. They help achieve parking availability goals, and therefore other goals such as reducing circling and greenhouse gas emissions and improving safety and transit performance.

Effectiveness of parking management

Managing parking with meters

While the evaluation of SF*park* shows that demand-responsive pricing helps to improve parking management and optimize outcomes, the starkest improvements come from whether or not (or when) parking meters are used as a parking management tool.

Key findings

Though not the focus of the SF*park* pilot project, one of the clearest findings of this evaluation is that parking meters are highly effective at managing parking demand. Meters help parking availability goals and thereby achieve other goals such as reducing circling and greenhouse gas emissions and improving safety and transit performance.

The SFMTA introduced new meters in several areas inside and outside of SF*park* pilot and control areas in 2011. These newly installed meters resulted in a dramatic improvement to parking availability. Prior to installing meters, these blocks were too full 90% of the time. After the installation of meters, this figure dropped to just 15% of the time.

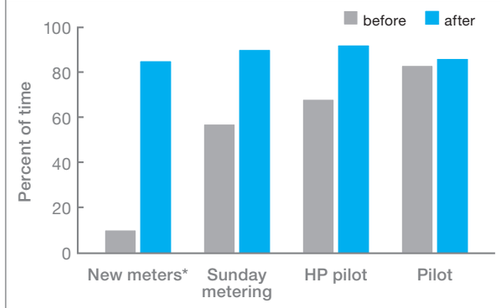
As another example, in January 2013 the SFMTA began operating meters on Sundays from 12pm to 6pm with four-hour time limits. The SFMTA found several changes as a result of operating meters on Sundays:

- It was easier to find parking spaces in commercial and mixed-use areas.
- More people could park because there was more turnover.
- More people parked in SFMTA parking garages, opening up more on-street spaces.
- People spent less time circling to find a parking space.

Introducing new meters as well as enforcing meters on Sundays had a dramatic effect on the amount of time that parking was available. As a point of reference, on blocks in SF*park* pilot areas with high payment compliance (where parking pricing is most effective), SF*park*'s demand-responsive pricing successfully improved parking availability in the following way; parking was available 68% of the time before pricing and 92% of the time after. By comparison, as a result of newly installed meters, the percent of time parking was available increased from 10% to 85%, and it increased from 57% to 90% as a result of metering on Sundays.

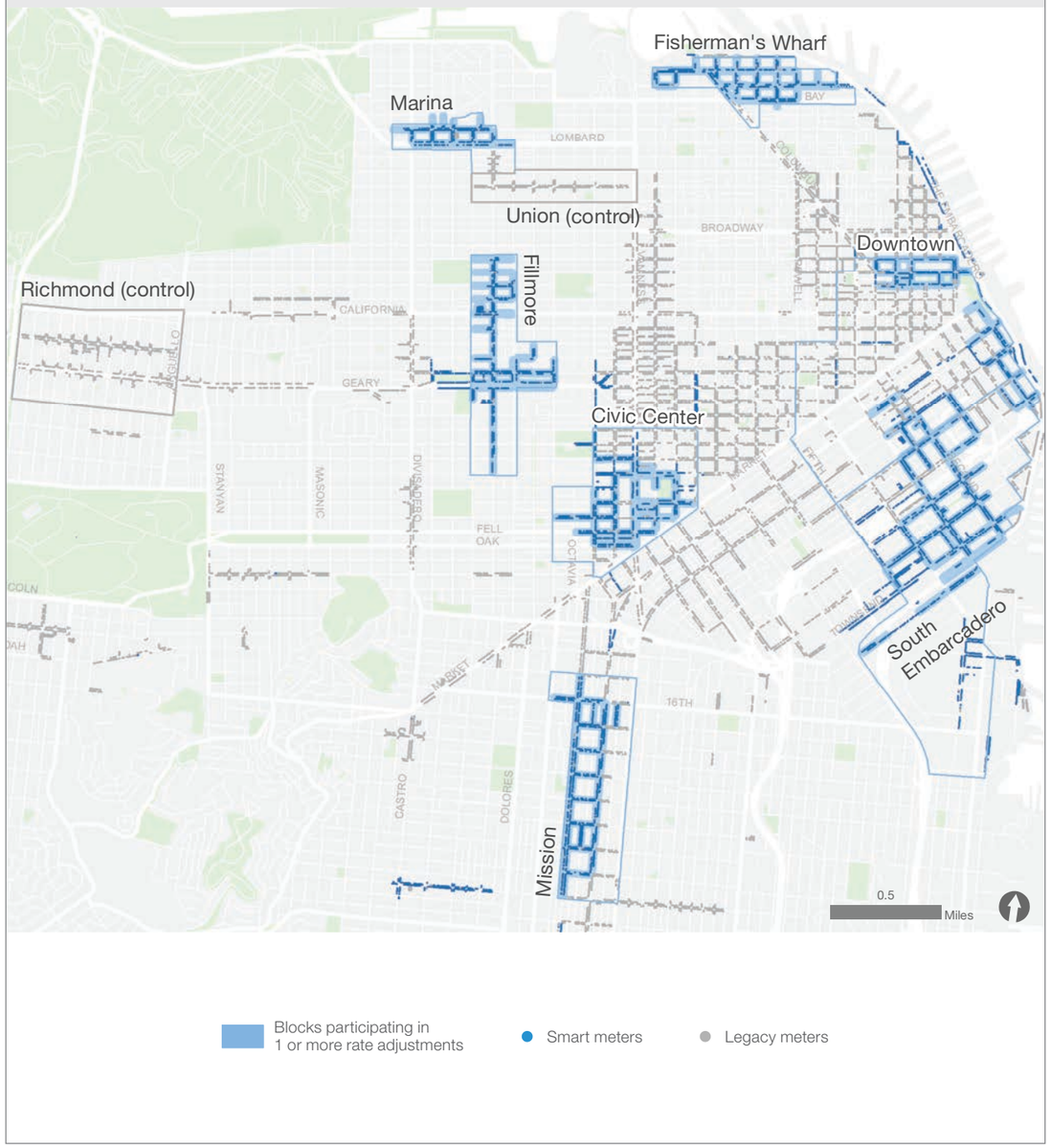
Parking availability

How often is parking available? Before and after
New meters, Sunday metering, and demand-responsive pricing



Smart meters, legacy meters and SF*park* areas

Location of smart meters and blocks participating in rate adjustments



Effects of new meters

In 2010 and 2011, the SFMTA Board approved the installation of additional smart parking meters in several mixed-use and commercial areas.

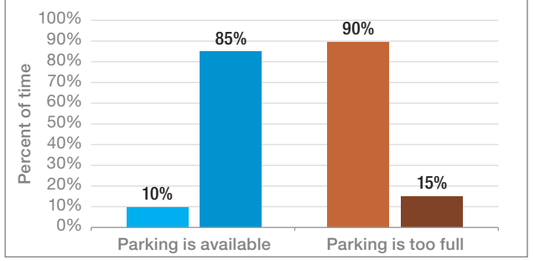
Parking availability

To evaluate how these parking meters affected parking availability and helped the SFMTA achieve its parking management goals, the SFMTA conducted a parking occupancy survey before and after the installing these parking meters.

During weekday metered hours, there was adequate parking availability only ten% of the time before the new meters, and this jumped to 85% of the time after the new meters were installed. Conversely, parking was too full 90% of the time before the new meters installed, compared to only 15% of the time after meters were installed.

Parking availability, new meters

How often is parking available vs being too full?
Before and after new meters
Weekdays, metered hours

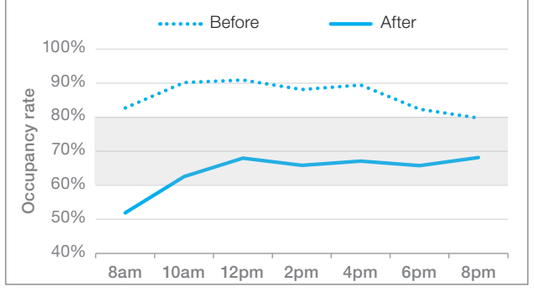


Average occupancy by time of day

Over the span of a weekday, occupancy before installing new meters was routinely high, hovering between 80% to 90% occupied from 8am until 8pm. After the meters were installed, occupancy remained within the target occupancy range of 60 to 80% for most of the day; occupancy was slightly below 60% at 8am, but from 10am until 8pm, occupancy was relatively level between 60 and 70%. So the meters provided a parking benefit for most the day even though they were only operated from 9am to 6pm.

Occupancy by time of day, new meters

Weekdays
Before vs after new meters



Effects of metering on Sundays

For many years, most parking meters in San Francisco were enforced Monday through Saturday from 9am to 6pm. Most businesses were closed on Sundays when parking meters were first installed in San Francisco in 1947, but that has changed significantly since then. A survey of 32 neighborhood commercial districts in 2009 found that 72% of San Francisco businesses are open on Sunday.

To open up parking spaces for those businesses that are open on Sundays and to help achieve broad transportation goals, on January 6, 2013 the SFMTA began operating parking meters throughout the city from 12 to 6pm on Sundays with four-hour time limits. The SFMTA gathered data to evaluate how this change in parking management affected parking availability (both on-street and in SFMTA garages), parking search time, and length of stay.

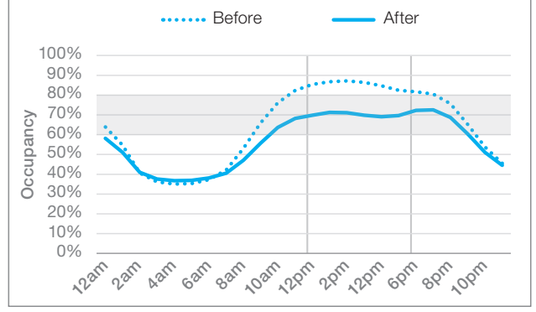
Parking availability

In 2009, the SFMTA conducted parking occupancy surveys across the city. Manual surveys from 32 neighborhood commercial areas demonstrated that it is hard to find open parking spaces when meters are not operating. On Sundays, parking occupancy was higher than 85% in 30 out of 32 areas. To evaluate how effectively meters help to achieve a minimum level of parking availability on Sundays, the SFMTA analyzed parking occupancy data from the Mission, Marina, Union, Civic Center, Fillmore, and Richmond areas (where rich data from SF*park* parking sensors was available).

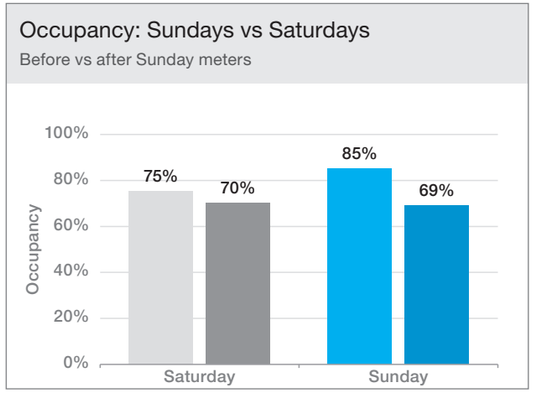
On-street availability. In 2012, available on-street parking spaces were scarce during the day on Sunday but were more available in the early morning hours and late at night. In 2013, parking spaces were more likely to be available during the day on Sunday, both during metered hours as well as in the morning. Parking demand peaked during the afternoon and evening, but the highest occupancies remained within the target occupancy range.

Occupancy by time of day, Sunday meters

Before vs after Sunday meters



Analysis of the average occupancy from 12pm to 6pm across the week showed a slight decrease in occupancy across all days of the week. However, occupancy decreased more on Sundays than on any other day of the week. The decrease in occupancy between noon and 6pm on Sundays was 19%, versus 7% on Saturday and during the week. This decrease in occupancy on Sunday brought the average occupancy during metered hours from 85% to just under 70%, which is within the target occupancy range and consistent with other days of the week.

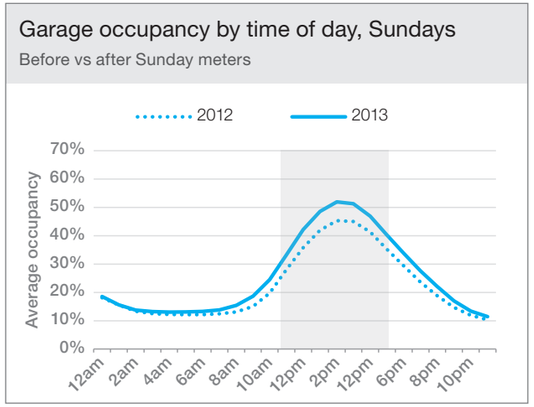


Occupancy by day of week

Day of week	Percent occupancy 12pm – 6pm 2012	2013	Percent change
Monday	70	65	6%
Tuesday	74	68	7%
Wednesday	74	69	7%
Thursday	75	68	8%
Friday	75	70	7%
Saturday	75	70	7%
Sunday	**85**	**69**	**19%**

Finally, this change in occupancy on Sunday is not simply a historic trend; parking occupancy on Sundays from 12pm to 6pm was the same in 2011 as 2012.

Garage use. Operating parking meters on Sundays appears to have contributed to an increase in occupancy at SFMTA parking garages. Occupancy increased particularly during the hours when meters were operating on Sundays, but also before meters began operating at noon.



In general, parking occupancy increased between 2012 and 2013 at the city-owned garages included in this evaluation. However, from 2012 to 2013, Sunday occupancy increased by 15%, versus 4% on Saturday and an average of 4% on the weekdays. This indicates that Sunday metering prompted many drivers to go directly to a garage and park rather than circling to find free, on-street parking.

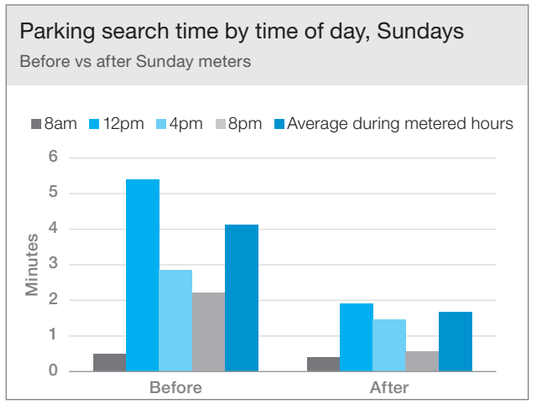
Garage occupancy
Before vs after Sunday meters

Day of week	Percent occupancy 12pm – 6pm 2012	2013	Percent change
Monday	54	57	5%
Tuesday	63	67	6%
Wednesday	65	67	4%
Thursday	66	67	1%
Friday	61	62	2%
Saturday	59	61	4%
Sunday	**41**	**47**	**15%**

Parking search time decreased

Metering on Sundays aimed to shorten the amount of time it takes to find a parking space on Sundays. Using set routes in Civic Center, Fillmore, Marina, Mission, Richmond, and Union Street commercial districts, the SFMTA measured parking search time in April and May of 2012 and April and May of 2013. The parking search time surveys were conducted over the course of the day, starting at 8am, 12pm, 4pm, and 8pm.

In 2012, these all-day surveys show that the longest parking search times tend to be at 12pm and 4pm, which are both within Sunday metering hours (12pm until 6pm). Between 2012 and 2013, the average parking search time decreased by 61% during Sunday metering hours from 4 minutes in 2012 to 1.6 minutes in 2013. By discouraging people from parking overnight and storing cars on-street in commercial areas for part of the weekend, data suggest that metering on Sundays from 12pm to 6pm also reduced parking search time outside of metering hours.

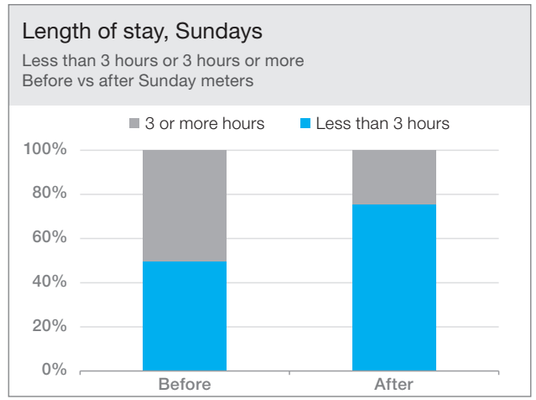


Finally, historic data suggests that the decrease in parking search time on Sundays between 2012 and 2013 was not part of a trend for the past few years. Between spring 2011 and spring 2012, overall parking search time decreased by 6%. The 61% decrease from 2012 to 2013 is almost certainly a direct result of implementing metering on Sundays.

Length of stay and turnover improved

One factor that lowers parking availability on Sundays is cars that are stored for long periods of time in commercial areas. This includes cars parked all day Sunday as well as cars parked on Saturday evening and stored through business hours on Sunday. The SFMTA conducted parking turnover surveys with license plate data before and after the implementation of Sunday metering.

In 2012, cars tended to remain parked for longer than they did in 2013. In 2012, 50% of cars parked for less than three hours, and 50% parked for three or more hours. In 2013, 76% cars stayed for less than three hours; 50% stayed for less than one hour, and 26% stayed for two hours. Less than one quarter of all cars parked stayed for three or more hours in 2013, and more potential customers were able to access the limited number of parking spaces in neighborhood commercial districts.



Cars stayed longer in parking spaces on Sundays in 2012 and were also more likely to have been parked there since Saturday evening. In 2012, 6% of the spaces surveyed had the same car parked on Saturday evening at 9pm and Sunday at 12pm. In 2013, only 2% of the spaces surveyed were occupied by the same car on Saturday evening and Sunday at noon.

4.

PARKING ENFORCEMENT

Parking enforcement is a critical component of parking management. While enforcement was not the focus of the SF*park* pilot projects, this chapter evaluates how SF*park* affected enforcement-related aspects of parking management.

Parking enforcement

How SF*park* affected this critical area of parking management

This chapter outlines how SF*park* increased payment compliance, reduced citations, and addressed other issues related to payment compliance.

Key findings

One of the goals of the SF*park* pilot project was to increase payment compliance, or the percent of time that metered spaces are occupied and paid. Higher payment compliance is important because it results in not only a better customer experience (because it results in drivers receiving fewer meter-related parking citations), but it also improves the effectiveness of parking pricing as a management strategy—parking prices are more effective when more drivers pay.

To help increase payment compliance, the SFMTA made it much easier to pay in SF*park* pilot areas by introducing PayByPhone as well as new meters that accept payment by credit card in addition to the SFMTA Parking Card and coins. The SFMTA also extended time limits at meters from one or two hours to at least four hours or, in some areas, eliminated time limits altogether.

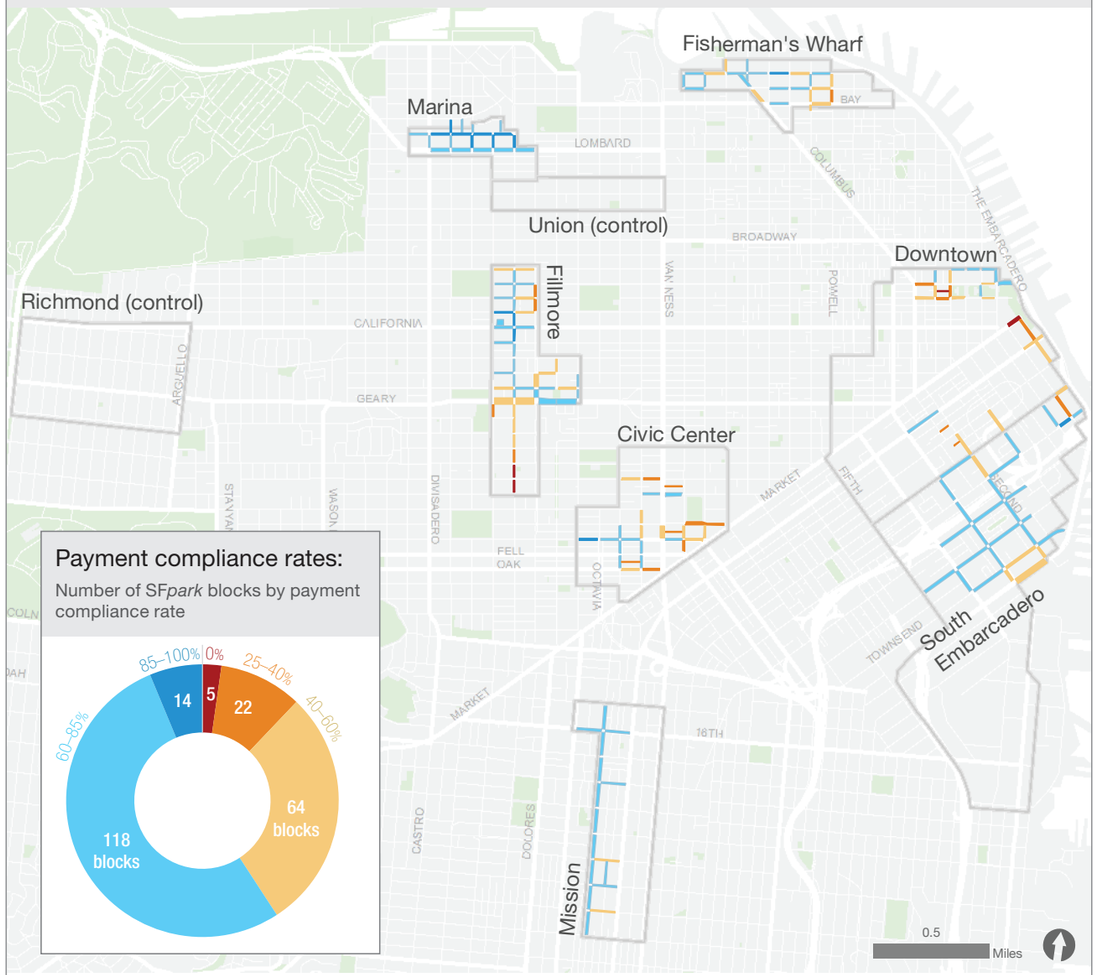
SF*park* successfully improved compliance and reduced the number of citations issued. During the pilot period, average payment compliance increased by 21% (from 45% to 54%) in pilot areas on weekdays, and the average number of citations issued for expired meters decreased by 23% compared to a 12% decrease in control areas. There is still more potential to improve payment compliance via more effective enforcement. However, overall payment compliance is limited somewhat by several factors, including state of California laws that exempt any driver that display disabled placards from paying the meter.

As part of the pilot, the SFMTA also developed and tested on a small scale directed enforcement software called reEnforce. The software combined real-time occupancy data from sensors and payment data from parking meters to identify parking spaces that were occupied and not paid. This information was displayed in a tablet computer mounted in several vehicles used by Parking Control Officers (PCOs). The purpose was to help PCOs more efficiently enforce parking meters, in theory allowing the same number of PCOs to provide a higher level of enforcement and therefore a higher level of payment compliance.

Data from the test of reEnforce does not allow the SFMTA to confidently conclude that reEnforce improved PCO productivity. We assume that when PCOs used the application, at a minimum reEnforce offered a small incremental benefit in helping PCOs direct themselves to find citations. However, PCO use of the application was inconsistent, in part because it was not well integrated into their workflow and other devices. Going forward, if SFMTA were to expand the use of parking sensors, the SFMTA could choose to expand the use of reEnforce at relatively low cost, but it would be more effective if it were integrated into the existing citation issuance software. This would make it easier for PCOs to use and enable the SFMTA to gather rich data to help improve PCO performance and parking management.

High payment compliance blocks

The 14 “HP” blocks are those with payment compliance rates over 85%. Calculated as paid time/occupied time. Average payment compliance rates calculated for 2011–2012. Other blocks shown for comparison purposes.



Map shows blocks that participated in the first 10 rate adjustments that also had high quality payment compliance data.

Payment compliance

Payment compliance is calculated by dividing the amount of time that metered spaces on a block are both paid and occupied by the amount of time that those metered spaces are occupied. Higher payment compliance means that more of the parking spaces that are occupied are also paid: a block where everyone who parks also pays the meter has 100% payment compliance, and a block where only half of the people who park also pay has 50% payment compliance. Higher payment compliance means that more people choose to pay the meter, which makes pricing a more effective form of parking management.

Using payment data from the new meters and occupancy data from the parking sensors, the SFMTA analyzed payment compliance in pilot areas on blocks that participated in all 10 rate adjustments. The analysis included general metered parking from Monday through Saturday from 9am to 6pm. Control areas were not included in this analysis because their legacy parking meters did not have the ability to report payment data with enough granularity to calculate payment compliance.

Payment compliance in SF*park* pilot areas increased significantly during the pilot period. Before SF*park*, compliance was 45% on weekdays and 53% on Saturdays, meaning that metered spaces were paid around half of the time that they were occupied. After SF*park*, payment compliance increased by 21% on weekdays and by 12% on Saturdays.

Analysis by pilot area showed that Civic Center, Fisherman's Wharf, and South Embarcadero saw the highest increases in payment compliance. The only pilot area to see a decrease in payment compliance was the Marina. However, this decrease was slight, and because the Marina had the highest payment compliance before SF*park*, it retained the highest payment compliance of the pilot areas even with a slight decrease. On Saturdays, Civic Center and South Embarcadero saw the highest increase in payment compliance.

Payment compliance rates by area

Pilot areas^
Weekdays, 9am to 6pm
Before vs after

	Before	After	Net change	% change
Civic Center	37%	50%	13%	35%
Downtown	32%	39%	7%	22%
Fillmore	48%	55%	7%	15%
Fisherman's Wharf	38%	54%	16%	42%
Marina	68%	66%	-2%	-4%
Mission	49%	57%	8%	16%
South Embarcadero	41%	59%	18%	45%

^ Data unavailable for control areas

Payment compliance rates: Weekdays and Saturdays

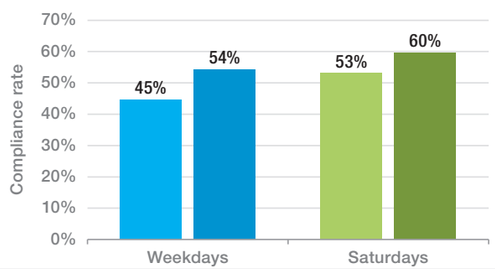
Pilot areas^
Weekdays and Saturdays, 9am to 6pm
Before vs after

	Before	After	Net Change	% change
Weekdays	45%	54%	10%	21%
Saturdays	53%	60%	6%	12%

^ Data unavailable for control areas

Payment compliance rates Weekdays and Saturdays

Pilot areas
Weekdays and Saturdays, 9am – 6pm
Before vs after



Disabled parking placards

When spaces are occupied but unpaid, those spaces typically either have a disabled placard (whereby payment is not required), the vehicle is attended, the driver has another type of permit, or the driver has chosen not to pay. Disabled placards being by far the largest source of non-payment. As summarized in chapter 2, parking pricing becomes particularly effective on blocks where compliance is at least 85%. While disabled placards reduce the effectiveness of parking pricing, there is also some scope for the SFMTA to improve the effectiveness of its enforcement to encourage more drivers without placards to pay the meter.

In general, a relatively high number of vehicles parked at metered spaces in San Francisco display a disabled placard. As one example, a 2008 SFMTA survey found that 45% of metered spaces in a downtown study area were occupied by vehicles displaying placards. Of the vehicles using placards, 57% were registered outside of San Francisco. During the test of real-time directed enforcement (described later in this chapter) in Fisherman's Wharf in 2013, at least 48% of spaces occupied but not paid were cars displaying placards. Another SFMTA survey of many neighborhoods in 2006 showed that in neighborhood commercial districts (e.g., Fillmore, Marina, etc.), about 10–20% of occupied parking spaces were cars displaying placards, with some areas between 20–40% and two areas over 50%.

Disabled placard rates, pilot vs control

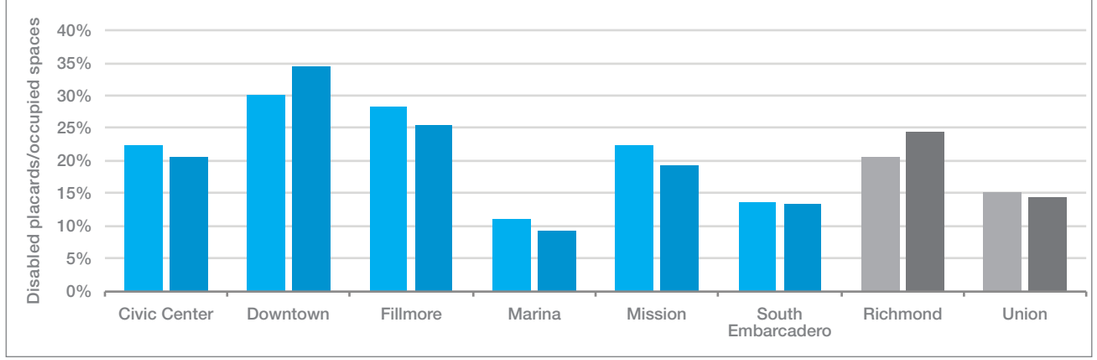
Number of disabled placards/number of occupied spaces
Pilot and control areas
Weekdays, 9am to 6pm
Before vs after

	Before	After	Net change	% change
Pilot areas	21%	20%	-1%	-4%
Control areas	18%	19%	1%	8%
Pilot vs. control areas	3%	1%	-2%	-12%

During the course of the SF*park* pilot project, the SFMTA gathered data on disabled placard usage on the same blocks year-over-year. These data show that areas with low payment compliance tend to have higher rates of disabled parking placard use. Disabled placards were observed on 76% of the blocks that were surveyed for disabled placard use that also had low payment compliance. During the SF*park* pilot period, the percent of parked vehicles displaying disabled placards stayed fairly constant, decreasing from 21% to 20% in pilot areas and increasing from 18% to 19% in control areas.

Disabled placard rates by area

Weekdays, 9am to 6pm
Before vs after



Citations

Enforcement of parking rules (and meters) is necessary for these parking management strategies to work; otherwise, drivers will soon learn that the rules can be ignored. While parking enforcement is necessary, one goal of SF*park* was to make parking so convenient and easy to pay for that drivers could easily avoid parking meter-related citations. This is part of better customer experience, helps PCOs be more efficient and focus on other issues (such as double parking), and reduces secondary costs related to subsequent citation processing and adjudication.

Enforcement was not the focus of the SF*park* pilot project, and the SFMTA did not ensure that there was a consistent level of enforcement in pilot and control areas from 2011 to 2013. Perfect consistency would have made the evaluation of enforcement data more rigorous, but levels of enforcement may have changed somewhat in these areas, and the SFMTA does not have data on the level of enforcement for particular areas over time. While enforcement levels likely remained relatively constant during this period, we cannot be certain, and this is a limitation of the analysis in this chapter.

Total citations

The number of average monthly parking citations issued on weekdays decreased by 23% in pilot areas, compared to a decrease of 12% in control areas.

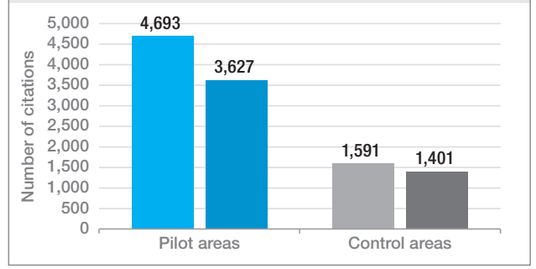
Total number of parking citations per month, pilot vs control

Pilot and control areas
Weekdays, all metered hours
Before vs after

	Before	After	Net change	% change
Pilot areas	4,693	3,627	-1066	-23%
Control areas	1,591	1,401	-190	-12%

Total number of parking citations per month, pilot vs control

Pilot and control areas
Before vs after | Weekdays, all metered hours



Citations per meter

Because the deployment of PCOs changes over time and the geographic extent of SF*park* areas varies, the average monthly citations per meter more clearly illustrates how citation issuance changed during SF*park*. Citations issued per meter per month on weekdays decreased by 23% in pilot areas, compared to a decrease of 12% in control areas. This is consistent with our expectations that longer time limits and making it easier to pay would help drivers avoid parking citations.

Monthly parking citations per meter, pilot vs control

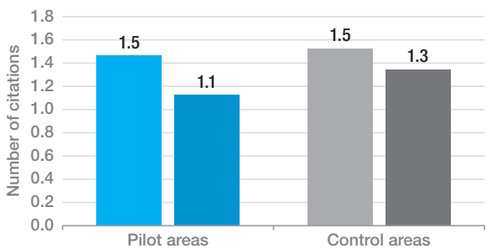
Pilot and control areas^
Weekdays, all metered hours
Before vs after

	Before	After	Net change	% change
Core pilot areas	1.5	1.1	-0.3	-23%
Control areas	1.5	1.3	-0.2	-12%
Pilot vs. control areas	-0.1	-0.2	-0.2	-11%

^ Calculated as total number of citations / total number of meters: average is for for all pilot and control areas. Not an average for each pilot or control area.

Monthly parking citations per meter, pilot vs control

Average number of parking meter citations per meter
Pilot and control areas
Before vs after | Weekdays, all metered hours



Monthly parking citations per meter by area

Pilot and control areas
Weekdays, all metered hours
Before vs after

	Before	After	Net change	% change
Civic Center	0.9	0.9	-0.1	-7%
Downtown	1.9	1.4	-0.5	-25%
Fillmore	1.0	0.8	-0.2	-22%
Fisherman's Wharf	1.2	0.8	-0.4	-35%
Marina	4.0	2.7	-1.4	-34%
Mission	1.6	1.4	-0.2	-15%
South Embarcadero	1.3	1.0	-0.3	-20%
Richmond	1.0	0.9	0.0	-4%
Union	3.0	2.5	-0.6	-19%

Directed enforcement

Access to parking sensor occupancy data and smart meter payment data provided the SFMTA with the opportunity to explore a new enforcement technique. For a limited pilot within SF*park*, some PCOs were provided with a tablet computer mounted in their vehicle that used an application the SFMTA developed called reEnforce. Where PCOs otherwise rely on instinct and experience within their predefined enforcement beat, reEnforce utilized real-time occupancy and payment data to allow PCOs to see on a map which parking meters were occupied but unpaid.

The test of reEnforce with the SFMTA Enforcement Division occurred over six months beginning in mid-November 2012 in two enforcement beats in the Fisherman's Wharf area. The goals of this project were to test how new technology can be used to help deploy PCOs more effectively, to provide PCOs with real-time data to improve their productivity, and to collect data about how on-street parking is being used.

Ultimately this pilot was too limited in its application and its integration in existing workflows to draw definitive conclusions about its effect on PCO productivity. Additionally, there was not a suitable baseline of PCO performance to use to evaluate the effect of reEnforce on PCO productivity. The evaluation of PCO productivity was also complicated by various factors including shifting enforcement priorities, seasonality, and a rotating beat deployment. However, the SFMTA did come to several qualitative conclusions after surveying enforcement personnel:

- PCOs generally reported that having more information available in the field was beneficial. While there are concerns about having too many devices, the PCOs generally felt that the ability to have real-time, targeted information was a benefit.
- The reEnforce software would greatly benefit from integration into citation processes. Future targeted enforcement applications must be fully integrated into the process of entering and printing citations. This would address PCO concerns about carrying too many devices, and it would also ensure that PCOs consistently use reEnforce and therefore create a reliable dataset.
- The reEnforce software provides potential for more representative performance metrics. Traditionally PCO performance has been tracked by citations issued, which can be a highly variable metric and may not accurately reflect the amount of work done by a PCO. The reEnforce software, which records both citations and opportunities that were dismissed, could provide a metric that more fairly represents the efforts of the PCOs.
- The reEnforce software is a useful data collection tool for staff. The underlying mapping, data collection, and data storage technology behind reEnforce could be utilized throughout the SFMTA for parking-related data collection.

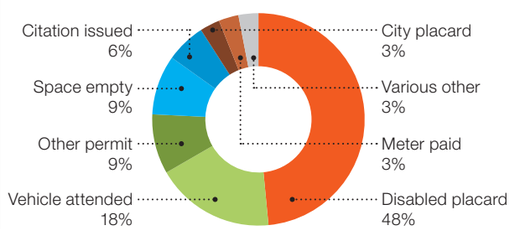
Reasons for non-payment

The test of reEnforce did provide valuable data about the sources of non-payment for the Fisherman's Wharf area. This data is summarized in the following table, which shows the disposition PCOs reported for parking spaces identified in reEnforce as occupied but unpaid.

Reason for non-payment	% of reports
Citation issued	6%
Disabled placard	48%
City placard	3%
Other permit	9%
Meter paid	3%
Space empty	9%
Space closed	1%
Broken meter	0%
Commercial vehicle	1%
Vehicle attended	18%
Vehicle already visited	0%
Other	1%

Reasons for non-payment

Fisherman's Wharf pilot area
reEnforce pilot findings



reEnforce functionality overview

Upon starting a shift, a PCO turned on the tablet and launched the application. A prompt required the user to login with their unique badge number and enforcement beat number. Once logged in, the PCO was presented with a map of their beat area and the locations of potential parking meter citation opportunities represented by a parking meter icon.

PCOs then touched the meter icon to get the Post ID of the meter where there is potential for a citation. The PCO assessed the situation and selected, from a pre-defined list, how the citation opportunity was resolved.

Upon submission, the icon indicating the citation opportunity disappeared from the map, and the PCO was free to investigate other opportunities.

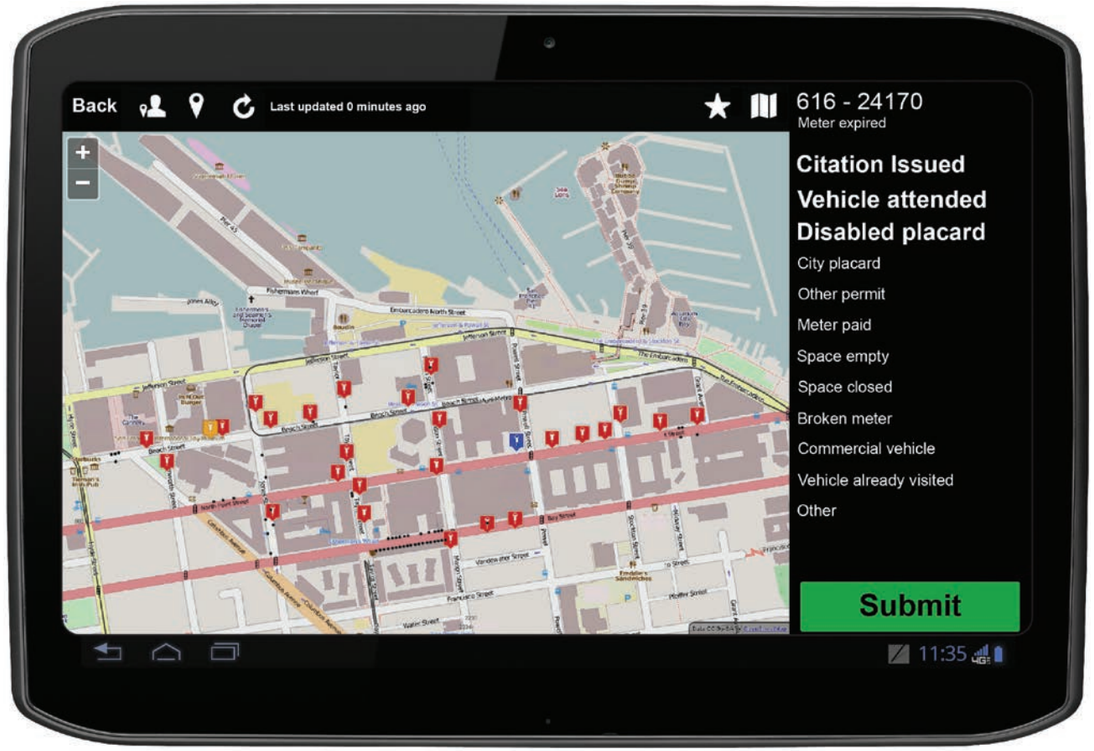
Each submission from PCOs was recorded in the SF*park* data warehouse. This new dataset allowed the SFMTA to create ad-hoc analyses in addition to a number of pre-defined reports, including:

- Percentage of citation opportunities cited
- Percentage of citation opportunities that resulted in no citation due to a permit
- PCO performance metrics to track total opportunities observed instead of citations

reEnforce software

To develop reEnforce, the SFMTA used an open source platform and software so that it could easily run on most hardware and operating systems so that other cities could easily adapt this tool for their use in the future. The SFMTA used OpenGeo as the open source geospatial foundation and developed the reEnforce software using Javascript and HTML5. The code for reEnforce can be found at SFpark.org.

Access the reEnforce HTML5 code here:
SFpark.org/how-it-works/open-data-page



5. CONGESTION AND ENVIRONMENT

Results from the SF*park* pilot project demonstrate that improving parking availability reduces parking search time, double parking, traffic congestion, and greenhouse gas emissions.

Congestion and environment

An overview of how SF*park* demand-responsive pricing affected traffic congestion and greenhouse gas emissions

This section outlines what the SFMTA learned from the impact of demand responsive pricing on parking search time, traffic congestion, double parking, and greenhouse gas emissions.

Key findings

By improving parking availability, the SF*park* pilot project successfully reduced traffic congestion and a host of other factors:

- Most drivers can now find parking within 6.5 minutes in pilot areas, which is a 43% reduction.
- Parking related vehicle miles traveled and associated greenhouse gases decreased by 30%.
- Traffic volume decreased by nearly 8% in areas with improved parking availability.
- Double parking reduced by 22% in pilot areas.

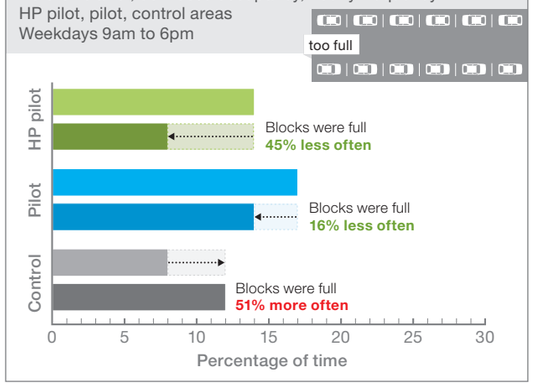
SF*park* pricing policy both increased and decreased meter rates with the goal of gradually achieving the 60–80% target occupancy rate. The secondary benefits discussed in this chapter are primarily associated with improvements to parking availability resulting from rate increases that increased parking availability.

Parking pricing and occupancy summary

During the first ten SF*park* rate adjustments, the SFMTA decreased average weekday rates on 42% of SF*park* blocks and increased rates on 47% of them. Parking availability improved throughout pilot areas, with some concentrations along particular corridors such as Lombard street in the Marina, along the northern stretch of Fillmore street in the Fillmore pilot area, and along Hayes street in the Civic Center pilot area.

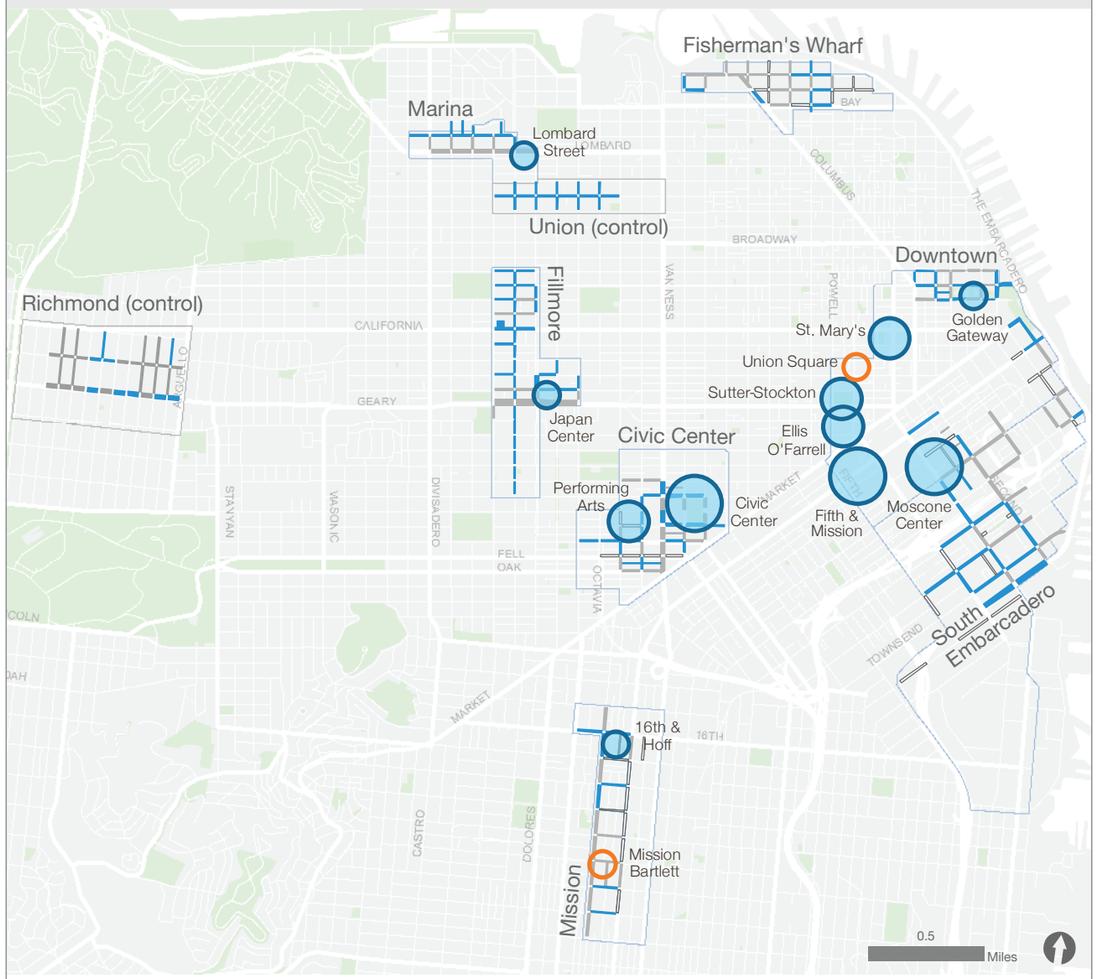
How often are blocks too full?

Before vs after, 90–100% occupancy, hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm



On-street parking availability and off-street usage, before vs after

Changes in on-street parking availabiltiy and off-street usage. On-street parking availability improved where frequency of 90–100% hourly occupancy rates decreased. Off-street usage measured as net change in number of hourly parkers per day.



On-street availability for weekdays 9am to 6pm. Off-street usage for all days, all times of day.

SF*park* pricing policy successfully improved parking availability throughout pilot areas. Data suggest that improvements to parking availability also led to secondary benefits: reduced parking search time, vehicle miles traveled, greenhouse gas emissions, double parking, and traffic volume.

Parking search time

As in every city, some portion of San Francisco's traffic congestion is due to drivers who have arrived at their destination and are simply searching for parking. The SF*park* pilot project aimed to reduce this portion of traffic. By improving parking availability, the SF*park* pilot project reduced parking search time and distance in pilot areas and therefore the amount of traffic that is searching for parking.

Results from two distinct surveys indicate that the SF*park* pilot project reduced parking search time by up to 43%, compared to control areas where parking search time did not show a significant change. These surveys include an intercept survey and a manual parking search time survey.

Intercept survey respondents in pilot areas reported a drop in parking search time from 11.5 to 6.5 minutes—a 43% decrease.

Change in reported parking search time

Parking search time (minutes)

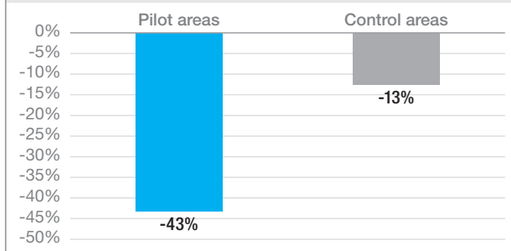
Reported parking search time, intercept survey responses
Weekdays, 9am to 6pm
Pilot and control areas
Before vs after

"How long did you look for parking once you got to the area?"

	Before	After	Net change	% change
Pilot areas	11.6	6.6	(5.0)	-43%
Control areas	6.4	5.6	(0.8)	-13%
Pilot vs. control areas	5.2	1.0	(4.2)	-31%

Reduction in reported parking search time

Percent change, before to after
Weekdays, 9am to 6pm
SF*park* pilot and control areas
Before vs after



Results from the manual parking search survey show that most of the time, drivers could find a space in just over 9 minutes prior to SF*park*.[1] After SF*park*, this dropped to 6.5 minutes. Neither survey shows a statistically significant change in parking search time in control areas.

During metered hours on a typical weekday, the longest parking search times occur during the lunch hour rush and in the late afternoon. For example, in the Marina area, drivers had to pass over 20 blocks most of the time[2] before finding a space during the late afternoon peak period. This dropped to 3.5 blocks after SF*park*.

The SF*park* pilot demonstrates how getting the price right can improve parking availability and parking search time, with some dramatic results during peak periods in neighborhoods like the Marina.

1 *"Most of the time" is defined as 98th percentile of parking search time survey runs*
2 *90th percentile*

Traffic congestion and greenhouse gas emissions

Results from two distinct analyses suggest that the SF*park* pilot also reduced traffic congestion and greenhouse gas emissions generated by drivers circling for parking.

Vehicle miles traveled and greenhouse gas emissions

Because drivers circle for parking at very low speeds with stop-and-go behavior, they slow traffic and emit more greenhouse gas emissions per mile. Improving parking availability reduces emissions from drivers searching for parking, and it also improves the flow of traffic to reduce emissions from through-traffic that would otherwise be forced into stop-and-go driving patterns. The SF*park* pilot project reduced vehicle miles traveled and associated greenhouse gases in pilot areas by 30%, compared to a 6% decrease in control areas.[3] On a per meter basis, daily vehicle miles traveled decreased by 3.7 miles to 2.6 miles per meter in pilot areas, compared to a decrease from 2.8 miles to 2.6 miles in control areas.

Daily vehicle miles traveled (VMT)

VMT generated by circling for metered parking
Weekdays 9am to 6pm
SF*park* pilot and control areas, 2011 to 2013

	Before	After	Net change	% change
Pilot areas	8,134	5,721	(2,413)	-30%
Control areas	3,110	2,933	(177)	-6%
Pilot vs control areas	5,024	2,788	(2,236)	-24%

Daily greenhouse gas emissions (metric tons of CO2)

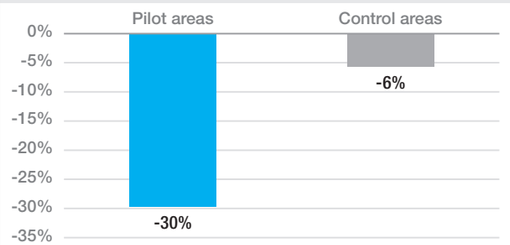
CO2 generated by circling for parking
Weekdays 9am to 6pm
SF*park* pilot and control areas, 2011 to 2013

	Before	After	Change	Change
Pilot areas	7.0	4.9	(2.1)	-30%
Control areas	2.7	2.5	(0.2)	-6%
Pilot vs. control areas	4.3	2.4	(1.9)	-24%

3 *Calculated using meter payment transaction data, meter payment compliance data, manual and intercept parking search survey data and the CA Air Resources Board EMFAC 2011 emissions rates for San Francisco County.*

Reduction in VMT and GHG: Percent change, before to after

Weekdays, 9am to 6pm
SF*park* pilot and control areas
Before vs after



Daily VMT per meter

Weekdays, 9am to 6pm
SF*park* pilot and control areas
Before vs after

Without demand responsive pricing, the SFMTA estimates that approximately 100,000 miles of driving is associated with the city's 27,000 metered parking spaces every weekday, resulting in over 85 tons of greenhouse gases every day. If every metered block in the city successfully met parking availability goals, drivers would find parking on the first block where they looked, dramatically reducing this source of greenhouse gas emissions.

However, metered parking accounts for only 10% of all on-street parking in San Francisco. Traffic congestion and greenhouse gas emissions due to drivers circling for non-metered parking is beyond the reach of demand-responsive pricing. While getting the price right can optimize benefits from metered parking, the act of metering parking at all—regardless of price—has a more

powerful impact. For example, the 2013 implementation of Sunday metering in San Francisco resulted in a 61% drop in average parking search times across the city and a 57% decrease in vehicle miles traveled and associated greenhouse gas emissions.

Traffic volume and speed

Traffic counts from roadway sensors also reveal that areas with improved parking availability show a decrease in traffic volume,[4] even as economic activity and parking demand increased throughout SF*park* pilot and control areas.

Areas with improvements to parking availability show a 7.7% decrease in traffic volume, while areas where parking availability didn't improve or worsened show a 4.5% increase in traffic volume. Similarly, traffic speed declined more significantly in areas where parking availability did not improve or where it worsened—a decrease of 6.3%, compared to a 4.3% decrease in areas with improved parking availability.[5]

In the context of increasing parking tax and sales tax revenues in pilot areas, the decrease in traffic volume is not likely a result of a decrease in economic activity or parking demand. In fact, parking demand and economic activity has increased more in pilot areas than in control areas and the rest of the city.

Hourly traffic volume vs parking availability

Weekdays, 9am to 6pm
Traffic volume in areas with improved vs worsened parking availability[5]
Includes both pilot and control areas
Before vs after

	Before	After	Net change	% change
Areas w/improved availability	377	348	(29)	-7.7%
Areas w/worsened availability	288	301	13	4.5%

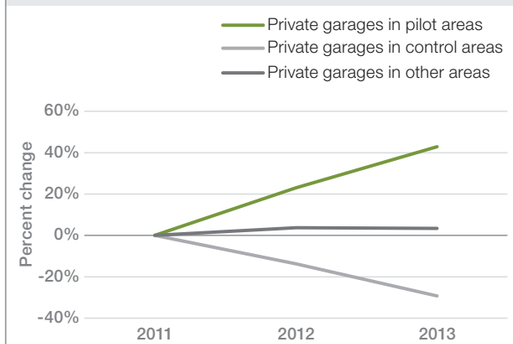
Traffic speed vs parking availability

Weekdays, 9am to 6pm
Traffic volume in areas with improved vs. worsened parking availability[5]
Includes both pilot and control areas
Before vs after

	Before	After	Net change	% change
Areas w/improved availability	19.9	19.1	(0.9)	-4.3%
Areas w/worsened availability	20.9	19.6	(1.3)	-6.3%

Non-SFMTA garages and lots: parking tax revenue

Annual percent change
FY2011 to FY2013



*4 To measure traffic congestion impacts of SF*park*, the SFMTA installed roadway sensors at dozens of locations throughout SF*park *pilot and control areas.*

5 Improved parking availability areas are defined as blocks within a 4 block radius of roadway sensors with an average decrease in the percent of time occupancy exceeded 90%. A 4 block radius area that had an average increase in the percent of time occupancy exceeded 90% is considered to be an area with "worsened availability."

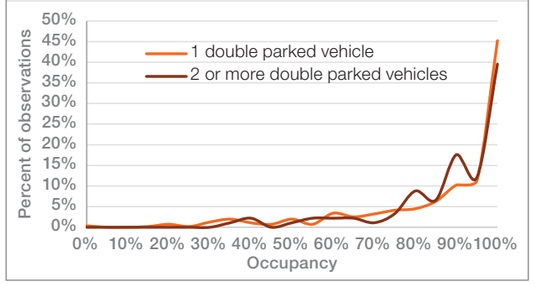
Double parking

Double parking contributes to traffic congestion and transit performance issues by creating unpredictable blockages of lanes of traffic. Besides impeding the flow of traffic and transit, double parking likely degrades safety for cyclists and motorists that are forced to change lanes to negotiate around a double parked vehicle.

Over 10,000 observations collected through field surveys show that as parking occupancy rates increase, so does the incidence of double parking. When occupancy hits 80%—or when 8 out of 10 spaces are full—incidents of double parking begin to spike.

Double parking vs occupancy rates

Frequency of double parked vehicles by occupancy rate
All pilot and control areas, 2010-2013
8am to midnight | Weekdays



Through improvements to parking availability, the SF*park* pilot reduced double parking in pilot areas. Overall, double parking decreased by 22% in pilot areas, from an average of 1 double parked car per block to 0.8 per block per day.

Double parked vehicles per block, per day

Weekdays, 9am to 6pm
Pilot and control areas
Before vs after

	Before	After	Change	Change
Pilot areas	1.0	0.8	(0.23)	-22.2%
Control areas	1.4	1.3	(0.06)	-4.6%
Pilot vs. control areas	(0.4)	(0.5)	(0.16)	-17.6%

Double parked vehicles, net change

Net change in the number of double parked vehicles per day per blockface, spring 2011 to spring 2013
Weekdays, 9am to 6pm | Before vs after

Decrease of 2 or more double parked vehicles per day

Decrease of 1 to 2

Decrease of 0 to 1

Increase of 0 to 1

Increase of 1 to 2

Increase of 2 or more

No change in double parking

6. TRANSIT PERFORMANCE

Congestion and double parking are two factors that reduce transit speed and reliability. SF*park* reduced circling and double parking by improving parking availability, which helped specific Muni routes.

Transit performance

Better parking management supports better transit performance

This chapter summarizes how SF*park* influenced Muni bus speed and reliability during the pilot period.

Trends in overall Muni speed and reliability

Between 2011 and 2013, the overall speed and reliability of Muni has not changed. Average speed for the system has remained at 9 mph and reliability (as measured by on-time performance) went from 59% to 60%.

To evaluate how SF*park* influenced transit performance, the SFMTA analyzed Muni speed and reliability (as measured by variability in speeds) along segments of key routes in SF*park* pilot and control areas. While congestion and double parking are two factors that influence Muni's speed and reliability, there is a wealth of other factors, including:

- Aging fleet and infrastructure
- Dwell times at stops
- Closely spaced transit stops
- Traffic congestion
- Growing competition for street space
- Friction between parking and loading vehicles
- Operator availability
- Increasing ridership

These factors are nuanced, complex, and difficult to isolate in an evaluation. This level of complexity presents many confounding factors, which make it difficult for this analysis to detect and/or confidently conclude how SF*park* affected overall transit system performance.

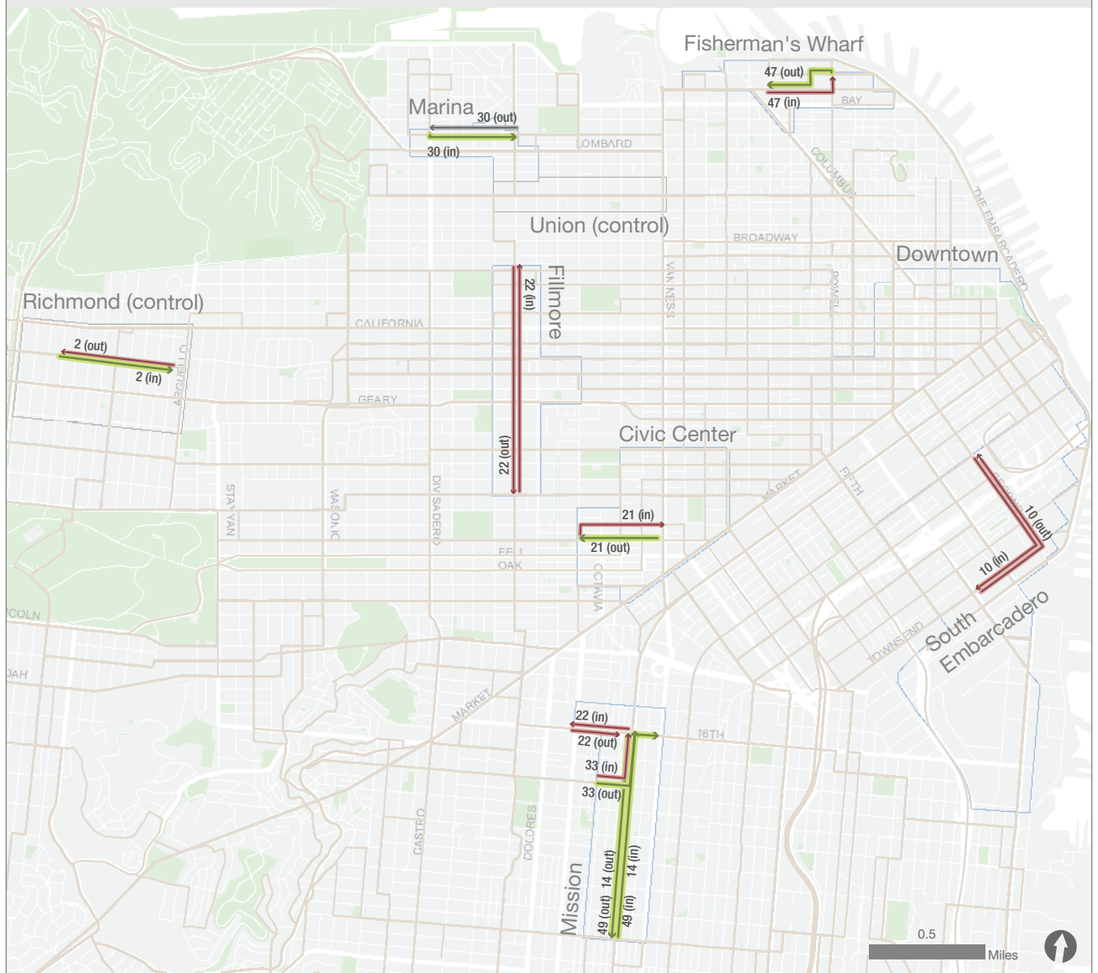
Tempered by those challenges in evaluating SF*park*'s influence on transit performance, after extensive analysis, the SFMTA found that SF*park* supported the goal of improving Muni speed and reliability in SF*park* areas. By improving parking availability, particularly during peak times when transit performance is most challenged and transit carries the most people, the SF*park* pilot project reduced congestion and double parking.

How improving parking availability can improve transit performance

SF*park* pricing policy was shown to have successfully improved parking availability, reduced congestion, and reduced double parking on most blocks in pilot areas. To assess the effect of reduced congestion and reduced double parking on Muni, the SFMTA examined transit segments where both parking availability increased and double parking decreased over the SF*park* pilot period. While these conditions were not necessarily met on all of the transit segments examined for the evaluation, they were met on Chestnut Street in the Marina and Hayes Street in Civic Center.

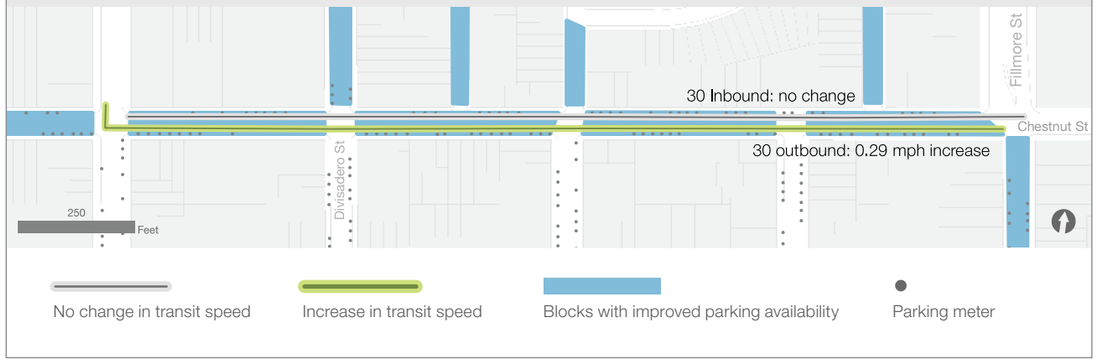
Transit speed

Net change in transit speed along transit segments in pilot and control areas. Excludes dwell time.
Weekdays 9am to 6pm | Before vs after



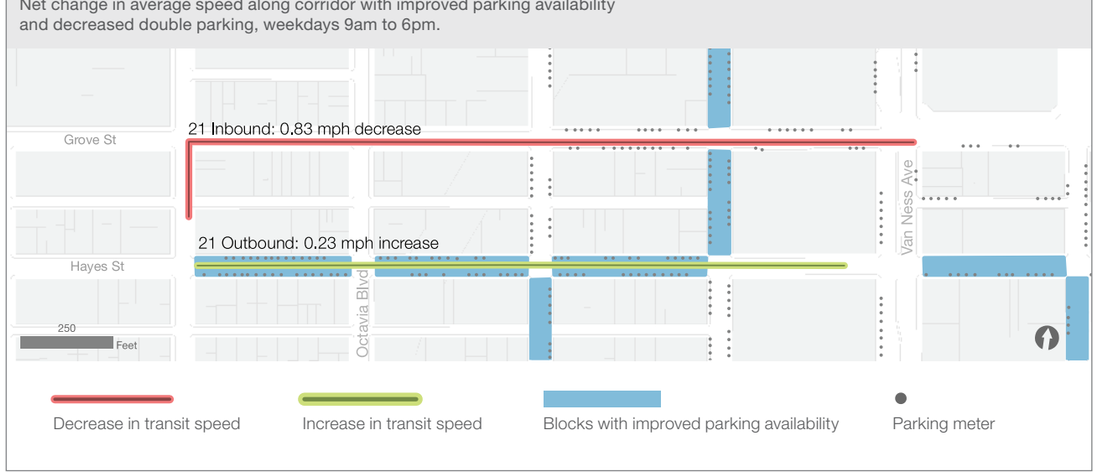
Transit speed case studies: 30-Stockton, Marina pilot area

Net change in average speed along corridor with improved parking availability and decreased double parking, weekdays 9am to 6pm.



Transit speed case studies: 21-Hayes, Civic Center pilot area

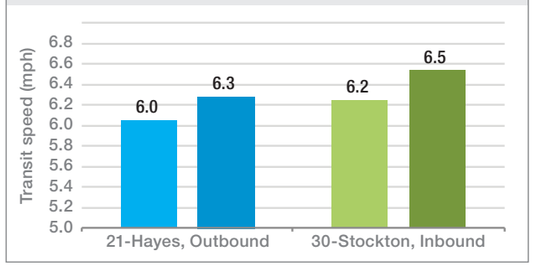
Net change in average speed along corridor with improved parking availability and decreased double parking, weekdays 9am to 6pm.



Specifically, speeds on the 30-Stockton (running inbound along Chestnut Street) increased by 5% and speed on the 21-Hayes (running outbound along Hayes Street) increased by 4%.

Transit speed case studies: 21-Hayes and 30-Stockton

21-Hayes, outbound (Civic Center) and 30-Stockton, inbound (Marina)
Weekdays, 9am to 6pm | Before vs after



Transit speed case studies: 21-Hayes and 30-Stockton

21-Hayes, outbound (Civic Center) and 30-Stockton, inbound (Marina)
Weekdays, 9am to 6pm | Before vs after

	Before	After	Net change	% change
21-Hayes, outbound	6.0	6.3	0.2	3.9%
30-Stockton, inbound	6.2	6.5	0.3	4.6%

Isolating the effect of double parking

Additionally, the SFMTA also found that reducing double parking can lead to improvements in transit speeds, regardless of trends in parking availability. The SFMTA compared changes in transit speeds to changes in double parking for all corridors where data was available. Results show that Muni speed increased from 6.4 to 6.6 mph along corridors with reduced double parking while transit slowed from 7.1 to 6.7 mph along corridors with increased double parking.

Transit speed and double parking

Transit speed on corridors with increased vs. decreased double parking (DP)
Weekdays, 9am to 6pm
Before vs after

	Before	After	Net change	% change
Corridors w/decrease in DP	6.4	6.6	0.2	2.3%
Corridors w/increase in DP	7.1	6.7	(0.4)	-5.3%

These findings are supported by a separate analysis conducted by SFMTA staff in 2012 that focused exclusively on Mission Street. That analysis found that double parking on Mission Street reduces transit speeds by 3 to 5%.[1]

These analyses suggest that reducing double parking—whether through improving parking availability, targeted enforcement, or other means—is one effective way to improve transit speeds.

1 *Carnarius, K.E. 2012. Double-Parked Commercial Vehicles and Bus Speeds in the Mission District of San Francisco. Master's Thesis. University of California, Berkeley.*

7.

CUSTOMER EXPERIENCE

SF*park* made it easier to quickly find a parking space and pay for parking.

Customer experience

How did SF*park* change the experience of finding and paying for parking?

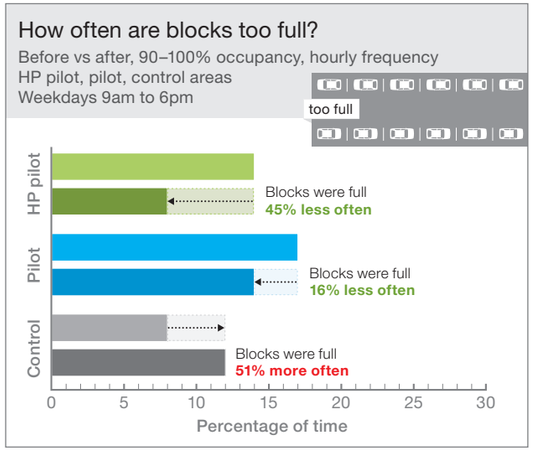
This section outlines how SF*park* improved the experience of parking in San Francisco by making parking more convenient. In particular, SF*park* made it easier both to quickly find a parking space closer to your destination and then to pay for parking.

Finding parking

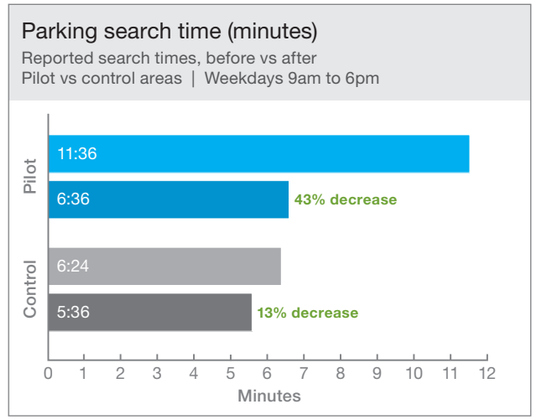
SF*park* made it easier to find parking

One of the challenges of parking in San Francisco is that the time it takes to find parking varies greatly, and drivers need to budget extra time to find a parking space because it can be so unpredictable. By making it easier to find parking by reducing the amount of time that blocks are too full, the SF*park* pilot project decreased the amount of time drivers need to budget to find a parking space.

When blocks are too full, drivers have a hard time finding a parking space. The SF*park* pilot projects reduced the amount of time that blocks are too full (or were higher than 90% occupied) on weekdays by 16% in pilot areas, compared to a 50% increase in control areas. On blocks in pilot areas where people paid the meter most of the time, the amount of time that blocks were too full decreased by 45%.



One measure of parking search time is variability, or the amount of time that a person needs to budget to find a parking space most of the time. In SF*park* areas, the amount of time needed to find a parking space most[1] of the time decreased by 41% from a search time of 9.2 minutes to 6.6 minutes. Qualitative surveys of drivers show the same trend, with drivers in pilot areas reporting that it took about 11 and a half minutes to find parking before SF*park* and 6 and a half minutes after SF*park*.

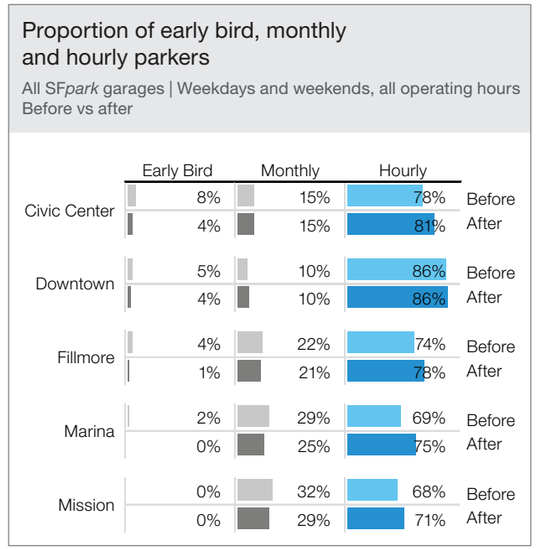


SF*park* made it easier for visitors and shoppers to find parking in garages

Drivers who chose to go straight to a garage spend less time looking for parking than drivers who chose to park on the street. One of the goals of SF*park* was to make parking in SFMTA-administered parking garages more attractive so that more and more drivers, particularly for short-term trips, would choose to park in a garage rather than searching for on-street parking.

Parking garages have two groups of customers: short-term parkers and commuters. Short-term, hourly parkers typically visit the neighborhood in order to shop or eat at nearby businesses. Drivers that park all day, usually via "early bird" or monthly parking passes, are typically commuters that arrive in the morning, work all day, and leave in the afternoon or evening. While they may shop or eat at nearby establishments over lunch, commuters use garages to store their vehicles for nine or more hours each day.

SF*park* took many steps to improve the customer experience at garages to attract more short-term parkers, including improved pricing, real-time information, static wayfinding signs, and improvements in garage cleanliness, painting, and lighting. As a result, over the course of the pilot project, the total number of short-term parkers at SF*park* garages went up by 11%, or about an additional 130,000 short-term parkers per year. At the same time, early-bird and monthly usage declined at SF*park* garages.



1 *98th percentile*

Paying for parking

The SF*park* project made it easier and more convenient to pay for parking

SF*park* also improved the experience and convenience of parking by making it much easier to pay for parking. PayByPhone options were introduced citywide during the SF*park* pilot project, while meters that accept credit card payment were introduced in SF*park* pilot areas in early 2011.

After SF*park*, customers reported an increase in ease of paying for parking in both pilot and control areas. However, the customer satisfaction in pilot areas increased twice as much as in control areas. Before SF*park*, less than half of survey respondents stated that it was somewhat or very easy to pay for parking. After SF*park*, this jumped up to 82%. In a separate survey of 72 customers where SF*park* meters were first installed (in Hayes Valley), 96% of customers responded that they preferred to pay with credit and debit cards at parking meters.

Trends in meter revenue confirm that people favor credit card payments over all other payment types. For example, in the Fisherman's Wharf pilot area, once smart meters were installed, credit card payments quickly surpassed coin and parking card payments. PayByPhone surpassed parking cards within the first year of use.

In other words, the SF*park* pilot project improved the customer experience of paying for parking citywide, and it had a greater impact in pilot areas.

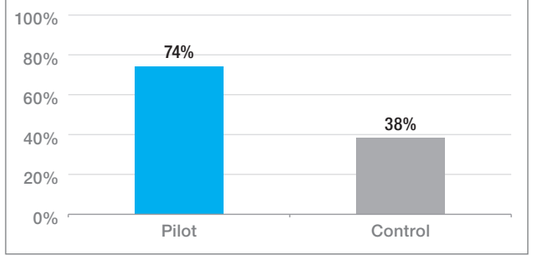
Ease of payment

Percent of respondents who stated it was "somewhat or very easy to pay for parking"
Pilot and control areas
Before vs after

	Before	After	Net change	% change
Pilot areas	47%	82%	35%	74%
Control areas	59%	82%	23%	38%
Pilot vs control areas	-12%	0	12%	36%

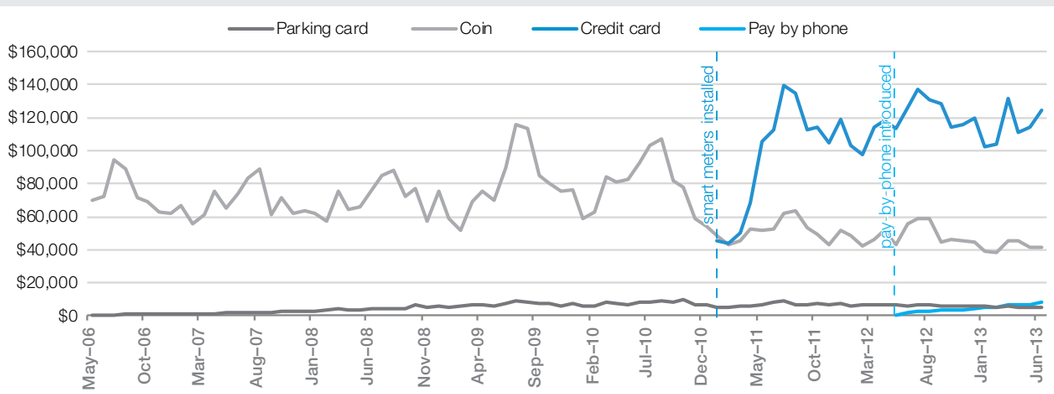
Ease of payment: percent increase

Respondents who stated "somewhat or very easy to pay for parking"
Pilot and control areas
Before vs after



Meter revenue by payment type

Fisherman's Wharf case study, May 2006 to June 2013



Accessing parking information

The SF*park* project provided real-time parking availability information

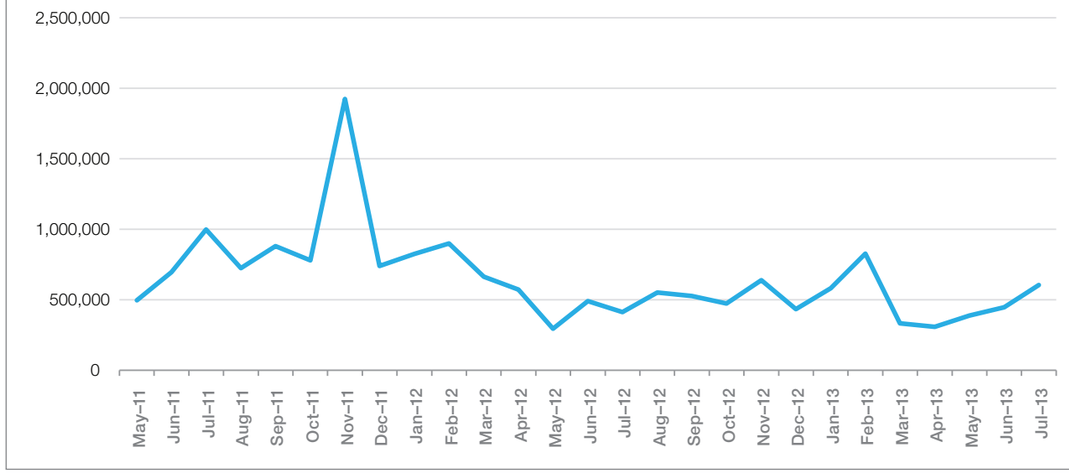
During the SF*park* pilot, drivers looking for parking could pull up real-time availability as well as price information via the SF*park* smartphone app and the SF*park* website. A number of third party apps also utilized the SF*park* availability feed.

Total requests made to the availability feed were highest when it was first rolled out in summer of 2011, often reaching close to a million hits per month. The monthly hits in 2012 and 2013 hovered around 500,000 per month.

A spike in November 2011 may have been due to a number of factors, including the release of the smartphone app source code to developers and heightened media coverage (The Atlantic and Chicago Tribune both featured articles on SF*park* that month).

Total requests to SF*park* data feed (API)

Including website and app hits
May 2011 through July 2013



8. ECONOMIC VITALITY

By providing a minimum level of parking availability and improving the experience of parking in San Francisco, the SFMTA sought to support the economic vitality and competitiveness of our commercial areas.

Economic vitality

Supporting local businesses by making it easier to park in commercial neighborhoods

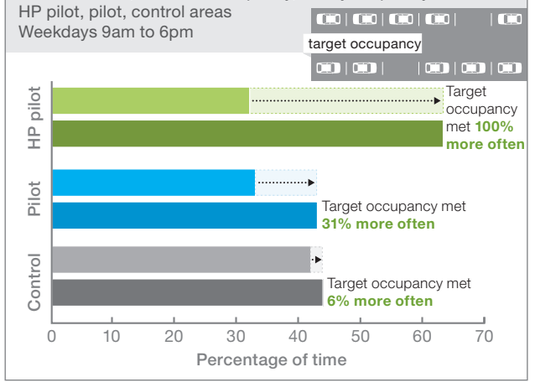
This chapter summarizes how SF*park* may have supported the economic vitality of commercial areas.

Improving access to neighborhood commercial districts

Demand-responsive rate adjustments in SF*park* pilot project increased parking availability and, where prices were lowered, improved utilization of blocks that previously were overpriced and empty. While available data does not allow us to confirm a causal relationship, the SFMTA assumes that improving parking availability improves customer access to commercial districts and therefore supports economic vitality.

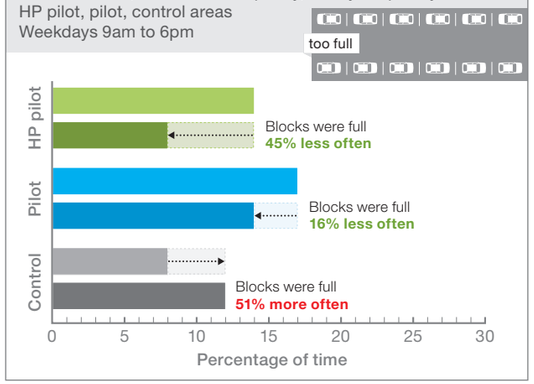
How often do blocks meet target occupancy?

Before vs after, 60–80% occupancy, hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm



How often are blocks too full?

Before vs after, 90–100% occupancy, hourly frequency
HP pilot, pilot, control areas
Weekdays 9am to 6pm



Even as the economy, population, and overall parking demand grew, parking availability improved dramatically in SF*park* pilot areas. The amount of time that the target parking occupancy rate of 60 to 80% was achieved increased by 31% in pilot areas, compared to a 6% increase in control areas. On blocks where people paid the meter most of the time (in high payment compliance or HP pilot areas), achievement of the target occupancy rate nearly doubled. Overall, parking spaces were better utilized in SF*park* pilot areas, which improved the potential for more customers to visit area businesses.

More importantly, the amount of time that blocks were too full to find parking decreased 16% in pilot areas while increasing 51% in control areas. In other words, SF*park* made it easier for drivers to quickly find parking spaces. In areas where people pay at the meter most of the time, the impacts were even more notable, with a 45% decrease.

Attracting visitors to neighborhood commercial districts

To evaluate how SF*park* influenced the number of visitors to an area, the SFMTA administered an intercept survey in the Downtown and Marina pilot areas and in control areas.

Overall, the percentage of people visiting pilot or control areas to shop, dine, or be entertained did not change over the course of the pilot project compared to respondents who visited the area for other purposes such as work or school.

Respondents visiting area for shopping, dining, entertainment

All travel modes, share (%) of respondents
Pilot and control areas | Weekdays and Saturdays, 9am to 6pm
Before vs after

	Before	After	Net Change	% Change
Pilot areas	40	40	0	1%*
Control areas	52	53	1	2%*

*indicates statistical insignificance

However, of people who drove, there was a 30% increase in pilot areas in people who visited for shopping or dining compared to people who drove for other reasons such as work or school. In other words, more of the people who chose to drive to pilot areas after SF*park* were visiting to shop, eat, or for entertainment. Control areas showed no change.

Drivers visiting area for shopping, dining, entertainment

Drivers and passengers only, share (%) of drivers
Pilot and control areas | Weekdays and Saturdays, 9am to 6pm
Before vs after

	Before	After	Net Change	% Change
Pilot areas	45	58	13	30%
Control areas	53	58	5	9%*

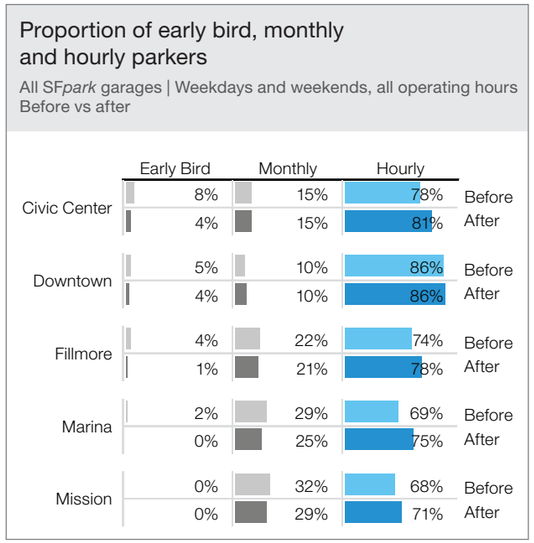
*indicates statistical insignificance

This trend suggests that SF*park* made it more attractive for drivers to shop, dine, and participate in other entertainment activities.

Similarly, garages in the SF*park* program saw a consistent redistribution of their customers from daily/monthly parkers to hourly parkers. In pilot areas, there was a 3% increase in hourly parkers; more than 130,000 more hourly parkers used SF*park* garages in April–May of 2013 than in the same time period in 2011.

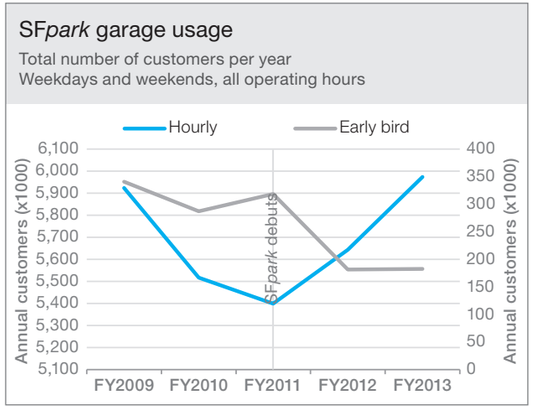
Proportion of early bird, monthly, and hourly parkers in SFMTA-administered garages

The impact of SF*park* is clearer when examining hourly and early bird usage separately. In FY2013, hourly usage increased by approximately 575,000 customers over FY2011 to exceed FY2009 levels. Early bird usage since the debut of SF*park* has declined about 43% from FY2011 levels.



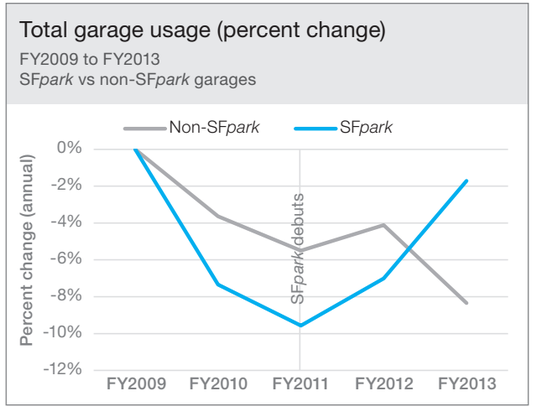
Hourly vs early bird usage in SFMTA-administered garages in SF*park* pilot areas

The increases in usage at garages in SF*park* pilot areas do not appear to be the result of overall changes in parking demand. SF*park* garages added customers in FY2012 and FY2013, reaching near FY2009 levels. Garages outside SF*park* areas, however, saw usage declined 4.4% from FY2012 to FY2013, and usage in FY2013 was 8% lower than in FY2009.



Percent change in hourly and early bird usage in SFMTA-administered garages in SF*park* pilot areas and outside of SF*park* pilot areas

The continuing usage increases in SF*park* garages in FY2013, while non-SF*park* garages declined, indicates that SF*park*'s rates, signage, and outreach may have attracted more customers (and more repeat customers) to the SF*park* garages.



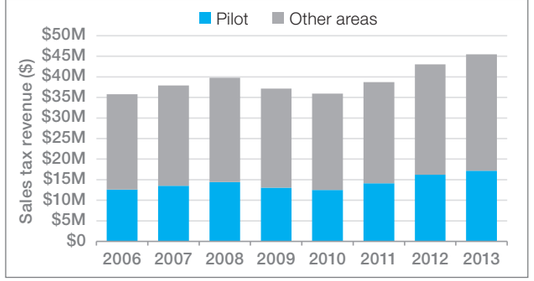
Visitor spending in neighborhood commercial districts

San Francisco collects sales tax from retail and dining purchases. An increase in sales tax collections would indicate more sales, which is an important measure of improved economic vitality.

During the SF*park* pilot project, pilot area sales tax revenue rose by 22% compared to a 15% increase in all other areas, which indicates a greater increase in visitor spending in pilot areas compared to the rest of the city. This is in keeping with historical trends; during the City's last two year period of growth (2006–2008), pilot area sales tax increased by 15% compared to a 9% increase for all other areas. In other words, pilot areas historically perform better than other areas in the city when it comes to economic growth and retail activity. As such, it is not possible to conclusively estimate the role of SF*park* in the increase of sales tax revenue in pilot areas.[1]

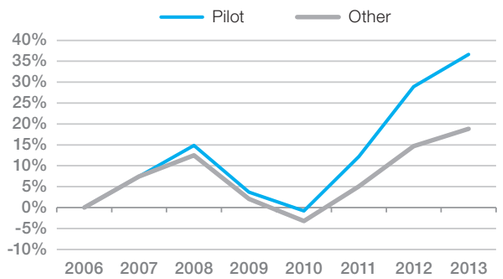
Sales tax revenue

Food product, general retail, misc sales tax receipts
SF*park* pilot and all other areas
2006 to 2013



Change in sales tax revenue, FY2006–2013

Food product, general retail and miscellaneous;
chain stores excluded



1 Sales tax data provided by the San Francisco Controller's Office. Excludes all chain store sales tax revenue which cannot be accurately disaggregated to pilot areas due to the manner in which the data is reported. Chain store sales tax revenue is a considerable portion of overall sales tax revenue and it is not possible to determine how it may have affected results of this analysis.

9. FINANCIAL ANALYSIS

A significant portion of the SFMTA's operating budget comes from parking-related revenue sources. While the purpose of the SF*park* pilot projects was to help achieve the SFMTA's goals for parking and transportation, the SFMTA also carefully monitored how SF*park* affected SFMTA's net parking revenue.

Financial analysis

The financial impact of the SF*park* pilot projects

This chapter surveys how SF*park* affected the SFMTA's net parking-related revenues. This analysis considers how revenue changed from meters, citations, garages, parking tax, and city employee parking.

Key findings and context

Revenues from parking and parking-related citations and fines make up approximately one-third of the SFMTA's annual operating budget (which is distinct from its capital budget). While parking is a critical source of funding for the SFMTA to subsidize operations of the local transit system, increasing net parking-related revenues was not an explicit goal of SF*park*. Instead, the SFMTA undertook the SF*park* pilot project with an empirical approach: test SF*park* as a means to achieve goals for parking and transportation while closely monitoring how it affected parking revenues.

SF*park* did have one explicit goal related to both revenue and customer experience: to shift the proportion of on-street parking revenue so that a greater portion is from meter payment and a smaller portion is from citations. The new meters, which introduced additional payment options, provided a better customer experience by making it easier to pay and therefore easier to avoid parking citations. Making it easier for more people to pay also enables pricing to be a more effective parking management tool.

SF*park* appears to have, in total, increased SFMTA net parking revenues by approximately $1.9M per year. In comparing the pilot areas to citywide trends, the installation of credit card enabled parking meters and longer time limits in SF*park* areas appears to have increased net annual revenues from meters by approximately $3.3M from FY2011 to FY2013. In the same period, annual citation revenues appear to have decreased by approximately $0.5M in SF*park* pilot areas (a decrease 10% greater than the citywide trend of declining citation issuance). SF*park* appears to have slightly slowed the growth of revenue for garages, accounting for about $0.9M in annual revenue that may have been earned had SF*park* garage revenue grown at the same pace as non-SF*park* garage revenue, though revenue from SF*park* garages increased at a faster rate since FY2012. Annual parking tax collected in pilot areas increased by nearly $6.5M, or 43%, during the same period, compared to a 3% increase in the rest of the city, but it is unclear what portion of that is attributable to SF*park*.

Meter payment revenue

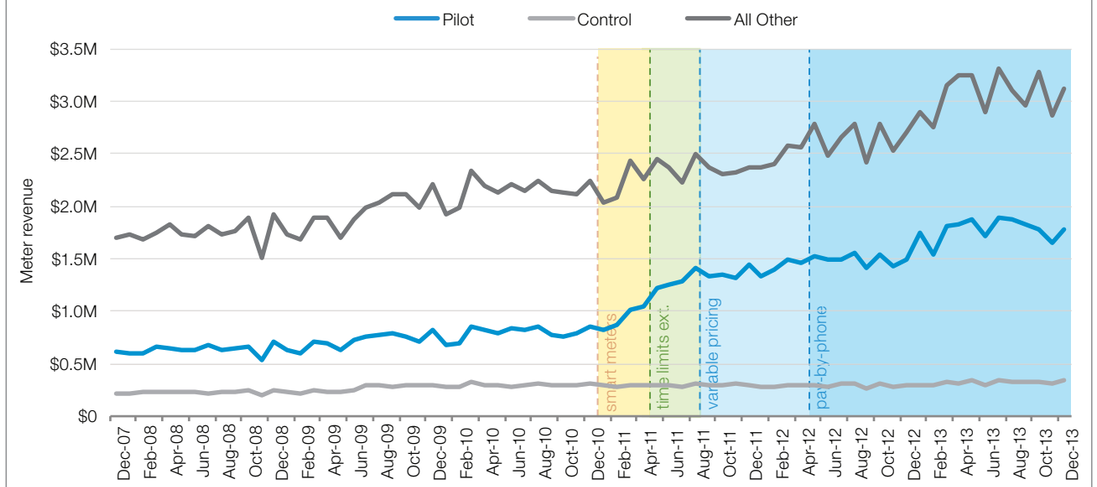
SF*park* affected meter revenue in three principal ways:

- Expanding payment options at meters by adding credit card and PayByPhone functionality. This made it easier for people to choose to pay for parking, which increased revenues.
- Extended meter time limits from one or two hours to four hours or, in some cases, no time limit at all. This increased revenues by allowing people to buy more time at the meter. Drivers appear to value being able to buy extra time at the meter to reduce the anxiety about when they might return to their car, even when they do not stay much longer.
- Adjusting rates based on demand. Demand-responsive rate changes had an unclear effect on revenues. Overall average hourly rates decreased during SF*park*, but SF*park* charged higher rates at higher demand times when more spaces were occupied, balancing any overall revenue impacts of demand-responsive pricing.

During the SF*park* pilot period, the SFMTA made other changes that also affected parking revenues. These changes, which were not affected by SF*park* and are not part of this analysis, include:

- Enforcement staffing levels and priorities.
- Adding or removing meters.
- Operating meters on Sundays.

Total meter payment revenue by month
Pilot, control, and all other areas
Monday – Saturday, all operating hours^
December 2007 – December 2013



^ Sundays removed from SF*park* before/after comparison due to impact of new Sunday metering in early 2013

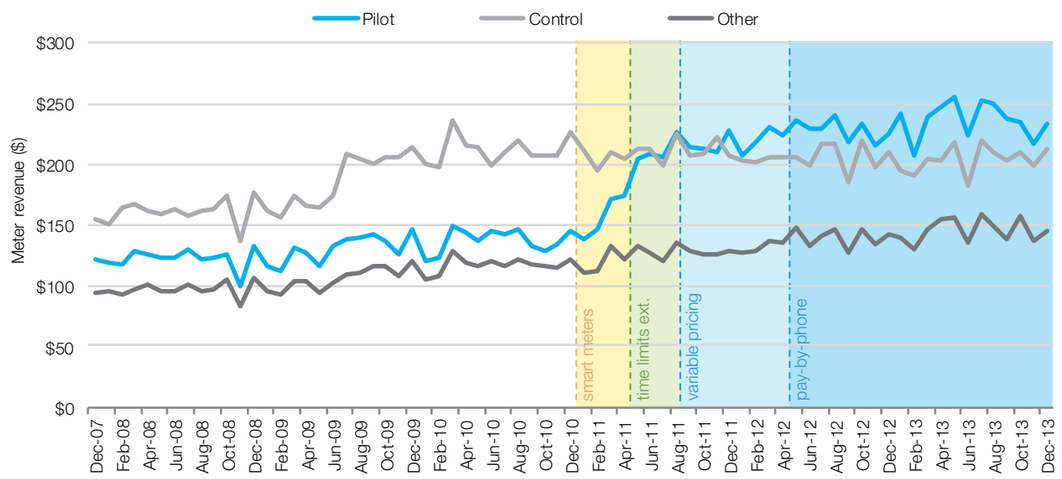
Viewing revenue on a monthly per-meter basis shows changes in meter revenue without the distorting effects of additional meters, changed meter operating schedules, Sunday metering, or other factors that affected revenue but were not part of SF*park*, outlined later in this chapter. The following chart compares average revenue per meter in the following areas:

- SF*park* pilot areas
- SF*park* control areas
- All other areas of the city

Additionally, on 24th street in Noe Valley, coin-only meters were replaced with SF*park* meters (i.e., that accept credit cards) in January 2011 with no changes to time limits or rates, which are two hours and $2.00/hr.

Average meter payment revenue by month, per meter

Pilot, control and other areas
Monday – Saturday, all operating hours^
December 2007 – December 2013



^ Sundays removed from SF*park* before/after comparison due to impact of new Sunday metering in early 2013

Average revenue per meter

Pilot areas, control areas and other areas
Monday – Saturday, all operating hours^
Before vs after SF*park*

	Before	After	Net change	% change
Pilot areas	$196	$242	$46	24%
Control areas	$211	$201	- $9	- 4%
Other areas	$128	$149	$21	17%

^ Sundays removed from SF*park* before/after comparison due to impact of new Sunday metering in early 2013

Comparing revenue for Spring 2011 to Spring 2013, average revenue per meter:

- Increased by 17% in all other areas of the city[1]
- Increased by 24% in pilot areas
- Decreased by -4% in control areas[2]

To examine the effects of these changes individually, total meter revenue was compared before and after each change took effect.

*1 Revenues from commercial meters are included in, and revenues from motorcycle meters are excluded from, this analysis. Commercial meters on SF*park *blocks charge the same rates as general meters; rates for commercial meters are adjusted using occupancy data for general metered parking.*

2 For purposes of this chapter, the West Portal parking management district is included in control areas

Credit card enabled meters

This evaluation compares December 2010 revenue (before installing new meters) to April 2011 revenue (after completing installation of new meters, and just before meter time limits were extended). Revenue in pilot areas increased from December 2010 to April 2011 by nearly 20%, which is significantly higher than any other December–April revenue change in past years in pilot areas, and significantly higher than any other December–April revenue change in control areas or all other areas in any year between 2008 and 2011. This increase suggests that credit card enabled meters by themselves increased revenue approximately 20% by simply allowing people to pay for parking more easily.

Smart meters: impact on revenue^

Percent change in revenue,
Before vs after smart meters installed
Pilot areas, Noe Valley 24th st, control areas and other areas
Weekdays and weekends, all operating hours

		2008	2009	2010	2011
Smart meters	Pilot	3%	- 4%	- 2%	20%
	Noe Valley	- 1%	- 5%	- 4%	- 5%
	Control	5%	- 6%	1%	- 9%
	Other	7%	- 2%	- 1%	1%

^ December – April

Extended time limits

Time limits at meters in SF*park* pilot areas were increased in mid-April 2011 from one or two hours to four hours or, in some areas, no time limit at all. Longer time limits were in effect for at least three months before the SFMTA made any demand-responsive rate adjustments, giving the SFMTA an opportunity to evaluate how longer time limits themselves affect revenues. Between April 2011 and July 2011, per meter monthly revenue in pilot areas increased 18%, suggesting that extending meter time limits significantly increased meter revenue in pilot areas.

Time limit extensions: impact on revenue^

Percent change in revenue,
Before vs after time limits were extended
Pilot areas, Noe Valley 24th st, control areas and other areas
Weekdays and weekends, all operating hours

		2008	2009	2010	2011
Ext time limits	Pilot	3%	8%	- 1%	18%
	Noe Valley	- 7%	8%	4%	- 5%
	Control	- 3%	25%	- 3%	- 3%
	Other	- 1%	5%	- 2%	- 1%

^ April – July

Demand responsive pricing

As demand-responsive pricing is dependent on smart meter technology and was implemented after time limits were extended, it is difficult to isolate the impacts on revenue.

Comparing revenue per meter from spring 2011 to spring 2013 provides a seasonally consistent comparison for before and after SF*park*: a 24% increase compared to a 17% increase citywide and a small decrease in control areas.

In comparison, the introduction of smart meters and time limit extensions show a more dramatic increase compared to all other areas: 20% and 18%, respectively. Overall, demand-responsive pricing appears to have had a modest impact on revenue.

SF*park*: impact on revenue

Smart meters, extended time limits and overall before/after
Pilot areas, control areas and other areas
Monday – Saturday, all operating hours^
Before vs after policy implementation

	Smart meters: Before/After	Extend time limits: Before/After	SF*park*: Before/After
Pilot areas	20%	18%	24%
Control areas	- 9%	- 3%	- 4%
Other areas	1%	- 1%	17%

^ Sundays removed from SF*park* before/after comparison due to impact of new Sunday metering in early 2013

Citation revenue

By making it easier to pay and easier to stay (by relaxing time limits) at meters, SF*park* intended to increase revenue at meters and reduce revenue from meter-related citations such as:

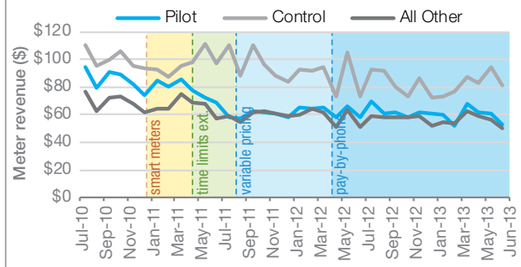
- Not paying the meter
- Overstaying the meter time limit
- Feeding the meter after time limit has expired

Citations and citation revenue decreased in pilot areas over the course of the pilot. In pilot areas, monthly meter related citation revenue dropped from $82 to $61 per meter—a 26% decrease. Control areas and all other areas in the city saw a decrease of 16% in meter related citation revenue. At the same time, payment compliance rates increased in pilot areas by 21% on weekdays. In other words, drivers paid more often and received fewer citations in pilot areas after SF*park*.

Citation issuance and revenue are affected by many factors that have little to do with management of parking spaces and are outside the purview of SF*park*, including staffing levels, enforcement priorities, and how many PCOs are dedicated on any given day to directing traffic or managing special events. These factors complicate a definitive evaluation of how SF*park* affected citation revenue in SF*park* areas, but it is clear that by making it easier to pay, more drivers paid the meter, which increased compliance rates and helped drivers avoid parking citations.

Monthly citation revenue per meter^

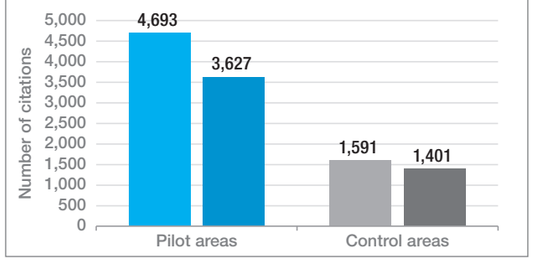
Mon–Sat, all operating hours | Pilot, control and all other areas
July 2010 –June 2013



^ Adjusted for citation fee increases

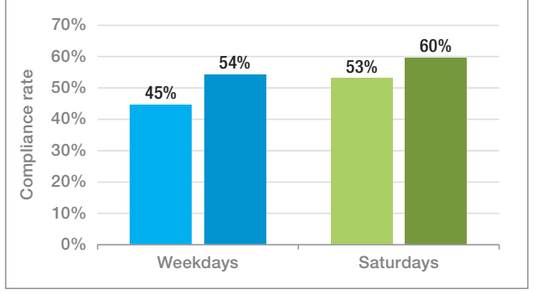
Total number of parking citations per month, pilot vs control

Pilot and control areas
Before vs after | Weekdays, all metered hours



Payment compliance rates
Weekdays and Saturdays

Pilot areas
Weekdays and Saturdays, 9am – 6pm
Before vs after



Revenue impacts of other parking management changes

When comparing total meter revenue in different areas of the city, it is important to note that some revenue changes cannot be attributed to SF*park*.

- Some newly metered spaces were added since FY2010. In SF*park* pilot areas, the SFMTA added 775 newly metered parking spaces between May 2011 and June 2013, primarily in 2011. In other areas of the city, the SFMTA added 413 meters, which were almost all new smart meters, over the same period near Geary and Steiner, Cathedral Hill, and Townsend and Bluxome Streets. These credit card enabled meters likely took in more revenue than new coin-only meters would have. The number of meters in control areas did not change.
- Sunday metering, which debuted citywide on January 6, 2013, increased meter revenues in all areas. Charging for parking on Sundays accounts for some portion of the total revenue increases seen in control areas and all other areas of the city[3]:
  - Control areas had no revenue increases between FY2010 and FY2012 but saw a 14% increase from FY2012 to FY2013 when Sunday metering began. Metering on Sundays, which increased weekly meter operating hours by 11%, is likely the reason for this increase in revenue.
  - In all other areas, the city had virtually no change in meter revenues between FY2010 and FY2012 and a 20% increase in revenues from FY2012 to FY2013.
  - In pilot areas, revenues increased by at least 20% each year, both before and after Sunday metering.
- Changes to meter hours and rates near AT&T Park. Starting March 4, 2013, some meters in the South Embarcadero Pilot Area began operating until 10pm Monday through Saturday with very low rates. Evening metering, which was active for only a few months of FY2013, affected 18% of meters in pilot areas and charged very low rates (e.g., $0.25 per hour) for most of their evening operational hours. As a result, evening metering likely had a very small impact on total pilot area revenues.
- Special event rates in South Embarcadero. Starting in March 2013, some meters in the South Embarcadero pilot area the SFMTA started charging special event rates of $5 or $7 per hour depending on their proximity to the ballpark. The vast majority of these special event rates were charged in the evenings (which are discussed above) because the majority of baseball games start after 7pm. For special event rates charged during day games, we can only estimate the changes in revenue that should be attributed to special event rates because:
  - Meters would have been charging for parking, so revenue attributable to special event rates is only that revenue in excess of what would have been charged had there been no special event.
  - Because SF*park*'s demand-responsive rates vary by block, it is not possible to know what rates would have been on each block absent special event pricing.
  - Furthermore, it is not possible to know what demand for parking would have been in the absence of special events and special event rates.
  - Special event rates were used at 1,338 of about 6,800 total meters in all SF*park* pilot areas during that year for 29 daytime events (or a total of about 145 hours of operating time for each meter) in 2013, or less than 1% of the total meter operating time in pilot areas. As a result, the effect of special event rates on overall meter revenue is likely to have been small.
- Shorter meter schedules for Port meters near AT&T Park. The Port of San Francisco shifted operating hours at 314 meters in their jurisdiction near AT&T Park (which are included in the "all other areas" category) to stop operating at 10pm rather than 11pm to match the SFMTA's operating hours in the area. Though revenue data cannot be effectively parsed by hour for these meters, this small change to operating hours very slightly lowered the revenue from those meters.
- Additional meters in Port jurisdiction. Between December 2010 and June 2013, the Port of San Francisco added 144 meters on streets south of Mission Creek channel. These meters contributed a small increase in revenue to the "all other areas" category.

3 For this analysis we cannot remove Sunday revenues from non-SFpark meters because those meters do not support reporting revenue on a daily basis.

Garage revenue

SF*park* also included changes in pricing at 14 of the 19 parking garages managed by the SFMTA. As part of SF*park*, at these garages the SFMTA:

- Introduced demand-responsive, time-of-day rates.
- Adjusted the time requirements for "early bird" rates so that drivers would have to arrive earlier to receive the early bird discount.
- Reduced somewhat the discount implied in commute-oriented (i.e., early bird, daily, and monthly) rates relative to hourly rates to discourage use of garage spaces for commuting and to make more spaces available for short-term parkers.
- Introduced off-peak discounts to give drivers a financial incentive to arrive before the morning rush or leave after the evening rush.

These changes were introduced at 13 garages between April and November 2011 and at a fourteenth garage in May 2012. At four garages that were not a part of the SF*park* program, no rates or policies were changed.[4]

Hourly and early bird revenue

SF*park* and non-SF*park* garages
FY2009–2013

	SF*park*	Non-SF*park*
FY2009	$ 55,639,000	$ 5,123,000
FY2010	$ 57,755,000	$ 5,557,000
FY2011	$ 58,696,000	$ 5,572,000
FY2012	$ 55,345,000	$ 5,818,000
FY2013	$ 59,757,000	$ 5,797,000
FY2012–13	8.0%	-0.4%

*4 Two other non-SF*park *garages—7th & Harrison and San Francisco General Hospital—were excluded from this analysis. The 7th & Harrison garage was closed for several months in 2012 due to construction on the skyway approaching the Bay Bridge. SF General caters almost exclusively to employees of and visitors to the hospital, and demand for its parking spaces largely reflects activity at this single demand generator.*

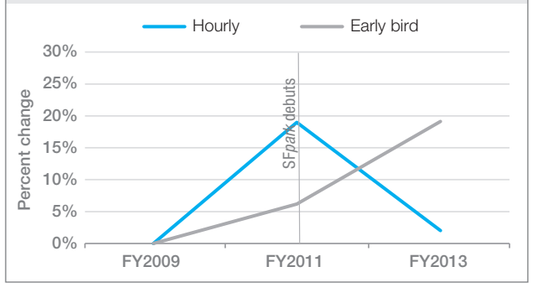
Garage rates

Basing rates on demand at historically underutilized garages in the SF*park* pilot was intended to lower garage rates and bring them closer to (or even below) rates of nearby on-street meters. These lower garage rates were intended to give drivers a financial incentive to go straight to garages for parking rather than circle the streets for what had formerly been cheaper on-street spaces. By making early-bird time requirements more restrictive, SF*park* expected to shift demand away from all-day commuter parking and toward use of the garages as short-term parking for visitors and shoppers in the neighborhoods.

Before SF*park*, daytime hourly rates rose nearly 20% while early bird rates rose 6%. SF*park* reversed that trend, decreasing daytime hourly rates to FY2009 levels and raising average early bird rates nearly 20% above FY2009 levels.

Garage daytime rates, hourly and early bird

SF*park* garages
Weekdays and weekends, all operating hours
FY2009 to FY2013

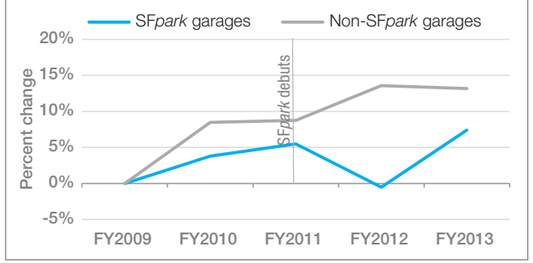


Garage revenues

As expected, SF*park* garage revenue fell after the initial rollout reduced garage rates and discouraged early bird parking. As customers learned the new rates and adjusted behavior, demand and therefore revenues at SF*park* garages rebounded to above pre-SF*park* levels. Revenue at non-SF*park* garages increased in FY2012 but declined slightly in FY2013, even as overall parking demand increased citywide.

Hourly and early bird garage revenue

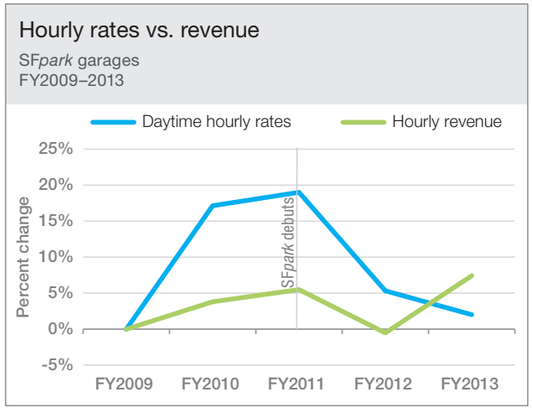
Annual percent change
SF*park* vs non-SF*park* garages
Weekdays and weekends, all operating hours
FY2009 to FY2013



Before SF*park*, from FY2009 to FY2011, the hourly garage rate increased by nearly 20% while revenue increased by about 5%. This suggests that revenues were increasing by charging higher prices to fewer customers. In FY2012, after SF*park*'s debut and its initial rate reductions, average daytime hourly rates decreased by 15% and revenue fell by 5%. In FY2013, usage increased dramatically, and revenue was higher than before SF*park*, even as average daytime rates continued to fall.

Hourly rates vs. revenue

SF*park* garages
FY2009–2013



SF*park* has successfully helped shift the focus of garage parking from all-day commuters to short-term visitors, which is intended to support the local economy as well as overall goals for the transportation system in the form of fewer drive-alone commute trips. Lower rates have attracted more users (and probably more repeat users), who likely would have otherwise circled for on-street parking.

Parking tax revenue

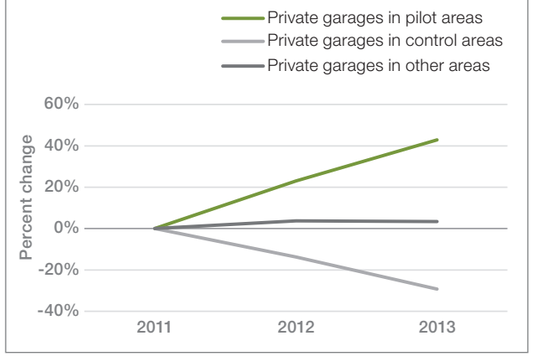
San Francisco collects a 25% tax on all paid parking in the City, 80% of which goes to the SFMTA.[5] This means that if a consumer spends $10 to park at a publicly-available parking garage or lot, $8 goes to the garage and $2 to the city as parking tax, and $1.60 of the $2 parking tax goes to the SFMTA. The SFMTA expected SF*park* to have a minimal but positive impact on parking tax revenues from privately owned garages and lots by encouraging some drivers during peak times to park off-street rather than circle to find on-street parking. While SF*park* parking garages became more market-based and competitive during the pilot period, changes to the early bird pricing policy likely encouraged some commuters to shift to parking at other garages or lots, thereby increasing parking tax revenues from those other garages and lots. More generally, parking tax revenue can serve as an indicator for how overall parking demand changes in the city.[6]

Parking tax in pilot areas increased 43% from 2011 to 2013, compared to a 29% decrease in control areas and minimal change in all other areas. A large factor in the increase in parking tax is increased parking demand and therefore prices as a result of the city's economic growth after 2011.

Both price and usage indicate the level of demand for parking. The significant increase in parking tax revenues in pilot areas suggests that demand for parking in pilot areas increased considerably over the duration of the SF*park* pilot period. In contrast, demand for parking may have declined in control areas and stayed relatively constant in all other areas. To the extent that parking demand significantly increased in pilot areas, simply maintaining parking availability at pre-SF*park* levels could be considered a success for the SF*park* program.

Non-SFMTA garages and lots: parking tax revenue

Annual percent change
FY2011 to FY2013



Parking tax from non-SFMTA garages and lots (x1000)

FY2011 to FY2013

	Before	After	Net change	% change
Pilot areas	$14,715	$21,033	$6,318	43%
Control areas	$537	$380	-$157	-29%
Other areas	$33,256	$34,380	$1,124	3%

5 This analysis focuses on parking tax collected from garages and lots that are not managed by the SFMTA. Parking tax from SFMTA garages is included in the gross garage revenue numbers in the previous section.

6 The off-street parking business has frequent turnover both of companies and of ownership of particular lots or garages, meaning that the City Treasurer's Office does not have the necessary information on file to assign all past parking tax payments to particular garages/lots, and thus particular areas of the city (e.g., pilot, control, or all other areas). To arrive at revenue totals for pilot, control, and all other areas, un-locatable parking tax revenues were assigned to these areas in the same proportion as revenues that could be pinpointed to those areas. Thus, if pilot areas in FY2011 were responsible for 20% of all locatable parking tax revenue, then 20% of all non-locatable parking tax revenue was attributed to pilot areas for that fiscal year.

City employee parking revenue

Before FY2012, free parking for various city employees was common: several lots and garages were set aside for free parking for city employees, and many city agencies issued their employees parking passes so that city vehicles could park for free at metered (and unmetered) on-street parking spaces without paying the meter or observing time limits.

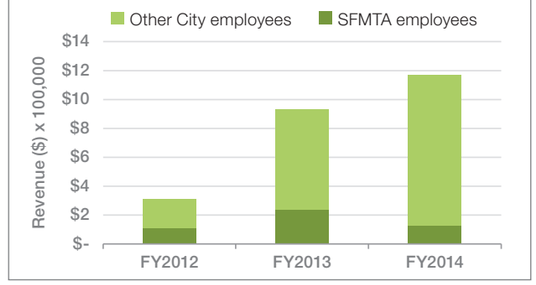
As part of preparing for the SF*park* pilot project, the SFMTA moved to eliminate most of the free and reserved on-street parking spaces in the city, as well as free parking for most city vehicles and employees. This was for several reasons, including to:

- Increase the proportion of cars that are affected by and therefore responsive to pricing.
- Remove the strong incentive that free parking provides to commuters to drive alone to work.
- Ensure that parking management is applied fairly and evenly in the city.
- To increase the on-street parking supply.

The SF*park* team planned and implemented a program to charge most city employees for parking. This involved revoking many agency-issued parking permits and installing payment machines and signage in city-owned lots and garages, especially at SFMTA facilities. These policy changes also increased revenues by more than $1M per year.

Parking revenue: city employees

FY2012 to FY2014



10. TECHNOLOGY

This chapter summarizes the SFMTA's experience with the suite of tools that were required to implement the SF*park* pilot project, many of which were emerging technologies.

Technology

A suite of new tools, many of which were emerging technologies, were required to implement the SF*park* pilot project

Underlying the operation and evaluation of the SF*park* pilot project were new technologies and an enormous amount of data. The SF*park* pilot project likely accelerated the development of several emerging parking management technologies, which was one of the goals of this federal investment. These technologies enable more sophisticated approaches to parking management in other cities.

Chapter overview

SF*park* employed a suite of tools for implementation, including:

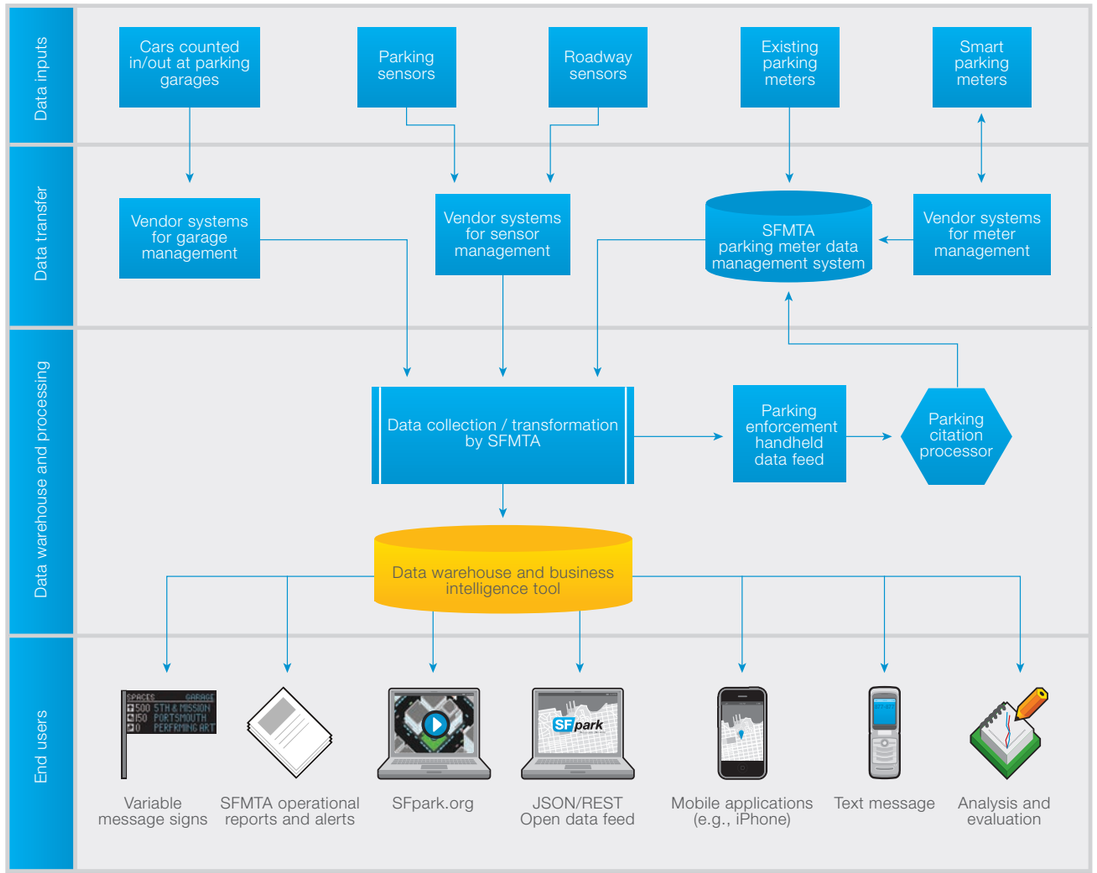
- Garage equipment
- Parking sensors
- Networked parking meters
- Real-time data and mobile applications
- Roadway sensors
- Data management and reporting tools

This chapter summarizes the SFMTA's experience with these tools. To complement what is found in this chapter, the SFMTA also produced an overview of the pilot project that provides an overview of the technologies and how they worked, as well as a detailed technical "how to" manual for a more technical audience.

Download the full SF*park* overview at:
SFpark.org/docs_pilotsummary

Download the full SF*park* technical "how to" manual at
SFpark.org/docs_techmanual

SF*park* system architecture



New technologies allow for a wide array of powerful services and processes that enable innovative policies. But new technologies also present new challenges and necessitate ongoing dedicated technical support. The next section includes "lessons learned" that arose when employing these technologies.

Parking garage equipment

Garage equipment overview

The garage revenue-control system kept track of how many cars were in the garage at any given time using equipment placed in each entry/exit lane. Entering/exiting cars go through a three-step process:

1. Roll over the "loop counter" (essentially a metal detector) that engages the ticket machine.
2. Hourly parkers press the button for a ticket upon entry, or insert their ticket upon exit. Monthly parkers scan their monthly parker card.
3. The gate is raised to let the car enter or exit the garage and then lowered once the car has cleared the gate.

Each time this process is completed, the revenue-control system counts a car entering or exiting the garage, and updates the total count of cars in the garage. This occupancy and payment data is sent to the SF*park* data warehouse.

How it worked

The garage gate systems accurately record the vast majority of the activity occurring at the garage. However, some entries, exits, payments, or other data points are occasionally missed for the following reasons:

- Monthly customers who forget their monthly card and enter by pulling a ticket
- Lost, mangled, or demagnetized tickets
- Gate malfunction
- Customers who enter or exit without taking a ticket or paying (intentionally or unintentionally)

Unlike on-street parking, which included parking sensors and meters specifically chosen for their capacity to implement the program, SF*park* was installed in garages using the technology already in place. The SFMTA was able to adapt both its policies and the aging technology to implement effective demand-responsive pricing and provide data to the public and SFMTA's business analysts.

The older technology required SF*park* to adapt its policies to make the program a true implementation of demand-responsive pricing. For example, garage rates changed in $0.50 rather than $0.25 increments because the garage revenue-control vendor's technology could not handle the decimals and rounding required by smaller increments. To accommodate rate change amounts that were double the rate changes at meters, SF*park* changed rates at garages every quarter, or only about half as often as at meters. The same limitations on decimals and rounding of parking charge totals required SF*park* to charge for garage parking in hourly increments rather than only charging customers for exactly the amount of time they parked.

SF*park* also adjusted rate change process to accommodate the limitations of the garage revenue-control technology. SF*park* calculated the rate adjustment weeks in advance to give the garage revenue-control vendor time to calculate entire garage rate schedules by hand, and to install the new rate schedules one-by-one on each paystation and cashier computer. In addition, while variable rate signs (akin to the digital meter screens on meters) would have made updating rate signs quick and seamless, the garage portion of SF*park* had to rely upon decals hand-adhered to traditional aluminum rate boards to update rates.

Technological limitations also required SF*park* to adapt existing internal operational tools to provide real-time occupancy and performance data. The garages' in/out counter application, traditionally used for internal garage operations, modified to provide real-time parking availability data. Daily manual counts of garage occupancy by the garage operators, which were used simply to manage the counter application, were used by SF*park* as a real-time data tool to audit operators' behavior and management of the garages. Entry-exit and payment data were traditionally used for internal auditing; SF*park* transformed those into near-real-time data feeds and reports for tracking garage performance.

Parking sensors

Sensor overview

SF*park* relied on wireless, in-ground parking sensors that detect when vehicles enter and exit a parking space. StreetSmart Technologies (SST, now known as Fybr) provided the parking sensors for SF*park*.

StreetSmart's sensor was an in-ground and self-powered wireless device. Each sensor had a magnetometer that looks for changes in the earth's electromagnetic field and is calibrated to detect vehicles in the surrounding area. The sensors sent data to the vendor sensor management system via a network of pole-mounted repeaters and gateways. The vendor servers then transmitted the data to the SF*park* data warehouse. The SFMTA paid for data and did not own, operate, or manage the sensor equipment.

How it worked

Parking sensors are a nascent technology and the SF*park* pilot served as a learning opportunity for both the SFMTA and sensor providers. A number of unexpected field issues posed challenges for both operations and analysis of parking sensor data:

- Electromagnetic interference. Once the parking sensor network was deployed, the vendor noticed high levels of electromagnetic interference coming from overhead transit lines and a variety of utility-related facilities. This electromagnetic noise varied from block to block and even from space to space. While various hardware and software solutions were developed to overcome noise, including placing two sensors in nearly half of all parking spaces, sensor accuracy varied more than expected.
- Early battery degradation. The parking sensor batteries were originally expected to last about five years, but specialized software designed to filter out some of the electromagnetic noise reduced this estimate to three years. However, some sensor batteries started to fail in late 2012 and early 2013, about one year earlier than expected. The geographical distribution of battery failures was seemingly random; they were not clustered according to any discernible pattern and were difficult to predict.
- Street construction. The SFMTA coordinated internally and with other City agencies and third-party contractors to remove parking sensors prior to street paving and other street construction. However, sensors were new and unknown devices out in the field, and there were instances where sensors were paved over or otherwise destroyed without notification.
- Operational control over data transmissions. The SFMTA discovered the need to closely monitor data transmissions from the vendor to ensure that data for all spaces was successfully being transmitted. This included monitoring and comparing real-time flows of data flow to historical profiles to alert the SFMTA to potential outages and operational issues.

The SFMTA used four methods to evaluate the performance of parking sensors. This included detailed tests of the sensors used for the SF*park* pilot as well as trials of four newer sensor technologies. In some cases, results varied considerably across methodologies. To interpret results and properly assess performance, performance measurement should be linked to how sensor data will be used.

The SFMTA determined that the magnetometer sensors used for the SF*park* pilot provided low-latency and reliable data for occupancy calculations, which is the key metric for the SFMTA's goals for parking management. However, low and variable results from some field tests meant the SFMTA could not use the sensor data to calculate turnover and length of stay. Newer sensors demonstrated improved accuracy and may be able to more reliably support additional metrics and applications.

Parking sensors provided critical data to measure parking demand for the SF*park* pilot. This federally-funded pilot helped to catalyze parking sensor technology, and it is likely that sensor technology will grow and improve over time.

Sensor evaluation

This document describes the technology utilized for the SF*park* pilot, how the SFMTA measured parking sensor performance, and the results for sensors used during the SF*park* pilot and four emerging technologies.

Download the full document at:
SFpark.org/docs_sensorevaluation

Parking sensor performance standards and measurement

This document outlines detailed field methodologies and contractual performance standards used during the course of the SF*park* pilot.

Download the full document at:
SFpark.org/docs_sensorperformance

Parking sensor data guide

This document explains how the SFMTA collected and processed parking sensor data.

Download the full document at:
SFpark.org/docs_sensordata

Networked parking meters

Meter overview

To support the more challenging and novel core requirements of SF*park*, the SFMTA installed a new generation of smart parking meters that support wireless communications, accommodate complex programming, and accept credit cards.

To enable SF*park*, there were several ways that parking meter vendors needed to evolve and adapt their products. As examples:

- The new meters were required to transmit payment data to a central server in real-time in a highly accurate and granular manner, which enabled directed enforcement and supported the SF*park* evaluation.
- The SFMTA overcame seemingly simple but challenging user interface issues such as being able to clearly display time-of-day pricing at the meter.
- Implementing frequent rate changes that varied by time of day and by day of week involved challenges to ensure that meter rate changes could be programmed and deployed remotely rather than requiring a technician to touch ever meter on the street. To enable this process, the SFMTA developed a XML data exchange specification and protocol. This data exchange protocol ensured sound communication with meter vendors, facilitated data reconciliation, and simplified back-end programming capabilities.
- The meter payment web service enables the SF*park* meter payment providers to transmit real time payment event records in XML format to the SF*park* data warehouse.

How it worked

While parking meters are a well-established technology, demand-responsive pricing pushed cutting-edge parking meters to the limit of their capabilities. Meter vendors have since worked to improve their technology based on the SF*park* pilot experience. Some of the issues that the SFMTA encountered using the new technology included:

- Battery life. Every new feature on smart meters used battery power. Most smart meters rely on solar power to extend battery life. However, battery life was difficult to predict due to the placement of meters in some shady locations and the variable amount of communications from meter to meter. This presented a challenge for using these meters in parking garages and other shady locations.
- Cellular coverage gaps. New meter technology relied on cellular communications. If network coverage was inadequate, the operations, reporting, and maintenance capabilities were compromised.
- Meter management. There were a host of stakeholders that interfaced with the meters and the back-end meter management systems (e.g., public, maintenance personnel, parking control officers, finance, customer service, adjudication, and coin collection). Systems used for SF*park* did not necessarily serve all users equally well, and changes to the systems to improve usability to one group sometimes affected usability for another group.

Without effective smart meters, SF*park* would not have been possible. After developing new processes to overcome these issues, the meters successfully worked with the SFMTA's system and enabled SF*park* to meet the goals of making it easier to pay for parking and reducing meter citations. The ability to quickly change meter rates and accommodate complex rates that vary by time of day and day of week was essential for a project of this scope.

The SFMTA used lessons learned from the pilot to develop a new specification for a 2013 parking meter RFP, which required parking meter vendors to evolve and enhance their products. This will enable the SFMTA and other cities to do more sophisticated and effective parking management in the future.

Download the 2013 parking RFP here:
SFpark.org/docs_meterrfp

Real-time data and mobile applications

Web and mobile app overview

The SFMTA used data from parking sensors and garages to provide real-time parking availability information to the public. This data was via a free open JSON/REST data feed. Other app developers and organizations further disseminated this information to maximize its social benefit. Parking information was also available via 511 during the pilot period.

Download the full document at:
SFpark.org/docs_api

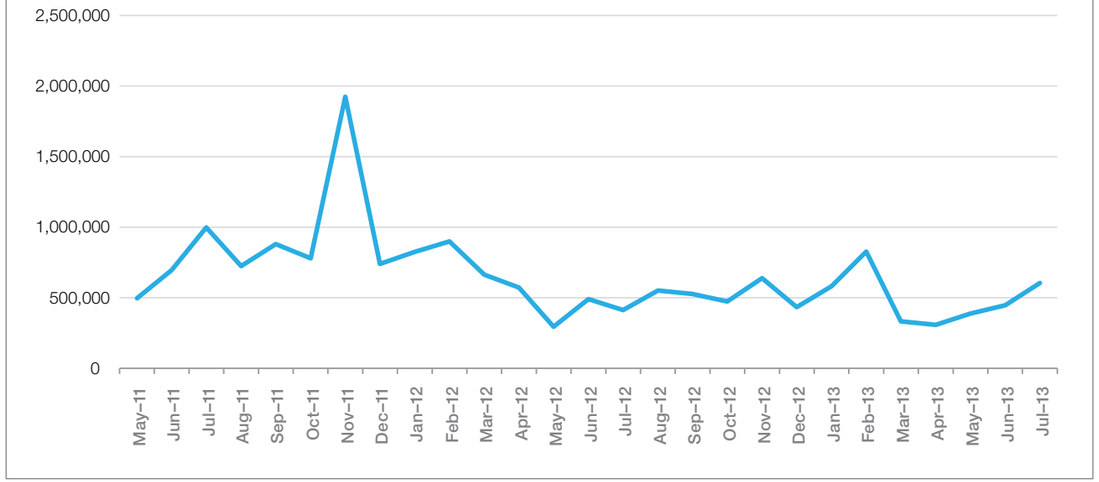
How it worked

In addition to the SF*park* website and mobile apps, multiple independent app developers used the data feed. Total requests made to the availability feed were highest when it was first rolled out in summer of 2011, often reaching close to a million hits per month. The monthly hits in 2012 and 2013 hovered around 500,000 per month.

As of July 2013, the SF*park* app had been downloaded by approximately 61,700 iPhone users and 11,800 Android users.

While the benefit of the app is difficult to quantify, providing real-time data about availability and price for a wider audience meant that more people could make smarter travel decisions and maximize the benefit of the data.

Total requests to SF*park* data feed (API)
Including website and app hits
May 2011 through July 2013

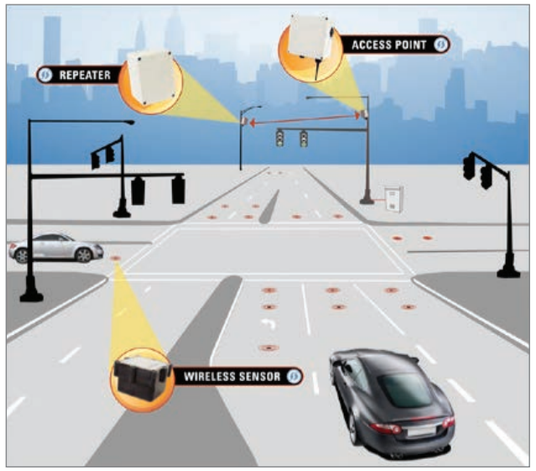


Roadway sensors

Roadway sensor overview

The SFMTA used roadway sensor technology to measure traffic volume and speed to help evaluate the programs' impact on vehicle traffic

Roadway sensors captured raw traffic and speed data and sent to it the vendor sensor management system via a network of pole-mounted repeaters and access points. The sensor management system processed the raw data and aggregated it into 15 minute intervals. These sensors worked in tandem to detect the presence and movement of vehicles, and then they communicated this data to the sensor management system to calculate traffic counts and speeds.



How it worked

A portion of the roadways sensors did not perform as expected; many of them failed to transmit data, did so infrequently, or transmitted erroneous data points. Nonetheless, with transmissions every 15 minutes over two years and rigorous data cleaning, roadway sensors provided the SF*park* team with critical information to help evaluate the pilot project. It was initially thought that the sensors would provide a continuous data stream that could be analyzed throughout the year. Ultimately this was not the case due to various technological and environmental outages.

There were major gaps and issues with the data, including:

1. Missing data. Across the entire dataset, 40% of all records for both traffic counts and speed were missing.
2. Error code data. The SFMTA observed a high amount of error codes in the data: For average speed data, 18% of all records contained error codes, and 15% of traffic count data contained error codes. However, the SFMTA developed a process to convert them, which salvaged some of the data.

After accounting for missing data and error code data, 43% of average speed data and 45% of traffic records was potentially usable.

Data management and reporting tools

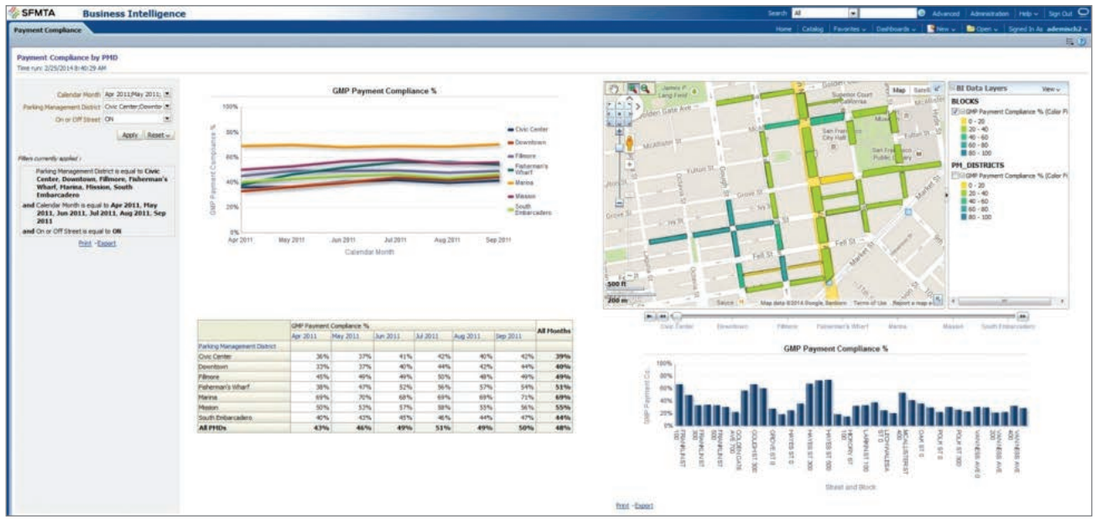
Database overview

Part of the SF*park* project was to develop a set of complex and unique data management tools to enable project operation and evaluation. The tools allow the SFMTA to increasingly use data to make more informed decisions for how it manages the overall transportation system. For parking, these tools already have enabled much more sophisticated operations, contract management, evaluation, and analyses.

The SF*park* system database design involved two different disciplines. The first, a transaction-oriented data store, is designed to be "lean and mean" to support high volumes of database read and write operations but relatively low volumes of data. The second, analytical processing, typically involves much lower volumes of users but higher volumes of data.

The data management tools that the SFMTA used for SF*park* included:

- Servers and database systems. The SF*park* system was built upon commercially available commodity servers. The application and database layers were deployed on physical servers. A multi-node database was spread among the blades and overall blade servers to provide for maximum High Availability and Disaster Recovery.
- Operational data store. The Operational Data Store (ODS) is a generic term to describe any source of mostly raw unprocessed data. SF*park* set up an ODS for data from external vendor systems such as meter payment data from a meter management system, or from other operational or transaction-based software that already exists within the SFMTA. This data was typically transactional in nature, with small files and a potentially high number of records.
- Data warehouse. The data warehouse enabled SF*park* to analyze parking occupancy to make data driven pricing decisions, provide real-time parking availability information to the public, manage the city's on-street spaces, and monitor the performance of the meter, sensor, and garage vendors. It stored and normalized the incoming data and addressed any inconsistencies.



- Business intelligence reports and analytics. Business Intelligence (BI) refers to software programs, suites, or packages that allow an organization to analyze large amounts of data from disparate sources and turn it into actionable information. The SF*park* BI system leveraged a data warehouse that can process enormous quantities of detailed raw data (e.g., hundreds of thousands of records from parking sensors and meters daily) and transform data. Transforming data, or Extract, Transform, Load (ETL) processes allowed the SF*park* BI system to analyze large volumes of data quickly and to "slice and dice" the data across various temporal and geographic dimensions. This enabled analysts to easily explore data and investigate relationships on an ad-hoc basis as well as develop ongoing reporting tools to monitor performance.

How it worked

Using data from multiple vendors and sources required significant cleaning, assembling, and reconciliation of data. Having consultants on-site to work directly with SFMTA staff was essential in working through the numerous data processing issues. Some vendors were new to software engineering, especially with XML validation and processing. Vendors often sent a significant number of empty, duplicate, and invalid records. Database administration, particularly tuning for high performance and high transaction volume, was also challenging for many equipment vendors.

The SF*park* data management system was successful in providing an architecture that was open, flexible, and accommodated complex data, a large number of data sources, and a wide variety of types of data sources. It enabled efficient and sophisticated search, analysis, and exportation of data which was necessary for evaluation and operations. The BI system allowed automated reporting of data and made generating ad-hoc reports with no programming required.