

Parking Guidebook for Chinese Cities

Includes Chapter on Guangzhou

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Table of Contents

- 4 Executive Summary
- 7 I. Introduction
- 8 II. Why Parking Matters
- 10 III. Harmonizing Parking Within The Context Of The Transport System: Eight Strategies
- 21 IV. Guangzhou: Current Policies And Future Prospects
- 34 V. Conclusion

35 Appendices

A. Case Studies

- Amsterdam: High-Tech Enforcement Solution
- Barcelona: Centralized Management Of Parking Inventory
- Beijing: Increased Parking Fees To Tackle Congestion
- Budapest: Parking Control Center For More Effective Management
- Hong Kong: Comprehensive Strategy Includes Shared Parking And Market Pricing
- London: Changing Laws To Enable Controlled Parking Zones (Cpzs)
- Mexico City: Anti-Corruption Enforcement Techniques
- New York: Comprehensive Strategies Caused By Air Quality Concern
- San Francisco: Using Dynamic Pricing To Reduce Congestion
- Seattle: Low-Tech Pricing Solution
- Seoul: Low Minimums Address Oversupply Of Parking
- Zurich: Fighting Congestion With Parking Caps
- B. Guangzhou Parking And Travel Behavior
- C. Outsourcing Parking Management To The Private Sector
- D. Works Cited

Executive Summary

Transportation systems in many Chinese cities have reached a critical moment in dealing with traffic congestion and perceived parking shortages stemming from rapid motorization. Recent research shows that oversupplying parking, as many cities did in response to increased car use, in fact, worsens congestion problems. Cities that have limited or capped parking supply in dense areas effectively reduced congestion and increased use of other modes even as development continues. Cities that link development to transit rather than parking are the most successful in tackling traffic congestion and air quality issues while promoting prosperity.

Using the lessons from international best practices, Chinese cities should pursue a mix of parking policies that harmonize all aspects of the transportation system and better manage all existing parking spaces, both on- and off-street. Such a system should align parking demand with, and thus ensure an efficient management of, the existing supply as well as road capacity, ensuring efficient management of existing spaces. Other modes such as BRT, metro, bicycle or walking should exist and be promoted to reach the central business district and other popular destinations. This approach will allow developers to dedicate as much buildable space as possible to active uses (such as offices and retail) that benefit city life and the economy.

Many Chinese cities can reduce congestion and increase access to destinations through eight basic strategies that will bring demand for on-street space in line with supply, shift drivers to off-street spaces or other transport modes, and increase the safety and comfort for pedestrians in important commercial areas, fostering the kinds of thriving urban environments that are a hallmark of the world class cities.

The eight strategies for better parking management are:

1. Establish a centralized management of all parking activities. For a parking management system to be efficient, both on- and off-street parking must be managed together. This is best achieved by putting one entity in charge of the overall supply and allowing it to alter prices based on parking demand. When on-street

spaces are underpriced or managed independently of off-street parking supply, cities see excess demand for the former and low use of the latter. Such imbalances lead policy makers to believe that there is a parking shortage when, in fact, there is hidden capacity. Limited but convenient on-street spaces should be the most expensive, nearby off-street spaces less expensive, and remote off-street spaces the cheapest. San Francisco, Barcelona, and several other European cities have used this approach to varying degrees.

2. Implement performance standards for parking management. Drivers gravitate toward parking spaces right in front of their destination. Studies show that if those spaces are free or cheap, people will compete to use them, which results in overconsumption and perceived shortages while parking in other area lies underutilized. This often means that all on-street spaces will be occupied during peak hours, forcing drivers to circle in search of an open space, slowing traffic flow around them, and parking illegally, creating safety risks. Seattle and San Francisco, most notably, have started to adjust parking prices to ensure on-street parking availability at all times by setting an occupancy performance target. This can ensure that drivers unwilling to pay higher fees either use less convenient spaces or take public transport. Those willing to pay for a space can find one quickly, which reduces congestion. This strategy should include introducing on-street parking fees where demand exists and using pricing to ensure that there is an available

space approximately every 50 or 60 meters (or 1 space per block face).

- 3. Use Appropriate Technology for Payment and Data Collection. Technology can help make parking management more efficient based on easier data collection and analysis. Multi-space parking meters and pay-by-phone services, for example, can make it easier for drivers to comply with parking fees. Such technologies can help cities track on-street parking use in real time and adjust prices across a whole area through a central computer, giving managers better control over the whole parking system. Cities across Europe have implemented these technologies. When cities do not have the internal capacity to implement and manage a modern parking system, it is appropriate to outsource the system or component tasks to a competent private sector partner. Cities like Barcelona and the City of Westminster in London have found success with such arrangements.
- 4. Reduce or eliminate parking minimums, establish maximum allowances or area-wide parking caps. Cities often implement minimum parking requirements in the hope that developers will build enough parking to account for increased demand generated by their projects, but development drives the need for access, not for parking per se. Studies show that required minimums induce more driving than would otherwise occur. Minimums cause other negative byproducts affecting city form and development costs. Typically, developers only build up to the minimum requirements, implying that if parking supply were left to market forces, they would build less. Many developers even negotiate to build less parking than required. Most often, they are required to build beyond what needed and passing the cost of these potentially expensive parking elements on to tenants, whether those tenants own cars or would choose to drive if they had to pay directly for their parking space. Numerous cities across Europe eliminated minimums setting instead maximum limits on the number of spaces developers are allowed to build

in densely developed and transit rich districts. Others, including Amsterdam and Zurich, have capped the number of parking spaces allowed in whole districts, prohibiting private developers from building additional parking unless spaces are eliminated elsewhere. To implement a strategy of district caps, all spaces in a district must be available for any user.

5. Decouple land use from off-street parking requirements and implement shared parking.

Off-street parking requirements are based on initial building uses, but these uses change. A new business may have needs that are different from those of the previous tenant. Car ownership desires change throughout the lifecycle stages, such as upon having children or growing older. City planners cannot anticipate parking needs for each individual unit and should think, instead, of area-wide requirements, decoupling parking from specific land-uses. Furthermore, use-specific parking often sits empty for a predictable portion of the day. For instance, parking built as part of an apartment building will be most occupied at night, while an office building next door will likely need parking only during the day. In cities with off-street parking requirements, developers must build many more spaces than would be necessary if shared parking were the norm. Cities can implement such a decoupling in a few ways. San Francisco has mandated that building owners charge tenants separately for parking, thus allowing the tenant to realize savings if they chose to forego car ownership. Seoul helps owners of off-street parking negotiate deals for sharing parking. Boulder, Colorado, has used proceeds from parking fees to build several shared public parking garages, making space for cars without forcing developers to build excessive use-specific parking.

6. Price or tax off-street parking according to Market Cost: Publicly financed off-street parking is often provided for free or at prices far below levels that would allow governments to recoup the costs of building such facilities. Like private off-street parking with its costs hidden in renting

or buying space in a building, underpriced public parking induces people to drive. Increasing the price of shared parking can reduce congestion by forcing the driver to choose carefully between driving, carpooling, and other modes. Some cities require that employers who provide free parking charge their employees for it and offer them its cash value. The employees, in turn, can choose to pay the market value for parking (equal to the cash-out payment) or use another transport mode and keep the money. Another strategy is to tax the value of the parking space since by paying for the space, an employer is effectively paying the employee an additional stipend. Cities in California and the United Kingdom have used such approaches successfully.

7. Enhance enforcement with electronic technology and physical design. Most systems are only as good as their enforcement. Drivers should expect to face penalties if they park illegally or fail to pay meter fees. A good enforcement system starts with reliable car registration records that allow authorities to find violators and collect fines. , New technologies like vanmounted license plate readers, in-street sensors and smart meters can efficiently target tens or hundreds of enforcement officers that cities normally hire for this task. Amsterdam is one city that has made extensive use of vehicle-mounted license plate readers. Physical design approaches can reduce the need for human enforcement as they ensure that drivers do not park illegally or unsafely. Treatments like bollards that block cars from driving onto sidewalks and clearly delineated no-parking zones can ensure that drivers use only legal spaces and stay out of cyclist and pedestrian zones, increasing overall street safety. Zurich and Paris have both used bollard and

other physical elements to make clear where drivers can and cannot park and to slow vehicle speeds in certain residential neighborhoods.

8. Provide clear information on parking supply to ensure its effective use: Electronic displays that show where available off-street parking spaces are can help drivers find those spaces efficiently. More broadly, such displays can also help ensure that an area's whole parking supply—both on- and off-street—is better utilized. Cities throughout Germany have implemented such systems.

Guangzhou is a dynamic city that is used as a case study for application of these six strategies. Parking issues are rising to the forefront of Guangzhou's urban concerns. Drivers complain about parking shortages. Illegal parking is on the rise as citizens choose to pay fines or expect authorities to look the other way.

With Guangzhou's population growing and motorization rates rising, parking issues are only expected to get worse. The many entities involved in seeking to solve this problem have led to policies that mostly increase supply. In addition to increasing minimum parking requirements for developers, the city is introducing formalized on-street parking in some areas, encouraging shared parking while also working to build new off-street parking spaces.

The solutions sometimes conflict with other strategies for the city. The six strategies can ensure that Guangzhou will absorb predicted population increases without choking from congestion. These strategies will allow the city to continue developing thriving commercial centers around public transit.

I. Introduction

For years, the primary approach to parking has been to address perceived parking shortages by requiring developers to increase (free or low-priced) supply commensurate with the level of development. Many cities now recognize this strategy as a failed approach. In light of the evidence, parking is now recognized as a powerful tool for affecting traffic speed, mode choice, urban density, urban design, quality of life and a host of related issues with impacts on the built environment, the natural environment and equitable access to opportunities. As Chinese cities recognize that parking policy affects these broader policy areas, they are seeing the problems of their traditional approach. Many are beginning to recognize that far from solving their parking and traffic problems, increasing parking supply and requiring developers to meet minimum parking thresholds has exacerbated the very problems they are trying to solve.

This guidebook looks at international strategies from many regions where parking has been tackled in a variety of ways. It offers recommendations that can be adopted in any Chinese city experiencing increased motorization and perceived parking shortages. The guidebook offers eight strategies for cities to improve their parking situation. These recommendations illustrate how handling on-street and off-street parking in harmony with transportation policy objectives can help any city achieve its long-term goals. A special section focusing on Guangzhou serves as a case study of one particular Chinese city coming to grips with how to approach growing motorization and the seemingly unyielding demand for parking in the best possible way.

II. Why Parking Matters

In many Chinese cities, parking issues are moving to the forefront of urban concerns. Drivers complain about parking shortages, and illegal parking is on the rise. The problem is frequently over-simplified as a shortage of places to park, in which case there is a clear solution: provide more parking spaces. But the problem is complex, and the proposed solution reveals a host of related issues which cities must address:

- traffic congestion many surveys estimate that a significant share of traffic is caused by people looking for bargain parking places. Counterintuitively, excess parking is a leading cause of congestion because it induces car travel;
- bias against non-auto alternatives meeting the demand for free or low-cost parking requires subsidizing auto use. This subsidy shifts away any tendency toward bicycle use, walking and transit, thus tilting the choice toward excess auto use;
- degradation of air quality provision of additional parking encourages increased use of automobiles, which, in terms of air quality, is the least efficient mobility option.

Built environments affect mode choice and other travel behavior. The sum of travel behavior¹ results in higher or lower levels of vehicle kilometers traveled, levels of congestion, opportunities and/or limits on economic growth and levels of greenhouse gas emissions. The built environment is also extremely durable and city leaders must make decisions today that allow for an economically, environmentally and socially sustainable future. A critical and poorly understood element of urban development policy is parking supply and management. Misapplied parking policies undermine a host of economic development, mobility and sustainability goals. They lock cities into development

trajectories, and all but guarantee unacceptable levels of congestion. Concurrent with guaranteed congestion, misapplied parking policies also guarantee wasted infrastructure. In many cases, the congested roadways act as a bottleneck preventing access to available parking spaces. In other cases the preponderance of parking forces the dispersion of active uses, which, in turn, makes use of alternative modes impractical. To ensure a better future, city leaders must grasp these issues and develop appropriate policies to achieve their cities' objectives.

As car ownership increases beyond the capacity of their road systems, Chinese cities have begun to suffer the consequences of congestion. The Guangzhou municipal government, for example, has set a goal of keeping automobile travel speeds at a minimum of 25 kmh.2 Modifying the current parking policy is one of the most effective tools the municipal government can use to reach this goal, but leaders must embrace the fact that a minimum speed of 25 kmh cannot be achieved for an unbounded number of vehicles. While there are several ways to set a limit on the number of vehicles such as congestion charges or heavy taxes on vehicles—limiting parking supply and pricing parking appropriately are extremely powerful tools that can ease congestion and thus help the city to achieve its goal.3

While some transport management tools can improve auto traffic (often at the expense of other modes), such improvements inevitably lead to additional traffic and thus congestion and decrease in traffic speed again. It is often simply not possible to move more vehicles across a network. Cities like Singapore, London, and Stockholm have implemented congestion pricing to scale demand to supply while increasing accessibility by other modes. Copenhagen has deliberately reduced parking supply by a small amount every year for the last fifty years to foster smoother traffic flow and better quality of

 $^{^{\}mathrm{1}}$ Lucas, Blumenberg, and Weinberger, Understanding Car Use .

² Guangzhou Municipal Communications Commission. Mitigating Traffic Jam.

³ Vaca and Kuzmyak, "Parking Pricing and Fees"; Pratt, Kuzmyak, Weinberger, and Levinson, "Parking Management and Supply."

⁴ Mogridge, "Urban Road Capacity Policy."

⁵ European Commission Directorate for the Environment, Reclaiming City Streets for People: Chaos or Quality of Life?

life in the city.⁵ Vancouver, British Columbia, has a downtown plan to reduce parking per downtown employee and achieve a higher transit and non-motorized mode share as part of their parking management strategy.⁶ For each of these cities the objective is to reduce the number of vehicles, but not the number of people moving across the network.

When parking is oversupplied, the road system provides an upper bound on auto access. Alternatively, limited parking results in limits on auto traffic as well. Increasing parking supply induces more vehicles onto the streets and highways, which causes congestion and delays, and exacerbates pollution. Excess parking supply implies waste in space and corresponding revenues as well as in construction costs and time. In cities where traffic has reached unacceptable levels, the increase in parking results only in more traffic and more underutilized space.

Recognizing that increased parking leads to increased driving, many cities, including Antwerp, Seoul, New York City, and Zurich, have implemented parking maximums. The purpose of the maximums is to ensure smooth traffic movement and to reduce private vehicle use. There is no reason for cities today to repeat the past errors. Guangzhou and other Chinese cities can revisit their parking policies by unpacking zoning regulations and better managing building setbacks and on-street parking. To avoid worsening traffic conditions and placing a drag on the growing economy, Chinese cities would be wise to rethink off-street parking requirements and consider access planning instead. Better parking policy means putting an end to inadvertent fostering of car dependency and the beginning of sustainable communities.

Cities that have developed according to principles that ease and ensure high levels of auto dependence share the common characteristics of excess parking and lack of lively streets. Cities that emphasize multi-modal, rather than auto

access, tend to be more prosperous. These cities still tend to have high levels of vehicle congestion, but because they also have high transit ridership and non-motorized mode use, fewer people are directly affected by or subject to traffic congestion.⁷

Parking may be the single most poignant intersection of land use and transportation. While it is a critical component of the transportation system, parking is largely administered by land use departments in cities, generally without reference to transportation capacity or context. Without a coordinated policy, land use decisions will necessarily conflict with transportation. It stands to reason, therefore, that land use and transportation must be harmonized. Parking policy must be harmonized with the transportation system.

Chinese cities are at a crossroads. The public is clamoring for more parking, traffic congestion is rising, and air quality is getting worse. Many cities suffer irregular and dangerous parking behavior, with vehicles crossing and blocking footpaths and fighting for limited free or underpriced spaces. As demand for space outpaces good street management, the overall quality of the city deteriorates.

Leaders in many Chinese cities have put considerable thought into developing parking programs. Their plans, which typically build on common practice more than best practice, address some of the goals and threaten others. Rather than adopting outdated and incomplete zoning regulations including free on-street spaces and off-street parking minimums from the US suburbs and other car-dominated societies, these cities can forge new paths, create best practices, and serve as exemplars for cities around the world. Later in this guidebook we provide a critical analysis of Guangzhou to illustrate the issue of achieving some goals while threatening others.

⁶ City of Vancouver, Downtown Transportation Plan.

⁷ Schrank, Eisele, and Lomax, 2012 Urban Mobility Report.

III. Harmonizing Parking Policy within the Context of the Transportation System

Chinese officials can create clean, accessible, and thriving cities by adopting the following parking policy goals:

Goal 1 Harmonize parking policy within the whole of the transportation system.

When automobile travel is the only viable option, then parking places become the manifestation of demand for access. By setting parking policy in tandem with the transportation system, solutions can be specifically tailored to local contexts. There are three main aspects to this recommendation. The first is the appropriate provision of parking where it is required for an area to function. The second is the restriction of parking where its provision may hinder the area's best functioning (such restrictions have been successfully implemented in London, Hong Kong, and New York City). The third is the preservation of viable non-automobile mode function and especially good functioning pedestrian space.

Goal 2 Better manage the existing parking supply.

Most policy makers and users see the problem of on-street parking, but on-street and off-street parking supply are two sides of the same coin. They comprise the entire parking system supply and must be treated accordingly. Many cities have parking chaos on their streets, which the government tries to fix by requiring additional off-street parking supply. In many cases the offstreet supply is vastly underutilized in spite of the parking chaos on the streets. Part of the problem is the price difference between the on-street and off-street parking; therefore, the two must be coordinated. Off-street parking is expensive to build, which suggests that it should also be expensive to use. Hong Kong is one of the few cities in the world where parking prices actually reflect the cost of supplying parking.

The adoption of these goals is borne out by the experience of Asian, European, and American cities that can be summarized in these key findings:

1. Good parking policy can reduce congestion. Study after study reveals that between 30% and 50% of cars on the roads in downtown and

residential neighborhoods are looking for parking. When parking supply is better managed, drivers spend less time searching for available space. Moreover, excess parking supply induces auto trips and thus leads to more traffic that frequently exceeds road capacity.

2. Parking shortages are created by systematic underpricing. By providing free or below- cost parking, cities create artificially high parking demand which leads, in turn, to perceived shortages. Hong Kong is one of the few cities where the cost consumers pay for parking equals the cost of providing it.

3. Parking shortages are often more perception than reality. When parking is managed appropriately and priced correctly, perceived shortages disappear. In Guangzhou, ITDP surveyed major new developments and found underutilization in their parking garages. One development, Taikoo Hui, had an average occupancy of 35% and never exceeded 58%. In other words, on average, 560 of the parking spaces in this development were always unused, and a full 360 spaces were never used in the survey period. Another development, IFC, never exceeded 35% occupancy. While this latter development was not fully leased and could attract more parkers, traffic in the area suggested that reaching those empty parking spaces would be a congested and tedious affair.

4. Road capacity acts as a constraint to reaching parking space. Roads can handle only so much traffic before capacity is exceeded and traffic begins to slow and congest. Even if the government could supply a parking space for every trip to a particular area, the cars wouldn't reach the spaces; the roads would be clogged. That is why parking policy-both on-street and off-street (from parking garages, setback, and parking required by building codes)—needs to be harmonized so that supply is comprehensively managed within the context of the transportation system.

What does it mean to learn from the above

findings and to harmonize parking policy with the rest of the transportation system while better managing the existing parking supply? Here we present eight strategies that answer this complex practical question. Adopting even one strategy will improve almost any city's parking and mobility situation; adopting all eight will put the city on track to be a global model for effective transportation. These operational strategies can be implemented directly by any city, though many cities have sought to contract out some operations. Appendix C provides an in-depth discussion of how an outsourcing arrangement might work.



8 Strategies for Comprehensive Parking Program for Any Chinese City

- Establish a centralized entity to manage all parking activities.
- 2. Manage on-street parking through better pricing
- Technological solutions and outsourcing when appropriate
- Eliminate Parking Minimums and Establish Maximums or Parking Caps
- 5. Decouple land use from off-street parking requirements and implement shared parking.
- **6.** Price or tax off-street parking according to market cost.
- **7.** Enhance enforcement with electronic technology and physical design.
- **8.** Provide clear information on parking supply to ensure it is used effectively.

Strategy 1: Establish a centralized entity to manage all parking activities.

Create a single agency that has jurisdiction to regulate the entire parking supply. Responsibilities of this entity could include:

- Implementing a zone-based parking system where policies are coordinated within and across the zones.
- Requiring new developments to conduct transportation impact assessments and mitigation plans.
- Restricting parking in transit-rich and dense areas.
- Setting priorities for different parts of the parking supply. For example:
 - Prioritizing on-street parking as the primary source of short-term parking.
 - Setting shared off-street parking as the primary source for long-term parking.
- Decoupling parking from other property uses and facilitating shared parking to ensure effective use of available space throughout week.

A centralized parking agency would make a comprehensive contribution to achieving broad city and regional objectives with respect to economic development, land use, mobility, accessibility, and environmental protection. A much weaker solution would be to create a coordinating mechanism like a committee or task force that brings together different agencies with different responsibilities.

Implementation examples

 Antwerp, Belgium: The city created a semiprivate authority to manage all public on-street and off-street parking. Since the authority has jurisdiction over the street

- spaces, they can program it for other uses besides parking.
- San Francisco, United States: The city has brought all public parking facilities—both on- and off-street—under SFPark, a project of the San Francisco Metropolitan Transport Authority. SFpark coordinates pricing to redistribute parking from congested to less congested streets.

In-depth case studies: "Barcelona: Centralized Management of Parking Inventory," "London: Changing Laws to Enable Controlled Parking Zones (CPZs)," and "Zurich: Fighting Congestion with Parking Caps" (Appendix A)...

Strategy 2: Implement performance standards for parking management.

Performance standards for parking management should be implemented in two main ways:

Introduce paid on-street parking where demand is high

Paid on-street parking was first introduced over 80 years in the United States after urging from a business community in Oklahoma City. It was prompted by a concern by merchants that employees who arrived early would park all day leaving no spaces for customers. Business owners wanted to increase access to their stores by ensuring available space for convenient customer parking. Metering worked because employees did not want to pay to park all day and instead opted to park in slightly less convenient (but free) locations away from the main streets.

Despite the introduction of this crucial differentiation, parking areas are sometimes arranged in haphazard ways. Free parking

might exist on one side of a road, with paid parking places on the other, causing many people to try to save money by looking or waiting for free spaces rather than parking in a priced space across the street. This behavior adds to congestion. The problem can be ameliorated by eliminating the free zones where these behaviors occur. San Francisco and Budapest provide models of charging for parking to eliminate the problem. In Budapest charges are set by zone; in San Francisco they are set on a street-by-street basis.

The fact that land itself has value is a fundamental idea that is frequently overlooked by those setting parking policy. Ignoring this fact, many cities give land for free parking for privately owned vehicles. No one would think to allow people to live an apartment, set up a shop, or even use a locker in a train station without paying for it, but that is the standard for car storage across the world, and it amounts to providing an explicit subsidy to the wealthiest members of society while throwing the transportation system out of balance.

In many cases, while parkers hunt for free or cheap spaces on the street, nearby off-street supply lies unused. To ensure that drivers use the full supply of parking in a given area as efficiently as possible, it is critical that prices for on-street spaces be allowed to rise to levels that reflect market demand.

Use pricing to ensure an available space

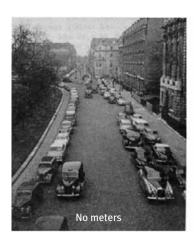
Charging for parking is one of the most important traffic control tools, but it is only effective when used well. The basic role of a parking fee is to balance demand for parking with supply and to incentivize long-term parkers to use remote, lower-priced spaces, leaving more

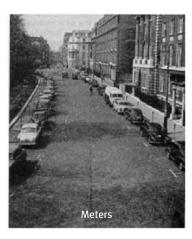
accessible spaces for short-term parkers. An unintended advantage of this structure is that quick trips are then accommodated on-street eliminating the need for vehicles to cross the pedestrian paths as they would have to access off-street spaces.

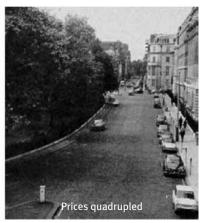
Parking meters were installed in London for the first time in the 1950s. Immediately city managers were able to see driver sensitivity to prices. The image below shows that after parking charges were implemented, the city was able to eliminate double parking as competition for available space at the curb eased up. As prices were increased, fewer and fewer drivers chose to park on the street. Thus proving that drivers tend to be sensitive to costs and will adjust their behavior based on relative prices and that there is a "right price" depending on the performance standard or policy goal. Additional price increases led more drivers to park in cheaper areas or use alternative modes.

Drivers often pay a flat parking fee in Chinese cities (fee-per-visit instead of a fee-per-hour), which encourages longer stays. This is the opposite of what the pricing policy should be doing. Establishing a fee based on a shorter increment of time, such as 15 minutes, incentivizes the driver to drive to the area only as needed and use other access modes when appropriate.

In the previous section of this report, the recommended strategy was to introduce paid parking where demand exists. This strategy refines that idea by suggesting what the pay rate should be. Parking rates should be increased when occupancy is consistently above 70%. Prices should vary to ensure that there is at least one available parking space per 50 meters. Rather than charging a flat fee to park regardless of the length of stay, a per-hour or escalating fee will encourage







people to use the system more efficiently, staying for long periods of time only when necessary. This is not a static process; it requires monitoring and supervision, including:

- Expanding paid parking zones when to do so does not compromise non-driving access modes and other city goals;
- Increasing fees so that there is always space available on street for those who will pay to use it.
- Ensuring that there are alternatives for those who cannot or prefer not to pay the fee. Alternatives can include cheaper offstreet parking in garages, less convenient but cheaper on-street parking in more remote locations or alternative access modes such as bicycle, BRT or metro, and
- Creating a fee structure that allows space at the curb for freight deliveries.

If cities set prices with the goal of keeping some curb space available, drivers willing to pay for a spot will be able to find one without adding to traffic congestion and air pollution. Ultimately, this could reduce VKT and traffic delay experienced by other drivers. In addition, experts speculate that having readily available parking spaces reduces the stress of searching and allows drivers to focus more on pedestrians and other vehicles, resulting in safer streets for all users.

Prices can be set to meet occupancy targets as proposed here or by some other numerical standard. This decision should be based on the efficiency of the street system and not subject to political interests. Budapest, San Francisco, and Seattle impose or increase on-street parking fees when demand is such that the space taken up by parked vehicles regularly exceeds a certain percentage of the street length. Regardless of the metric, this approach requires monitoring and supervision so that the management entity knows when occupancy exceeds the target.

Another approach is to connect parking fees to another transportation-related cost, such as fuel prices or transit fares. National regulations in Europe typically link parking fees to fuel prices. Local municipalities typically link parking fees to the cost of a transit ticket, which is less directly linked to the cost of fuel. In some cities in India

(Chennai, Ahmedabad), some have suggested that the cities charge for parking at a percentage of typical land rents. In any case, parking fees should not fall below starting thresholds after their introduction and should be adjusted upward until the demand and supply are brought into line. Falling below the starting levels would constitute a subsidy to private auto use.

Implementation examples

• Vienna, Austria: The introduction of parking fees led to a two-thirds drop in the VKT (from ten to three million) resulting from reduced searches for an available space.8

In-depth case studies: "San Francisco: Using Dynamic Pricing to Reduce Congestion," "Seattle: Low Tech Pricing Solutions," and "Budapest: Tiered Parking and Technology" (Appendix A).

Strategy 3: Use Appropriate Technology for Payment and Data Collection

Cities around the world have begun to use technology and creative administrative arrangements to make managing their parking supplies as efficient as possible. Such steps make parking programs more flexible and parking policy decisions more data-driven. Perhaps most importantly, they can provide important safeguards to ensure payment collection and limiting opportunities for evasion, fraud, leakage, or other loss of revenue.

Modern smart meters can accept many forms of payment including coins, bills, pre-paid parking cards, and credit cards; many cities have also started allowing users to pay for parking by mobile phone. Such technologies can allow cities to track curbside utilization in real time and adjust prices across a whole area through a central computer, giving managers better control over the whole parking system. Cities across Europe have implemented these technologies. In the United States, San Francisco represents one extreme where the city relies heavily on technology to monitor and manage performance standards. A good technological solution can benefit both the city and the users: it can allow the city to receive the information it needs and ensure the financial integrity of the system, and it can provide the users with several easy payment

⁸ Kodransky and Hermann, Europe's Parking U-Turn.

options and clear information.

Technological advances have also helped in the enforcement arena. These are discussed in greater detail in the section on enforcement strategy.

Cities may consider outsourcing technological enhancement of parking management to private contractors when internal capacity issues exist, when there is a lack of political will to make changes required for an efficient parking system, or when efficiency can be otherwise improved through such an arrangement.

Operators should always be chosen in a public procurement tender or bid. The tender establishes what the city wants—the technical and service requirements—and the winning bid should be the most cost-effective offer that meets those requirements. Other factors may influence the decision, including the financial stability and viability of the private operator, relevant experience, references, financial composition, and equity requirements for investment. This can be included in the tender as pre-qualification criteria, or it can be formally evaluated in the bid process. More details on outsourcing arrangements are provided in Appendix C..

Implementation examples

- Amsterdam, the Netherlands: Every borough in Amsterdam has a contract with Cition, a company owned by the municipality. Cition is fined if it does not collect parking fees from visitors. Cition is a private company, but the city is a 100% shareholder.9
- Antwerp, Belgium: All parking is managed through Gemeentelijk Autonoom Parkeerbedrijf Antwerpen (the Municipal Autonomous Parking Antwerp, or GAPA), a semi-private parking authority. The parking program emphasizes pricing, enforcement, and the use of technology to reach the program's goals. All revenues are collected through a special escrow account. The contract encourages GAPA to be innovative by using technology for enforcement and data collection. GAPA, unlike the city, is also more flexible in its ability to negotiate work agreements with employees.10

In-depth case studies: "Budapest: Parking Control Center for More Effective Management," "Hong Kong: Comprehensive Strategy Includes Shared Parking & Market Pricing" "Amsterdam: The High Tech Enforcement Solution" and "Mexico City: Anti-corruption enforcement techniques" (Appendix A).

Strategy 4: Eliminate Parking Minimums and **Establish Maximums or Parking Caps**

Parking minimums are embedded in zoning codes and are usually set without reference to the capacity of the transportation system. Parking spaces are required whether the street system can accommodate the increased traffic or not. The application of parking minimums typically results in more off-street parking than the market would otherwise provide. In most cases, developers build only the exact minimum number of spaces required, which indicates that they would provide fewer spaces if they could.11 In many cases, developers have negotiated lower minimums and still built successful projects. In London, the Swiss Re building contains 48,000 sq m of office and retail space and includes only five parking spaces—those are restricted for use by people with physical disabilities. Also in London, the Shard, a mixed-use building of 110,000 sq m which includes residences, has been built with only 47 parking spaces—those are also reserved



The Shard, London

⁹ Kodransky and Hermann, Europe's Parking U-Turn.

¹¹ Wilson, "Suburban Parking Requirements"; Regional Transportation Authority (Chicago), Municipal Parking Requirements.

for people with physical handicaps. These examples demonstrate that projects can succeed with lower requirements, especially projects in locations that are well served by alternative modes.

Minimums also lead developers to spread the cost of parking among all occupants of a given building, regardless of their transportation choices. Indeed, under parking minimums, those without cars subsidize the auto use of those with them. Usually, this is a subsidy going from people with lower means to the more affluent. Minimums also reduce the amount of inhabitable area in a given development because of the space requirements for parking, on the one hand, and the limits imposed through zoning—in the form of floor-area-ratios, setbacks, and height limits—on the other. Finally, because parking requirements reduce the amount of developable space in individual buildings, development must spread out geographically to allow for the same number of activities as might otherwise be incorporated in a smaller area.

Maximums are also implemented through zoning codes or by other city ordinances. Cities have typically implemented parking maximums only in their densest, most central, most transitrich areas. In four United States cities, maximums were put in place in response to Clean Air Act-related lawsuits that required the cities to reduce auto-related emissions. 12 Other cities have more recently implemented maximums to reduce traffic and improve quality of life. Several European cities have prohibited the expansion of parking supplies in central areas, requiring that any new off-street parking spaces be offset by eliminating an equal number of on-street spaces.

To be most effective, maximums should be imposed in tandem with shared parking and on-street parking coordination. They need not be applied across the entire city at once but can be implemented strategically and incrementally, beginning with areas that are transit-rich (see below) or that are designated as pedestrian-priority zones.

The net outcome is more efficient use of

space, better parking demand management, and better environmental and health outcomes (such as lower asthma rates and reduced pollutants from particulate matter).

Some cities have moved away from the idea that they can predict parking needs over the lifetime of a building and have instead begun to think about district-wide parking supplies. Zurich established a parking cap in the city center in the 1990s. Any new parking spaces created off-street must be done in conjunction with removal of an equal number of on-street spaces. The net supply of parking is, therefore, never meant to increase. New York City is currently contemplating a new law which would eliminate private parking in buildings making any space commercially available. This is a first step to an effective management of area-wide parking limits to ensure smoother traffic flow.

Implementation examples

- **Singapore:** The parking minimum is set quite low and operates, effectively, as a maximum. ¹³ "Parking beyond the requirement is not exempt from inclusion in the allowable building floor area," so the financial incentive is to build for the primary use of the building, rather than the accessory parking use. ¹⁴
- Seoul: South Korea: Parking minimums are set to 10% of the usual level in the city center, and the maximum is set at 50% of usual. 15 This is the clearest example of "constraint-focused parking policy found in Asian cities."
- New York City, Portland, and Boston have maximums in place because of early Clean Air Act lawsuits. ¹⁶ Mostly, they just switched their minimums for maximums. In San Francisco, the maximum is up to 7% of gross floor area. ¹⁷ In Portland, the maximums are 1 per 400 ft2 of office area, or 1 per 2 employees. ¹⁸
- Amsterdam, Zurich and Copenhagen all instituted freezes on parking quantities in downtown zones. With new off-street parking, the commensurate amount of on-street

¹² Weinberger, Kaehny, and Rufo, U.S. Parking Policies, 7

¹³ Barter, "Parking Policy," 48.

¹⁴ Ibid.

¹⁵ Thid

¹⁶Weinberger, Kaehny, and Rufo, U.S. Parking Policies, 7.

¹⁷ Ibid., 42.

¹⁸ Ibid.

parking must be eliminated. 19 Amsterdam also has a curbside residential permit maximum set, which is determined by the number of residential permits to issue based on total parking supply minus 10%. The wait for a residential permit can take several years and even a decade.20

In-depth case studies: "New York City: Comprehensive Strategies Caused by Air Quality Concern," "Seoul: Low Minimums address oversupply of parking," "Zurich: Fighting congestion with parking caps," and "Hong Kong: Comprehensive Strategy Includes Shared Parking & Market Pricing" (Appendix A).

Strategy 5: Decouple Land Use from Off-Street Parking Requirements and Implement Shared **Parking**

As indicated above, most zoning codes require that developments include a minimum number of parking spaces specifically for building users. Such reserved spaces create hyperinefficiency in the parking system. Residential users usually demand overnight parking, while commercial tenants use parking spaces during the day. Given the exclusive use arrangements and the disparate-time-of-day user needs, these rules result in empty spaces in one place during the daytime and empty spaces elsewhere during the night. The interests of both user groups can be satisfied by allowing for the spaces to be shared between users whose needs are complementary rather than overlapping. Decoupling land use from parking requirements can open up all parking supplies to shared use.

Furthermore, buildings are far more durable than their individual uses, and, so, the parking requirements put in place with construction may not reflect future uses. In the United States, for example, some schools have been converted into apartments, one into a museum, and a movie theater has become a clothing store; in Paris, a train station was turned into a museum. Former residences become businesses and former business establishments become residences or give

way to different businesses, sometimes with very different access profiles and, therefore, potentially different parking needs. Residences, even when they do not switch to other uses, will have different needs as the occupants move through their life cycle stages. A single person or young couple will have different car ownership characteristics from those of a more established couple, whose needs will change again if their adult child lives at home and once more when they are older and unable to drive safely.

Shared parking can ensure that the total amount of parking space in a particular area is in line with the number of vehicles in that area at any given time. In the case of an office and a movie theater, a shared parking scheme would accommodate workers and movie theater patrons in a fraction of the space.²¹ Overall, shared parking schemes make parking a less onerous on neighborhoods by encouraging "the centralization, consolidation and reduction of a neighborhood's parking facilities, thus improving urban design and allowing more productive land uses."22 They can also reduce development costs and foster "park-once neighborhoods" that effectively reduce VKT by allowing people to accomplish more things in a particular area at one time.23 The net outcome is more efficient use of space and lower development costs.

Setback parking, in its current form, presents a similar problem. Setback parking spots tend to be operated by the owners of the building in front of which they are located. In some cases, only owners, tenants, or visitors to the building can use these, but there are instances when others can use them for a fee when an operator is granted a concession. Although we recommend the elimination of setback parking, as long as setback parking exists, sharing should be encouraged.

Implementation examples

 Beijing, Hong Kong, Hanoi, Ahmedabad, Taipei: Each city has provisions of publicand private-sector off-street parking, which are priced and shared.24

¹⁹ Kodransky and Hermann, Europe's Parking U-Turn, 27, 40, 70.

²⁰Ibid., 26..

²¹Weinberger, Kaehny, and Rufo, U.S. Parking Policies, 45.

²³Barter, "Parking Policy," 37.

²⁴Barter, "Parking Policy," 55.

- Hamburg, Germany: Developers pay a fee in lieu of providing parking, to "encourage shared parking".²⁵
- Palo Alto, California: As in Hamburg, developers may pay a fee in lieu of providing parking.
- Antwerp, Belgium: The city is working to allow private lots to become public at night in order to be shared. The city also offers a number of services to facilitate shared parking: arranging for residents to get reduced rates, drafting agreement contracts, creating an online parking database, facilitating private initiatives in other ways.²⁶
- Tokyo, Japan: Residents must secure parking, mostly off-site, in order to purchase a car.²⁷ Parking is not bundled as part of the residential unit.
- Hanoi, Taipei: For both cities, it is common that residents secure off-site parking or that residential parking is open to residents of other buildings.²⁸ Again, parking is unbundled from the residential unit.
- Copenhagen, Denmark: The city leases spots in some private garages to allow them to be used by overnight parkers.²⁹

In-depth case study: "Hong Kong: Comprehensive strategy includes shared parking and market pricing" (Appendix A).

Strategy 6: Price or Tax Off-Street Parking according to Market Cost

Today, off-street parking is often provided below market cost. In Chinese cities in particular, pricing bureaus set fees well below what the market might bear and below the price point for cost recovery. The price of off-street parking is frequently masked by bundling it into the cost of a unit, regardless of demand.

To make it more attractive than on-street space, off-street parking needs to be competitively priced. Besides simply setting up tollbooths at the entrance to every off-street parking facil-

ity, pricing mechanisms that have shown real promise include employee cash-out programs and taxing employee parking.

Employers frequently provide parking to their employees for free or at a deep discount while commuters who choose other modes must pay out-of-pocket for all transportation costs. This is usually an extra tax-free financial benefit to drivers. It is not available for non-drivers (who tend to have lower incomes). Providing free or lowcost off-street parking subsidizes private vehicle use and influences whether commuters will use private, public, or non-motorized transport. More people will chose private modes when parking is subsidized than if the price reflects its actual cost or value. Thus, existing policy artificially inflates demand for driving and parking, putting municipalities in a cycle of providing more and more parking, which, in turn, fosters a perception of more demand than actually exists.

In contrast, employee cash-out programs add the cost of parking to an employee's pay. The additional income can then be used to pay for parking or anything else if the employee prefers another mode (such as carpooling or cycling). Essentially, the program compensates commuters who choose not to drive by allowing them a bonus up to the cost of parking when they choose alternative access modes. Monetizing and taxing employee parking treats parking spaces in much the same way as health or other employee benefits.

Governments that charge adequate prices for parking, both on- and off-street, can use revenues to both maintain off-street facilities and to support other transportation-related programs. In Barcelona, the net parking revenue supports the Bicing bike share program. In London, parking revenues help partially fund the Freedom Pass program, which provides free transit tickets for seniors and the disabled. Such programs can better address any potential capacity problems by improving service on modes that are more space-efficient.

²⁵Kodransky and Hermann, Europe's Parking U-Turn, 17.

²⁶Ibid., 32.

²⁷ Barter, "Parking Policy," 44.

²⁸Ibid., 44-45.

²⁹Kodransky and Hermann, Europe's Parking U-Turn, 40.

Implementation Examples:

- California, USA: Parking cash-out is required throughout the state for companies of 100 employees or more. Prior to the law's implementation, a study of several companies found an average drive-alone drop of 11%.30 Some companies have used cash-out programs to head off the need to invest large sums in new parking facilities.31
- United Kingdom: The United Kingdom charges employers up to 250 pounds per year per space, and employers often pass this cost on to their employees.32
- Taipei, Taiwan: The city uses targeted pricing in their off-street parking to keep occupancy between 50% and 80%.33
- Boulder, USA: The city has built five garages downtown since the advent of parking benefit district, coordinates on- and off-street prices, ensures good urban design and more revenue by wrapping ground floor of garages in retail. Garage parking revenues fund transit passes to reduce the need for additional parking.34
- Zurich and other European cities: Unbundled parking is the de facto policy in densest parts of the cities.

Strategy 7: Enhance Enforcement

Effective enforcement is critical to the success of any parking program. Enforcement includes both penalizing and preventing unwanted behavior. Better monitoring systems and procedures, coupled with physical design strategies, can help ensure that parking enforcement is effective.

A cornerstone of effective enforcement is consistency. Whether a user has parked in an illegal spot, parked longer than allowed, or has failed to pay for on-street parking, he or she must be penalized.

Studies show that parking enforcement is

"rarely adequate to prevent widespread illegal parking."35 In Asian cities, "inability or unwillingness to carry out adequate enforcement is a key problem."36 Enforcement efforts tend to be underfunded or delegated to the police, for whom parking is a "low priority or an opportunity for rent seeking"; vehicle registries tend to be unreliable, and parking enforcement employees have "low social status...relative to motorists." Streets in Asian cities also tend to "lack the basics of clear parking rules and signage," making enforcement even more difficult.37

The existing policy results in extensive illegal parking, which undermines the goals of parking policies. In many Asian cities, illegal parking is quite common.38 Likewise, most Western cities lack efficient or effective enforcement systems.

Cities with the best enforcement programs tend to use new technologies to make policing effective and consistent. Smart meters that communicate with a central office and vans equipped with high-speed digital cameras can automatically read license plates to determine if cars have paid for their parking time and establish how long they have been parked in a certain zone. For this to work, the license plate numbers need to be standardized for the advanced license plate technology readers. Amsterdam is a leader in deploying such technology,39 while Budapest and San Francisco have both made good use of it, too.

To ensure that adequate personnel are dispatched for enforcement, the collected penalties should first finance enforcement efforts, then alternative access enhancements (with additional monies prioritized for this purpose) and finally other needs. The goal of good enforcement, though, should be to reduce infractions and, therefore, to reduce the revenue it generates. It is best to implement a system that makes compliance easy and non-compliance costly and unwise.

Coupled with strong, electronically assisted

³⁰ Shoup, "Cashing Out Employer-Paid Parking."

³¹ Hamilton, "Transportation Demand Management."

³² Kodransky and Hermann, Europe's Parking U-Turn, 16.

³³ Barter, "Parking Policy," 39.

³⁴ Weinberger, Kaehny, and Rufo, U.S. Parking Policies, 56.

³⁵ Ibid. 9, referring to Office of the Comptroller, City and County of San Francisco (2007) and Transportation Alternatives (2006)

³⁶Barter, "Parking Policy," 36.

³⁷ Barter, "Parking Policy," 36.

³⁸ Barter, "Parking Policy," 36.

³⁹ Kodransky and Hermann, Europe's Parking U-Turn, 28.

enforcement, physical barriers are often the best way to ensure that cars park in ways that maintain or enhance the safety of other road users. For example, bulbed-out curbs at corners prevent cars from parking in places that would cut down on visibility while providing shorter crossing distances for pedestrians.

Physical design strategies can have other benefits, too, including obscuring parking facilities to preserve neighborhood character.

Examples of physical interventions include:

- Bollards or high curbs: Cities can use steel
 or concrete bollards along sidewalks to
 ensure that drivers do not park on the sidewalk. Another effective technique to prevent
 parking on sidewalks is to increase the curb
 height so that vehicles cannot easily mount
 the curb.
- Bulb-out curbs: Extending the sidewalk at intersections and near fire hydrants prevents cars from parking too close to them.

Implementation Examples:

 Zurich, Antwerp, and Amsterdam all allow parking (parallel or angled) on alternate sides of streets to create an effective chicane, which slows traffic speeds.⁴⁰ **In-depth case studies:** "Amsterdam: The High Tech Enforcement Solution" and "Mexico City: Anti-Corruption Enforcement Techniques" (Appendix A).

Strategy 8: Provide Clear Information on Parking Supply to Ensure It Is Used Effectively

Parking guidance signage can provide minimal directions (straight, left, or right) to lead drivers to available parking facilities in dense areas. Such signs typically show the number of available parking spaces in downtown garages. This system is meant to minimize the time drivers spend looking for an available parking space, and it may also encourage off-street parking, reducing pressure on limited on-street space.

Such systems can include parking operators using sensor technology to see how many spaces are open in specific parts of their facilities. The main concern with such information systems is that they add to visual clutter of downtown streets.

Implementation Examples:

- Beijing and Guangzhou have implemented some digital parking guidance signage.
- $\bullet\,$ All German cities have this signage in place. 41

⁴⁰ Ibid., 19

 $^{^{41}}$ Kodransky and Hermann, Europe's Parking U-Turn, 20.

IV. Guangzhou: Current Policy and Future Prospects

This section analyzes the current parking situation in Guangzhou. It discusses how the eight strategies, applied to Guangzhou, would work to make the city more pleasant, livable, and prosperous.

Guangzhou Population and Auto Ownership

Guangzhou's current population is 12.7 million,⁴² which is a 33% increase since 2005⁴³. In 2005, of the 1.8 million vehicles in the city, 31% were private cars. As shown in Figure 1, there are now 2.15 million motorized vehicles of which 1.34 million⁴⁴, or 62%, are private cars. Some have estimated the private vehicle fleet to be as high as 1.7 to 2 million.45

Growth in private vehicle ownership has outpaced population growth by 30%, with

private vehicles per 1,000 increasing from 90 to 105. The total number of vehicles per 1,000 population stands at 170, which is greater than car ownership in Singapore. 47 Other official reports indicate that 21% of households own vehicles⁴⁸ --on par with New York City, which instituted parking maximums in order to address air pollution by reducing auto use. Discounting a large number of households owning multiple vehicles, and assuming an average household size of 3 the number of personal vehicles reported

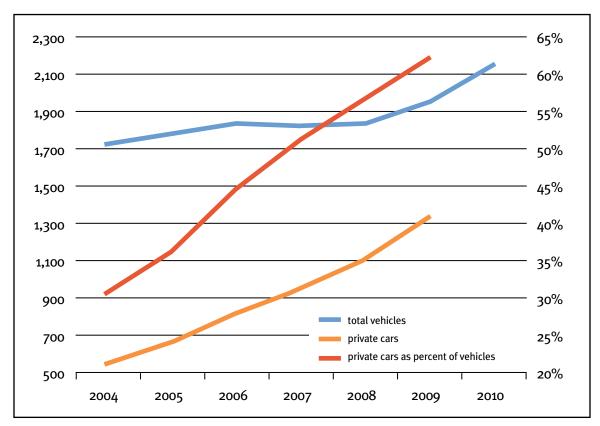


Figure 1. Guangzhou Vehicle Growth⁴⁶

⁴¹Kodransky and Hermann, Europe's Parking U-Turn, 20.

⁴²Guangzhou Transport Planning Research Institute, Guangzhou Transport Development Annual Report.

⁴³Statistics Bureau of Guangzhou [广州市统计局], "1% Sample Survey of Population 2005 [2005年1%人口抽样调查]."

⁴⁴ Ibid.

^{45&}quot;Car Ownership of Guangzhou Will Exceed 2 Million Next Year [广州汽车保有量明年将超200万]," Guangzhou Daily [广州日报] July 17,

⁴⁶Gunagzhou Transport Planning Research Institute, Guangzhou Transport Development Annual Report.

⁴⁷World Bank World Development Indicators. http://data.worldbank.org/indicator/IS.VEH.NVEH.P3?order=wbapi_data_ value_2008+wbapi_data_value+wbapi_data_value-last&sort=desc.

^{48 2010} GZ census.

by the 2010 Guangzhou Transport Development Annual Report equates to auto ownership by 31% of households.49

Car ownership is predicted to increase to 3.65 million by 2020,50 nearly doubling from current levels, while the population will reach 15 million,⁵¹ resulting in ownership of 243 vehicles per 1,000 population. It is unclear that this projection will be realized without a codified policy to pace parking supply with the prediction. In any case, Guangzhou is unlikely to be able to absorb the implied traffic that will accompany this kind of growth in auto ownership.

The legal parking supply in Guangzhou, as of 2010, was 634,000 parking spaces (about onethird as many spaces as owned automobiles). These spaces are classified as 400,000 reserved, 189, 600 shared, and 44,400 paid on-street spaces.52

On-street spaces are mainly located in the city center—for example, in the Yuexiu, Liwan, and Tianhe districts.

Guangzhou Parking Policy

It has proven extremely difficult to pin down the policies and requirements that govern parking in Guangzhou. Information is inconsistent and often contradictory. The complexity is not unique to Guangzhou but illustrates an obstacle to assessing the effectiveness of policies as well as highlighting the difficulty that developers may face in deciding whether to build in Guangzhou or not. In this section we catalog what we have learned with respect to off-street parking policies in effect in Guangzhou. We then analyze these policies and provide some insight to the expected outcome of the current policy approach.

As in most cities, Guangzhou's parking policy is broken into two subsets: off-street and onstreet parking. Off-street policies are set by the Planning Bureau with the approval of the municipal government. On-street parking is governed by the Communications Commission, an operating agency responsible for street management.



An additional stakeholder, the Price Bureau, sets maximum parking rates. The overriding policy is to increase supply while controlling price.

Between these agencies, Guangzhou employs the following explicit tools to implement and manage their parking policies:

- 1. Minimum parking requirements for development in two areas;
- **2. Parking price limits** on three levels;
- 3. Supply of public parking garages (130,000 new spaces are proposed in ten districts).

A fourth, implicit policy, is the permissive posture toward setback parking. This posture has implications for the other policy areas and for performance of the transportation system.

As noted above, the Guangzhou Planning Bureau and the Communications Commission are the main entities that set parking policy. The former has responsibility for off-street parking and the latter for on-street parking. From

⁴⁹CIA World Factbook via Wikipedia.

⁵⁰ Statistics Bureau of Guangzhou [广州市统计局], Ownership per 100 Urban Households of Consumer Durables (2010) [城市居民家庭平均每 百户年末耐用消费品拥有量 (2010)].

⁵¹China Academy of Urban Planning and Design [中国城市规划设计研究院], Guangzhou Urban Planning and Research Centre [广州 市城市规划编制研究中心], Guangzhou Urban Planning and Design Survey Research Institute [广州市城市规划勘察设计研究院] and Guangzhou Transport Planning Research Institute [广州市交通规划研究所], Overall Planning of Guangzhou (2010-2020) [广州城市总体规划(2010-2020) 纲要]

⁵² Data from Guangzhou Communication Commission's Planning & Design Institute



Figure 2. Parking Intensity designations

a user's and a functioning city's point of view, these subsets of parking supply are mutually dependent and should be managed in tandem. The Communications Commission, in spite of holding responsibility for on-street parking, is not currently considered a participating body in off-street parking management.

The Planning Bureau and Communications Commission have created multiple area designations to describe their approaches to parking. One system describes areas where parking should be "restricted," "moderate," or "encouraged." These areas are illustrated in the map shown in Figure 2. Another system describing Areas "A" and "B" delineates specific levels of minimum required parking. The A and B area designations are shown in Figure 3. Parking requirements for each of these areas are described in Table 1 (p. 24).53

In addition, different off-street charging areas, illustrated in Figure 4, are designated as:

- the "1st level" (which comprises the three major business circles);
- the "2nd level" (which includes the districts



Figure 3. Area A, Area B and Non-designated Areas of GZ⁵⁴



Figure 4. Parking Charging Districts

south of Beihuan highway, Xinjiaon North Road, and Gongye Avenue; the areas north of Chongxi West Road; the areas east of the Pearl River's main channel; and the areas west of Huanan high-speed artery);

the "3rd level" (residual areas).

In a 2009 interview with representatives of GTPRI, an ITDP consultant documented the

⁵³Guangzhou Transport Planning Research Institute [广州市交通规划研究所],Guangzhou Urban Comprehensive Transport Planning [广州市综合交通规划],190.

⁵⁴ Ibid.

	SUBTYPES	UNIT	SPACES REQUIRED		NON-
BUILDING TYPES			Area A	Area B	MOTORIZED
RESIDENTIAL	Development	/100m2 floor area	0.5-0.8	0.7-1.0	1
	Economic Housing	/100m2 floor area	0.3	0.4	1
	Low-rent Housing	/100m2 floor area	0.2	0.3	1.5
	Dormitory	/100m2 floor area	0.2-0.3	0.3	2
HOTEL	Hotels	/100m2 floor area	0.3-0.4	0.5	0.25
	Hostels	/100m2 floor area	0.1-0.12	0.15	0.25
OFFICE	Administration	/100m2 floor area	0.6-0.8	1.2	0.7
	Business (>15000m2)	/100m2 floor area	0.5-0.6	0.9	0.7
	Business(<=15000m2)	/100m2 floor area	0.6-0.7	1.0	0.7
COMMERCIAL	Retail and Mall	/100m2 floor area	0.5-0.6	0.8	1
	Wholesale market	/100m2 floor area	0.8-1.2	1.5	1
	Warehouse Supermarket	/100m2 flo or area	1.0-1.5	2.5	1
	Single-Use Restaurant and Entertainment	/100m2 floor area	1.0-1.5	2.5	1
CULTURE	Theatre	/100 seats	3-5	5	3
	Conference Centre	/100 seats	3-5	10	3
	Museum/Library	/100m2 floor area	0.3-0.4	0.8	3
	Exhibition Centre	/100m2 floor area	0.4-0.6	0.8	2
STADIUM	Large-Scale	/100 seats	_	6	10
	Small-Scale	/100 seats	4-5	6	15
HOSPITAL	Hospitals	/100m2 floor area	0.5-0.7	0.8	3
	Clinic	/100m2 floor area	0.6-0.8	1.0	3
	Sanatorium	/100m2 floor area	0.3-0.5	0.5	3
SCHOOL	Primary schools	/100m2 floor area	0.1-0.15	0.15	3
	Middle schools	/100m2 floor area	0.1-0.15	0.15	8
	Colleges	/100m2 floor area	0.5-0.8	0.8	5
TOURISM	Historic sites/Theme parks	/100m2 land area	4-8	12-15	30
	City Parks/Resorts	/100m2 land area	1-2	4-6	20
INDUSTRY / WAREHOUSE	Industrial Factories	/100m2 floor area	0.1-0.2	0.2	1
	Warehouse facilities	/100m2 floor area	0.1-0.2	0.2	1

Table 1. Off-Street Parking Requirements

belief that developers wanted to build excess parking because it was profitable⁵⁵. In more recent interviews with the Transportation Planning Research Institute, it was clarified that developers are not interested in building the additional spaces that the Planning Bureau has programmed⁵⁶. Other evidence that reinforces the idea that developers may prefer fewer parking spaces can be found at the International Finance Center and Taikoo Hui, developments which are described in greater detail later in this report. These developments include parking garages with space below the required minimums, which demonstrates that developers built less, not more parking. The situation at these developments suggests that providing even less parking may have been beneficial as parking utilization is well below supply, and most visitors to these sites come by public transportation. Furthermore, Guangzhou's street system may lack the capacity to bring more vehicles to the sites.

It is frequently the case that ineffective management of on-street parking leads to the perception of insufficient space overall. A 2009 analysis of setback parking done as part of the Guangzhou BRT corridor analysis documents a concern regarding parking shortages, but the analysis shows no shortages. Rather, it shows ample opportunities to replace setback parking in close proximity to setbacks crowded with cars. Analysis for this white paper shows a maximum occupancy of 58% on the weekend and 38% on a weekday for Taikoo Hui, a major development, with average occupancies of 33% and 18% for weekend days and weekdays during the prime open hours of 10am to 8pm. For IFC, another successful development we analyzed, the maximum weekday and weekend occupancy rates are 35% and 30%, respectively. These data suggest that poor management and coordination, rather than insufficient supply, are the problems that need to be addressed.

Nevertheless, the GTPRI has developed a plan to provide 130,000 new public off-street parking spaces throughout the city⁵⁷. The new spaces will be distributed as outlined in Table 2. Assuming each space is used by four different car drivers each day, the 130,000 spaces will result in over 1,000,000 additional trips each day.

Ironically, the majority of proposed new public parking space is proposed in "restricted" area which also coincides heavily with the "A" designation. Obviously, the "restricted" area, as opposed to "moderate" and "encouraged" parking designation, implies lower levels of parking. This implicit call for less parking is borne out by the lower requirements in "A" areas. Yet, the GTPRI has targeted these same areas for significant increases in parking supply.

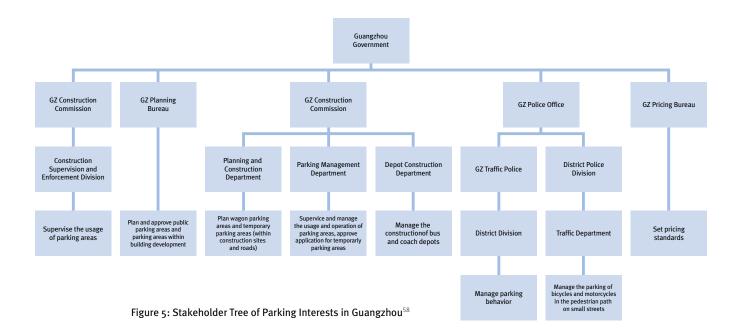
DISTRICT	PARKING SPACES PLANNED	PARKING SPACES PLANNED/ DISTRICT LAND AREA (M2)
Baiyun, Tianhe, Haizhu, Liwan, Yuexiu, Huangpu, Luogang	76,716	0.016
Panyu	32,950	0.038
Huadu	13,050	0.035
Nansha	7,200	0.030
Total	129,916	0.021

Table 2 Distribution of Proposed Parking Spaces

⁵⁵ Guangzhou Transport Planning Research Institute representatives, interview by Adam Millard-Ball August 2009

⁵⁶Guangzhou Transport Planning Research Institute representatives, interview by Rachel Weinberger, December 2011.

⁵⁷ Guangzhou Transport Planning Research Institute [广州市交通规划研究所],Guangzhou Urban Comprehensive Transport Planning [广州市综合交通规划].



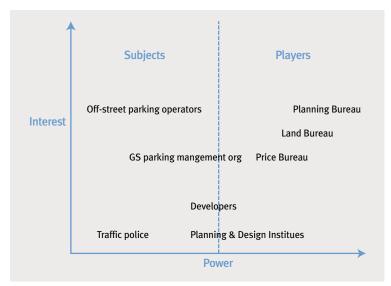


Figure 6. Power Interest Grid in Off-Street Parking (ITDP, 2011)

Stakeholders

Several agencies/organizations play a role in off-street parking decisions. The stakeholders tree is in Figure 5, and Figure 6 shows power and interest they hold. It is noteworthy that the Communications Commission is identified neither as an interested party nor as an empowered agency on off-street parking policy.

Guangzhou's Long-Term Goals

Parking policy affects several long-term goals set out by Guangzhou's administration in a variety of documents, official presentations, and discussions with public officials.

Parking goals:59

- 1. Develop an integrated transport system to ensure the balance between parking supply and demand.
- 2. Achieve the right supply by concentrating parking in developments; public off-street and on-street parking are only the necessary supplements. Coordinate the scale and location of parking with road and transit capacities.
- 3. Increase citywide supply of underground parking by 130,000 spaces.

Transportation goals:60

4. Maintain travel speeds of 25 kmh or higher.

Economic development goals:

- 5. 5. Encourage additional land development.
- 6. Encourage purchase of automobiles by residents in order to support three automobile manufacturing plants in the city.⁶¹

⁵⁸ Ibid.

⁵⁹Ibid., 189-199.

 $^{^{60}}$ Guangzhou Municipal Communications Commission, Mitigating Traffic Jam .

⁶¹ Transport Planning Research Institute (Planning Bureau) meeting December 12, 2011.

Analysis of Goals

1. Develop an integrated transport system to ensure the balance between parking supply and demand.

The first part of the goal—developing an integrated transport system—is laudable, but given the structure of parking minimums, it is unobtainable. To address this goal, the amount of parking that is allowed to be constructed must be set in accordance with the capacity of the road system. The current policy (illustrated in Table 1) of requiring minimum amounts of parking space consistent with levels of development and regardless of road capacity undermines this important integration. In general, parking minimums should be dropped for the following reasons:

- 1. When parking demand is lower than the mandated standard, minimum requirements will oversupply parking space. This leads to three additional problems:
 - a. Because supply and demand are codetermined, such an oversupply may actually be inducing rather than simply accommodating car ownership and use.62
 - b. Parking provision may force the developers to incur direct and indirect costs that they may, otherwise, avoid. 63 Research shows that each parking space adds significantly to the cost of residential and commercial development.65 The additional costs may reduce the developer's profit margins, which sometimes leads to the abandonment of the project altogether or to the transference of these costs to the end-users.66
 - **c.** Parking takes up valuable land, thereby forcing not only a preclusion of other land uses (which constitutes opportunity cost of parking) but also their dispersion. The implied density decrease associated with that dispersion degrades pedestrian,

- bike, and transit environments, contributing to a cycle of auto dependence.67
- 2. When parking demand is higher than the mandated standard, minimum requirements exert no control over the parking supply.
- 3. Minimum requirements are set as a function of the developed area (space/m2)—i.e., they are considered a function of land planning but parking is part of the transportation system and must be considered as such in addition to being part of the development function.

The imposition of minimum standards is undergirded by the fallacy that anticipating and meeting parking demand is of paramount importance to successful development. This fallacy is based on the equally false premise that there is an exogenously determined parking demand. What planners, traffic engineers, and other urban policy makers frequently fail to grasp is that there is no demand for parking per se. There is demand for access to locations, and to the extent that such access is available via walking, biking, or transit in all of its manifestations, the demand is met, and no parking need be provided. A particularly well-known modern development that rose on the principle of demand for access is the Swiss Re building at 30 St. Mary Axe in London. The Swiss Re building comprises 40 stories and 76,400 m2 of commercial space.68 The building, completed in 2004 and able to accommodate 4,000 employees in the office area, includes only five car parking spaces that are reserved for people with physical disabilities.

At 0.5 spaces per 100 m2(the current requirement for a development of this type in Guanghzou⁶⁹), the developers would have had to provide 373 additional spaces. The developers understood that in a transit rich context, access needs were satisfied without adding parking. They saved ¥47.5 to ¥83 million RMB in construc-

⁶² Weinberger,."Choice to Drive."

⁶³McDonnell, Madar, and Been, "Minimum Parking Requirements."

⁶⁴ Jia and Wachs, "Parking Requirements"; United States Environmental Protection Agency, Parking Spaces/Community Places.

⁶⁵ Shoup, The High Cost of Free Parking.

⁶⁶For general discussion on these market distortions, see Weinberger, Seaman, and Johnson.

⁶⁷ Weinberger, Kaehny, and Rufo, U.S. Parking Policies.

 $^{^{68}\}mbox{Foster}$ and Partners , "Swiss Re Headquarters." .

⁶⁹ Transport Research Institute, "Parking in Guangzhou."

tion costs, 70 reduced the size of their building by 11%, and eliminated thousands of weekly auto trips to and within downtown.71

The reduction in auto trips translates directly into cyclical reinforcement of reductions in congestion, air pollution, and greenhouse gas emissions. Lack of accommodation for auto trips forces the travelers to avail themselves more of transit and not-motorized modes. Increasing demand on transit, can justify higher frequencies and better service, which, in turn, makes transit more attractive to more people.72 Supplying the additionally required parking spaces would have had the opposite result. Weaker transit would have required additional transit subsidies.

The second part of the goal—ensuring the balance of parking supply and demand—fails to recognize that supply and demand are co-determined and mediated by price. Little is understood about parking demand in the context of price because most parking throughout the world is subsidized. The subsidy is an outcome of the oversupply that usually accompanies parking minimums. Unless the parking price is unbundled from the primary development and calculated to cover the cost of parking provision, "demand" is simply an expression of desire for an underpriced good.

2. Achieve the right supply by parking in developments; public off-street and on-street parking are only the necessary supplements. Coordinate the scale and location of parking road and transit facilities.

The first goal's objective can be achieved by ensuring a balance between parking supply and demand. The arguments against this approach are found in the preceding paragraph.

As for the relationship between parking in developments, on the one hand, and off-street and on-street parking, on the other, we must point out that depending on the context, onstreet parking should be a primary, not a supplemental, subset of the parking supply. There are three critical advantages of on-street parking in this regard:

- 1. On-street parking offers the most flexibility across uses and time of day. Whereas development-based parking is typically limited to users of the specific development, on-street parking may be used by anyone seeking to park. This provides particular efficiencies when developments have different time-of-day use profiles. Shared parking, in which multiple developments with different time-of-day demands will rely on the same spaces, is a more efficient use of space. A hardware store and a movie theater are a classic example of a shared parking opportunity. The hardware store needs to accommodate customers during the day, and the theater accommodates customers at night. Rather than require each development to supply a full complement of parking with one set idle while another nearby is oversaturated, a shared parking arrangement can lead to more efficient use of both. On-street parking provides the ultimate efficiency by providing maximum sharing.
- 2. On-street parking is safer than setback or off-street parking because drivers are not required to travel across the pedestrian path to access the parking spaces. Parking lanes can be designed between the carriageway and bicycle or pedestrian lanes as a way to protect the non-motorized lanes from moving traffic incursions.

Public off-street parking also provides an important opportunity for shared parking, thus limiting the amount of time that spaces are idle. New York City is currently considering a policy that would make all parking in developments in certain parts of the city public. Rather than being the primary source for parking space, private development parking should be limited to the maximum extent possible.

Finally, it is critically important, as the goal states, that the scale and location of parking facilities are coordinated with road and transit capacity. At present, there is no mechanism by which this can occur in Guangzhou.

⁷⁰Based on estimates in The High Cost of Free Parking by Shoup and in "Housing Affordability" by Litman "(USD \$20-35,000 per structured space).

⁷¹Auto use is highly dependent on the cost and supply of parking (c.f. Vaca, and Kuzmyak, "Parking Pricing and Fees"; Pratt, Kuzmyak, Weinberger, and Levinson, "Parking Management and Supply.".

⁷² Mogridge, "Urban Road Capacity Policy."

3. Increase citywide supply of underground parking by 130,000 spaces.

The proposed increase in citywide supply of underground parking stands in stark contrast to the other objectives. In particular, the additional spaces are proposed for the areas that the City has identified as places where parking should be restricted and where the city has explicitly lower requirements set for development. To our knowledge there has been no analysis, consistent with Goal Two, that verifies whether there is road capacity to accommodate the increase in auto trips that will be induced by the increase in parking supply.

4. Maintain travel speeds of 25 kmh or higher.

Guangzhou has set forth a policy goal of maintaining central city arterial speeds of 25kmh.73 It would also be appropriate to set a safety target along with a traffic flow target. In addition, urban design guidelines and street design guidelines can accompany vehicle flow targets. While improvements can frequently be made in signal timing and other technologies, traffic speed is primarily a function of traffic density. Additional parking increases the utility of driving, which leads directly to increased congestion and lowers traffic speeds. When congestion is a limiting factor, then additional parking goes unused.

The travel speed of public transit determines the travel speed of cars, and vice versa. This has been demonstrated theoretically and empirically.74 When transit speeds are below car speeds, people will prefer to use the private car adding more congestion to the road until car speeds are equal to transit speeds. When transit vehicles do not operate in exclusive rights-of-way, they are subject to and slowed by auto congestion. Managing parking supply so that it matches road capacity is one of the most powerful tools cities have to reduce congestion.

5. Encourage additional land development.

Based on the research cited above, analysis of

the Swiss Re building, and the evidence presented in the next section on the IFC and Taikoo Hui developments, it is clear that after a point, parking is considered a sunk cost and not an asset to developers. In small and medium-size cities in the United States, development increases have been linked to the abolition of costly minimum parking requirements.75 Large cities like London and New York City have implemented parking maximums rather than minimums, and developers have consistently chosen to use their investments to create active, revenue- and taxgenerating uses over parking.

6. Encourage purchase of automobiles by residents in order to support three automobile manufacturing plants in the city.76

Cities are very complex and must try to meet a variety of needs. A very effective way to foster automobile ownership is to subsidize it. Whether the subsidy comes as a direct cash incentive, a tax credit, a municipal investment in auto infrastructure or some other form, it will have the effect of increasing auto ownership. Increased auto ownership will bring increased auto use with all the implied benefits and detriments.77 As far as traffic and transportation are concerned, this policy will further exacerbate congestion and environmental externalities associated with auto use.

Summary

Current off-street parking regulations in Guangzhou are made irrespective of the transportation system. Some evidence suggests that parts of Guangzhou are already oversupplied, relative to the transportation system. As it was argued above, continuing on the current path is expected to foster the following outcomes:

- Limits on development
- Lower density development
 - Poorer quality of pedestrian environment
 - Poorer quality of public transit
- Increased subsidies to car ownership and use
- Greater car dependence
- Increased congestion

⁷³Guangzhou Municipal Communications Commission, Mitigating Traffic Jam.

⁷⁴Mogridge, The self-defeating nature of "Urban Road Capacity Policy.".

⁷⁵ Siegman, "Less Traffic, Better Places."

⁷⁶Transport Planning Research Institute (Planning Bureau) meeting, December 12, 2011.

⁷⁷Kain, "Postwar Metropolitan Development"; Schimek, "Household Motor Vehicle Ownership"; Holtzclaw, Clear, Dittmar, Goldstein, and Haas, "Auto Ownership"; Weinberger, "Choice to Drive."

Findings

The major findings of this analysis are that parking policy in Guangzhou is inconsistent and seemingly ad hoc. There are many agencies involved in setting the various parts of the policy, and there is insufficient coordination among these agencies. The city intends to supply massive amounts of parking spaces in the very areas that have been designated for limited parking construction. Current parking policy has the potential to undermine objectives that the city has set with respect to traffic performance and economic development. The apparent commitment to automobile travel may also contravene national sustainability goals.⁷⁸

Our review of Taikoo Hui and the IFC reveals that existing parking is underutilized. While the lots may see more intense usage in the future, the current access mode split is 92% non-auto versus 8% auto at Taikoo Hui and 87% non-auto versus 13% auto at IFC. The excellent access opportunities, including metro, bus, bicycle, and walking greatly reduce the need for auto access and other auto accommodation such as parking.

We do not infer from utilization at these developments that parking shortages are not felt in other parts of the city. We do, however, caution that a perceived parking shortage can be addressed by appropriate pricing concomitant with the provision of alternative access modes.

Finally, of paramount importance is the fact that the existing parking rules seem to be set to ensure the convenience of drivers and car owners irrespective of any urban planning or urban design principles that correspond to livable, sustainable, and economically successful cities.

Eight Strategies: Impact on Guangzhou

Strategy 1: Establish a centralized entity to manage all parking activities.

As discussed in the previous chapter, on- and off-street parking are two interrelated components of the parking supply. Parking policy is most effective when both on- and off-street spaces are managed together and in concert with the rest of the transportation system. Bringing all of Guangzhou's parking spaces under the control of a single entity will enable the municipal government to manage supply more effectively and set prices to ensure that cars use the available parking capacity effectively. This is much more efficient than simply building new spaces in the areas of highest congestion or highest perceived parking shortages. This would be an improvement over the city's current arrangement where different entities manage on-street spaces, off-street spaces, and parking pricing. It will break down barriers to creating coordinated parking policy.

Strategy 2: Manage On-Street Parking Through Better Pricing

Appropriately pricing on-street parking can ensure that drivers make the best use of limited on-street parking space, relying on it for shortterm stops at local shops and moving off-street for longer-term stays in a particular area. Guangzhou currently employs on-street charges in certain areas, but prices are limited by municipal policy aimed at keeping parking affordable rather than meeting transportation-related performance targets. This leads to a situation in which in certain areas, street spaces are completely filled while nearby garage spaces sit empty. Relaxing price limits and implementing paid parking in all congested commercial corridors, with prices tied to performance objectives, will greatly reduce congestion while improving the pedestrian environment, a key to fostering thriving commercial corridors. Experience around the world shows that appropriate management of parking demand is especially critical in a rapidly motorizing city like Guangzhou: cities that failed to manage parking demand in the same situation saw degradation in the pedestrian environment in commercial areas.

As outlined in Section III, appropriate management of parking demand can be implement-

ed in several key ways:

Introduce paid on-street parking

Free curbside parking is by nature an underpriced commodity that will be over consumed in the highest-congestion corridors. By implementing paid parking in all commercial corridors, Guangzhou can send better price signals to drivers about the cost of bringing a car into a congested area and taking up scarce street space. This will either make longer-term parkers find space further away from the most congested areas (either on-street or in garages) or make people take transit. Either way, with parking rates set at the optimal level, commercial corridors should actually see more customers with less congestion. There is significant existing capacity off-street to absorb drivers redirected by new parking fees, as evidenced at Taikoo Hui and the International Finance Center shows that. Hong Kong is a successful example of a city that instituted priced curbside parking in large parts of the city as one strategy for dealing with congestion as the city rapidly motorized in the 1970s.

Use pricing to achieve an available space every block face

Setting prices at a level that achieves a performance target of one open space per block face will further reduce congestion by ensuring that drivers looking for a space will always find one near their destination without spending too much time circling in search of a spot. As earlier in the paper, a large percentage of traffic in congested areas consists of people circling in search of an underpriced curbside space. Adjusting prices to meet an occupancy target can solve this problem, making Guangzhou's commercial corridors more accessible and pleasant environments. Minimizing slower traffic that is circling for parking can also help the city achieve its 25 kmh traffic speed target. Seattle, San Francisco, New York City, and Taipei all adjust prices to meet a performance standard like this, and all have shown success in reducing congestion with this approach.

Link parking to transit and demand

Using some parking proceeds to fund transit enhancements will further ensure that people

who would have driven if not for parking prices will be able to find an easy way to get to a particular commercial corridor. Guangzhou has already made significant investments in transit in the last few years. Parking prices should not drive potential customers away from transit now that its service to key corridors can be improved with small enhancements and thus made more attractive. Such an approach to managing parking demand should also allow the city to make more effective investments than the significant amount of money that is currently planned for new garage spaces. Parking demand will vary throughout the day and over time, so it is critical that prices be able to adjust to meet curbside occupancy targets. Boulder, Colorado, is an example of explicitly tying parking revenues to transit enhancements, and cities like Barcelona have also created similar programs.

Strategy 3: Technological Solutions and Outsourcing When Appropriate

Payment- and data-collection technologies implemented in cities around the world can help ensure that Guangzhou's on-street pricing program can adjust to different levels of demand over time and can help make curbside parking easier for those willing to pay. In concert with convenient transit service, this can ensure that every potential visitor to a particular corridor can focus on why they are there, not the journey to get there. Multi-space meters or pay-by-phone technologies can also help ensure that limited curbside space is used as efficiently as possible, allowing cars of different sizes to take only the space they need (where metered spaces are all the same size, regardless of the occupant). In addition to the space efficiency and convenience of these technologies, they can also help collect and share data with a central data center, allowing administrators to more easily adjust prices based on occupancy levels. Newer technologies that embed sensors in the street can also help with data collection, though such devices have yet to prove reliable. Coupled with technology, a creative administrative arrangement can help ensure an efficient parking operation.

Use contracts to specify performance standards

Some cities have had success contracting out parking management efforts to a private entity. For such a scheme to be successful in Guang-

zhou, contracts must set clear performance standards while allowing the private operator flexibility to meet those standards creatively. This can create an incentive to use data, structure labor contracts, and orient administrative structures to meet performance targets as efficiently as possible. For Guangzhou, such an arrangement can also simplify parking policy and oversight, consolidating all parking management duties under one parking management entity. Barcelona is an example of a city that has successfully contracted parking operations out to a private operator.

Define financing obligations and revenue model

It is critical that contracts clearly lay out the operator's financial obligations and create clear revenue streams for the city over the life of the contract, to ensure that such contracts are not simply government revenue transfers to private enterprise. Without clear arrangements on these fronts, such contracts could tie Guangzhou's hands for years to come and deny the city critical revenue. An example of a less successful contract arrangement is Chicago's deal to sell its parking meters, which serves as a cautionary tale for other cities.

Strategy 4: Eliminate Parking Minimums and Establish Maximums or Parking Caps

Guangzhou's current off-street parking requirements will ultimately oversupply parking, inducing people to drive at higher rates than they might have otherwise and leading to other negative consequences over time, as discussed in section III. As the International Finance Center and Taikoo Hui's success with lower-than-mandated levels of parking shows, developers will build much less parking if given that option, and such developments can still be successful. Establishing parking maximums, rather than minimums, can ensure that the price of parking is in line with the negative externalities of buying a car and bringing it into a dense city. Along with adequately priced curbside and off-street public parking, this can ensure that people use the most space-efficient modes of transportation to get around Guangzhou. Cities around the world have shown that this mix is the best way to create thriving urban environments. New York City and Zurich are examples of the cities that have successfully implemented parking maximums in certain city districts.

Strategy 5: Decouple Land Use from Off-Street **Parking Requirements**

Guangzhou's parking supplies should be set according to street and transit capacity, not land use (currently, Guangzhou's parking minimums are set without consideration of the capacity of surrounding streets). Moving parking requirements from land use regulations to the transportation arena can ensure that this happens. It can also ensure that developers do not build the cost of parking into the price of every unit, regardless of the tenants' transportation habits, which can in turn ensure that non-drivers do not effectively subsidize others' driving. This will bring down the overall cost of development and open limited urban space to active uses rather than car storage. It will also correspond to the Transportation Planning Research Institute's finding that developers do not want to build as much parking as minimums currently require. Cities with downtown parking freezes, such as Zurich and Copenhagen, have effectively decoupled land use from parking requirements.

Strategy 6: Price or Tax Off-Street Parking according to Market Cost

Pricing or taxing off-street parking, in concert with the pricing of on-street parking can ensure that only those who must drive to congested areas do so while everyone else uses spaceefficient modes to get to work and other destinations. Without financial disincentive to driving in Guangzhou, current vehicleownership and usage trends will continue. This, in turn, will cripple the city with congestion during commute hours because the street system lacks capacity to handle as many vehicles as are projected to be on the city's roads by 2020.

Allow employee cash-out programs

Employee cash-out programs compensate workers for passing up a free or subsidized parking spot in favor of more space-efficient modes. This can ensure that employees in Guangzhou office buildings that already have plentiful parking can make rational transportation choices that align with broader interests of reducing congestion and other single-occupancy-vehicle externalities. Such programs have been successful in reducing single-occupancy vehicle commuting. California has instituted a state-wide parking cash-out program that can serve as a model for this kind of program.

Tax employee parking

Taxing employee parking can ensure that those who do drive to work feel some of the hidden costs of this choice. In Guangzhou, this means the incremental congestion, pollution, and other negative externalities drivers cause in passing up more space-efficient modes to take a car to work. Seoul and London are examples of two different approaches to taxing employee parking spaces.

Charge market rates for off-street parking

Coupled with on-street pricing, off-street parking charges can send drivers clear price signals about the cost of bringing cars into congested areas. This can also give Guangzhou a clearer idea of actual parking demand (instead of an idea of how much people will overconsume a currently underpriced good), likely saving the city from building some of the 130,000 expensive garage spaces currently planned. Hong Kong and Tokyo are examples of cities that have allowed off-street prices to float to rates commensurate with market demand

Sell parking as a luxury item

Treating parking as a luxury commodity can ensure that people do not overconsume what is a truly limited good. Again, Tokyo, which has some of the highest on-street parking prices in the world, is a good example of such an approach.

Strategy 7: Enhance Enforcement through Electronic Technology and Physical Design

To ensure that cars use only legal on-street parking spaces, Guangzhou can use curbs, bollards, and other urban design treatments. Such devices can help increase street safety for all users by ensuring that cars do not intrude upon pedestrian and bike rights-of-way. This is critical in Guangzhou given the widespread use of building setbacks for parking spaces. Stopping drivers from this practice will require clear physical barriers that prevent cars from driving over sidewalks, in addition to strong enforcement measures. Physical design approaches can also help make corridors more inviting to all users through visual cues that slow cars down. Paris and Zurich are great examples of using physical design to guide driver behavior.

in the latest smart meters and license plate recognition technology that communicate information about occupancy, duration of stay, and

even data regarding the function of the meter itself to a coordinating center will promote great efficiencies in enforcement efforts.

Strategy 8: Provide Clear Information on Parking Supply to Ensure It Is Used Effectively.

Expanding Guangzhou's downtown parking information systems can help drivers quickly find an open space, allowing them to avoid adding to congestion in their pursuit of an open on-

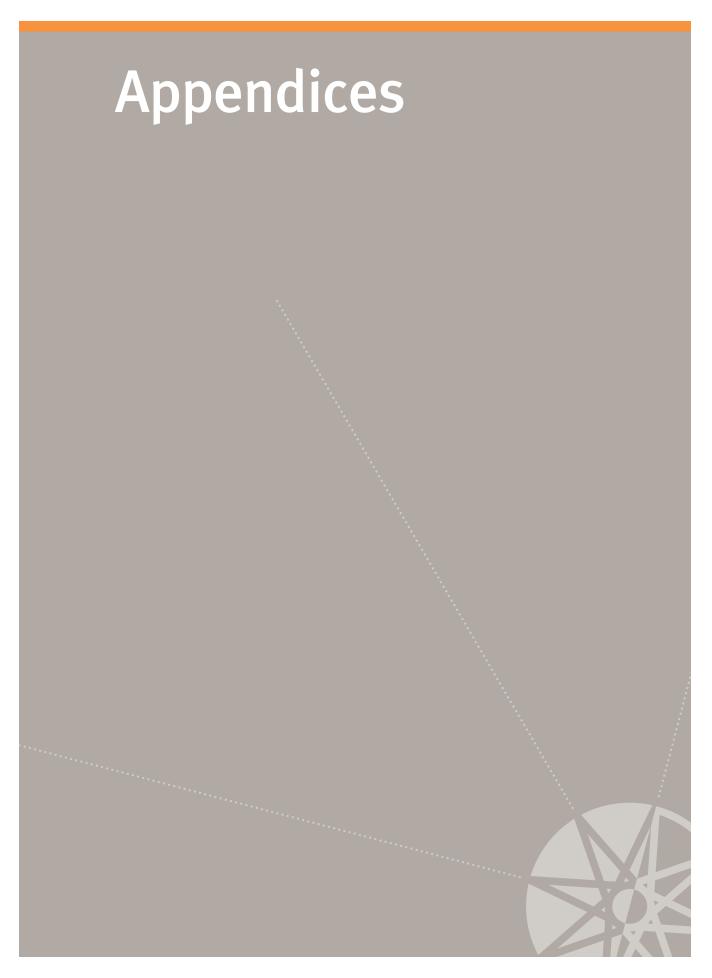
or off-street space. Such systems can also help alert drivers to off-street spaces in garages about which they might not have otherwise known, opening up curb space to short-term parkers. Such systems should allow drivers to make better use of the existing capacity, which will also help Guangzhou save the cost of building expensive new garages in areas with perceived parking shortages. Seoul is an example of a city with an expansive parking information system.

V. Conclusion

It is often simply not physically possible to move more vehicles across a road network. The road system's capacity provides an upper limit on private vehicle access. When that limit is reached, increased congestion is the result. Parking supply affects decisions people make about how they will travel, impacting congestion, air quality, and the quality of life. Increasing parking supply induces more vehicles onto the streets and highways causing congestion, delay, and exacerbating pollution.

Recognizing that increased parking leads to increased driving, many cities, including Antwerp, Seoul, New York City, and Zurich, have implemented parking maximums. The purpose of the maximums is to ensure smooth traffic movements and to reduce private vehicle use. There is no reason for cities today to repeat the errors. Chinese cities can revisit their parking policies by unpacking zoning regulations and better managing setback and on-street parking. To avoid worsening traffic conditions and placing a drag on the growing economy, Chinese cities can use off-street parking as a solution to on-street parking problems. They should consider access planning using multiple modes instead. Cities that emphasize multi-modal rather than private-vehicle access alone tend to be more prosperous.

The outcome of following the parking policy recommendations will be a more rational utilization of the existing parking capacity in an area, lower vehicle kilometers traveled, less traffic congestion in dense areas, more efficient use of on-street space, and safer streets for all users.



Appendix A: Case Studies

Amsterdam: The High-Tech Enforcement Solution

Problem

In Amsterdam, parking enforcement was mostly carried out by parking wardens patrolling the streets on foot. This was often quite inefficient, requiring a large number of employees, each of whom had limited range.

Strategy

The city implemented an enforcement scheme that requires fewer people to execute.

Programs

Scan cars accompanied by wardens on scooters have begun to take over enforcement responsibilities. The scan cars, designed by Abstract Computing International B.V. using a Volkswagen Caddy Maxi vans, use six cameras and automatic license plate number recognition technology to identify illegal parkers. The scan cars travel at 40 kmh up and down the streets taking 160 scans per second. Wardens follow the scan cars on scooter and issue tickets for any violation they find. This system is twice as efficient as the previous one. Scan cars have a 98% accuracy rate, but some cars, usually foreign, still need to be checked manually.



o: Michael Kodransky



o: Michael Kod

Top: Amsterdam parking meter, Bottom: Amsterdam parking ward

Barcelona: Centralized Management of Parking Inventory

Problem

Barcelona's center-city congestion has become a major problem in the last several decades.

Strategy

The city put together an integrated set of solutions that made it more expensive to park in the city center and gave residents and visitors more ways to get around the dense area.

Programs

Barcelona launched an integrated parking program called Area Verde (Green Zone). Its purpose was to regulate visitor parking supply by limiting parking time with a pricing mechanism and by giving priority to residents. Payand-display parking is available in 20 districts with varying pricing. Residential and preferential parking permits are also available. Residential permits allow residents in the Green Zone to park at a lower rate while preferential permits allow non-residents to park in exchange for paying the city's highest hourly rates. The project also converted parking spaces into motorcycle

parking and Bicing stations.

In Barcelona, 100% of the net revenue generated by on-street parking fees has been used to fund the city's bike share system, Bicing. Bicycle trips increased from 30,000 trips a day in 2006 to nearly 100,000 a day in 2009. This is due to the introduction of the Bicing system as well as a 150 km expansion of bicycle paths.

The city has a parking management corporation (B:SM) that oversees both on- and publicly owned off-street parking, and tries to harmonize prices.79

Results

As a result of these reforms, traffic congestion has been reduced by 5—10%. In 2007, mode share was roughly one-third each for public transit, automobiles, and non-motorized transit. Approximately 40,000 of 2009's 100,000 daily trips were made by Bicing users. Roughly 4% of Bicing users are former car commuting drivers; nearly 5% are former car commuting passengers or motorcyclists.



Barcelona Gracia district parking & plaza

⁷⁹ Kodransky and Hermann, Europe's Parking U-Turn, 36.

Beijing: Increased Parking Fees to Tackle Congestion

Problem

The parking spaces are seriously insufficient in Beijing. The statistics of the Beijing Municipal Commission of Transport shows that by June 2021, there will be 5,100,000 registered vehicles and only 2,500,000 parking spaces in Beijing. In particular, the shortage of parking spaces is most severe in the areas within the 3rd ring road where hospitals, schools, government agencies, and business centers are located. This is one of the factors causing the notorious traffic congestion in Beijing.

Strategy

The Beijing government has attached great importance to the parking issue and adopted various policies and measures to address it. One innovative measure adopted is the adjustment of parking fees. The Beijing Development and Reform Commission issued the Circular on Adjusting Parking Fees in the Non-Residential Areas on Dec.18, 2010, and new parking fees came into effect on April 1, 2011. The Circular's strategy is to charge based on the area the car is parked in—the nearer to the city center, the higher the charge. Moreover, parking fees are raised for the cars parked in the designated key areas. It is designed to provide disincentives for parking in the city center and thus encourage people even more to use public transport.

Program

To implement the new parking fees system, the parking lots in the non-residential areas have been divided into three categories. Category 1 is the area within the 3rd ring road as well as 4 other designated key areas where business and commercial centers are concentrated, and the fee is 35 RMB for 1 parking space per day. Category 2 includes areas within the 5th ring road except the Category 1 area, and the parking fee is 15 RMB. Category 3 is the area outside the 5th ring road, with the parking fee of 3.6 RMB.

Furthermore, the timing unit was changed from the previous 30 minutes to 15 minutes, and the unit parking fee is differentiated based on the



oto: Karl Fjellstr

type of parking lot in which the car stays. Take small vehicles parked in the Category 1 area for an example: if a small vehicle is parked on the parking lot occupying the road, the fee is 2.5 RMB per 15 minutes, and it will be increased to 3.75 per 15 minutes after the 1st hour; if it is parked on an open parking lot off the road, the fee is 2 RMB per 15 minutes; and if it is parked in a closed facility like a parking garage or an underground parking lot, the fee is 1.5 RMB per 15 minutes. In particular, for the 4 designated key areas, the parking fee increases to 15 RMB per hour after the 1st hour passes. In the other 2 category areas, the unit fee is lower than that in Category 1, but the fee for the parking lots occupying the road is higher than that for the other types of lot.

In short, the adjusted parking fee discourages drivers from parking in the city center, and if they need to park, then the charging system encourages them to use a parking lot off the road.

Result

By the end of the first month since the implementation of the adjusted parking fee, the number of cars parked in off-street surface parking lots has declined by 19%. Due to a combination of the adjusted parking fee and other measures, the traffic congestion has decreased by 1 hour and 45 minutes daily within the 5th ring road, and the daily passenger traffic of public transport has increased by 3.3% compared with the same period in the previous year.⁸¹

^{80 &}quot;Beijing Lacks More Than 2 Million Parking Spaces, Where to Park Cars?" People Website, July 7, 2012. http://auto.people.com. cn/n/2012/0707/c1005-18464913.html

^{81 &}quot;105 Minutes Less in Traffic Congestion within the Beijing 5th Ring Road, Rising Parking Fees Plays a Key Role," Phoenix Website, May 10, 2011. http://auto.ifeng.com/usecar/traffic/20110510/607017.shtml..

Budapest: Parking Control Center for More Effective Management

Problem

Budapest rapidly motorized in the 1980s and 1990s, and with motorization came heavy congestion and parking problems.

Strategy

The city government used a three-pronged strategy to attack the problems. It worked to centralize control of the entire transportation system, including parking. It also tried to bring the price of parking and other transportation choices more in line with the city's transportation goals and more reflective of high building densities and limited street capacity in central areas. Finally, the city worked to incorporate modern technology to better manage and enforce compliance with the parking system.

Programs

Budapest's transportation system is centralized under the City Operation Committee, a group of policy makers that makes key decisions about public transit, parking, and non-motorized transportation. The committee established the Budapesti Közlekedési Központ (Budapest Transport Center) to manage the transportation system on a day-to-day basis.

The committee has established four parking zones in the city; prices vary between zones based on density, transportation system capacity, and documented parking occupancy. Parking is more expensive than a transit ticket in the two most central zones, and prices are also close to the 1.2 Euro base transit fare in the other two zones. The city has also overlaid the highestprice zones over historic districts in which they want to minimize traffic.

Budapest has also used technology to make parking management and enforcement easier. The city uses multi-space electronic meters, which allow a variety of payment methods, to

collect parking fees in most areas, and the city has started using pay-by-phone systems in certain areas as well.82 The city also uses parking sensors to better understand parking utilization rates and communicate that information in real time to the public.

To make enforcement more efficient, the city uses van-mounted license plate readers and sensor technology to alert parking enforcement officers to violators. Enforcement officers also carry GPS-enabled devices that share data with the parking operator and central government.

A final element that the city feels was critical to their success was the use of private sector companies to install the meters and to implement operation and enforcement. The expectation is that after a number of years, the private companies will train and turn over the systems to the city proper.



Results

In the more expensive inner-city zones, the occupancy rate is around 70-80% because of the higher parking fees and the many off-street parking spaces. Parking conflicts are usually in areas where the fee is lower or where there is no fee at all. In those areas the occupancy can be 110%.

⁸² Institute for Transportation and Development Policy. "Sustainable Traffic in Budapest."

Hong Kong: Comprehensive Strategy Includes Shared Parking and Market Pricing

Problem

With very high urban densities even by Asian standards, Hong Kong began to grapple with automobile-related congestion in the 1970s, as the city motorized. The city saw rapid growth in curbside parking issues, and until the mid-1990s, leaders believed the city had a significant parking shortage. Today, while the parking supply has not changed dramatically, the role of parking has been recast. The city leaders no longer believe there is a parking shortage, and official policy now aims to ration scarce space in the urban core and encourage people to take other modes.

Strategy

Hong Kong has used a two-pronged strategy to deal with limited space for cars in its city center: most off-street parking has effectively become shared while the curbside has been priced according to its market cost.. These strategies couple nicely with an extensive and highly efficient public transportation system.

Programs

To make the most of limited space, Hong Kong has reduced accessory parking requirements to near zero in some areas.⁸³ It is one of the few Asian cities that, in some cases, allows developers to pay a fee in lieu of building parking,⁸⁴ and though it still uses mandated parking minimums in private development, these minimums are quite low. In the central business district, developers are mandated to build .4 parking spaces per 100 m22 of commercial space. Minimums outside the CBD are not much higher, at 0.6 spaces per 100 m2, and the requirements for shopping facilities are quite low relative to those in many Asian cities, at 0.4 spaces per 100 m2.⁸⁵

Residential minimums are also low. Private

developments must build 0.1 spaces per unit for small developments and 0.6 spaces per unit for medium-sized ones. All subsidized housing developments are required to build only 0.03 spaces per unit.⁸⁶

The city's on-street parking management program is generally effective, with relatively high curbside prices and effective enforcement. On-street spaces cost a universal HK\$8 per hour—this price is set by legislation and does not vary by geography or time of day.⁸⁷ Where demand is highest, the city establishes curbside parking time limits. Meters only accept payment via special Octopus contactless cards.

Finally, the government has invested a significant amount of money in off-street shared parking facilities. Much of the government-owned capacity was built as part of public housing developments, though the housing authority has "divested a large portion of its former stock." The government has built a small number of stand-alone garages as well.

A good portion of off-street parking is on vacant lots. Because the government owns all land in the administrative region, it must explicitly lease lots for use as parking, which gives it important control over supply. Much of the off-street supply—both government and privately operated—is priced to the market.⁸⁹ Hong Kong's "parking prices... are the only ones [in Asia] at close to cost-recovery levels."

Results: Hong Kong has very low car ownership, especially given the wealth of its citizens. As in New York City, this fact must be attributed to its relatively low accessory parking mandates, its use of market pricing to ration parking demand, and its extensive and efficient public transportation system.

⁸³ Barter, "Parking Policy," 19.

⁸⁴ Ibid., 20.

⁸⁵ Ibid., 14.

⁸⁶ Ibid., 16.

⁸⁷Ibid., 32.

⁸⁸ Ibid., 38

⁸⁹ Barter, "Parking Policy," 39.

⁹⁰ Ibid., 50..

London: Changing Laws to Enable Controlled Parking Zones (CPZs)

Problem

With growing car ownership and use, London experienced heavy traffic on its narrow, medieval streets. Demand for limited parking supply led many cars to circulate in search of an available space, contributing to traffic congestion as well as air pollution and noise.

Strategy

The Road Regulation Traffic Act of 1991 shifted the responsibility of traffic violation enforcement from the police to local borough councils. The passage of this Act allowed individual borough parking authorities to decide what the best way of handling parking enforcement was. . The borough of Camden was the first to take advantage of the new power by using it to fill a budget gap, setting quotas for tickets issued in order to raise more revenue. Other boroughs eventually instituted a similar strategy, using private companies. The public grew suspicious and angry that these private enforcers misused their powers and issued excessive tickets.

With the passage of the Traffic Management Act (TMA) in 1994, it became illegal to set quotas for the issuance of parking tickets. The new regulation also required that parking contracts include measures to better track how parking revenue is generated (e.g., whether through parking fines or on-street fee collection). Until March 2008, all boroughs had to comply with the TMA. The borough of Islington thought it would be a best practice to hold a public forum with numerous citizen stakeholders to gauge what different people wanted in the new parking agreements. The result was a Common Sense Parking Contract that has now been replicated by other boroughs. As a best fiscal practice, income from parking fines is considered collateral rather than the main target of parking policy.

In London, the boroughs are advised to set curbside rates to achieve an 85% saturations rate. Parking income is limited by statute, which restricts surplus income to transportation projects. A number of boroughs use the money from parking fees to fund the Freedom Pass program, which allows elderly (60+) and disabled residents to use public transit for free.

Program

London is divided into 33 boroughs, each with its own local authority that handles parking issues. The local authorities are coordinated in their strategic actions, such as releasing annual reports on the state of parking, by the London Councils—an umbrella lobbying group working to further the interests of borough councils while also overseeing certain government functions across the city. Each borough can choose to have much stricter regulations that go further than those outlined by the London Councils. Many boroughs institute Controlled Parking Zones (CPZs) that specify when and where a car can park on-street. These zones are meant to discourage long-term parking through hyperlocalized fees rationed over an entire district.

London started pricing curbside parking in the 1950s to stimulate turnover of cars. Since drivers are price sensitive, the scheme helped generate turnover at the curb. As a result, fewer cars spent time contributing to traffic while searching for an available parking space. London is, perhaps, the first city to pioneer CO2-based parking fees that vary based on the vehicle's engine standards. It is also one of the first to charge for motorcycle parking in former carparking spaces. Motorcycles have become more popular in the city since the congestion charge was implemented in 2003. Motorcycles can enter the priced zone for free.

Every borough is required to have an annual report on the state of parking.

Results

A UK-based study compared the effect of parking restrictions and improved public transit on car use. Doubling parking fees reduced car usage by 20%. Cutting the parking supply in half led to a 30% drop in car use.91

⁹¹ Dasgupta, Oldfield, Sharman, and Webster, Transport Policies in Five Cities.

Mexico City: Anti-corruption Enforcement Techniques

Problem

Until recently, Mexico City's on-street parking was either free or controlled by franeleros (informal street valets). Franeleros accommodated many drivers' parking needs, but their system led to a chaotic and unattractive street environment with vehicles parked on sidewalks, corners, and in private driveways.

Strategy

Facing increased congestion, Mexico City has experimented with several parking management systems in an attempt to replace the franeleros with a more effective system.

Programs

Most recently, the city implemented ecoParq. ecoParq began with Mexico City's sustainable development plan and its goal of installing

1,633 multi-space parking meters by 2011. Mexico City outsourced the operation of the parking system to a private contractor that receives 70% of the revenue. The system was launched in December 2011 with the installation of 77 parking meters in the south center of the Polanco neighborhood. As of 2012, expansion throughout Polanco has created 6,600 spaces overseen by 436 multi-space meters. The key to success was ecoParq's solution of the enforcement problem. Corruption was a concern; so, the city paired each ecoParq employee with a female police officer, who are less likely to be assaulted by disgruntled drivers than male officers, and both are rotated from zone to zone to avoid corruption. Upon violation, a clamp is put on the tire and can be removed only by an ecoParq employee after paying the fine.





notos: Michael I

Before and after meter implementation in Polanco

New York City: Comprehensive Strategies Caused by **Air Quality Concern**

Problem

Recognition of automobile-related problems in New York City came in two waves over the last several decades. The first wave was during the 1970s and 1980s, when people began to raise major concerns about the air-quality impacts of automobile congestion and looked at limiting parking as a way to reduce cars in the most congested districts. The second came in the last decade, as residents and officials raised further questions about congestion and safety in commercial corridors and how excess auto traffic adversely affected the quality of life.

Strategy

In response to the earlier era of concern, the city eliminated accessory parking minimums in the "Manhattan Core," below 110th Street on the West Side and below 96th Street on the East side.92 In place of the minimum parking requirements, the city set maximum parking allowances. Setting parking policy in the context of the broader transportation system, the city also revised all the other districts' minimums, setting them in relation to each area's density and proximity to transit.

The second era began in the 1990s, when the city started raising the meter rates in midtown Manhattan, an area with extreme office density, to encourage more short-term parking. In the 2000s, the city initiated efforts to vary curbside parking prices based on demand, to modify their maximum allowances in accordance with street capacity, and to re-program street space in order to enhance accessibility by meeting the needs of all kinds of users, not just drivers.93

Programs

New York City's Manhattan Core parking maximums were established in 1982, and they are set much lower than parking minimums in the rest of the city and most cities throughout the United States. Residential uses are allowed from 0.2 to 0.35 spaces per residential unit, and maximums are set even lower for low-income housing (from 0.12 to 0.25 spaces per unit and up to 200 spaces).94 Commercial uses are allowed 1 space per 4,000 ft2 of development and up to 100 spaces. Privately-operated public lots and garages are allowed by special permit.

Outside the core, the city's residential parking minimums are also quite low, relative to most North American cities, and are based on density and proximity to transit. In medium- and highdensity districts, typically near transit, developers are mandated to build from 0.4 to 0.5 spaces per dwelling unit.95 In lower-density districts, the mandate is from 0.66 to 1 space per unit, with higher minimums in areas called "low density growth management areas," where there are fewer transit options.

New York City's Department of City Planning has also started to further lower or eliminate parking minimums in specific areas with high density and high levels of transit access.96

At the curb, the city has long used meters in many commercial districts and restricted onstreet space to delivery vehicles on many Manhattan Core streets during business hours. But in 2008, it began piloting further efforts to more effectively ration the use of curb space. In the heaviest commercial area, the city charges progressive hourly rates (i.e., that increase for longer stays). This has managed to reduce automobile congestion and circling. Since longer stays are now very expensive, deliveries are made more quickly, and drivers then move along to make space for the next user. A more recent initiative, called PARK Smart, raised meter rates on the commercial streets of several residential areas

⁹² New York City Department of City Planning, Parking Best Practices, 9.

⁹³ New York City Department of City Planning, Manhattan Core Public Parking Study, 1-2.

⁹⁴ New York City Department of City Planning, Parking Best Practices, 11.

 $^{^{96}}$ New York City Department of City Planning, "Off-Street Residential Accessory Parking."

⁹⁷New York City Department of Transportation, PARK Smart Greenwich Village, 2.

⁹⁸ New York City Department of City Planning, Manhattan Core Public Parking Study, 6.



during the hours of peak demand.97

Results

In the 30 years that they have been in place, Manhattan's parking maximums have led to a reduction in off-street parking spaces from about 127,000 in the early 1980s to 102,000 today.98 Traffic has risen only slightly in the area since the policy change even as Manhattan's power as a population and job center has grown dramatically. During this period, the city's core saw significant office and residential development;99 the air quality improved, and the city has met most federal requirements in the area. 100

PARK Smart reduced curbside occupancy just enough to reduce congestion associated with parking searches. 101 In surveys, drivers reported that the new meter rates did reduce their parking time. Because the pilots met their goals, they were made permanent, and the city expects to expand the program to new areas. 102

Summary

New York has implemented a number of parking programs to improve air quality, reduce congestion, and improve the quality of life. The city has replaced parking minimums with maximums in the city core, which has improved air quality and reduced congestion concomitant with major expansions in commercial and residential space. In outlying areas, the city implemented low parking minimums which vary according to density and proximity to transit. Meter rates in some commercial zones escalate after the first hour, which has facilitated parking turnover and reduced double parking associated with delivery and other commercial transactions. More recently, the city has implemented performance standards for on-street parking, increasing curbside prices in the commercial areas of residential neighborhoods during peak hours. To date, each of these policies has been successful, and the city is looking to expand their implementation.

⁹⁹ Ibid.. 4.

¹⁰⁰ Ibid., 12.

 $^{^{\}rm 101}{\rm New}$ York City Department of Transportation, PARK Smart Greenwich Village, 11.

¹⁰²New York City Department of Transportation, "PARK Smart."

San Francisco: Using Dynamic Pricing to Reduce Congestion

Problem

San Francisco determined that a large share of traffic was related to vehicles searching for parking spaces in a few prime locations while vacant spaces existed nearby. They wished to eliminate the wasteful parking search and eliminate the negative environmental impacts associated with it.

Strategy

The San Francisco strategy is to set prices on every block to rebalance the demand. It encourages the cost-conscious parking to move to nearby blocks and reduces demand on the streets whose parking capacity is already exceeded.

Programs

In April 2011, San Francisco launched its SFpark pilot program. SFpark uses demandresponsive pricing to aim for a parking vacancy rate of 20% to 40% per block. Higher prices in the areas with the most demand encourage shorter stays and increase the availability of parking spaces. The increased availability of parking spaces reduces congestion caused by drivers cruising for parking. Wireless parking sensors are used to measure demand and determine pricing. These sensors also allow drivers to search for available parking via smartphone or the internet. In the pilot area, pricing can range from a minimum of \$0.25 per hour to a maximum of \$6.00 per hour. Rates vary by block, time of day, and

day of week. Rates can be adjusted by no more than \$0.50 per hour down or \$0.25 per hour up, and no more than once per month.

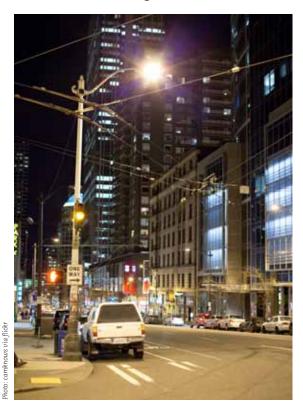
Results: The San Francisco Municipal Transportation Agency is in the process of compiling a comprehensive study of the pilot program, which will be released later this year. The agency announced in early 2012 that meter collections were up and citations down under the new program, both of which were goals of the program.



Seattle: Low-Tech Pricing Solution

Problem

Seattle has used parking meters to manage curbside parking for decades, but in 2010 the City Council and mayor decided to make the program more targeted and data-driven after seeing other American cities explore similar reforms. 103 Since the middle of the 20th century, the city has used one city-wide meter rate. Though the city began to vary rates geographically in three broad zones in the mid 2000s, city leaders wanted to use a data-driven approach to regulating curbside demand at the neighborhood level.



Strategy

In 2011, the city began setting curbside parking rates on a neighborhood-by-neighborhood basis and allowing rates to vary between \$1 and \$4 based on utilization. Regulations now

stipulate that the DOT adjust prices "based on measured occupancy so that approximately one or two open spaces are available on each block face throughout the day." 104

Program

The city implemented neighborhood-specific parking rates in 2011. Rates are to adjust based on parking utilization data, collected annually through manual studies. To date, the studies have cost \$125,000-\$250,000 and run from June to October. 105

In 2012, the DOT increased rates in 4 neighborhoods, kept rates the same in 7, and decreased rates in 11. For next year, the department plans to increase rates in 4 areas, decrease them in 3 areas, adjust time limits in 10 areas, and add 6 "best value" areas, with longer time limits and lower rates. 106

The program also includes a rebranding of the city's parking management efforts. The program is publicly called "SeaPark," and DOT has rolled out new signs and graphics to make clearer what time limits and rates are in different areas. Included in the signage program are labels for the "best-value" areas, to encourage drivers to park in these areas. The department has also implemented a public education campaign and plans to add new payment options with the aim of making parking a "fast, convenient experience." 107

Results

Through data collection and existing payand-display meter technology, Seattle has been able to adjust prices on a neighborhood-by-neighborhood basis, based on local parking demand. In 2012, the department found higher levels of parking availability in the four areas with rate increases. In all other areas, the department found no major shifts in utilization, whether rates stayed the same or decreased.

¹⁰³Mary Catherin Snyder, Parking Strategist, Seattle Department of Transportation, Interview, August 29, 2012.

¹⁰⁴ Seattle Department of Transportation, "Seattle's Performance-Based Parking Program," 11 and 14.

¹⁰⁵Ibid..

¹⁰⁶ Ibid., 14.

¹⁰⁷Ibid., 20-29.

Seoul: Low Minimums Address Oversupply of Parking

Problem

After years of high parking minimums and increasing automobile use, Seoul declared in 2009 that it had a "city center traffic disorder" related to the oversupply of parking in its densest districts. At the time, the city had 105.6% more parking spaces than cars, and the imbalance was concentrated in commercial areas. The city also found that it had capacity to fill just 93.4% of demand in the city's residential areas.



Strategy

Seoul has been the "most active of the Asian cities in adopting and innovating with parking management policy tools, including its parking maximums, residential permits, and varying onstreet parking pricing by zone, among others".

The city's 2009 parking strategy called for a reduction in overall parking supply by limiting the number of "annex parking lots". It also called for an effort to adjust the city's on-street fee system, open new shared lots, and implement an electronic parking information system in the city center in order to direct cars to open off-street spaces more easily.

Program

Off-street parking minimums for commercial uses in the central business district were lowered to just 10% of normal minimums, at 0.1 spaces per 100 m2.109 The city also set maximums in such areas, amounting to about 50% of the minimums in most outlying areas. 110

The city also prices street parking on a broader scale than most Asian cities. Prices reach as high as \$7.86 per hour in the most central of the five parking zones. 111 Prices slope down as one moves outward across the zones that are essentially concentric circles. Few other Asian cities employ a similar policy. 112

In most other areas of the city, however, Seoul's parking policies are quite traditional, in part because of the perceived parking shortage in residential areas. Parking minimums in outlying areas are quite high, compared to those in other Asian cities, at 1 space per 100 m2 of commercial space and 1.3 to 1.5 spaces per 100 m2 of residential space. The residential minimums were the highest of any city Barter studied in "Parking Policy in Asian Cities." According to Barter, this "may reflect an overcompensation for shortages in the past" when the city "faced serious parking conflicts in its traditional, low-rise residential areas and in older high-rise areas". 113

Results

The city has pursued a number of other efforts to get drivers to take other modes into the city, including the removal of the Chunggyecheon Expressway, new bus rapid transit routes, and congestion pricing. With the city's parking policies, these other changes have led to reduced traffic in the city center, improved air quality, and more ecological diversity in particular corridors. 114 Though the city's parking policy changes are not exclusively responsible for these improvements, they are a key element.

¹⁰⁸ Barter, "Parking Policy," 68.

¹⁰⁹ Ibid., 14, 48.

¹¹⁰ Ibid., 48.

¹¹¹ Ibid., 32.

¹¹² Ibid.

¹¹⁴Institute for Transportation and Development Policy, Urban Highways, 30...

Zurich: Fighting Congestion with Parking Caps

Problem

The city's mobility plan of the 1960s and 1970s sought to accommodate more cars on the road, including parking for them. Road capacity, however, was limited, which resulted in increasing congestion as well as air and noise pollution. In response to the worsening conditions on the road, Zurich began to enact more restrictive parking policies by the 1990s. The city expected that these policies would shift commuters toward public transit, walking, or biking.

Strategy

Zurich implemented district-wide parking supply caps in the 1990s, which required provision of fewer parking spaces in areas served by transit. The city increased its transit supply, prioritizing transit access over parking availability, and also introduced progressive parking pricing to ensure a high turnover of the existing parking spaces.

Programs

To reverse the legacy of the past decades and encourage the desired mode shift away from cars, Zurich improved public transit and invested in bicycle infrastructure. Zurich's 790 km street network now contains 447 km dedicated to public transit and 340 km dedicated to bicycle infrastructure. Throughout the city, a tram or bus stop is no more than 300 m away. In residential areas, some on-street parking for cars was removed and replaced with bicycle parking.

In 1996, a policy called Historischer Parkplatz Kompromiss (Historic Parking Compromise) was established. It placed a cap on Zurich's parking supply in the city center, which froze the numbers of parking spots in a particular district. If any off-street parking is created in the capped area, an equal amount of on-street parking must be removed. If the city does not agree to remove on-street parking, the off-street parking cannot be built. The removal of on-street parking allows for improvements for other modes of transport and for the creation of public plazas.

Outside of the city center, new developments



may provide parking, but steps are taken to limit its provision especially near transit. Developments near a tram or bus stop are required to have less parking than those that are not. The city can also reduce the allowed amount of parking according to an area's air quality and nearby road capacity, forcing developers to provide a mobility management plan. Traffic-contingent trip caps have been set outside of the city center, and a limit on the number of car trips to a new development is assigned. This is done by limiting parking. The city also allows and encourages car-free developments. A development qualifies as car-free if the builder can assure that all visitors will make the trip by transit, walking, bicycle, or motorcycle.

Zurich has two types of regulated on-street parking. Blue zones allow up to 9 minutes of free parking with the purchase of a monthly or annual permit. White zones require payment, and the price per 30 minutes is increased over time to encourage shorter stays. The second 30 minutes costs 4 times as much as the first.

Results

These measures have resulted in the intended mode shift. Between 2000 and 2005, public transit's modal share increased by 7%, while the automobile's share declined by 6%. Public transit now makes up the largest mode share in the city.

Appendix B: Guangzhou Parking and **Travel Behavior**

To get a deeper and more nuanced understanding of how travel and transportation work in Guangzhou, we selected two developments with similar characteristics. Each site was surveyed on a weekend day and a Friday to learn the access modes. The Guangzhou International Finance Center had higher use on the weekday, likely because it has more office tenants, while Taikoo Hui, the other development site, had approximately 30% more visitors on the weekend. The relevant parameters of the sites are described in Table 3.

Surveyors were stationed at every entrance to each site and instructed to count people entering on foot or by automobile. Efforts to ascertain the access mode and origin were undermined by the security guards who forbade the surveyor team from engaging with the site visitors, but we were able to infer valuable information from the entrance counts. In two days, over 18,000 people visited the International Finance Center (IFC), which comprises an extensive retail area, office space, a conference center and hotel, and serviced apartments. The vast majority of the IFC visitors walked or came by public transit, but 16% of the weekend visitors and 12% of the weekday visitors came by car. The site generated over 1,500 auto trips.

. Though it is zoned for 0.5 parking spaces per 100 m2, the developers supplied as few as 0.37 spaces per 100 m2 instead. The comparison site, Taikoo Hui, saw almost 55,000 visitors. As with the IFC, the majority of people came by transit or walked from nearby locations; only 9% came by car on the weekend, and 7% came by car on the weekdays. The site generated 3,000 auto trips. In spite of attracting three times as many visitors, Taikoo Hui generated only twice as many car trips. Both sites are located along the new metro, but Taikoo Hui, which is also accessible by BRT, has half as many parking places. The price difference is almost negligible: only 2RMB/hour.

The prevalence of parking, rather than affecting the number of trips to these sites, appears to have a larger impact on the way in which people choose to access the sites. The modal splits are shown in Table 4. IFC, with more auto infrastructure, has disproportionately more auto trips. Taikoo Hui, with far more total trips, suffers no ill consequences of having provided fewer parking spaces. Auto access peaks at Taikoo Hui in the early evening and is relatively flat throughout the day at IFC. Diurnal access is shown in Figure 7 and Figure 8 (p. 50).

Analysis of parking utilization showed that

	TAIKOO HUI	GUANGZHOU INTERNATIONAL FINANCE CENTER
Site size (sq. meters)	50,000	31,000
Floor area (sq. meters)	358,000	450,000
Uses	Retail, office, hotel, serviced apartments	Retail, office, hotel, conference center, serviced apartments.
Parking spaces	859 ¹¹⁵	1,700
Parking/100 sq. meter	0.19	0.37
Parking Price	8am-10pm: 10RMB/hour	8RMB/hr
Year opened	2011	2010
District	Tianhe	Tianhe
Transport context	Shipai Qiao BRT and Metro station	Zhujiang Xincheng metro station (lines 3 and 5)

Table 3. Development site comparison

both sites had an excess of available parking and that neither site externalized excess parking demand to the nearby areas. At Taikoo Hui, the site with fewer parking spaces, average weekday and weekend occupancy was 20% and 36%

respectively. Peak occupancy never exceeded 60%. At IFC, average occupancy was 27% on weekdays and 23% on weekends. Peak occupancy was 35%.

Table 5 summarizes these findings.

	PEDESTRIAN OR METRO ACCESS	AUTO ACCESS	AUTO MODE SHARE
International Financial Center	15,728	2,420	13%
Weekend	5,770	1,076	16%
Weekday	9,958	1,344	12%
TaiKoo Hui	49,768	4,557	8%
Weekend	28,483	2,861	9%
Weekday	21,285	1,696	7%

	PEDESTRIAN OR METRO ACCESS	AUTO ACCESS	AUTO MODE SHARE
International Financial Center	15,728	2,420	13%
Weekend	5,770	1,076	16%
Weekday	9,958	1,344	12%
TaiKoo Hui	49,768	4,557	8%
Weekend	28,483	2,861	9%
Weekday	21,285	1,696	7%

Table 4. Site Access

	TAIKOO HUI		IFC	
	weekday	weekend	weekday	weekend
Average occupancy				
(10am to 10pm)	19.5%	35.8%	27.2%	23.1%
Peak occupancy	38.4%	57.6%	34.6%	29.6%
Average parking duration	1:22	1:48	2:19	2:21

Table 5. 10am to 10pm Parking Occupancy Taikoo Hui and IFC

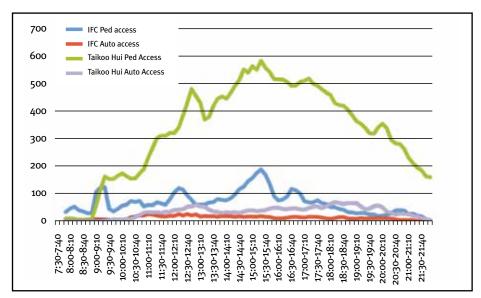


Figure 7. Weekend Access by Time of Day

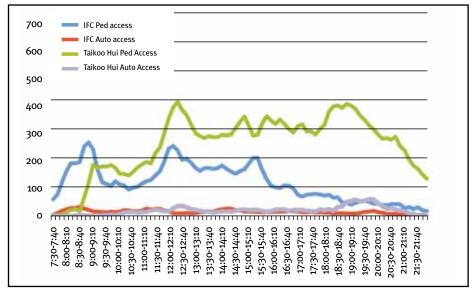


Figure 8. Weekday Access by Time of Day

Appendix C: Outsourcing Parking Management to the Private Sector

While parking management is a government function, the private sector can play an important role in providing the operations and in financing. It needs to be in the appropriate legal form, and it must protect the interests of the government and citizens. By contracting with the private sector, the government minimizes for itself the burden of financing the parking management system. The contract is the main mechanism that the government has to control the level of service and determine the fundamental parameters of operations.

There are two main components of the contract: the rights and obligations of the operator. The obligations should establish the performance standards the government wants while the rights establish the payment or revenue that the operator gets in return. The rights and obligations of the government also need to be defined.

Contracting with the private sector to manage parking operations and enforcement can, but does not necessarily, result in greater efficiency of operations. Typically, cities execute such arrangements by guaranteeing private operators a basic annual payment. Operators then have some flexibility in cutting costs to enhance their profits. Contracts also typically allow private operators to raise fees by a certain amount each year, thus allowing parking prices to match the market conditions more closely. Such fee increases might not be possible for public operators because of political pressure. 116

Define Financing Obligations and Revenue Model

As part of the operator's rights, the revenue flow needs to be defined and specified. The government can require that the private sector finance the investment in the parking management system, including the costs of equipment, hardware and software, as well as the operational costs. In return, the operator receives a fee, usually based on parking revenues that the operator safeguards by ensuring that the complicated

system of parking management works properly. There are two main revenue models:

- 1. Build-Operate-Transfer: The private sector pays for any initial investments, capital financing, and operational costs. In exchange, the operator receives a fee. With this revenue model, the income from the parking system can go directly to the city, including fees from the parking machines as well as fines. Payment to the operator is made at regular intervals, as specified in the contract (e.g., monthly), as a flat fee per parking space or a percentage of the revenue. This should cover the investment, financing fees, profit, and the cost of operations. After the contract expires, the parking system (including assets) is transferred to the city. Governments typically prefer having revenues go directly to the city, but a private operator may find this arrangement unsuitable, calling into question the government's ability to make timely disbursements. Another option in such a case is to set up an escrow account, and have another, independent operator disburse payments to
- 2. Joint Venture (JV): The private operator and the government agency in charge of parking are shareholders in a joint corporation. This option typically requires a complex legal arrangement and a high level of trust between the partners. JVs are usually for large projects where guarantors are worried about saddling the private-sector partner with all of the risk of a costly investment. Many private-sector companies do not like to enter into JVs with governments as the latter can make divesting from the project, if something goes wrong, much more difficult. If the government and the private operator form a joint venture, the private sector will often finance the investment while the government provides labor and rights to operate. Revenues go directly to the joint

¹¹⁶ Kodransky and Hermann, Europe's Parking U-Turn, 30-31.

venture company, and payments are made to the owners, including the city agency, in the form of dividends, based on the number of shares they each have.

The contracted operator should be responsible for procuring both the hardware and the software for system management and operation. The operator needs to ensure that

- all the machinery (tools, devices, equipment) and information technology are mutually compatible, operational, and reliable as a system;
- all hardware replacement and troubleshooting (especially for parking machines) is done within the designated time period;
- there is a preventative hardware maintenance regime;
- replacement of tickets, collection and processing of cash payments (if there is a cash option), issuance of receipts, and cleaning of the parking machines are all performed timely and accurately;
- the customer services include daily monitoring and recording of customer issues for review:
- the data created by monitoring and reviewing of customer issues is easily searchable, filterable, and backed up to prevent loss;
- the software allows the parking system to respond quickly to customer issues and provides customers with reliable information;
- · parking activity is monitored daily;
- the monitoring of the parking activity is equipped with vehicles and a dispatcher service while parking enforcement relies on adequate information technology;
- the enforcement activities (fining, wheelclamping and/or vehicle removal) are duly carried out;
- the data from parking enforcement as well as from monitoring of the parking system itself are collected, stored, and handled properly;
- there is a control center that:
 - monitors the parking system and, especially, the cash flow data from the parking machines;
 - develops and dispatches any real time interventions into daily operations;
 - analyzes all the data and shares it with the city.

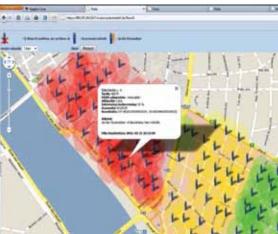
Choose the Right Technology

The fundamental element of the modern, controlled, paid on-street parking system is a parking machine. Multi-space parking machines, also known as pay-and-display machines, are an attractive option as they are easy for the customer to use and easy for the government and operator to maintain (fewer of them are required per parking space) as well as to collect information and money from .

These smart machines support real-time remote monitoring and two-way communication with the control center and/or the city, which makes parking system management easier for the operator and the government. In particular, smart parking machines can:

- send current information on their technical conditions directly to the control center, which then organizes maintenance schedules and troubleshooting accordingly;
- send current information on usage, turn-





Real-time view of parking situation in Budapest as it appears in the control center.

over, and revenue generated by the whole parking system and by each machine, which allows the control center to prepare reports and accounts, to see changes in usage and determine if pricing, zones, or times of usage need adjusting;

• receive and implement adjustments in fees, zones, or allowable time periods directly from the control center.

Monitoring is critical for on-street parking because it allows the operator and government to know the occupancy and turnover rates. With this information, the operator can adjust the parking prices to ensure that the government's objectives of 70%--85% occupancy and parking times of less than 3 hours are achieved.

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