

Europe's Parking U-Turn: From Accommodation to Regulation

By Michael Kodransky and Gabrielle Hermann
Spring, 2011



A tremendous and special thanks to Walter Hook for his invaluable guidance and critical review of this publication. Thanks to Diego Salzillo Arriaga for his assistance collecting data and developing the Munich case study. This report also could not have been produced without the support of a number of other people such as Heiner Monheim, Julien Allaire, Marius Navazo, Bram van Liupen, Carina Zell, Mandy Held, Jan Willing, Nicole Foletta, Felix Bode, Willy Staley, Ryan Whitney, Matthew Egan, and Holly LaDue.

Michael Kodranksy is Global Research Manager for ITDP and Gabrielle Hermann is a consultant to ITDP.



Table of Contents

4	Executive Summary
8	Introduction
10	Part 1: Historical Context
12	Part 2: Current State of Successful Parking Management Strategies
	Economic Mechanisms
	Regulatory Measures
	Physical Design
	Quality of Service Contracting
22	Part 3: Case Studies
	Amsterdam, The Netherlands
	Antwerp, Belgium
	Barcelona, Spain
	Copenhagen, Denmark
	London, United Kingdom
	Munich, Germany
	Paris, France
	Stockholm, Sweden
	Strasbourg, France
	Zurich, Switzerland
74	Conclusion
76	Appendix A: Munich Minimum Parking Requirements
77	Appendix B: Additional Resources
78	Appendix C: Parking Management and Technology Vendors
80	Appendix D: Pay-by-phone Vendors
81	Appendix E: Reference List

Executive Summary

This paper is the second in a series of policy papers from ITDP on parking. The first paper, released in Spring 2010, focused on successful parking practices in U.S. cities. This paper reviews successful parking practices in European cities. Parking management is a critical and often overlooked tool for achieving a variety of social goals. For much of the 20th Century, cities in Europe, like cities in the rest of the world, used parking policy mainly to encourage the construction of additional off-street parking, hoping to ease a perceived shortage of parking.

In the last few decades a growing number of European cities have led the world in changing the direction of parking policy. European citizens grew tired of having public spaces and footpaths occupied by surface parking. Each parking space consumes from 15 m² to 30 m², and the average motorist uses two to five different parking spaces every day. In dense European cities, a growing number of citizens began to question whether dedicating scarce public space to car parking was wise social policy, and whether encouraging new buildings to build parking spaces was a good idea. No matter how many new parking garages and motorways they built, the traffic congestion only grew worse, and as much as 50% of traffic congestion was caused by drivers cruising around in search of a cheaper parking space.

In the cities reviewed here, parking policy has been reoriented around alternative social goals. Some recent parking reforms are driven by the need to comply with EU ambient air quality or national greenhouse gas targets. Other new parking policies are part of broader mobility targets encouraging reductions in the use of private motor vehicles. While London, Stockholm, and a few other European cities have managed to implement congestion charging to reduce motor vehicle use, more are turning to parking.

Every car trip begins and ends in a parking space, so parking regulation is one of the best ways to regulate car use. Vehicles cruising for parking often make up a significant share of total traffic. Other reasons for changing parking policies were driven by the desire to revitalize city centers and repurpose scarce road space for bike lanes or bike parking.

The amount of parking available in a city is heavily influenced by public policy. On-street parking is governed by municipal or district policy, and off-street parking is generally controlled through zoning and building regulations. These are ultimately political questions: how much parking is built in new buildings, and how much public space should be dedicated to motor vehicle parking as opposed to other uses.

The impacts of these new parking policies have been impressive: revitalized and thriving town centers; significant reductions in private car trips; reductions in air pollution; and generally improved quality of life.

Progress in Europe on parking reform should not be overstated. Most cities still impose minimum parking requirements on developers, and few cities have imposed maximum parking requirements. While a growing number of cities have mandated charges for both on- and off-street parking, they generally charge rates that are too low. The most innovative European parking practices are discussed below as actionable measures that can be applied by any city government depending on their short- and long-term goals.¹

EFFECTIVE PARKING MANAGEMENT STRATEGIES

Economic Mechanisms

- **Pricing:** Traffic experts know that having 15% of parking spaces unoccupied is optimal from the perspective of minimizing the time people spend cruising for parking. European cities are ahead of their U.S. counterparts, with most of the cities reviewed in this report setting parking fees at levels which vary at different locations and different times of day to keep occupancy rates at 85%. Some European cities like Strasbourg are also ahead of US cities in coordinating on-street parking pricing and supply with off-street pricing and supply. These measures help ensure that more desirable parking spaces are used by those most willing to pay for the privilege.
- **Emissions-Based Parking Charges:** Some municipalities, such as Amsterdam and about a dozen boroughs in London, have started to vary parking charges based on the CO₂ emission levels of vehicles at the time of registration. The London boroughs base the price of residential parking permits on the CO₂ emission standards of the driver's vehicle. Cleaner vehicles pay a discount rate, while a higher rate applies to cars that pollute more.
- **Workplace Levies:** Nottingham, in the UK, recently decided to impose a tax of £250 per year on companies for each parking space they provide for employees. The levy, which goes into effect beginning 2012, only applies to companies with over 10 parking spaces. Municipalities across the UK are considering following suit.² If all the districts currently considering the levy decide to implement it, an estimated ten million drivers would be impacted, as employers would likely pass down the cost on to employees.³ Other cities like Hamburg are allowing companies to provide fewer parking spaces than required by zoning regulations if they provide a monthly transit pass to employees.
- **Earmarking/Ring Fencing:** Revenue generated from parking fees goes to support sustainable transport goals. Barcelona, Strasbourg, and certain boroughs in London funnel revenue from parking fees to transit projects rather than putting the money into a general fund. Political buy-in can be earned with this type of initiative because the public sees how money from parking charges is spent. In Barcelona, 100% of parking fees go to support Bicing—the city's bike sharing program.

Regulatory Mechanisms

- **Parking Supply Caps:** Both Zurich and Hamburg froze the existing parking supply in the city center. When a new space is built off-street, an on-street space has to be removed, so it can be repurposed for other needs like widened sidewalks or bikeways. This type of cap-and-trade was implemented in Hamburg in 1976 and in Zurich as part of its “historic parking compromise” in 1996. Zurich went even further. Outside of the zone where the parking cap applies, the City of Zurich only allows developers to build new parking spaces if the surrounding roads can absorb additional traffic without congestion, and the air can handle additional pollution without violating ambient air quality norms. This policy has helped make Zurich one of the most livable cities in Europe.
- **Parking Maximums:** Historically, most cities required developers to build a minimum number of new parking spaces. Residential buildings had to include at least one, if not more, parking spaces per residential unit, and commercial developments had to build a minimum number of parking spaces per square meter depending on how the building would be used. European cities today are abolishing these parking minimums in town centers and placing new ceilings on the number of new parking spaces they can build. In the past, planners thought that requiring developers to build more parking would transfer the cost of parking supply onto private developers. Unfortunately, it also created a perverse incentive for developers to build more parking than the market required and stimulated car

use. Paris abolished parking minimums and several other cities established zone-based maximums. Dutch cities, following the national “A, B, C” policy introduced in 1989, divided themselves into three types of zones: areas with excellent transit access and poor car access (designated with the letter A), areas with good transit access and good car access (B), and areas with good car access but poor transit access (C). Each zone had its own parking minimum and parking maximum. New developments in zone “A” could only build a few parking spaces. In zone “B” they had to build a moderate amount of parking within a specified range, and in zone “C” they could build even more parking, but again within a specified range. Many cities outside of the Netherlands, like Antwerp and Zurich, also reduced parking maximums and minimums in locations proximate to transit facilities.

- **Regulating the Location of Parking:** While most cities regulate where parking can occur during different times of the day, European cities have used this regulatory power more frequently for the purpose of encouraging transit use and creating vibrant street life. Many cities push parking to peripheral locations, while giving transit passengers and cyclists more convenient access to popular destinations than private motorists.

Physical Design

- **Bollards:** Some cities install this type of barrier to prevent cars from parking in pedestrian paths and in public plazas. The safety hazards caused by vehicles encroaching on walkways and bike paths can be avoided by erecting physical obstructions. Since 2001, Paris has invested approximately €15 million to install nearly 335,000 bollards. Bollards are also ubiquitous on the narrow streets of Madrid to prevent cars from blocking building entrances and sidewalks. These may be automated and retract into the ground to allow limited access to certain vehicles, such as delivery vans, at certain times.
- **Striped Lines:** Stockholm uses painted lines to mark reserved spaces for vehicles with disability privileges. Individual spaces were once marked for all vehicles, but now this is only done for special cases. Entire sections of curbside are demarcated with one large box sometimes taking up an entire street as the latest practice. One large box encourages smaller vehicles to squeeze into the limited space. In this way the city optimizes revenue from its pricing program.
- **Repurposing Public Spaces:** Copenhagen has transformed its city center by creating high-quality pedestrian districts and high-quality bicycle paths by eliminating hundreds of parking spaces. Danes can be seen riding their bikes and lingering in public spaces on the coldest, snowiest days of the year. As the urban planner Jan Gehl has remarked, Copenhagen eliminated winter in just 40 years. Removal of on-street parking from historic districts and central shopping streets has become a signature feature of many European cities. This is often a boon for business, too; shops within the pedestrian precincts generate more income than those outside. Treating street space as a valuable public asset, by reclaiming it from cars, can lead to much better land uses. Reducing the number of on-street car parking can be a way to encourage the use of other transportation modes by transforming former spaces to bicycle paths or wider walkways.
- **Street Geometry:** Strategically arranging existing parking spaces can help make other street users more comfortable. In Zurich, alternating parking spaces on two sides of a narrow street act as a chicane that slows vehicle speeds. Amsterdam has zones called *woonerfs* that use parked cars to create a winding passage which forces vehicles to move at a pedestrian's pace. Paris and Copenhagen have bike lanes that are protected by parked cars—these act as a barrier between the cyclists and moving traffic. Copenhagen and Antwerp have play-streets that allow children to safely spend time on the street without the threat of getting hit by a car—trees, benches, and other physical obstructions cue vehicles that they are guests in the space.

Quality of Service Contracting and Technologies

Outsourcing aspects of a city's parking management to a private third party can be an efficient tool to improve parking management and increase revenue collected from fines and fees. In Stockholm, many

traditional government functions have been contracted out to private companies. This type of public-private arrangement is relevant at a time when cities are moving toward austerity as a result of smaller public budgets. City employees manage private contracts, review delivered products and services, as well as make sure contract agreements are kept on track. Some of the technologies being implemented by third parties are outlined below.

- **Electronic Parking Guidance Systems:** Installing real-time message boards to direct drivers into nearby parking facilities can help decrease search time. Drivers spend nearly 25% of their travel time searching for parking.⁴ Every major city in Germany uses these advanced parking guidance systems. Barcelona, Antwerp, Paris, and many other major cities have installed such systems. The next wave of guidance technology will include in-car information delivery.
- **Pay-by-phone:** Implementing pay-by-phone services can eliminate some of the problems associated with parking fee collection, like theft and spillage. These payment services can be outsourced to a third-party vendor, which charges customers a small service fee, thereby passing down any costs associated with the service to the customer, not the city. The pay-by-phone company Verrus handles parking transactions in London and receives 10% of the revenue as compensation. Three competing companies are trying to corner the market in offering this service. Pay-by-phone is also a good way to get political buy-in for introducing performance pricing because it makes parking so much easier for drivers, who don't need to look for coins or rush back to a meter when running late.
- **Smart Meters:** Installing smart meters that use magnetic induction to recognize the metal mass of vehicles can lead to more efficient enforcement when drivers overstay their allotted time in a parking space. Both enforcement wardens and drivers receive a text message on their mobile phones when a meter has expired. These meters have been piloted in Paris and are widely used throughout France.
- **Scan Cars:** Digitizing license plate registrations and using a scan car to monitor parking compliance can improve the performance of a parking program. Enforcement of parking has been revolutionized in Amsterdam, where a scan van travels down the streets and reads digitized license plate numbers to assess whether a car is legally parked.

Tightening the valve on driving through parking reform means embracing innovations such as pay-by-phone services, revenue earmarking, and engaging in public-private partnerships. Favoring alternatives to car travel means developing a restrictive parking policy that uses financial, legal, physical, and technological measures. The net result is a more balanced transportation network with less emphasis on driving.

NOTES TO EXECUTIVE SUMMARY

¹ Gerd Steierwald, Hans Dieter Künne, Walter Vogt, Stadtverkehrsplanung, Berlin: Springer, 2005.

² Daily Mail Reporter, "Drivers facing £250-a-year tax to park at work despite pledge to end 'war on motorists,'" Daily Mail Online. URL: <http://www.dailymail.co.uk/news/article-1305362/Drivers-facing-250-tax-park-work-despite-end-war-motorists-pledge.html#ixzzoxbWxYyko>

³ James Tapsfield, "Workplace parking levies may be imposed by councils," The Independent: UK. (August 23, 2010) URL: <http://www.independent.co.uk/news/uk/politics/workplace-parking-levies-may-be-imposed-by-councils-2059468.html>

⁴ Polak, J.W. and K.W. Axhausen (1990). "Parking search behaviour: overview of current research and future prospects," Working paper, 540, Transport Studies Unit, Oxford University.



Introduction

This report examines European parking management over the last half century, through the prism of ten case studies. Parking management has been an effective policy tool to improve the quality of city centers and surrounding areas, saving time and money for shoppers, residents, commuters, and business owners alike. Parking can be managed through economic and regulatory mechanisms, the implementation of certain physical designs, as well as quality of service contracting. This report examines all four of these strategies.

The most innovative approaches to parking have improved the economic, social, and environmental quality of city centers. Choosing the right policies depends on a city's goal—whether it is to reduce CO₂ emissions, to relieve traffic jams, to remove vehicles because they are a nuisance, or any number of other reasons—and certain policies fit certain goals better than others. This paper illustrates which cities are meeting their goals with success.

Vehicle parking consumes a lot of land, is blighting, and contributes to dispersed development, increasing travel distances. Every car trip begins and ends in a parking space. Each parking space takes up an area that ranges from 15 to 30 m². Car drivers need between two to five different parking spaces every day. Most cities still require developers to build a minimum amount of parking, but cities at the forefront of parking reform are reducing or removing minimum parking requirements and replacing them with maximums.

The ample provision of parking, especially free parking, contributes to excess car use by making driving the most convenient and affordable travel option.

Cities aiming to reduce car use also remove or restrict on-street parking in central areas, and charge a high price for the remaining spaces.

European cities are ahead of the rest of the world in charging rational prices for on-street parking that leave an optimal amount of spaces vacant for newcomers. This substantially reduces traffic from vehicles cruising for parking.

Parking policy can be a powerful tool to encourage people to take public transportation or to bike. Because walking trips are slower than other trips, if a person can walk to their car faster than they can walk to the bus stop and catch a bus, most people will choose to drive.¹ Some European districts, like Vauban in Freiburg, Germany, place parking at the perimeter of the neighborhood, keeping the neighborhood core car free but accessible by bike and transit.

Some cities are even charging for parking based on vehicle emissions. For example, several boroughs in London have introduced CO₂ emission-based residential parking permit schemes. The vehicles that emit the most CO₂ pay the highest fees, while electric cars can park for free. More European cities are using parking management to encourage replacement of clunkers with low-emission or emission-free vehicles in an effort to improve air quality and tackle climate change. In France, for example, parking is viewed as a tool that can influence a 14% reduction of the greenhouse gas emissions emitted every year nationwide.²



The entrance leading to the Palace of Louis XIV in Versailles, France is inundated with surface parking.



A seven-story municipal parking facility sits along a prominent canal in the center of Hamburg, preventing other uses, like giving people access to the waterfront.

Starting in the 1950s and 1960s, many European cities found their once vibrant public plazas and boulevards encroached upon by vehicular parking. While most cities tried to accommodate the growing tide of car use, Zurich and Copenhagen took the lead in reclaiming this space for pedestrians and tightly restricting parking in their urban core. These decisions paid off and these cities are now among the most attractive and competitive cities in Europe.

THIS REPORT HAS BEEN DIVIDED INTO THREE PARTS:

Part 1 of this report provides a historic background from which many of the current progressive parking policies in Europe stem. The recent reversal of 50-year-old parking policy practices in Europe is a revolt against the lowered quality of life that cars bring with them to public spaces.

Part 2 details the tools used to manage parking by restricting it through regulatory procedures, physical design elements, and economic mechanisms. The current range of strategies that fit into these categories are outlined and discussed, in addition to a discussion of technologies like pay-by-phone and smart meters that enable better performance of these management measures.

Part 3 illustrates the ways in which each city documented in the case studies has successfully shifted trips away from car travel toward more sustainable modes of transport.

The conclusions reached are based on a review of research texts and public policy documents as well as phone, email, and face-to-face interviews. Parking managers, academics, private sector professionals, advocacy groups, and parking technology experts were consulted to understand the multi-layered parking practices in Europe.

NOTES TO INTRODUCTION

¹ Interview with Hermann Knoflacher, August 2010.

² Eric Gantelet and Christophe Begon, (2008) "The Impact of Car Parking Policies on Greenhouse Gas Emissions," Association for European Transport.

³ Knopflicher, Hermann (2009). "The value of parking organization for economy, society and environment." Technical University of Vienna. Institute of Transportation, Research Center of Transport Planning & Traffic Engineering.

PART 1:

Historical Context

Since the 1960s, there has been a gradual shift across Europe, mainly in city centers, away from unregulated or minimally regulated car parking to more restrictive policies that better balance the competing demands for urban space. Following the Second World War, motor vehicle ownership and use started to climb in and around European cities as new neighborhoods were designed to enable easier car travel. Eastern Europe was an exception, where car ownership only started to climb most significantly after the introduction of market economies in the 1990s. New town developments that formed outside of the city center often mimicked the kind of building trends that, at the time, also dominated the U.S., Canada, and Australia—and in most cases still do. Residents from the dense inner cities started parking close to their home, often blocking pedestrian paths and carriageways allocated for moving traffic. Sidewalks were eaten away to feed the driving and parking demand frenzy while roads were widened, giving more public space away for private vehicle use.

Local European governments, at first, allowed vehicles to park at no cost in public squares, on sidewalks and nearly anywhere a car could fit.¹ After decades of unfettered accommodation to cars within the densest and most visited parts of the city—often the historic districts, central business areas, and nearby residential zones—many local administrations developed more stringent parking regulations. City governments began to realize that public life had been allowed to degrade as a result of traffic congestion, air pollution, noise, diminished street safety, and cars encroaching on public gathering places.

Parking infrastructure can diminish the quality of streetscapes, interrupt walking paths, and increase distances between destinations.

Drivers' desire for nearby parking spots was almost always appeased, but at the same time an opportunity was lost to develop the land for other potential uses such as housing, office space, or retail—especially where land is scarce, in already built-out districts. Parking space may take up property that has a higher social, environmental, and even economic value if developed differently.

In the Dutch city of Breda, a canal had been

drained to build a 200-space underground car parking facility with a road above it. Officials in Breda decided the underground parking facility did not sufficiently justify losing the waterfront. The canal has since been restored in a widely successful project that has transformed the old waterfront into a popular destination. On-street spaces were also removed to create a pedestrian promenade.

Once the on-street parking spaces in many European cities had been consumed, local authorities found themselves lacking public funds to satiate an ever-growing demand for even more parking, so they offered private parking companies concessions—often for indefinite or very long periods of time—to build and manage off-street facilities.² Building regulations were also changed, requiring new developments of all types—commercial, residential, educational and others—to accommodate what was viewed as the mobility paradigm of the future: personal travel by private car. These two policy decisions—forefeiting control of off-street parking inventory and creating countless square meters of new parking spaces—created a system of parking supply that would later prove quite challenging to reverse.

In the 1960s and 70s, after a few decades of fulfilling the unending demand for car parking, certain Western European cities, like Copenhagen and Zurich, began to realize that excessive parking supply was part of a system-wide policy mismatch that contributed to traffic congestion. Parking plans that responded to demand without controlling supply threatened the economic prosperity, community vitality, and historic advantage of many central city locations.³ The demand for more parking spaces had long been viewed as an indicator of a thriving economy, except when traffic conditions began to impact productivity, polluted the air, and led to other undesirable conditions. These negative externalities demonstrated a need to reassess transportation investment priorities and pricing mechanisms, which can influence travel behavior.⁴

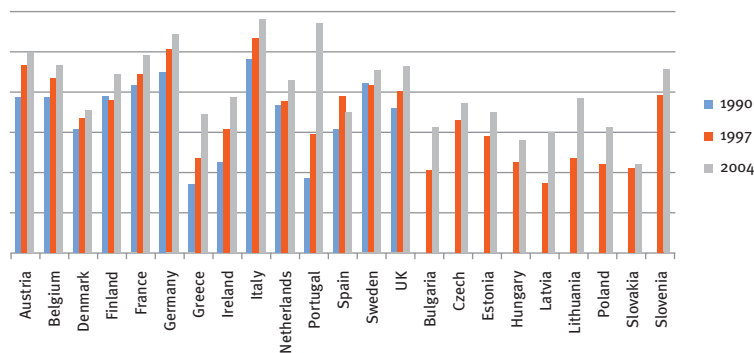
Car ownership increased in nearly every European country throughout the 1990s and in the beginning of the 2000s. Emerging market economies in Eastern Europe, like Slovenia and the Czech Republic, have outpaced more car-oriented countries, like Greece and Ireland, when it comes to car ownership. (See Figure 1.) This growth influenced numerous cities to shift away from catering to increased parking demand toward an approach that addressed many of the unintended and adverse impacts resulting from unregulated parking supply.

Parking demands fluctuate based on location, time of day, and day of the week. Central rail stations are often high demand areas for quick passenger drop-offs and pick-ups. Employment districts have high parking demand during business hours on the weekday, and experience less demand over the weekends. Sports arenas only experience an influx of cars during events. Meanwhile, residential areas may have long-term parking demands overnight on weekdays, but lower demand on the weekends, when households may use the family car for retreats to the countryside.



Before (top) and after (bottom) the Nieuwe Mark was restored from a road and underground parking facility to the original canal in Breda, The Netherlands. Source: Wessel Keizer

Figure 1:
Change in number of passenger cars per 1,000 residents, 1990–2004⁵



NOTES TO PART I

¹ Jan Gehl and Lars Gemzoe (2006). *New City Life*. The Danish Architectural Press: Copenhagen.

² Kenneth J. Button (2006). "The political economy of parking charges in 'first' and 'second-best' worlds." *Transportation Policy*. 13 (6), 470–478.

³ Jan Gehl and Lars Gemzoe (2003). *New City Spaces*. The Danish Architectural Press: Copenhagen. Third Edition

⁴ COST Action 342 (2006). "Parking Policies and the Effects on Economy and Mobility." Technical Committee on Transport.

⁵ Eurostat (2003). "Are we moving in the right direction," European Environment Agency. Statistical yearbook on candidate countries, Office for Official Publications.

PART 2:

Current State of Successful Parking Management Strategies

The main strategies for parking management fall into four categories: pricing mechanisms, regulatory measures, physical design elements, and quality of service contracting (and the advanced technologies that enable these four). These can be employed in different combinations to achieve different effects, so the best practices ultimately depend on the goals of the city implementing the policy.¹



No Meters



Meters



Prices quadrupled

Grosvenor Square, London.
Source: TRL⁴

ECONOMIC MECHANISMS

On-Street Pricing

The first parking meter in the world was installed in Oklahoma City in the United States in 1935,² while the first version in Europe was introduced in the summer of 1958 on Grosvenor Square in London outside of the American Embassy in the Mayfair district.³

On-street parking fees are set to optimize the use of curb space, influencing turnover and minimizing the number of vehicles slowing traffic by searching for parking. Prices are calibrated based on demand sensitivities (i.e., vacancy and occupancy targets). Drivers will park as close to their destination as possible even if it means blocking the moving traffic lane and pedestrian paths.⁵

Market-based performance pricing mechanisms can work to shift the behavior of those who choose to drive. Harmonizing off-street and on-street prices is essential to nudge drivers into off-street facilities. Municipal garages in Strasbourg slightly undercut on-street parking costs to encourage drivers to park out of sight.

Drivers circulating to find a free or cheap on-street space slow overall traffic flow, while those already parked monopolize underpriced curbside space—preventing turnover that could bring more customers into area shops. Vehicles searching for parking make up one-third of traffic in London.⁶ Decreasing the number of available spaces while increasing the cost to park may have five effects on the behavior of drivers with different implications for commuters, short-term drivers, and residents⁷:

- Find an alternative parking location
- Start their journey at another time
- Shift to another mode of transport
- Change their destination
- Avoid making the trip altogether

The introduction of parking fees in Vienna led to a two-thirds drop in the vehicle kilometers traveled (from ten to three million) resulting from searches for an available space. Figure 1 compares parking fees in 11 city centers. An increase in the price of parking in off-street municipal facilities led to a 30% dip in occupancy. At the same time, public transit and bike commuting increased, with 25% of car users switching modes.⁸

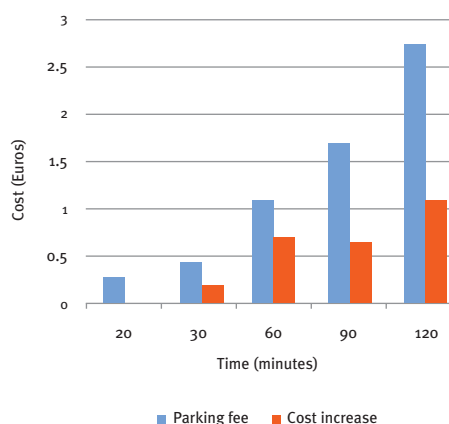
A UK-based study compared the effect of parking restrictions and improved public transit on car use. Doubling parking fees reduced car usage by 20%, while an increase in public transit frequency was predicted to only decrease car use by a meager 1 or 2%. Cutting the parking supply in half led to a 30% drop in car use.⁹

The price of parking linked to the number of available spaces influences travel behavior in areas that have a high demand for parking. These

Figure 1:
First hour parking city comparisons

CITY	CITY CENTER FIRST HOUR COST (Euros)
Amsterdam	5.00 €
London	4.00 €
Stockholm	3.87 €
Copenhagen	3.86 €
Paris	3.60 €
Barcelona	2.85 €
Antwerp	2.50 €
Munich	2.50 €
Hamburg	2.00 €
Strasbourg	1.60 €
Vienna	1.20 €

Figure 2:
Madrid blue zone progressive parking charges



15-Minute Short-Term Parking in Versailles

Special devices designed by the French company AMCO have been installed along major commercial corridors in Versailles at individual parking spaces to control short-term 15minute free parking between 8 a.m. and 8 p.m. These spaces are meant for drivers making quick errands. Other French cities control short-term on-street parking using this device as well and can adjust the time. A red LED light begins to blink furiously to alert drivers and enforcement wardens that a vehicle has exceeded the allowable stay time. When the vehicle leaves, the light turns off. A magnetic detection wire is implanted under the parking space and connected to the blinking device. It is unclear if the cost of installing and maintaining

the hardware justifies its purpose. The same function can be programmed into a pay-and-display machine or pay-by-phone service, especially since time limitations are harder to enforce than pricing mechanisms.



Limited Free Parking

Several policies exist across Europe that allow free parking within zones that otherwise require payment. This is part of a theory that short-term errands should be enabled and the time of allowable free parking should be limited, encouraging turnover.

BLUE DISCS

Time-limited free spaces are often regulated at central locations in cities using the blue discs, widely recognized across Europe. Drivers must display the disc behind the car's windshield indicating time of arrival. Sign posts display how long parking is permitted using the blue discs. The typical time limitation is up to 90 minutes.

CLEAN VEHICLES

Stockholm and Copenhagen allow "clean" vehicles to park for free as a way to encourage purchase of electric vehicles or those with low emissions. The long-view of this strategy is not sustainable since a fleet of clean vehicles can still have undesirable consequences—such as the need for parking infrastructure at the expense of other land use possibilities.

MOTORCYCLES

Paris, Stockholm, Copenhagen, and Amsterdam allow motorcycles to park for free. The result has been a proliferation of motorized two-wheelers, seen initially as a better alternative to private vehicle use. The borough of Westminster in London instituted paid motorcycle parking after the proliferation of two-wheelers became problematic with added congestion, noise, and air pollution.

CAR SHARING CLUBS

Companies in Amsterdam and the borough of Westminster in London that run car sharing clubs are given limited, free on-street space.

DISABLED PARKING

Disabled badges allow free parking for an unlimited time. The central London region was excluded from the national disabled badge scheme, instead issuing its own scheme. These badges are issued by local authorities and 70% of them are misused (e.g., used by a family member). The badges can get sold for £2,000 on the black market. Some badge holders need to go before a panel to determine that they are legitimately disabled, while others are required to get a signed affidavit from a local doctor.

Richmond-Upon-Thames CO₂-Based Residential Parking Permits

Richmond-Upon-Thames, a leafy and affluent borough in the Southwest of London, was the first to issue residential parking permits based on vehicle CO₂ emission levels, in 2007. Since then, the percentage of permits issued for the most emission-intensive cars has fallen from 16% to 13% and the amount issued to the lowest emission vehicles has increased from 25% to 32%.¹⁰

Richmond is also the first borough to go one step further and charge for on-street and off-street metered parking based on vehicle emissions. Payments can be made using pay-by-phone services or by purchasing a pre-paid RichmondCard, which is debited every time a driver parks in a metered space. Under this

scheme, the standard parking fee was increased by 25% and drivers with cleaner vehicles could qualify for a discount.

As a way to gain support from local businesses for the emission-based parking measures, the borough council came up with a proposal called 20:20 that allows drivers to park for 20 minutes on-street for only 20 pence—thus encouraging visitors to make short errands to local shops. Lower emission vehicles pay 10 pence for the same amount of time.¹¹

In 2010, the new conservative government that took office immediately abolished the CO₂-based measure in Richmond-upon-Thames. Other boroughs still have their policies intact.



Construction of a 400-space underground parking facility with residential units above, in the Islands Brygge neighborhood of Copenhagen, Denmark.

demands vary based on whether the area has a concentration of commercial, residential, industrial or other uses. A Controlled Parking Zone (CPZ) is a designated section of the city that can be as small as a block, or as large as an entire neighborhood. CPZs allow each council in London to determine what fees and regulations are appropriate to the local context, like setting the cost in a popular shopping district, in order to prevent all-day commuters from parking, while favoring short-term visitors, and businesses. Zurich and Munich use a similar approach with a block-by-block pricing designation that varies in cost based on location and time of day.

Progressive Charges

Zurich, Antwerp, Vienna, and Madrid have on-street pricing schemes that charge a marginal cost increase with successive time to capture the increased marginal burden of a car's presence. Visitors to Madrid are allowed to park for a maximum of two hours and the fee increases a marginal amount following each time interval. Figure 2 (previous spread) illustrates how the parking fee increases at a progressive rate.

Residential Permits

Spillover from central business districts (CBDs) into residential areas prompts the need for residential parking permits. It is also a way to better manage the particular demands of residents, which differ from short-term visitor and commuter parking. Residents in the Camden and Islington boroughs of London pay for residential parking permits based on their vehicle's CO₂ emission standards that are assessed at the time of registration—the most noxious cars pay a higher price.

Residential parking permits in Munich helped reduce the share of car trips from 44% to 32%. Nearly 27% of car commuters switched to another mode of transport.¹² Meanwhile, public transit ridership increased from 40% to 47%.¹³

Workplace Levies

Companies can be taxed for spaces provided at work sites. Municipalities across the UK are ready to charge up to £250 per year, as has been proposed in Nottingham beginning in 2012, for a parking space at a work site.¹⁴ The plan, gaining traction in many UK cities in recent months, would impact an estimated ten million drivers, as employers would likely pass down the cost imposed by local governments to employees.¹⁵

A study done in Paris found that given a scenario in which no workplace parking existed, 20% of drivers would walk or cycle instead, 20% would take public transit, 15% would car pool, 40% would search for free spaces further out, and 5% would be willing to pay for a spot. An estimated 75% of commuters to the city center in the 2001 study had a parking space provided by an employer.¹⁶

Earmarking/Ring Fencing

Barcelona, Strasbourg, Munich, and certain boroughs in London earmark revenue from parking funds to support sustainable transport. Public support for parking charges can be won when the surplus funds are used to improve public transit, walking, or cycling conditions. In the London borough of Kensington and Chelsea, 12% of parking revenue is used to fund Freedom Pass—a program that gives free transit tickets to the elderly (60+) and disabled. In Barcelona, 100% of parking fees are used to support Bicing—the city’s bike sharing program arranged as a public-private partnership with ClearChannel.

REGULATORY MEASURES

Parking Supply Caps

Hamburg, Zurich,¹⁷ and Budapest have instituted caps on the total parking supply in the city center, reforming the building codes to freeze the existing inventory and ban any further increases. The Hamburg supply cap was instituted in 1976, sealing the inventory at roughly 30,000 spaces.

Zurich instituted a cap in 1996. While commuters are mostly dissuaded from driving into the central business district, some flexibility still exists for other types of uses, like delivery trucks. For every off-street space created within the capped area, an equal number of spaces must be removed from the on-street supply. This type of a parking-based cap-and-trade allows the supply to stay constant while repurposing the on-street uses.

In Copenhagen, this type of arrangement was used as political leverage to remove 1,000 on-street spaces for repurposing as bike and pedestrian paths in exchange for the creation of 3,000 off-street spaces built by a private developer. Car ownership in the city, especially in the areas immediately outside the municipal boundaries, has been increasing in the last decade, as it has all across Europe.

Parking Maximums

Some cities in Europe have recognized the need to institute parking maximums, creating ceilings for the amount of parking included in new developments. Cities like Zurich, Amsterdam, and Strasbourg are leading the way in this initiative while most other cities are still following regulations for minimums based on antiquated building codes that have not been updated in decades. Switzerland, the United Kingdom, and Italy set maximums as national guidelines. The Milan metropolitan area tailors national standards to the local context.

Public Transit Employee Benefit Program

Companies in Hamburg are required to provide less parking than is mandated by the city’s minimum parking requirements if a significant number of employees have public transit passes. The transit-pass benefit program requires opt-in from employees, whose payment is deducted from a pre-tax salary.

Some portion of the pass is also subsidized by the company. The parking spaces offered to those who still wish to commute by car may be accommodated off-site at a certain distance from the company building.¹⁸

Figure 3:
A comparison of parking minimums in a dozen cities.

CITY	MINIMUM RESIDENTIAL STANDARDS
Amsterdam	1 spot/housing unit + 0.2 added for guests
Antwerp	1.1 spots/dwelling unit; 2 bicycle spots/dwelling unit
Barcelona	1 spot/2–6 apartments (depending on area)
Copenhagen	1 spot/100 sq. meters
Hamburg	0.2/living unit in CBD, 0.8/living unit outside CBD
Madrid	1 spot/unit
Munich	1 spot/unit
Stockholm	0.14 spots/room
Strasbourg	0.5 spots/apartment if within 500 meters of PT, 1 spot/apartment otherwise
Vienna	1 spot/dwelling



A Bicing station in Barcelona in the Gracia district.

Local jurisdictions in the UK are required to set maximums as a way to “promote sustainable transport choices, reduce the land-take of development, enable schemes to fit into central urban sites, promote linked-trips and access to development for those without use of a car, and to tackle congestion.”¹⁹ For non-residential developments, the policy goes further and says that the maximum requirements should be set based on what is locally appropriate to reduce the car use, promote cycling and walking, reduce carbon emissions, attain air quality standards, reduce sprawl, and meet other objectives.²⁰ Despite the strong language, however, the requirements are not legally binding.

The idea of requiring parking minimums is that new developments will generate driving trips and demand for parking. Requiring a minimum provision is thought to transfer the burden of creating new parking onto private developers. Yet forecasting for parking demand is not based on any well-studied algorithm. Most parking managers cannot explain the origin or rationale to parking requirements for buildings, which force opportunity costs onto developers who may prefer to use the square meters for other purposes. In older historic districts, the regulations do not have as much of an impact because there is limited change to the buildings. In parts of the city where many

new construction projects exist, the effects of the policy are palpable. Zurich has demonstrated with such projects as SihlCity that it is possible to regulate demand for parking by requiring developments to promote visits by transit, biking, and walking trips while capping how many allowable car trips can be made to the site.

Figure 3 shows how parking minimums vary between cities for residential accessory parking.

Hamburg may be an outlier in this case because of the amount of unregulated on-street space that exists in many districts immediately outside the CBD. Developers can also pay a fee in lieu of providing parking—to reduce development costs and encourage shared parking—and in fact must do so in the CBD as a result of the city’s parking cap. The in-lieu fee amounts to \$20,705 per parking space in the city center, and \$11,300 in the surrounding neighborhoods.²¹

Stockholm has the lowest mandated provision of any city analyzed for this report. Developers there can fulfill parking requirements by finding available spaces in nearby parking facilities with the assistance of Stockholm Parkering, the local parking authority. In fact, the city requires them to do a scan of available spaces before complying with the building code on parking.



Bollards on a street in a residential neighborhood in the city center of Madrid.

In Madrid, which has the highest share of residential parking facilities in Europe (120,000 facilities), owners of spaces in these car garages can lend them temporarily to visitors by way of controlled reservations. In the London borough of Westminster, on-street residential bays have also been opened up to visitors. And in Paris, an experiment has been underway since 2009 allowing residential vehicles to park overnight in loading zones. These shared space arrangements decrease the forecasted need to build more parking infrastructure.

Parking requirements can be further limited depending on public transit accessibility as has been done in Antwerp, Paris, Amsterdam, and Zurich. The Dutch “A, B, C” policy modifies non-residential parking standards based on distance to a transit stop—developments closest to transit (at A locations) are required to build limited parking while those near no transit access (at C locations) are encouraged to build more parking. In Paris, building parking at new developments is forbidden 500 meters from a transit stop—nearly every part of the inner city is within this distance.

Regulating the Location of Parking

Vehicles may be limited or banned altogether in pedestrian priority districts, except for delivery of goods during specific times of the day. Cars have been restricted or banned in many historic centers and popular retail corridors. Barcelona has a traffic cell in the Gracia District called the Super

Manzanas project, which forces traffic to move along the periphery of the zone that has been reprioritized for pedestrians and cyclists—special permissions may be granted for vehicles to park inside for short periods, but otherwise parking inside the zone is forbidden.

Certain categories of vehicles are banned from city centers based on their emission levels. This type of strategy is used in Berlin, London, Milan, and dozens of other cities. While not a parking-based strategy per se, the effect is that those vehicles with high emissions are not permitted to park in the city due to the specific driving prescription.

PHYSICAL DESIGNS

Bollards

Paris and Madrid have bollards installed throughout the city to prevent vehicles from blocking pedestrian paths and encroaching on public plazas. Since 2001, Paris has invested approximately €15 million to install nearly 335,000 bollards. Sometimes retractable bollards, vehicle-height-limiting bars, and other types of barricades are used to restrict street access, while giving emergency vehicles and delivery vans the flexibility to enter and park, if needed.

Striped Lines

Stockholm has painted white lines demarcating where parking is allowed on a given street, serving as a soft visual cue that organizes parking from other functional spaces such as pedestrian paths, bike lanes, and moving traffic lanes. Painted markers can also include words that limit demarcated spaces to specific users—such as car-sharing club vehicles. The success of this type of installation is dependent on strong compliance and enforcement of parking rules.

Repurposing Public Space

Copenhagen started removing parking spaces from the city center in the 1960s, especially along Strøget Street—the main car-free retail corridor in the city. The total number of parking spaces in the inner city was reduced by 400 spaces from 3,100 to 2,720 between 1995 and 2000, through

small reductions over time, while the network of pedestrian areas increased by 4,020 m² in roughly the same period.²²

Other compelling reasons for removing parking spaces include: the improvement of sightlines at intersections; decreasing crossing times for pedestrians by installing bulb-outs (sidewalk expansions at crosswalks); greening the streetscape with tree plantings; expanding the space available to cafes on narrow streets; and the addition of benches to encourage lingering. All these alternative uses slowly decrease the overall parking supply on the street, while improving the streetscape for other uses.

Retailers are sometimes the loudest critics of restrictive parking policies, because they believe that the economic vitality of a city is linked to accessibility by car. A study conducted in Rotterdam, The Netherlands, found that retailers on one of the busiest shopping streets grossly overestimated the percentage of customers who arrive by car.²³ Shops in a pedestrian zone where parking spaces have been wholly removed generate more income than those outside.²⁴ In the most prominent pedestrianized shopping district in Munich, only 16% of people come by car, while 72% come by public transit. The remainder walk or bike.²⁵

Street space has been reclaimed throughout Europe, and treated as a public asset that can be used for more highly valued purposes. In France, most first- and second-tier cities have built costly underground parking facilities to revitalize public squares that were once overwhelmed by parked cars. Reducing the on-street supply can be a way to encourage the use of other transportation modes and improve the local environment.²⁶ The enlargement of the tram network in Strasbourg, France, for example, resulted in the relocation of on-street space to off-street facilities beneath pedestrianized streets, the building of park-and-ride facilities at the ends of tram lines and the expansion of paid parking zones. These measures reflect a general attitude that took hold in many European cities and has been decades in the making—one where unquestioned support for increased parking demand shifted toward the strict control of supply, especially near transit.



Single designated parking space on a street in Stockholm.

Street Geometry

Where on-street spaces have not been removed, they can be organized in a way to meet street safety goals. In Zurich, alternating parking spaces on two sides of a narrow street act as a chicane that slows vehicle speeds. Amsterdam has zones called *woonerfs* that use parked cars to create a winding passage that forces vehicles to move at a slower pace alongside cyclists and pedestrians. Paris and Copenhagen have bike lanes protected by parked cars that act as a barrier between the cyclists and moving traffic. Copenhagen and Antwerp have play-streets that allow children to safely spend time on their street while limiting the threat of getting hit by a car—here trees, benches, and other physical obstructions cue vehicles that they are guests in the space.

QUALITY OF SERVICE CONTRACTING AND TECHNOLOGIES

In Stockholm, many traditional government functions have been contracted out to private companies. Urban planning and health department tasks are now handled by outside consultants. This type of public-private arrangement is especially relevant for cities facing budget constraints.



A street within the Super Manzanos zone in the Gracia district, Barcelona, Spain.

Stockholm managed to decrease the number of in-house staff. Remaining employees oversee private contracts, review delivered products and services as well as make sure contract agreements are kept on track. Two private security companies, for instance, handle parking enforcement—one responsible for the northern part of the city and the other the southern portion. Both companies must meet certain performance targets and their payment allocations can fluctuate based on delivery of service. Parking wardens are expected to monitor a set number of parking spots during a shift. The companies are also evaluated based on the percentage of vehicles within compliance of parking rules—with the ultimate goal of reaching 100% compliance.

Technological advancements in the last decade have allowed cities to meet parking-related goals more effectively. Private companies can better fulfill contract terms for services offered to cities, such as parking enforcement and revenue collection, through data-supported assistance and monitoring. The latest hardware and software is also meant to improve the customer experience for drivers. Four technologies that enable better parking management are described.

Electronic Parking Guidance Systems

Drivers can spend nearly 25% of their travel time searching for parking. Real-time message boards placed at specific locations along the roadway direct drivers to available parking spaces in nearby garages. Every major city in Germany uses these advanced parking guidance systems. The next

wave of guidance technology will include in-car information delivery.

Smart Meters

These types of meters have magnetic fields capable of registering the metal mass of vehicles. They have a direct computer link to a police station and send a signal to parking wardens when a vehicle is parked beyond the allowable time. Drivers also receive an alert text message on their mobile phones. These meters have been installed throughout France with much success.

Pay-by-phone

While paying for parking is still possible in many places using pre-paid cards, coins, or credit cards, pay-by-phone is increasingly the preferred payment collection method because the handling of money is outsourced to a third-party vendor, thereby eliminating any chance of theft. The London borough of Westminster was losing £200,000 per week to theft before going cashless. The pay-by-phone company Verrus handles parking transactions and receives 10% of the revenue as compensation. In Stockholm, customers pay a subscription fee to EasyPark of €3 per month and a transaction fee of €0.50. EasyPark receives 3% of all revenue collected as compensation. The competing companies in Amsterdam—Parkmobile, Parkline, and SMS Parking—get 4 to 5% of revenue as compensation for their services. Cities that have yet to implement pricing mechanisms for parking can bypass some of the problems associated with theft and spillage of parking

fee collection by starting with a pay-by-phone program. Pay-by-phone is also a good way to get political buy-in for introducing performance pricing because it makes parking so much easier for drivers, who don't need to look for coins or rush back to a meter when running late.

Scan Cars

Enforcement of parking has been revolutionized in Amsterdam, where a van with six cameras mounted on top—three on each side—moving at

40 km per hour, takes more than 160 photos per second. The scans capture license plate numbers using Automated Number Plate Recognition technology, to assess whether a car is parked legally. The vans have a 98% accuracy rate. The remaining 2% is due to unrecognizable vehicles from outside The Netherlands. Three wardens on scooters follow the van to issue penalty tickets. Some of the central London boroughs use CCTV for enforcement activities.

NOTES ON PART 2

¹ Robert Joumard et al. (1996). "Air quality and urban space management," *The Science of the Total Environment*, 189/190, 57-67.

² Rachel Weinberger et al (2010). "U.S. Parking Policies: An Overview of Management Strategies," Institute for Transportation and Development Policy.

³ "Parkeon Celebrates the Golden Anniversary of the Parking Meter." Accessed online July 2010. [URL: <http://www.parkeon.com/de/Press-Release/Parkeon-celebrates-the-golden-anniversary-of-the-parking-meter.html>].

⁴ TRL (Transport Research Laboratory), UK.

⁵ Simon Anderson and André de Palma (2004). "The economics of pricing parking," *Journal of Urban Economics*. University of Virginia. Volume 55, Issue 1.

⁶ Interview with London Councils, September 2009.

⁷ Bernard P. Feeney (1989). "A review of the impact of parking policy measures on travel demand," *Transportation Planning and Technology*, 13 (4), pp. 229-244.

⁸ Bundesministerium für Verkehr, Innovation und Technologie (2007). *Verkehr in Zahlen-Ausgabe*, pp. 64-70. Accessed online July 2010. [URL: http://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/vizo7_kap4.pdf].

⁹ M. Dasgupta et al. (1994). "The Impact of Transport Policies in Five Cities," Transport Research Laboratory.

¹⁰ "CO₂ Based Charges." Accessed online August, 2010. [URL: http://www.richmond.libdems.org.uk/news/002936/co2_based_parking_charges.html].

¹¹ "CO₂ Emissions Based Parking in Richmond upon Thames" [URL: http://www.richmond.gov.uk/co2_emissions_based_parking_leaflet.pdf].

¹² Harmut H. Topp (1994). "Zur Rolle des Parkens in der Verkehrsberuhigung," *Straßenverkehrstechnik*, pp. 375-379.

¹³ Tom Rye et al. (2006). "Expansion of a Controlled Parking Zone (CPZ) and its Influence on Modal Split: The Case of Edinburgh," *Transportation Planning and Technology*, 29 (1) pp 75-89.

¹⁴ Daily Mail Reporter. "Drivers facing £250-a-year tax to park at work despite pledge to end 'war on motorists'" *Daily Mail Online*.

Accessed online August 2010. [URL: <http://www.dailymail.co.uk/news/article-1305362/Drivers-facing-250-tax-park-work-despite-end-war-motorists-pledge.html#ixzzoxbWxYyko>].

¹⁵ James Tapsfield (2010). "Workplace parking levies may be imposed by councils." *The Independent: UK*. Accessed online August 2010. [URL: <http://www.independent.co.uk/news/uk/politics/workplace-parking-levies-may-be-imposed-by-councils-2059468.html>].

¹⁶ W. Young et al. (1991). "A review of urban car parking models," *Transport Reviews*: 11 (1), 63-84.

¹⁷ Zurich Historic Compromise Parking Cap. Accessed online October 2010. [URL: www.stadt-zuerich.ch/parkplatzkompromiss].

¹⁸ Interview with City of Hamburg, September 2009.

¹⁹ Annex D: Maximum Parking Standards (2001). "Planning Policy Guidance 13: Transport" Department for Communities and Local Government. Accessed online September 2010. [URL: <http://www.ashford.gov.uk/pdf/PPG%2013%20Annex%20D.pdf>].

²⁰ Department of Communities and Local Governments (2009). "Planning for Prosperous Economies, EC10.2" Accessed online August 2010. [URL: <http://www.communities.gov.uk/documents/planningandbuilding/pdf/pps4summaryresponses.pdf>].

²¹ Donald Shoup (1999). "In Lieu of Require Parking," *Journal of Planning Education and Research*. Association of Collegiate Schools of Planning: 18:307-320.

²² Jan Gehl et al. (2006). *New City Life*. The Danish Architectural Press: Copenhagen.

²³ Giuliano Mingardo et al. (2009). "No parking, still business," *Verkeerskunde*, No. 4.

²⁴ Carmen Hass-Klau (1993). "Impact of pedestrianization and traffic calming on retailing: A review of the evidence from Germany and the UK," *Transport Policy*, 1 (1), pp 21-31.

²⁵ Rolf Monheim (2001). "The Role of Pedestrian Precincts in the Evolution of German City Centres from Shopping to Urban Entertainment Centres," Presented at Australia: Walking the 21st Century, Perth, Western Australia.

²⁶ GTZ (2010). "Parking Management: A Contribution Towards Livable Cities," *Sustainable Transport: A Sourcebook for Policymakers in Developing Cities*. Module 2C Division of Water, Energy and Transport.

PART 3:

Case Studies

This section will examine ten different cities based on the variety of measures they use to decrease vehicle kilometres travelled (VKT) and shift travel from car trips to other modes of transport. Figure 1 outlines which policy instruments have been applied in each city.

Figure 1:
Policies applied in European cities

	Amsterdam	Antwerp	Barcelona	Copenhagen	London	Munich	Paris	Stockholm	Strasbourg	Zurich
Pricing Mechanisms										
Curbside Charges	x	x	x	x	x	x	x	x	x	x
Progressive Fee Structure		x								x
Off-Street Price Harmonization		x						x		
Residential Permits	x	x	x		x	x	x	x		
Workplace Levies										
Ring Fencing			x		x					
Regulatory Measures										
Supply Caps	x									x
Minimums	x	x	x	x	x	x	x	x	x	x
Maximums				x						x
Transit Based Min/Max Reductions	x	x			x		x		x	x
Access Bans			x							
Emissions Reduction Goals	x			x			x			x
Public-Private Partnership		x	x		x	x	x	x		
Physical Designs										
Bollards	x						x			
Striped Lines				x	x			x		
Repurposing Public Space	x		x	x			x		x	x
Advanced Technologies										
Electronic Parking Guidance Systems			x			x	x		x	x
Smart Meters							x			
Pay-by-Phone	x	x	x	x	x	x	x	x	x	x
Scan Cars	x									

Each case study city can be viewed as a prime application of the following specific strategies:

Amsterdam

Nearly all license plates are digitized, allowing for enforcement to be handled using scan cars that rapidly photograph and assess whether a vehicle is compliant with parking rules.

Antwerp

A public-private partnership allows for parking to be managed more efficiently.

Barcelona

All the revenue generated by parking fees pay for operation and maintenance of a bike-sharing scheme.

Copenhagen

Thousands of meters of street space have been pedestrianized over several decades with hundreds of car spaces removed.

London

Emission standards are recorded at the time of a vehicle's registration and this has allowed several boroughs to charge CO₂-based parking fees.

Munich

Overall restrictive policies with a goal of shifting away from car trips has proven successful.

Paris

Street space has been repurposed for bike sharing and tramways.

Stockholm

Enforcement is outsourced to a couple private companies that better survey parked vehicles.

Strasbourg

Parking provision is dependent on distance and access to transit.

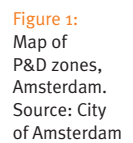
Zurich

Existing supply in the city center has been capped and allowable car trips generated by new developments are also capped.

Amsterdam, The Netherlands

Policy Goals: Emissions Reduction, Congestion Mitigation, Alternative Mode Promotion

Before 1993, vehicle exhaust was not registered in any way. Now car plate numbers are registered with emissions information. Yet Amsterdam has not linked parking fees to vehicle emissions





P&D customer paying for a parking space.



Van Swindenstraat is a 10-Cent Zone from Monday to Saturday between 9 a.m.—7 p.m. All other times residential permits and visitor P&D fees are in effect.

directly as has already been done by several boroughs in London. A parking authority is being established with 100% ownership by the government to better manage parking, issue parking permits, and communicate about changes in policy. Parking policy is still made by the city council.

Pay-and-display (P&D) Parking

Pay-and-display machines are gradually being replaced with license plate input technology. Approximately 3,000 P&D machines are used to handle payments. The cost of on-street parking ranges from €0.90 per hour all the way up to €5.00 per hour in the historical city center, which is amongst most expensive street parking in the world. Most of the on-street parking within the A10 ring road has a fee as do some areas outside the ring. Figure 1 shows all the pay zones.

One of the newest pay zones, originally 90-cents-per-hour, was implemented in an outer borough that has a high on-street parking occupancy rate near a large shopping center. The fee has risen to €1.10 per hour, and will increase to €1.30 in 2012. Blue zones are areas where parking is free.

Blue Zones

Parking spaces that accept the European parking disk, which is a time-limited short-term parking management tool, are in this zone. Any parking fine incurred in a blue zone goes to the federal government, not the city. The city only collects fines in P&D spaces.

10-Cent Zones

The lowest fee for on-street short-term parking in the city is 10 cents per hour, with a time limit of one hour. 10-cent zones exist on certain shopping streets in non-central areas and near cemeteries. Currently, the only way to restrict immediate re-parking in the same spot is if a driver pays by mobile phone. Drivers are known to renew payment for parking immediately.

The nominal fee is the smallest amount that P&D machines will accept. By charging this small fee, the city can retain jurisdiction over these parking spaces. Otherwise, the fines from illegal parking would go to the federal government because they would be in default “blue zones.”

Cars with residential permits are not allowed in the 10-cent zones from 9 a.m. to about 7 p.m., giving short-term parking priority.

Residential Parking Permits

A driver in Amsterdam has three options if they want to park in the central city: apply for a permit; rent space in a garage; or buy a parking space (general cost: €40,000). Owners of a private parking space forfeit the chance to get a residential permit. Residential permits cost up to €150.00 annually and are in such high demand that a several year wait is usually required. Once obtained, a residential permit is only valid near a vehicle owner's home. Drivers must still pay the P&D rate



P&R wayfinding signage is meant to help decrease cruising for a parking space.



Green Wheels is one of the many car clubs in Amsterdam offering car-sharing services to members.

A	Excellent public transit facilities, surrounding main train stations	1 parking space/250 m ²
B	Good public transit and also good accessibility by car	1 parking space/125 m ²
C	Mainly well accessible by car	Tailor made, no norms

Figure 2:
ABC location scheme for parking inclusion in developments

outside of their own neighborhoods. As of 2009, residential parking permits can be forfeited in exchange for a one-year transit pass. This has no impact on the parking supply since the permit is simply transferred to another driver and the spot remains.

City officials determine how many on-street permits to issue by subtracting 10% from the total parking supply. New developments, usually in outer boroughs, have garages included with each apartment. If a parking spot is not secured at the time of purchase, a resident is ineligible to get an on-street permit.

Disabled persons and delivery trucks get special parking permits too. Doctors have signs for their own designated spaces. Midwives get free spots as well. A different ordinance applies for each case.

Car-sharing

Permits for on-street car-sharing parking spots are issued just like residential permits, except the car-sharing companies get dedicated parking spaces. A car-sharing company must have at least ten cars in its fleet to be recognized as legitimate. The city has made contractual provisions so that the car-sharing company must use the parking place.



Parking warden on a scooter.



A typical Volkswagen Caddy Maxi parking enforcement scan van.

Off-Street Parking Regulations

Parking norms for housing can be determined on a project-to-project basis by the boroughs. There is a regulation in Amsterdam that for every spot created off-street, an on-street spot should be removed.

The norms used include these maximums:

0.6 spaces per social (public) housing unit
1.0 space per normal housing unit, with 0.2 per house added for visitors

Commercial facilities are dealt with by the municipal “Location Policy 2008,” also known as the ABC system. For facilities, the norms vary with different types of location, mostly congruent with the A, B, and C locations (see Figure 2).

Park-and-ride (P&R)

P&R facilities are located on the outskirts of the city. Drivers pay €6 to park and can get a 24-hour public transit pass for up to five people. The stay can be extended with the same transit pass deal for 48 and 72 hours. This sends a clear message: people are welcome in the city center, but cars are not. In 2011 this fee will increase to €8, with a maximum transit pass for up to two people.

Wayfinding signage helps drivers locate P&R facilities. The next generation of signage uses an integrated dynamic parking (IDP) system, a type of advanced parking guidance system (APGS) that is meant to direct drivers to available parking spaces and curtail excess VKT from cruising. There is also a park-and-bike program. In lieu of a transit ticket, P&R users can borrow a city-owned bike for the whole day.

Pay-by-phone

Pay-by-phone service was introduced in Amsterdam around 2006. The city keeps a record of user information and sends bills based on what they gather from the pay-by-phone providers. There are three private companies that the city contracts to handle the mobile phone payments in Amsterdam:

- Parkmobile
- Parkline
- SMS Parking

These companies collect the revenues and then transfer them to the city. The city pays a fee at a rate of 4–5% of the revenue for the services. Residential parking permits are 90% digitized.



A truck driver parks on a narrow road and quickly unloads goods on before 9:30 a.m.



A woonerf with perpendicular parking arranged to calm the street, giving priority to pedestrians and bicyclists.

Drivers will soon be able to pay for parking mostly by phone or internet.

There has been some discussion about introducing a national pay-by-phone system that would help lower the overall fee, allowing smaller municipalities to take advantage of this service as well. Dutch cities are leading an effort, in conjunction with a private company, to implement such a national scheme.

Parking Enforcement

At the moment, parking enforcement is mostly managed by wardens who patrol the streets. The next generation uses a scan car and wardens on scooters. Designed by Abstract Computing International B.V. using a Volkswagen Caddy Maxi van, the car has six cameras—three on each side—and automatic license plate number recognition technology to recognize illegal parkers. Driven at 40 kilometers per hour up and down the street, the car takes scans of the surroundings at a rate of over 160 scans per second.

A small group of wardens follow the car on scooters and issue tickets for violations. This system is twice as efficient as the old one. The scan car system has a 98% accuracy rate, although some parked cars, mostly foreign vehicles, must be checked manually.

Parking Revenues

Every borough in Amsterdam has a contract with Cition, a company owned by the municipality. Cition gets a fine if it does not collect P&D fees from visitors. Parking revenues go back into infrastructure projects. These projects must be part of the citywide mobility scheme, not just within the borough where it happens to be collected. There is a parking fund, but the money can be used in many flexible ways, even to finance kindergartens. The parking fund comes from P&D fees, penalty fines, and permit revenues. Every borough is required to give about 30% of its parking revenue to the municipal government.

The fine for a parking violation in a paid spot is always €50.90 plus the price of one-hour parking (max €5). This applies even if the car is parked for ten hours in one spot having only paid for one hour. The maximum parking fine, €150, is reserved for parking in a handicapped spot.

Trucks and Freight

All trucks over three-and-a-half tons need to comply with stringent air quality norms. Most trucks older than seven or eight years will not be allowed into the city. Trucks can unload for a maximum of 15 minutes in spots where they are not allowed to park. Loading and unloading must be done before 10 a.m. or 11 a.m., depending on the street, and then the trucks need to exit the city.



The parking lane is designed to protect the bike lane from the moving traffic lane.

Fuel-Efficient Vehicle Incentives

There is a debate over whether to reduce the parking permit fees for electric cars, small and clean cars, or any environmentally upgraded vehicles. For this to be possible, national policies need to change to verify fuel efficiency of vehicles by license plate number. Parking permits will only go to clean or electric cars. By 2012, nearly 200 electric charge points across the city are expected to supply power by the renewable energy firm Nuon. If this happens, the city will need to simultaneously reduce the number of other parking permits issued. Electric cars can help improve air quality, but not energy efficiency or safety, and they still require parking spaces.

Street Design

Amsterdam has several streets that use parking orientation to create safer environments for bicycle users and pedestrians. A woonerf in the borough of Westerpark includes perpendicular parking to create a quasi-chicane. Motorists must give priority to people on bikes and walking when moving through the space. Other streets use parallel parking to protect the bike lane, which is segregated from the pedestrian space by a curb, and from the parking lane with a curb on the other side. The curb closer to the parking lane acts as a buffer, preventing collisions between cyclists and car doors opening into the bike lane.

SOURCES FOR AMSTERDAM

Abstract Computing International B.V. Accessed online July, 2009 (URL: <http://www.abstractcomputing.nl/>).

Claire Chevallier (2002). "A breath of fresh air" Fact Sheet. Transport and Environment (T&E).

Colliers International, Global CBD Parking Rate Survey 2009. Accessed online January, 2010 (URL: <http://www.colliers.com/content/globalcolliersparkingratesurvey2009.pdf>).

Dan Jones (February 2010). "Amsterdam businesses get €3m for electric car."

Power and Energy. GDS Publishing Ltd. Accessed online December 1, 2010. (URL: <http://www.ngpowereu.com/news/amsterdam-electric-cars/>).

Interview with Milieudefensie, Friends of the Earth Netherlands, July 2009.

Interview with City Surveillance Service (Dienst Stadstoezicht), July 2009.

Interview with City of Amsterdam, July 2009.

Interview with EcoRys Research and Consulting, July 2009.

"Parking Policy in Amsterdam (NL) Fact Sheet," Pollution Reduction Options Network (ProNet). Accessed online December 1, 2010. (URL: <http://www.umwelt.nrw.de/umwelt/pdf/pronet/factsheets/13.pdf>).

Visitor parking portal for Amsterdam – "iAmsterdam." Accessed online July, 2009. (URL: <http://www.iamsterdam.com/en/visiting/touristinformation/gettingaround/parking/parkinginamsterdam>).

Willi Loose (June 2009). "Car Sharing Station in Public Street Space" Intelligent Energy Europe. Momo Project. Car Sharing Fact sheet No. 6. Accessed online July 2009. (URL: <http://www.uitp.org/pdf/factsheet6estationsinpublicspace.pdf>).

CASE STUDY:

Antwerp, Belgium

CITY OVERVIEW

Population: 360,000

Population Density: 2,308 inhabitants per km²

Parking Supply: 38,318 inner city on-street, 93,516 outer city on-street; 11,280 off-street

Curbside Fees: Range is from €0.50/hour up to €3.50/hour, depending on zone and duration

Policy Goals: Optimal Curbside Visitor Turnover, Prioritized Residential Parking, Congestion Mitigation, Alternative Mode Promotion

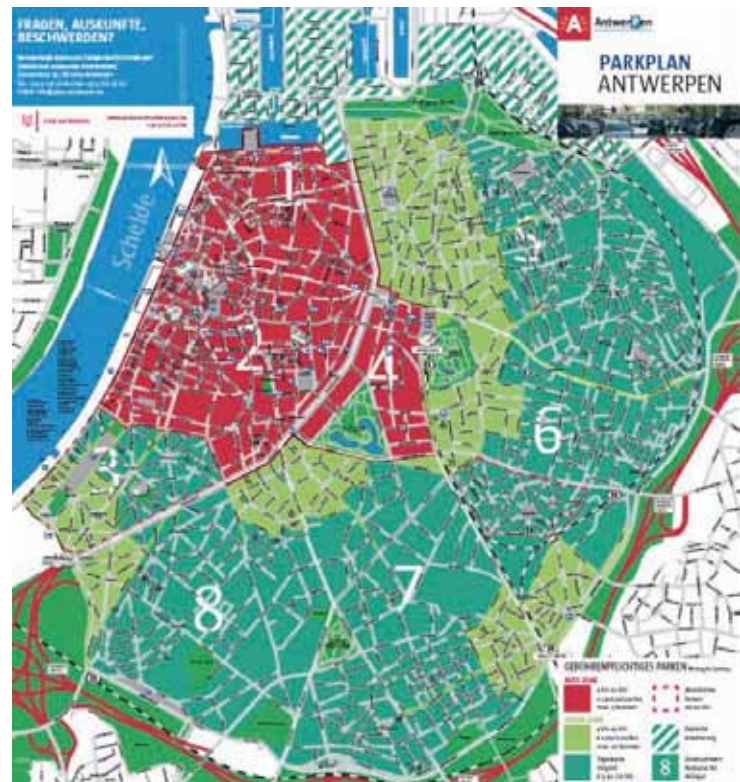
Antwerp, Belgium is using parking as a means of limiting car use in the city center. The city's goal is to create higher turnover at the curb for visitors, while accommodating residential parking needs. All parking is managed through a semi-private parking authority, Gemeentelijk Autonoom Parkeerbedrijf Antwerpen—Municipal Autonomous Parking Antwerp—or GAPA. Emphasis has been placed on pricing, enforcement, and the use of technology to reach the parking program's goals. In the summer of 2011, Antwerp is planning to launch a bike-sharing program, financially modeled after Barcelona's, using revenue collected from the parking programs. Parking fines are currently invested into mobility projects in the city.

Parking Authority as Public Private Partnership

The City Council founded GAPA in 2001 in a public-private partnership (PPP), transferring all existing parking-related contracts to GAPA and giving GAPA full authority to manage, oversee, and control all on-street and publicly-owned off-street facilities. GAPA is allowed to build and manage new off-street lots. In return, GAPA is expected to cooperate with other off-street parking operators, enforce parking regulations, prepare parking policies, and pay personnel and operational costs for enforcement. All revenues are collected through a special escrow account.

Figure 1:

Map of three Antwerp P&D zones. Source: GAPA



There are many benefits to running a parking authority through a PPP. The contract encourages and allows GAPA to be innovative by using technology for enforcement and data-collection needs. GAPA, unlike the city, is also more flexible in their ability to negotiate work agreements with employees. It is also in GAPA's best interest

to charge the highest feasible price for parking, thereby regulating the number of cars in the center city, even if political pressures and city council approval of parking fees do nevertheless suppress parking prices slightly below market value.

Pay-and-display Parking

Antwerp is divided into three P&D zones (red, dark green, and light green) ranging from most to least expensive respectively (Figure 1). Parking fees range from €0.50 to €3.50 per hour, depending on the zone and the duration of stay (Figure 4). The number of paid on-street parking spots has increased from 9,500 in December 2003 to 14,460 in March 2005. GAPA has doubled its number of P&D machines between 2003 and 2006 from 500 to 1,000.

The fine for nonpayment or overstaying is €23.

Enforcement and Parking Revenue

GAPA has enjoyed a steady increase in revenue from the P&D machines (Figure 2). To improve compliance, both auxiliary police and parking wardens of GAPA work on enforcement. Figure 3 shows how compliance levels increased along with enforcement. Red represents income from fines and blue represents income from the P&D machines.

Figure 2:
Revenue from P&D machines (2001–2003)

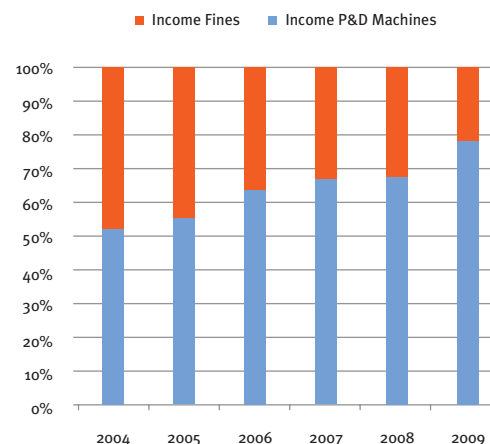
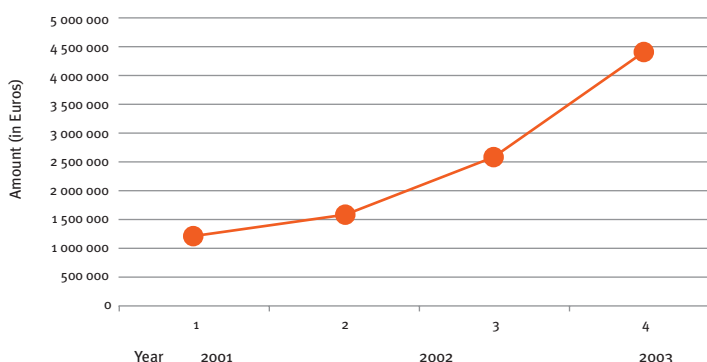


Figure 3:
Parking income breakdown (%). Source: GAPA

Figure 4:
On-street parking summary fee structure

	RED ZONE (Central Station & CBD)	GREEN ZONE (within single semi-ring road)	YELLOW ZONE (outside single semi-ring road)
Days	Mon – Sat	Mon – Sat	Mon – Sat
Valid Times	9 a.m. – 10 p.m.	9am – 10 p.m.	9am – 10 p.m.
Linear Tariff			€0.50/hour
Progressive Tariff	€1.50/€2.50/€3.50 per hour	€0.60/€1.00/hour	€0.50/hour
Day Ticket	Not applicable	€3.50/10hours (not on shopping streets or when there is an off-street parking facility nearby)	€2.50/10 hours (not on shopping streets or when there is an off-street parking facility nearby)
Max. Parking Duration	3 hours	10 hours	10 hours
Commercial Rate	€23/12hours	€23/12hours	€23/12hours
Blue Zone	Not applicable	Restricted supply	Possible

P&D Technology and Payment Options

Customers can choose from four different types of payment methods: coins, SMS, pay-by-phone and Smart Card. P&D machines only accept coins and do not accept bills. The first ten minutes of SMS and pay-by-phone parking is free; the first 15 minutes of Smart Card parking is free.

The company Mobile-for (www.4411.be) has been operating SMS parking in Antwerp since 2004. Customers who are registered online can send an SMS to a special number located on the side of a P&D machine with their vehicle plate number and a code. A confirmation SMS is then sent in return. Each SMS sent and received costs €0.15.

Customers can view their parking history, billing, and settings online. Since the summer of 2009 there has been a GAPA-owned off-street parking lot at the National Bank that allows SMS parking.

Another payment option, offered by the company Park Line, allows customers to make a call from their mobile phone to start and end a parking session. There is a one-time fee of €10, and a monthly charge of €1.75.

Customers have the option of buying a personal electronic parking meter called a Smart Park. The device is hung in the rearview mirror and eliminates the need to go searching for the nearest P&D machine. Inserting a rechargeable card into the device activates the system. It is possible to preset the device so that it only runs during paid parking times. The first ten minutes is always free. A new starter kit costs €116.50 and reloadable cards cost €50. This technology is ideal for employees who must drive a lot and who do not want to pay out-of-pocket for parking.

Residential Parking Permits

Each household living in a paid or blue parking zone is entitled to two free residential parking permits. In partnership with the company Mobile-for, the distribution and control of resident permits are digitalized and issued through a new internet-based software application. This allows GAPA to better control how many residents have a permit, and it reduces paper use. In 2009, 32,510 resident permits were issued; each is valid for two years. There were approximately 70,000 resident



By the end of 2007, 15% of all parking transactions were paid for by mobile phone. Source: GAPA

permits in circulation at the end of 2010. The parking zones overlap so that residents are not required to walk more than 200 meters between zones. Residents can select the zone where they want their parking permit to be valid.

The digitized licensing system allows for efficient parking control. When a car has paid through SMS parking, the parking attendants can check through their hand-held computer terminals using the license plate of the car. Resident permits are placed in the windshield and must be checked manually by the attendants.

Off-Street Parking Regulations

In order for GAPA to manage privately owned off-street parking facilities, quality standards have been developed. GAPA is able to enforce these standards by closing down non-complying garages, or converting them to resident- or subscription-only garages.

Figure 5 summarizes the building code for car and bicycle parking.



Smart Park electronic parking meter (with card reader) for individual cars. Source: GAPA

Shared Use of Private Parking Spots

To improve the efficient use of parking spaces, GAPA is working on a scheme to bring privately owned parking lots into public use in the evenings, when privately owned lots, like those at supermarkets and office parks, are typically unused. GAPA believes that they are in a better position than public companies to negotiate with private owners to allow for shared space of privately-owned parking lots because they are able to offer technical assistance and subsidies for technical modifications.

GAPA is offering the following services to facilitate shared parking spaces:

- Arranging for residents to get reduced rates
- Drafting model contracts for owners and users
- Providing an online platform where parking spaces can be rented or put up for rent
- Subsidizing a private car park or the subscription of residents on the condition that they give up their on-street resident parking permit
- Facilitating private initiatives for the building of nearby parking lots
- Offering bicycle parking on private parking lots that can be used by the public

Car Sharing

GAPA reserves parking spots for car sharing in parking zones where parking time is limited. Residents who live within 200 meters of a parked car and who are car-sharing members receive the equivalent of a residential permit so that they can park car-sharing vehicles near the house.

The city's modal share for commuters—a population that tends to park the whole day—shows a trend toward more public transit and non-motorized transport. In the time period 2000 to 2006, the first years GAPA was active in implementing parking management, there was a 30% increase in public transit use, a 66% increase in walking, a 61% increase in bicycle riding, and a 50% decrease in private car use. Since parking management and improved bicycle infrastructure have been

	CAR PARKING	BICYCLE PARKING
Offices	Depends on where the parking is situated and on the Regional Urban Plan	Minimum 1/100 m ² floor area
Stores	At least 2.5 parking places/100 m ² floor area Up to 3.5 parking places/100 m ² floor area	Minimum 4/100 m ² floor area
Housing	Minimum 1.1 parking spot/dwelling unit. Visitors have a share of 0.3 parking spots	Minimum 2 bicycle parking spots/dwelling unit

the two most significant urban transportation projects during that time period, it can reasonably be assumed that parking management is partly responsible for people shifting to more sustainable transport modes.

Figure 5: Off-street regulations for car and bicycle parking. Source: City of Antwerp

SOURCES FOR ANTWERP

Gemeentelijk Autonoom Parkeerbedrijf Antwerpen (2008). [URL: <http://www.parkereninantwerpen.be/parkeren/bezoekers/smart-park/smart-park>].

Interview with Ludo Van Campenhout, Alderman, July 2009.

Interview with Cynthia Van der Linden, GAPA, July 2009.

"Parking in Antwerp" presentation (2005). Presented at the Interreg IIIC-Project "City Parking in Europe Partner Conference, Berlin. GAPA.

"Parkeerbeleidsplan 2008-2012" (2008). ["Parking Policy Plan 2008-2012"]. GAPA, p. 33-34.

CASE STUDY:

Barcelona, Spain

CITY OVERVIEW

Population: 1,673,075

Population Density: 16,499.8/km²

Total Parking Supply: 800,457 (on-street: 187,372; off-street: 613,085)

Car Ownership: 608,830

Curbside Fees: 2.42 (Zone A), €2.16 (B), €1.96 (C), €1.08 (D)

Parking Revenue: Approximately €5 million annually

Policy Goals: Revenue Earmarking/Ring-Fencing, Alternative Mode Promotion, Public Space Reclamation

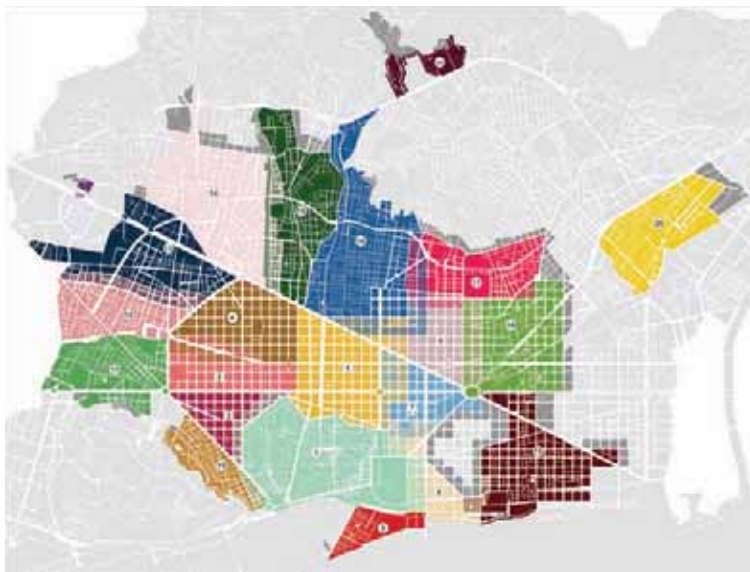


Figure 1:
Map of P&D districts in Barcelona
Source: B:SM

Barcelona is notable for being the first city to use 100% of the surplus from on-street parking fees to finance a public bicycle-sharing program, called Bicing. The city was also the first to decouple advertising from bike-sharing in a concession to ClearChannel's Smart Bike Division. Faced with congestion from 1.15 million vehicles entering the city center and 93% of these vehicles looking for parking spaces, in 2005 the city launched the integrated parking regulation program known as Area Verde, or "Green Zone." The purpose was to regulate visitor parking supply—limiting parking time using a pricing mechanism to control on-street demand for spaces, while giving priority

to residents. The parking project also included converting car spaces to motorcycle parking and Bicing stations. Traffic congestion was reduced by 5–10% as a result of the parking reforms. The mode split in 2007 was roughly one-third each between public transit, private motorized transit, and non-motorized transit.

There were 30,000 bicycle trips a day in Barcelona before Bicing began in 2006. In 2009 there were close to 100,000. Bicing, on average, accounts for 40,000 trips with the remaining 60,000 trips a day made by cyclists on private bikes. The introduction of Bicing, along with the expansion of bike infrastructure to 150 km of paths can be attributed to this two-fold increase in bicycle trips in three years. Approximately 4% of Bicing customers are former car commuting drivers and nearly 5% are former car commuting passengers or motorcycle users. Bicing has 440 stations and nearly 300 of them are on the street, each one using three to four spaces converted from car parking, which amounts to a repurposing of nearly 1,200 spaces.

For the last decade, Barcelona has also been removing parking in order to create better pedestrian streets. The historic city center is almost entirely pedestrianized, and there are many streets where only taxis, residents, and delivery vans can enter. The Super Manzanas, or superblock, project in the Gracia district was one of the most recent pedestrian projects. A square was drawn around a cluster of internal streets, where cars are



A Bicing customer near Plaza Universitat.



A pedestrianized street inside the super manzanas in the Gracia district with fastened chairs, high quality stone materials, and planters.



Area Verde P&D machine.

restricted from entering; they are only allowed to move along the perimeter of the cluster, along the square's edge. Limited vehicles can park inside, but no through-traffic is allowed.

Pay-and-display Parking

Area Verde is a regulated parking area divided into 20 P&D districts using 3,200 P&D machines. Blue zones are for visitor parking with a time limit of one to four hours, as indicated on the signage at the location, and vary in price based on fee level. Green zones are for residential parking. There are four main fee-type zones, with the most expensive prices in the Eixample area (part of the Barcelona grid) and Gothic quarter (outside of the grid), where the demand for parking is highest and the state of traffic conditions are used to justify the pricing. The city aims to keep 15% of spaces vacant to limit cruising for an available parking space.

The cost of parking in each fee level is shown in Figure 2 and can be paid using coins or a credit card. The most expensive fees are in the historic city center. The blue zone fees are typically adjusted every year based on the inflation index (in 2008 it was 1.4%, in 2007 it was 4%), while the fee in the residential green zone has not changed since 2005.

Loading and unloading are permitted in designated on-street parking spaces for a maximum of 30 minutes.

Drivers with a disabled badge can park anywhere.

Fee Type Zone	Price Per Hour (€)	Maximum Allowable Hours
A	2.42	1 or 2
B	2.26	2
C	1.96	3
D	1.08	4

Figure 2:
Fee type zones

Resident Parking

The green zone has two types of parking: resident and preferential. Certain spaces around Ciutat Vella, old Gracia, old Sarria, and Camp de l'Arpa are exclusively for residents' use. Residents can purchase a weekly parking sticker (only one per household) to use in any reserved space in the green zone and then pay 20 cents a day for a P&D ticket or €1 per week—about €50 a year. This was a political decision under the Socialist Party coalition. Weekly sticker holders are not guaranteed an available space since they are on a first-come, first-serve basis. Residents are forbidden to leave a car parked in the same space for more than seven days. For comparison, purchasing a monthly space in an off-street facility costs €100 per month on average, ranging from €150 per month in the city center and €50 per month in outskirt areas.

Unlike resident parking spaces, non-residents are permitted to park in preferential spaces in the green zone without purchasing a residential sticker. The cost of a residential sticker is the same for use in these spaces, but the price for non-residents is the highest hourly rate in the city. The non-resident price is divided into two fee levels—



Signage for a preferential parking zone.



Entrance to underground parking facility in the Gracia district.



Bicing customer dropping off a bike at a station.

A at €2.94 per hour and B at €2.68 per hour. Fee level A is 50 cents higher than the most expensive blue fee level zone in the center of the city.

Off-Street Parking

Barcelona has minimums, but no maximums for accessory parking requirements for new developments. The standards are outlined in Figure 3.

LAND USE	UNITS PER PARKING SPACE
Residential buildings	2 to 6 apartments depending on area
Offices	75 m ²
Commercial buildings over 500 m ²	75 m ²
Industrial	100 m ²
Entertainment under 5,000 spectators	50 seats; over 5,000 spec: 100 seats, min 100
Hotels	8 rooms
Hospitals	10 beds

Figure 3:
Accessory
parking require-
ments for new
developments

B:SM, the city-owned Barcelona Municipal Services company, is responsible for overseeing and building off-street car parks. Approximately 70 off-street garages have been constructed by B:SM and nearly 20 of these facilities are exclusively for residents, who lease a space for 50 years. The average cost to construct an off-street parking space is €21–24,000 plus value-added tax (VAT) to the construction company. Commuters buy season tickets for about €70–100 a month and are permitted to use the facility from 7 a.m. until 9 or 10 p.m. Residents can use the spaces overnight in some facilities for €50–70 a month.

B:SM and the private parking management company Saba Abertis are the two main companies

that receive concessions to manage off-street parking. The concessions used to be for 30–50 years, but the city reduced them to 13–15 in order to renegotiate the contracts more often with improved terms. In the last few years, B:SM has gained control of many off-street facilities and attempts to set the prices in relation to on-street fees. At the end of a contract period, B:SM may take over a former privately run facility or a private company may renegotiate a concession and offer more services—such as bicycle and motorcycle parking. Saba Abertis manages all of the parking facilities in the city center. Less popular facilities are usually overseen by B:SM, such as those with only 25% occupancy during off-peak periods.

B:SM has installed approximately 50 recharging points for electric cars in its off-street garages. Electric cars pay €1.20 per stay for using the plug-ins. There are less than ten electric cars in Barcelona at the end of 2010, but B:SM is preparing for anticipated future demand.

Revenue and Bicing

When Area Verde was launched, all the revenue from parking fees was directed to a special fund for mobility purposes. The first program to get financed was a 30-km zone of calmed streets and the remaining money went to Bicing. The request-for-proposals for Bicing was released in 2006, a year when the city had a €12 million surplus. The terms promised a payment of €3,000 per bike per year to cover service, maintenance, and customer support. ClearChannel responded to the RFP with an offer for almost half the price, plus made the initial €10 million capital investment.



Motorcycles serve as a buffer for the separated cycle track in the median of the street Carrer de Granados in the Eixample area.

The Bicing bikes cost about €400 each and weigh about 16 kilograms. B:SM pays a flat fee to ClearChannel for operation of Bicing, which costs €10 million annually to run.

The system has been expanded since it was first launched. The city is committed to assuring that Bicing works smoothly, but the parking funds alone can no longer fully finance the level of upkeep the city desires. As a result, the city is co-funding Bicing at nearly a 1:1 ratio. Maintenance needs to be better controlled. The contract terms negotiated with ClearChannel in 2009 state that 90% of the system must be in good shape and an audit must be done each month. If the city finds that only 80% is in a state of good repair including bicycles and stations, then ClearChannel is required to pay a fine.

Motorcycles

Barcelona has 300,000 motorcycles, the second highest number in any European city, after Rome. Motorcycles are permitted to park on sidewalks that are more than five meters wide. In the next few years, motorcycle parking will be more strictly regulated with a parking fee scheme likely to be introduced in the city center. Motorcycles are permitted to use the bus lanes, but not the cycle tracks. Bicycles are forbidden from using the busways. Some B:SM off-street parking facilities already have a system in place to charge motorcycles a fee proportional to the space they occupy. On average in the Saba Abertis-operated facilities, a 600-space garage will have only ten to 20 motorcycles parked inside.

Enforcement

The city police handle enforcement of parking regulations; surveillance of bus lanes, using a van-mounted camera, is the only aspect overseen by the private mobility management company TMB (Transports Metropolitan de Barcelona). Fines for parking infractions range from €30 to €100. Nearly 370 wardens monitor parking conditions by foot. The foot wardens look at P&D related issues, while 40 other wardens use a motorcycle to check non-payment-related illegal parking. They tend to look in areas where there are few parking places. The city is testing a pilot program, giving electric motorcycles to some wardens. The first tests went poorly because the motorcycle batteries died in five hours—two hours before a warden's shift is over.

SOURCES FOR BARCELONA

Àngel López Rodríguez (May 2006). "Movilidad y convivencia de la moto en Barcelona." Presentation at XIII Fórum Barcelona de Seguridad Vial. Accessed online October, 2009. [URL: <http://www.bcn.es/infotransit/xiiiiforum/ponencies/ponenciaAngel-Lopez.pdf>].

Asociación Española de Aparcamientos y Garajes [ASESGA] (2008). "Libro Blanco del Sector del Aparcamiento y Garaje en España" (2008).

Dades bàsiques de mobilitat (2009). Ajuntament de Barcelona. Accessed online October, 2009. URL: <http://w3.bcn.es/fitxers/mobilitat/dadesbasiques20092010compleert.822.pdf>.

Fee type zones. "Tarifes de l'Àrea Verda." Ajuntament de Barcelona. Accessed online October, 2009. URL: <http://www.areaverda.bsmsa.cat/funcionament-i-tarifes/tarifes-de-larea-verda/>.

Interview with RACC Automovil Club, September 2009.

Interview with Center for Innovation in Transport (CENIT), September 2009.

Interview with European Parking Association, September 2009.

Interview about On-Street Parking Regulations at B:SM, September 2009.

Interview with Bicicleta Club de Catalunya (BACC), September 2009.

Interview with Saba Abertis, September 2009.

Map of P&D District. "L'Àrea Verda es divideix en 22 zones." Ajuntament de Barcelona. Accessed online October, 2009. [URL: <http://www.areaverda.bsmsa.cat/que-es-larea-verda/mapa-zones-residents/>].

Resolution of the Ministry of Land Use and Public Works: Building Codes and Land Use. Resolució del Conseller de Política Territorial i Obres Públiques de 12 de novembre de 1992 (DOGC núm. 1690 de 04/01/1993). Accessed online, October 2009. URL: <http://www3.amb.cat/normaurb/URBANISTIQUES/1-5-4.pdf>.

CASE STUDY:

Copenhagen, Denmark

CITY OVERVIEW

Population: 518,574

Metropolitan Population: 1,892,233

Population Density: 5,892/km² (15,260.2/sq mi)

Paid On-Street Parking Supply: ~30,000

Excise Car Tax: 180% (nationwide)

Policy Goals: Emissions Reduction, Public Space Reclamation, Alternative Mode Promotion

Copenhagen encourages travel by public transit and bicycle while discouraging visitors and commuters from coming to the city by car. Parking fees are the highest in the city center, where traffic has dropped by 6% since 2005 despite a 13% increase in car ownership during the same period, and a 31% total increase since 1993. From 2002 to 2008, 219 parking spaces in Copenhagen were replaced by cycle tracks at an average rate of about 32 parking spots per year. The investment in new bicycle infrastructure has led to an increase in biking from 30% in 1998 to 37% in 2008. The mode split in 2008 was 37% bicycling, 31% car, 28% public transit, and 4% walking.

Pay-and-display Parking

In Copenhagen, parking is divided into three zones, each with different colors and prices. A pay-and-display ticket is valid in the zone in

which it is purchased and any cheaper zones. A red zone ticket may be used in the cheaper green or blue zone, while a blue zone ticket may not be used in the more expensive red zone. Weekly or monthly passes can be purchased at a discounted price from the Center for Parkering website along with pre-paid scratch cards that replace P&D tickets. The Center for Parkering is a city-owned company with 200 employees that oversees on-street parking operations and several off-street parking facilities. There are approximately 30,000 paid parking spaces. Free parking is permitted from Saturday afternoon until 8 a.m. Monday morning.

P&D Payment Methods

Payment for parking in a P&D space can be made by phone, credit card, and coins. There are two companies that handle collection of parking revenues: EasyPark and Siemens. Pay-by-phone

Figure 1:
Parking charges

		RED ZONE	GREEN ZONE	YELLOW ZONE
Weekdays	8 a.m. – 6 p.m.	DKK 29/hr	DKK 17/hr	DKK 10/hr
	6 p.m. – 11 p.m.	DKK 10/hr	DKK 10/hr	DKK 10/hr
	11 p.m. – 8 a.m.	DKK 3/hr	DKK 3/hr	DKK 3/hr
Saturdays	8 a.m. – 5 p.m.	DKK 29/hr	DKK 17/hr	DKK 10/hr
	After 5 p.m.	Free	Free	Free
Sundays, public holidays		Free	Free	Free



Former curbside parking replaced by bike infrastructure for cyclists.

customers can choose to enroll in either program. Both EasyPark and Siemens give 100% of collected revenues to the city. The city prefers fewer operators to keep book-keeping simple. Copenhagen dealt directly with the companies and asked them to handle mobile phone payments. No RFPs were ever issued.

These suppliers have an impact on the cost of parking for mobile phone payers because a user fee applies in addition to the normal parking rate. Drivers can avoid the fee by paying with coins or credit card instead. An estimated 50 DKK (€6.72) monthly membership is required for using the Easy Park service in addition to a 5 DKK fee (less than €1) for each transaction. The breakdown of

payment methods used is 42% by coins, 40% by credit card, and 18% by phone. P&D machines do not accept bills.

Upon payment, a ticket is issued by the P&D machine and must be displayed in the car's windshield. Pay-by-phone users also display a little sign under their windshield.

Residential Parking Fee

Residents living in P&D zones can purchase a special permit in lieu of paying the hourly fee, which is in place for visitors, not residents. Residential parking permits cost 690 DKK (~€ 93) a year. There has also been a discussion in the traffic department about different pricing for successive number of cars, with the second and third being more expensive.

Free Parking

Motorcycles, cars with disabled badges, and electric cars can park for free in any zone. So far, no one owns an electric car, even though they are exempt from the 180% excise tax on vehicle purchases. There are eight charging stations in the entire city. Four parking places are available at each station, and each space is equipped with an outlet. The city provides the electricity at no cost.

On-Street Parking Supply Reductions

The on-street parking supply has been decreasing at a steady pace over the last few decades due to the installation of cycle tracks, bicycle parking bulb-outs, daylighting measures, new pedestrian areas, and reallocation of street space for bus lanes.

The goal of daylighting is to make streets safer for pedestrian crossing. The city undertook daylighting measures in the last few years by removing curbside parking near intersections to improve visibility for approaching vehicles and pedestrian safety. Curbside parking is prohibited within five meters of a street corner, and the distance has recently been increased to ten meters, so further on-street parking supply reductions are expected.

Bus-only lanes exist during peak hours on certain streets. Car-sharing companies like Københavns Delebiler get permits to park on the street in spaces formerly occupied by private vehicles.

Figure 2:
(Left) Pay-and-display parking zones, Copenhagen



P&D solar-powered machine in the Islands Brygge district of Copenhagen.

Curbside bicycle parking bulb-outs also have a street-calming function, and decrease the crossing distance for pedestrians.



Nørrebrogade is a commercial street with a cycle track in both directions and a bus-only lane on which the most used route, 5A, operates.



Experimental Zones

The city is experimenting with the creation of pedestrian zones and retractable bollards. The most frequently-used bus in Copenhagen, 5A, operates on Nørrebrogade which is part of the experimental program. There are also plans to restrict car access even further to a huge section of the city near Strøget, one of the longest pedestrian streets in the world.

Off-Street Parking

There has been an effort to shift on-street parking spaces into off-street parking facilities. Each off-street spot costs about €60,000 to build, but the on-street spaces are then converted to an alternative use that supports another transportation mode.

While private parking facilities sometimes have the same hourly cost as on-street parking spaces, they tend to be more expensive. Two off-street facilities managed by the Center for Parkering have the same fee as the on-street metered spaces, but they only have 25–30% occupancy during the day. Despite this low-occupancy during off-peak times, the facilities are considered a success because their goal is to limit car use.

Approximately one billion DKK has been invested

in new off-street parking facilities for the 2009–2010 fiscal period. The Center for Parkering is building three new underground parking facilities, which will amount to 880 new off-street parking spaces. When a private company constructs a parking facility, they usually receive a concession from the city to collect fees and manage the facility. Green P-hus is such a facility, and it will be turned over to the Center for Parkering at the end of the contract period.

Shared Parking Strategies

An off-street parking facility at the Amare shopping center, located in the historic city center, is used by shoppers during the day, and also by local residents overnight. The facility is operated by a private company and the city leases several spaces to accommodate overnight residential parking needs from 6 p.m. until 8 a.m. The city has many similar arrangements with private parking facilities, in order to accommodate local residential parking needs. Certain on-street loading zones are also used as residential parking at night. These arrangements are determined on a case-by-case basis.

Off-Street Parking Regulations

The general plan for the city of Copenhagen requires the construction of one off-street parking space for every 100 m² of construction. In the southern parts of the city, around the borough of Ørestad, the plan only requires one spot for every 200 m², because of its proximity to the metro. Commercial developments may avoid the minimum parking requirement on a case-by-case basis. Refurbished buildings are required to be retrofitted for parking. A change in land use—from residential to commercial, say—prompts an adjustment to the accessory parking requirement.

Revenues

The city collected 180 million DKK (€24 million) in fines in 2008. The parking money goes into a general city fund. In Denmark, it is illegal to earmark parking funds for anything specific. The city council sets the level of the parking fees.

Parking Enforcement

There are 115 parking wardens who patrol by foot, and issue tickets using electronic hand held devices. On average, the city issues 350,000 fines every year—100,000 for parking in a P&D space



A street in Nørrebro where pedestrians and cyclists get priority.



TOP: Play-street that includes planted trees, picnic tables, bike parking, and an undulating street design which all compel cars to drive slowly.

BOTTOM: Parking-protected cycle track.

without paying and 250,000 for all other types of illegal parking—amounting to a revenue of 500 million DKK (€67 million). The standard penalty for every type of parking violation is 510 DKK (€69).

If a driver avoids paying his or her fine, the tax administration can collect the payment by deducting it from overpaid taxes. If that is not possible, the tax administration contacts the driver's employer to have the fine taken directly from the person's salary.

Street Designs

Copenhagen has been reclaiming public space from through traffic and car parking since the 1970s. Central areas like Strøget have long been pedestrianized, while districts like Nørrebro are currently being redesigned with limited car access, and better shared spaces.

The city has also designed play-streets, which use different obstructions to force traffic to move slowly. For example, former parking spaces may have been replaced by wooden picnic tables or cargo bike parking. Other elements like a hopscotch course, or a tree in the middle of the street remind drivers that they are entering a pedestrian priority zone.

SOURCES FOR COPENHAGEN

Parking Kbh, Pay and Display Zones. Accessed online July, 2009. [URL: <http://www.parking.dk/parking/tourists-and-visitors/>].

Timothy Beatley (2000). *Green urbanism: learning from European cities*. Island Press: Washington, D.C.

Interview with Green Left Party, July 2009.

Interview with Cyclist Foundation, July 2009.

Interview with of Copenhagen, July 2009.

Interview with Center for Parkering, July 2009.

Jan Gehl & Lars Gemzoo (1996). *Public Spaces Public Life*. The Danish Architectural Press: Copenhagen.

Jan Gehl & Lars Gemzoo (2006). *New City Life*. The Danish Architectural Press: Copenhagen.

CASE STUDY:

London, England

CITY OVERVIEW

Population: 7,556,900

Metropolitan Population: approx. 13,945,000

Population Density: 12,331/sq mi (4,761/km²)

Curbside Fees: Westminster (£4.40/hr), Islington (£4/hr)

Policy Goals: Congestion Mitigation, Public Space Reclamation, Alternative Mode Promotion

London is perhaps the first city to pioneer CO₂-based parking fees that vary based on a vehicle's engine standards. It is also one of the first to charge for motorcycle parking in former car-parking spaces. This is important because motorcycles have become more popular in the city since the congestion charge was implemented in 2003. Motorcycles can enter the priced zone for free.

London is divided into 33 boroughs, each with its own local authority that handles parking issues. The local authorities receive specifications from the London Councils—an umbrella lobbying group working to further the interests of borough councils while also overseeing certain government functions across the city—to follow particular strategic measures, such as releasing annual reports on the state of parking. 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.

Policy change that expedited parking reforms

The Road Regulation Traffic Act of 1991 shifted the responsibility of traffic violation enforcement from the police to local borough councils, in a process known as decriminalization. Police officers had been enforcing traffic violations since the Road Traffic Act was passed in 1984, which



Controlled Parking Zone (CPZ) signage at street entrance.

made parking violations criminal acts. Passage of the 1991 law allowed individual borough parking authorities to decide how to best handle parking enforcement. 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). All boroughs had until March 2008 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. Every borough must submit an annual report on the state of parking.

Parking Regulations Off-street

For any planning application filed to an authority, some provision must be made for off-street parking. For residential construction, there must be one parking space per dwelling unit. The standards may also be based on number of bedrooms. There was an understanding that the parking authorities would lower the price for off-street parking in the 4-5 boroughs most impacted by the congestion charge. As a result, the fee scale was lowered after the implementation of the congestion zone.

All boroughs grant residential permits, which allow drivers to park in an off-street facility, but demand outstrips supply. Having a permit doesn't guarantee parking. Each car is eligible for just one parking permit, which is only valid in its designated district.

CO₂-emission-based residential parking permits

Residential permits are issued when a driver applies for a vehicle registration. In 2007 Richmond-Upon-Thames was the first borough to introduce CO₂-based parking fees, and nearly a dozen other boroughs have now followed suit. Residents of Waltham Forest, a leafy and low-density residential district, pay the highest price if a vehicle's CO₂ emission is over 225 g/km. After the May 2010 elections, control of Richmond switched from the Liberal Democrats to the Conservatives. The

emissions-based residential parking permit plan was abolished for now. Meanwhile, other boroughs are still keeping their plans and making them even stricter.

Revenues

In London, the boroughs are advised to set curbside rates to achieve an 85% saturation rate. Parking income is limited by statute, which means there is a restriction in how surplus income is used—it must be channeled 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.

SPOTLIGHT ON THE CITY OF WESTMINSTER



Figure 1:
Westminster CPZs

- **Residential spots:** 32,000 (planning 1,000 more)
- **P&D spaces:** About 6,000
- **On-street car-club spaces:** 100 (planning 400 more by 2012)
- **Revenue:** £30 million (parking tickets, fine income, etc.)



Parking spaces reserved for doctors.



The Westminster Car Club has specially designated spots around the borough.

Controlled Parking Zones (CPZ)

Westminster has eight different CPZs and four different fees for parking, ranging from £1.10 to £4.40 per hour. Cars can park on-street for a maximum allowable time of four hours. There are no unregulated areas. When any occupancy rate gets higher than 80%, something must be done management-wise. To address this issue, Westminster is implementing a new payment scheme with different rates for peak and off-peak parking. The on-street tariffs are not indexed to an inflation rate, but an annual review of tariffs occurs city-wide. The prices increase about every two years, although they have been static since 2006.

Cost of motorcycle parking

TYPE	CHARGE
Daily	£1.00
Weekly	£3.50
Monthly	£13.50
Quarterly	£33.50
Yearly	£100.00

Westminster introduced pricing for motorcycles in August 2008, which was run as a pilot program before becoming permanent. The cost was initially £1.50 per day, but was then reduced to £1 per day or £100 per year for a permit. Motorcycles can park for free in public car parks owned by the City of London. Cash payments are only accepted in off-street parking facilities, not on-street. Figure 2 lists the different costs for different types of non-resident motorcycle permits in the borough of Westminster.

Pay-by-phone

Verrus, which operates in numerous cities in Europe, handles mobile-phone parking payments and keeps about 10% of revenues as compensation. Before the establishment of cashless payments, Westminster was losing about £200,000 per week from theft.

Residential Parking Permits

Westminster's residential parking is based on four different engine types. The cost is £132 (£115 online) per year for engines 1200 cubic centimeters (cc) and above; £94 (£83 online) for engines below 1200 cc; free for "eco vehicles," including electric, gas, and hybrid cars; and £50 for motorcycles. In June 2009 Westminster resident parking bays were changed to shared-use between 10 a.m. and 4 p.m. for visitor use. There has been a preliminary negative response from residents in Westminster, who complain of taking their kids to school and returning to no open parking spaces. Shared visitor and resident parking bays are indicated by signs painted on the street.

There are certain concessions for badge holders, such as doctors and construction workers.

Free Parking for Electric Vehicles

Electric vehicles can park for free. There are currently 12 on-street charging points and a few in off-street parking facilities.

Car Sharing

Zipcar, which helped popularize car sharing, has been re-branded the Westminster Car Club. The vehicles are permitted to park for free on the street.

Figure 2:
Costs of
Westminster
motorcycle
parking permits
Source: City of
Westminster

Off-street Parking

The prices for off-street parking are generally more expensive. For a longer stay, however, it's cheaper to park off-street, especially because on-street spaces have time limits.

Revenues

Parking funds go into a specific parking account, and a central finance team within the borough decides how to divide the funds to support transportation goals.

Enforcement

The borough has about 90% compliance with parking rules. Westminster is one of a few boroughs that hired private contractors to handle enforcement. As of the end of 2010, the new terms of the enforcement contract are based on compliance control and monitoring of the various ways curbside space is used throughout different times in the day. For example, about 200 vehicles use one loading zone every single day for different purposes. A GPS-equipped handheld device lets wardens check what is permitted at that particular space. Heat maps are being generated to identify problematic areas, so that wardens can be deployed where compliance is lowest.

Freight and Commercial Vehicles

“Light touch” is a concession policy introduced for better managing commercial vehicles. Commercial vehicles once generated a lot of parking tickets. The tickets would often be thrown out in court because there was no evidence to prove that a vehicle had violated the law. If a parking attendant sees a commercial vehicle in a bay, they make official note of the vehicle and return in 20 or 40 minutes. Before 11 a.m., vehicles can load and unload with no time limits. Light touch is the next generation of commercial parking management—it helped reduce the number of superfluous parking tickets issued, and reduced commercial operator costs. Westminster works closely with the Freight Transport Association, an official group that represents the interests of commercial truckers.

SPOTLIGHT ON THE BOROUGH OF ISLINGTON

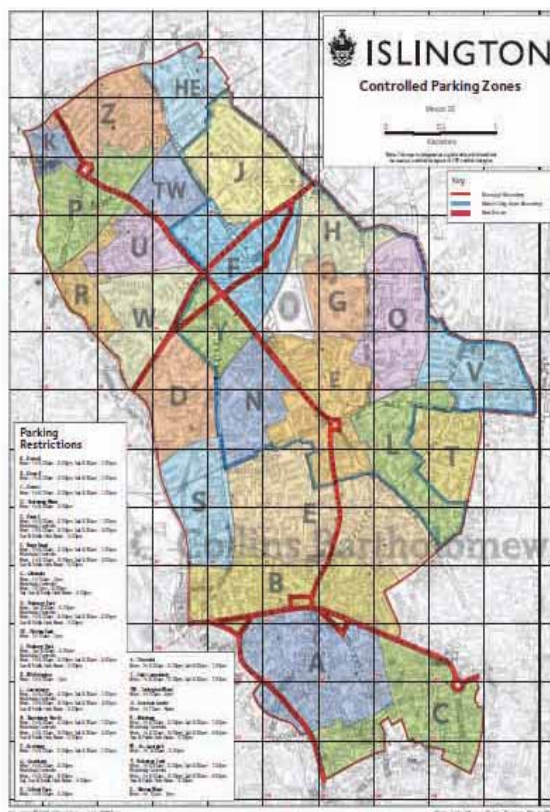


Figure 3:
Islington CPZs

- Number of On-Street Spaces: 20,000
- Cost in CPZ: 20 pence for 3 minutes, £4/hour

Islington, like other boroughs, uses CPZs to manage parking. Most of the funding to implement the parking program in Islington came from Transport for London after the introduction of the congestion charge. Some money came from planning agreements made in 2000 with the main football club in North London. The most significant change in the parking program in Islington was the decriminalization of parking.

On-Street Parking

Fees for curbside parking are minute-based and time-limited with a maximum of two or four hours allowed in different parts of the borough. It costs 20 pence to park for three minutes. As curbside fees increased, the maximum cost of £4 per hour meant using 16 coins.

BAND	VEHICLES REGISTERED BEFORE 01/03/01 (CC)	VEHICLES REGISTERED AFTER 01/03/01 (CO ₂)	12-MONTH PERMIT	6-MONTH PERMIT	3-MONTH PERMIT	1-MONTH PERMIT
A	Electric	0-100	Free	Free	Free	Free
B	1-900	101-110	£14	£7	£5	£5
C	901-1100	111-120	£25	£12.50	£6.25	£5
D	1101-1200	121-130	£67	£33.50	£16.75	£5.75
E	1201-1300	131-140	£81	£40.50	£20.25	£6.75
F	1301-1399	141-150	£88	£44	£2	£7.50
G	1400-1500	151-165	£109	£54.50	£27.25	£9.25
H	1501-1650	166-175	£126	£63	£31.50	£10.50
I	1651-1850	176-185	£147	£73.50	£36.75	£12.52
J	1851-2100	186-200	£189	£94.50	£47.25	£15.75
K	1201-2500	201-225	£217	£108.50	£54.25	£18.25
L	2501-2750	226-255	£301	£150.50	£75.25	£25.25
M	2751 and above	256 and above	£391	£195.50	£97.75	£32.75

Figure 4:
Cost of a residential parking permit in Islington depends on vehicle CO₂ emission levels.
Source: www.islington.gov.uk

Credit card and mobile phone payments have been introduced to facilitate cashless payments. Companies such as Verrus—which also operates in Camden and Westminster—and Ring-go received contracts to offer mobile phone-based payments. Drivers pay a 10-pence transaction fee to pay by mobile. Nearly 48% of revenue for short-stay parking comes from pay-by-mobile transactions. Verrus collects all the income from the transactions but only keeps the processing fee. Servicing a single P&D machine contributes more to the borough's carbon footprint than a sign on a post with a call center number and a payment code.

Car-sharing companies receive permission from the borough to park on-street with a special pass that functions like a residential permit. Other types of special permits exist for doctors, teachers, and certain tradesmen, like plumbers and construction workers. As of 2007, spaces are also reserved for emergency vehicles. A space may also be reserved by anyone for moving in or out of Islington. Car owners can apply to have a bay reserved at a cost of £15 a day and £90 for processing. Special signs and notices must be placed around the space to indicate that it is temporarily reserved.

Residential Parking Permits

Islington has a CO₂-emissions-based residential permitting scheme. There are seven different ratings and fees—the top price is £200, which is nearly double the old permit fee of £95 per year. Drivers with more polluting cars had a rude awakening. Prior to implementing the policy, there was a special vote on whether to implement the emissions-based charges, which had higher voter turnout than a regular election. Figure 4 shows the price of a residential permit based on the different banding categories. Electric cars can park for free. Every resident has an allowance of visitor vouchers, which are distributed in the form of a scratch-off card.

Off-Street Parking

Off-street parking exists in limited numbers in Islington and is managed by organizations such as the social housing group Homes For Islington (HFI).

Enforcement

There is a consultation process where each parking authority in London is asked to explain per-item costs. Parking penalties must be justified, and have a deterrent effect, instead of just being punitive.

Penalty costs range from £80 to £120. Each comes with a discounted quick payment option—if drivers pay within 14 days, they receive a 50% discount. The original reason for this policy was to prevent people from engaging with the council frivolously.

De Minimis Policy

A petty regulation rule was instituted—if a violation is petty, why bother enforcing it (e.g., if a car is bigger than the bay, as is the case increasingly). Bays are now marked off for an entire street and not just for individual spaces. This is a local policy decision just for Islington.



A pay-by-phone instruction sticker on the side of a pay-and-display machine.

Sources for London

Andrew Darvill (2009). "Parking Charges (Review Following Public Consultation). London Borough of Richmond upon Thames. Environment and Sustainability Overview and Scrutiny Committee.

City of Westminster Parking Services (2008). "Enforcement Code of Practice." Version 1.6.

Cost of a residential parking permit in Islington. Accessed online December 2010. [URL: http://www.islington.gov.uk/Transport/RoadsAndParking/Parking/parking_permits/details/resident-permit-detail-Dec.asp].

Danny Chalkley (2009). "Park Right." Westminster City Council Parking Services.

Interview with London Councils, September 2009.

Interview with Islington Council, September 2009.

Interview with Westminster Council, September 2009.

Interview with Camden Council, September 2009.

Islington Controlled Parking Zones. Accessed online December 2010. URL: <http://www.islington.gov.uk/Transport/RoadsAndParking/Parking/ParkingYourVehicle/ParkingRestrictions/>.

Islington's Local Implementation Plan (2006). "Appendix E: Islington Parking Policy Statement." Sustainable Transport Strategy 2006–2016.

Motorcycle parking costs in Westminster. Accessed online December 2010. URL: <http://www.westminster.gov.uk/services/transportandstreets/parking/wheretopark/vehicletype/motorcycle/>.

Nick Lester (2007). "Transport and environment services for London." London Councils.

Office of the Deputy Prime Minister (2004). "The Building Regulations 2000." Creating Sustainable Communities.

CASE STUDY:

Munich, Germany

CITY OVERVIEW

Population: 1,356,594

Population Density: 4,370 /km² (11,318 /sq mi)

Parking Supply: 322,620 total within the Middle Ring road.

Curbside Fees: €1/hr within the Middle Ring Road, €2.50/hr in the Old City, maximum daily fee €6/day (not valid in Old City)

Car Ownership: 516 vehicles per 1,000 inhabitants

Policy Goals: Congestion Mitigation, Public Space Reclamation, Alternative Mode Promotion



Figure 1: Gärtnersplatz, a central residential neighborhood well known for its nightlife and cafés, with eight general parking regulations

In 1993, Munich began to focus on parking management as a measure to reduce car use in the city center. The city analyzes every neighborhood and street separately to reach the right balance of mixed, residential, and visitor parking.

Of the total supply, 33% of parking spaces are on-street, 61% are in private hands, and 6% are in parking lots. Total P&D spaces is 54,000.

Joint Public-Private Efforts to set up Parking Management

Throughout the 1980s there were isolated but inadequate and unpopular attempts to regulate parking in certain neighborhoods in Munich. By the 1990s, congestion and long-term parkers were recognized as issues affecting the city's quality of life. In 1995, in the face of intense debate about mobility in Munich, the City of Munich and BMW founded and funded the Inzell Initiative, which took on the parking problem as one of its mandates. In 1998 Inzell was awarded €140 million in federal funds to do a parking pilot project called MOBINET. Two neighborhoods were chosen. To reduce cruising, each street and neighborhood was separately studied to get the right mix of residential parking, mixed parking streets, and delivery zones. After one year the number of overnight parkers was reduced by 25%, and the number of parking spots taken by all-day parkers was reduced by 40%. Illegal parking and cruising were also greatly reduced.

In 2003 the MOBINET project ended and the City Council took over responsibility for parking policy. In exchange for immediate and accelerated implementation of a parking management plan, the Green Party abandoned its politically unpopular demands to initiate a congestion-pricing scheme. As of late 2010, all of Munich's 58 parking areas have been converted to priced parking, utilizing either pay-and-display machines or resident permits.



There has been a 40% increase in cycling over the past six years.



A resident-only parking street, with 30-kph speed limit.

Pay-and-display Parking

Visitors must purchase a parking voucher at a pay-and-display vending machine, which allows for parking up to an entire day. The parking fee is €1 per hour or €6 for the entire day in most areas of the city, and €2.50 in the historic city center, which has a two-hour maximum time limit. The parking fee is also usually limited to workdays, Monday through Saturday, between 9 a.m. and 11 p.m. Parking is usually free at night, on Sundays and for public holidays. Munich has 58 parking zones and over 54,000 P&D parking spaces.

In general, priority is given to residents, who generate the greatest parking pressure, followed by shoppers and visitors. Special regulations are set according to the times of highest demand for each group. The city was divided into zones of manageable size, which were gradually incorporated into the parking program according to their characteristics and needs. The general P&D regulations and restrictions are described below. Munich also has arranged alternating or mixed rules according to the time of day:

- **Residential parking zones (green):** park with resident permit between 9 a.m. and 11 p.m.
- **Mixed parking zones (blue):** free parking with resident permit, €1/hour or €6/day for visitors.
- **Short stay parking zones (yellow):** payment required by residents and visitors—€1/hour for a maximum of two hours.
- **No parking allowed (red).**
- **Alternating resident-mixed (green/blue line):** free parking with permit and visitors allowed between 9 a.m. and 6 p.m. for the €1/hour €6/day fee. From 6 p.m. to 11 p.m. only residents are allowed.
- **Alternating mixed-short stay (yellow/blue line):** payment required for residents and visitors from 9 a.m. to 6 p.m. Free parking for residents and payment required for visitors after 6 p.m.
- **Mixed parking with parking disc (brown lines):** free with permit, maximum three hours with parking disc.
- **Special case for the Altstadt ring short-stay and residents:** free with permit, payment required from 9 a.m. to 11 p.m. for visitors €2.5/hour for a maximum of two hours.
- **Special case for ring road surrounding the Old City (yellow/green):** €1/hour parking fee from 9 a.m. to 11 a.m. for a maximum of two hours, and free parking for residents with a permit from 7 p.m. onward.
- **No parking and resident parking (red/green line):** normally allows resident parking only after 6 p.m. or 11 p.m.
- **Alternating no parking - mixed parking:** mixed parking after 7 p.m.

On-Street Residential Parking Permits

For €30 per year, parking permits are issued to residents who do not have a private parking spot and would like one close to home. Special permits are also granted to businesses registered in the parking area if the user owns a car and has no private parking. Only one permit per business is allowed for a price of €120 per year. It is estimated that on average for every public on-street parking spot, there are three privately owned spots. There is a huge discrepancy between the cost of residential and business permits and a private parking spot, which tends to cost around €80 per month.

On-street Parking for Commercial Vehicles

Business permits work similarly to residential parking permits, but they are more expensive. These are granted to business enterprises with no access to a private parking space. Only one permit may be obtained per business, but the permit is not assigned to any specific vehicle.

Accessory Parking Regulations for New Developments

The current building ordinance came into effect in January 2008. The requirement for accessory parking allows non-residential land uses to provide a discounted number of spaces for new buildings. Residential can opt-out of the requirements by paying a special fee. The main areas identified in the new ordinance are the following:

Figure 2:
New development parking requirements based on Bavarian law

	ZONE I (Old City, Around Main Station)	ZONE II (Outer parts of Central City, 600 m to S- or U-bahn or 400 m to Tram)
Residential	Must meet 100% spaces required or pay €12,500 restitution fee	Must meet 100% spaces required or pay €7,500 to €10,000 restitution fee
Non-Residential	Discounted 50%	Discounted 25%



Most of Munich's Old City is pedestrianized.

- **Zone I:**
Corresponds to the Old City, as well as the north and south surroundings of the main train station.

- **Zone II:**
Corresponds to the outer parts of the inner city.

The ordinance was reformed so that the required number of parking spaces to be provided for non-residential land uses is lower than the amount required by Bavarian law. Depending on the zone, required parking spots for new buildings can be discounted by 25 or 50% of Bavarian law (see Appendix A for Bavarian law parking requirements). Figure 2 summarizes those changes.

If a building does not meet the minimum requirement, as outlined above, a restitution must be paid. In-lieu fees for Zone I cost €12,500 for every space not built, €10,000 for Zone II and €7,500 for the outer city.

Park-and-ride

The P&R network consists of over 120 parking garages situated at rail stations outside of the Middle Ring Road and can be divided into four categories according to their cost and location: the nine lots closest to the inner city cost €1.50

per day, or €17 per month; the next category consists of 16 garages located further away but still within the greater city of Munich, cost €1 per day and €8.50 per month; the third category charges €0.50 per day or €7.50 per month; the rest, and the majority of them outside of the greater area of Munich, are free of charge. At the suburban railway and underground stations (S-bahns and U-bahns) there are approximately 25,300 P&R parking spaces available. On an average working day in 2006 about 26,100 vehicles were parked at the suburban P&R.

Results

Along with improving bicycle infrastructure and continued quality public transit, parking management has been a central tactic for reducing car use in Munich. There has been a significant shift in mode share over the period that parking management has been phased into Munich's neighborhoods, resulting in less CO₂ emissions and local pollutants.

In 2000—when parking management was just beginning—42% of all trips were made by car, 32% by public transit, 8% by bicycle, and 18% by foot. In 2008, when parking was managed across the whole inner city, 36% of all trips were made by car, 21% by public transit, 14% by bicycle, and 29% by foot. That amounts to a 14% reduction in car use, a 75% increase in bicycle use and a 61% increase in walking. From 2000 to 2008, every year there were 1,700 fewer automobiles owned by residents in the inner city.

SOURCES FOR MUNICH

Diego Salzillo Arriaga (2009). *Parking Management as a Contribution to Sustainable Urban Mobility: A Policy Analysis of the Munich Case*. München: Chair of Urban Design and Regional Planning, Technische Universität München.

Interview with C. Weis-Hiller, Referat für Stadtplanung und Bauordnung, July 2009.

Interview with K. Sonntag & M. Glöckner from Green City, July 2009.

Interview with J. Mühlhaus, September 2009.

Kreisverwaltungsreferat, Landeshauptstadt München (2003). *MOBINET Abschlussbericht 2003: 5 Jahre Mobilitätsforschung im Ballungsraum München*. München: Kreisverwaltungsreferat, Landeshauptstadt München.

MOBINET: Mobility in the Conurbation Munich.
[URL: <http://www.mobinet.de/Fachinformation/english/allgemein/startframeset.html>].

Münchner Verkehrs- und Tarifverbund GmbH (MVG) (2009). *Münchner Verkehrs- und Tarifverbund*. Accessed online October, 2009. URL: http://www.mvv-muen-chen.de/en/home/mvv_network/transportnetworkmaps/parkride/index.html.

CASE STUDY:

Paris, France

CITY OVERVIEW

Population: 2,167,994

Metropolitan Population: 11,769,433

Population Density: 24,948 /km² (64,620 /sq mi)

Total Parking Supply: 755,000 (on-street: 165,000; off-street: 590,000)

Curbside Fees: €1, €2 or €3 per hour depending on zone, €0.5 per day for residents (2007)

Policy Goals: Emissions Reduction, Congestion Mitigation, Public Space Reclamation, Alternative Mode Promotion

The two decades leading up to the mid-1990s in Paris were marked by a pro-car agenda and relaxed parking regulations. As the new millennium approached, perceptions of the utility cars served in a dense urban space began to shift. The city administration that took over at the start of the 21st century held a firmer stance on the place of private cars in public spaces.

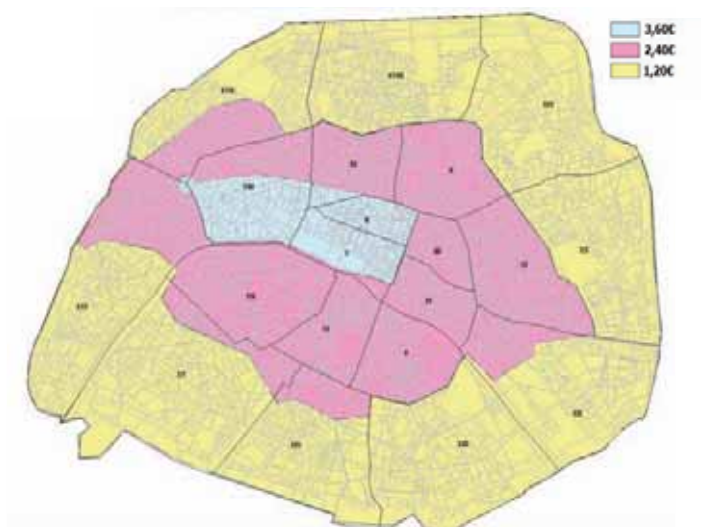
Since 2003, Paris has managed to decrease vehicle kilometers traveled by 13% (Figure 1) through a package of successful measures. Overall on-street parking supply was reduced by 9% (or 14,300 spots), while 95% of free spots were turned into paid parking spaces (Figure 2).

Roughly 4,000 parking bays were removed to accommodate 1,451 new Velib stations that hold about 20,000 public rental bikes. Space was also reallocated for motorcycle parking, bicycle parking, disabled parking, and tramway corridor access. Approximately 6,000 additional parking spots were removed by request of the fire department for improved maneuvering around narrow streets. There are also 14 stations of car sharing in the city—three spots per station converted from regular parking. More on-street parking supply reductions may result from a 2008 national mandate that opened up counter-flow cycling (against the direction of traffic) in 30-km zones. Cities across France had two years to implement the measure. Paris, like many other French cities, has also been clearing public space of cars by shifting



TOP: Contra-flow bike lanes installed where curbside car parking was removed.

BOTTOM: "Velo"-marked curbside spaces in former car parking spots, now used as two-wheeler parking.



Parking zones in Paris

the supply to underground parking facilities. See Figure 3 for the on-street parking supply trend.

Between 2003 and 2006, the share of private vehicles in Paris traffic decreased from 68% to 60%. During the same period, 118 km of new bicycle lanes were installed. About 15% of cyclists reported that they had previously been car commuters.

Pay-and-display Parking

P&D parking spaces are effective from 9 a.m. to 7 p.m. Monday to Friday in Paris. The duration of parking is limited to two consecutive hours. The fees (as of July 1, 2009) range from €1.20 to €3.60 per hour for visitors, depending on the zone.

- Zone I: €1.20
- Zone II: €2.40
- Zone III: €3.60

Residential Parking Permits

In an effort to limit traffic in Paris, residents who own personal vehicles are required to obtain a residential parking card. The card allows for a vehicle to be parked in four city districts near a vehicle owner's home for a period not exceeding seven consecutive days. Paris is divided into 160 metered parking areas. Residential parking is allowed on the residential streets near a vehicle owner's home where P&D meters have yellow dots (see photo above).

Residential Parking Costs: €0.65 per day or €3.25 per week for a period of time that cannot exceed seven consecutive days.

Figure 1:
Vehicle kilometers traveled (vkt) workdays 7 a.m.–9 p.m. in Paris (2003–2007). Source: Paris Transport and Travel Report (2007)

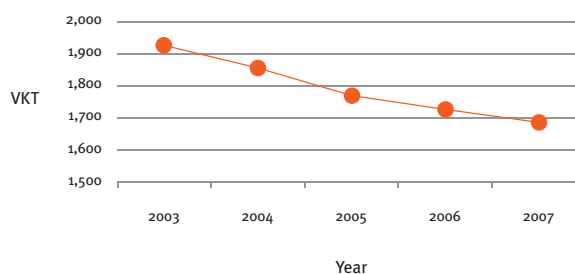


Figure 2:
Free parking spaces in Paris (2003–2007)
Source: Paris Transport and Travel Report (2007)

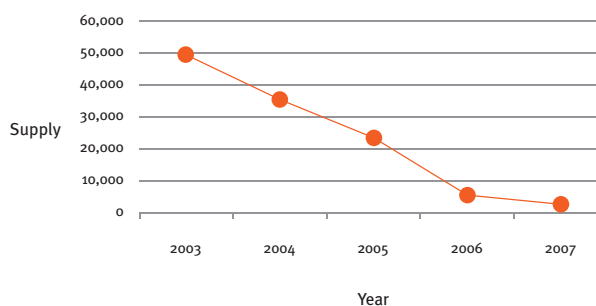
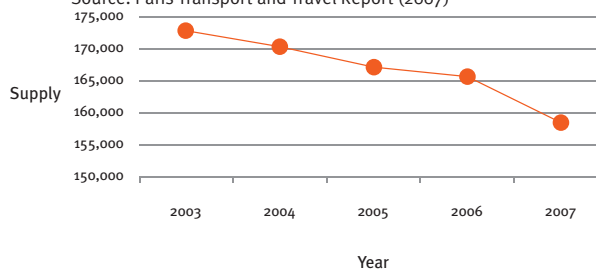


Figure 3:
Number of on-street parking spaces in Paris (2003–2007)
Source: Paris Transport and Travel Report (2007)





Yellow dot near the “P” on the meter indicates that vehicles with residential parking permits may park in the nearby spots.



A “place mixte” space with a delivery van and a residential permit vehicle sharing an adjacent parking spot.



Motorcycles in former on-street car parking.

Free Residential Parking: Saturdays, Sundays, holidays, and August.

Paying the lowest hourly visitor fee (€1) for a week would be over 50 times more expensive. The low cost of the residential parking card relative to the higher cost of parking in other parts of the city is meant to keep cars immobile, impacting VKT levels. Resident parking card-holders are subject to the same visitor fees for parking in other neighborhoods. Since 2008 the on-street fee was increased 30% for residents and 20% for visitors.

The following documents must be placed behind the windscreen of the vehicle:

- A residential parking card issued by Paris (free of cost) that is valid for three years; and
- A daily or weekly P&D ticket with a timestamp, valid for up to seven consecutive days.

A new experimental program—called place mixte, literally, mixed place—allows sharing of loading zones to satisfy resident parking needs overnight. Residents can park in the spots 8 p.m. to 7 a.m. and all day on Sundays, which is contradictory to the residential parking policy, because drivers need to move their cars before 7 a.m. rather than keep them immobile. There are about 9,000 spots for deliveries. Some dedicated charter bus spots are also being considered for shared use.

Motorcycle Parking

Motorcycle parking is a big issue. About 15% of the total supply of parking space is for two-wheelers. The city aims to increase it to 30%, based on the recent mode split observed. Motorized

two-wheelers now comprise 2% of the mode share. Very often people who acquire two-wheelers also own a car. There's a rising consciousness that two-wheelers are problematic and political stakeholders are increasingly convinced that two-wheelers are clogging the sidewalks. For this reason, the stakeholders want to remove car parking to accommodate two-wheelers. Paris is looking to Rome for guidance in developing a two-wheeler parking policy. Paid parking for two-wheelers is in the works.

Off-Street Regulations

If a development is 500 meters from a metro stop, there is no obligation to build parking, though it is allowed. La Defense, the business quarter in the western portion of the city, built a lot of parking, even though it is very well served by transit. Every 500–600 meters there is a metro in Paris and every 1.5–2 kilometers a regional rail station. Minimum requirements were eliminated while maximum parking for housing is one spot for every 100 m².

Parking in public housing was unbundled ten years ago in the east, after the overturning of a requirement that linked the rental of one housing unit to one parking spot. The off-street parking spots were not well managed—there was a lot of vandalism and people preferred to leave cars on-street. But now on-street parking in the east is limited to two hours and is no longer free.

Engaging the Private Sector

The city encourages competition between off-street parking management companies through their contract process. The contracts are fairly

specific with guidelines for what service private companies should provide to the public. Since 1992, builders can offer services beyond initial guidelines and increase their competitive edge by proposing additional services when responding to RFPs. When management is privatized, parking companies like Vinci pay a flat fee to the city.

Revenue

In the center, the on-street and off-street rates are the same. Near the peripherique, the city's ring road, the off-street facilities are more expensive. The mayor reduced rates of on-street residential parking near the peripherique. The rationale was that people would keep their cars parked and ride public transit instead. The price doubles after a given period. Parking revenues go into a general city fund.

Bollard Measures

The penalty for parking in a non-parking spot is €35 or €60. The city has installed approximately 335,000 bollards on the edge of sidewalks to prevent cars from parking illegally. Over €15 million has been invested in this initiative since 2001. Each bollard costs approximately €24–38. There is an additional €30 cost for the labor to install the parking barriers.



Bollards installed to keep cars from parking illegally on the sidewalk.

SOURCES FOR PARIS

City of Paris (2009). "Prix du stationnement." Accessed online August, 2009. [URL: <http://www.paris.fr/portail/deplacements>].

Enerdata (2009). Paris Case Study. China Council for International Cooperation for environment and Development. Phase IV. Energy efficiency and Urban Development Task Force.

Eric Gantelet & Christophe Begon Sarecto (2008). "The Impact of Car parking Policies on Greenhouse Gas Emissions." European Transport Proceedings. Accessed online June, 2009. [URL: <http://www.etcproceedings.org/paper/the-impact-of-car-parking-policies-on-greenhouse-gas-emissions>].

Interview with Groupement des Autorités Responsables de Transport (GART), July 2009.

Interview with Mairie de Paris, July 2009.

Interview with Yves Contassot at Hotel de Ville, July 2009.

Interview with Réseau Vert, July 2009.

Interview with Vélorution, July 2009.

Le Mairie de Paris (2009). "La politique du stationnement à Paris" presentation. Direction de la Voirie et des Déplacements. Service des Déplacements.

Le Mairie de Paris (2007). "Direction de la Voirie et des Déplacements." Elaboration du Plan de déplacements de Paris (PDP). Paris Transport and Travel.

Le Mairie de Paris. [URL: http://www.paris.fr/portail/pratique/Portal.lut?page_id=5779&document_type_id=5&document_id=4812&portlet_id=12654].

CASE STUDY:

Stockholm, Sweden

CITY OVERVIEW

Population: 814,418

Metropolitan Population: 2,011,047

Population Density: 4,332/km² (11,219.8/sq mi)

Total Inner City Parking Supply: 60,000-90,000 (on-street: about 32,000; off-street: 30,000-60,000)

Curbside Fees: 15, 25, and 40 SEK (€1.5, €2.5, €4)

Car density citywide: 370 cars/1,000 people

Policy Goals: Congestion Mitigation, Public Space Reclamation, Alternative Mode Promotion



Cyclists use a curbside bike lane in the Södermalm quarter on the central island of Åsön.



Pedestrians and lingering shoppers on Sergelgatan, a street that was pedestrianized after parking spaces were removed and through traffic rerouted.

The current parking regulations in Stockholm, a city built on 14 islands, were established in the 1970s as a way to manage traffic after the baseline level of car ownership in the city was determined. The inner city has been gentrifying in the last few decades and the new residents have more cars than previous residents—currently there are about 370 cars per 1,000 people in the city overall and the inner city has 300 cars per 1,000 people. The overall mode share for all journeys in the county is 44% car, 29% walking, 24% public transit, 10% bicycles and 3% motorcycle. In the city center, where parking prices are highest, walking and cycling trips dominate the mode share at 67%, with cars accounting for only 8% and public transit for 25%. Aside from focusing on better management of parking in the central business district and outer islands, the city is also trying to work with suburbs to reform parking.

The City of Stockholm has outsourced certain government functions, such as development of public housing and aspects of parking management, to corporate subsidiaries. Stockholm Parkering is one such company that handles all off-street parking issues. Meanwhile two other private companies have been contracted to manage parking enforcement: Securitas, an international private security firm, oversees the Southern side of the city, and Svensk Bevakningstjänst patrols the Northern part.

It costs the city's parking division 100 million SEK (€10 million) to manage the parking program and 500 million SEK (€50 million), on average, in surplus goes to city hall.



Pay-by-phone parking customers can call the EasyPark number and dial location code—91, in this case—to pay the on-street parking fee.



Free on-street motorcycle parking.

Pay-and-display Parking

Individual parking meters were removed in 2001 and replaced with P&D machines. The P&D area (see map) is divided into three payment zones illustrated in the table below.

ZONE	TIME OF DAY	PRICE (SEK per hour)*
Blue	9 a.m.–5 p.m.	15
	All other times	Free
Red	9 a.m.–5 p.m.	25
	All other times	15
Green	All times	40

*Note: As of December 2010, the exchange rate is 1 EUR = 9.11007 SEK

The blue zone is free at night. The green zone is a small time-limited parking area near the city's central rail station. Drivers can only park for up to an hour. Fees were raised by 20% in 2009, which was the first time they increased in ten years. The fees will continue to be adjusted annually for all zones based on an inflation index, but will stay unchanged if the inflation rate goes down.

On-Street Parking Payment Methods

Payment for parking can be made by mobile phone, credit card, or coins. Parking vouchers were once sold at tobacco shops, but this practice was abolished in 2005. A P&D customer must display a sticker under the car's windshield. The parking warden uses a hand-held device to scan a unique barcode on the sticker to assess if the parking fee has been paid or whether the car is parked illegally. Pay-by-phone was introduced in 1992 after the city put out a request for proposals. EasyPark, along with TeleP and Mobill (the latter two are both Swedish-based companies), offer pay-by-phone services in Stockholm.

In the case of EasyPark, a customer can have multiple cars using the same barcode. Multiple stickers can be ordered to manage everything in one account. Customers have the option to receive a receipt for using the service by SMS and/or email. All service fees are charged directly to the account owner's credit card. EasyPark keeps 3 to 4% of the revenue and gives 97% to the municipality. Customers pay a subscription fee to EasyPark of 30 SEK (~€3) per month and a parking transaction fee (~€0.50). Mobill provides premium SMS services—customers must pay for each message sent. TeleP provides SMS, but not premium service. These companies keep 10% of the revenues they collect. Approximately 10% of parking is paid by mobile phone.

Congestion cordon on the island of Lilla Essingen leading to Stockholm suburbs.



Free on-street charging station for electric cars.



Paying for parking at the exit of a Stockholm-Parkering-managed underground facility.



On-street Parking Supply

Parking spaces were once demarcated with a white stripe box spot-by-spot on the street until multi-space P&D machines were installed in 2001. After the practice was abolished, especially since the white lines required repainting every winter, more vehicles could fit along the curb. Approximately 450 of the city's 1,200 blocks were measured to help determine the maximum number of cars that would fit.

Striped lines still demarcate the space where motorcycles can park for free. The future of charging motorcycles in Stockholm might be done using a pay-by-phone plan because there is no secure way to attach a P&D ticket to a motorcycle without it getting tethered or blown away.

Impact of Congestion Cordon on Parking

Low-emission and ethanol vehicles were exempt from the residential parking charges until the beginning of 2009. Now they are subject to the same charges as all other vehicles. The congestion charge technology has detected that the number of such vehicles made up 15% of all traffic in 2008 and more car owners are replacing old clunkers to take advantage of the economic incentives. The congestion charge is in effect from 6:30 a.m. to 6:30 p.m. on weekdays. While the congestion charge reduced traffic by 20%, it had a minimal effect on number of cars in the city. There are 2,000 less vehicles entering the city compared to several years ago.

Residential Parking Permits

There are 44,000 residential parking permits in use. As of December 2010, the price for purchasing a permit was 700 SEK (€77) per month. The cheapest equivalent cost at 15 SEK/hour (€1.5) to park in a visitor spot would be 2,400 SEK (€263) per month. Residents can buy a ticket from vending machines for 50 SEK (€5) per day, while an equivalent visitor ticket would cost 30 SEK (€3) per day more. A residential permit allows a car to remain parked all day or week. At the end of 2009, the traffic committee voted to increase the residential parking permit charge from 600 to 700 SEK per month, with the goal of encouraging more people to park in off-street facilities by reducing the disparity between the cost of on-street and off-street parking.



Entrance to Parkering Höterget, an underground parking facility managed by Stockholm Parkering, which was built to clear away parked cars from a large pedestrianized public space above ground.

Free Parking Exceptions

Parking is currently free for electric vehicles, motorcycles, those with disabled badges, and construction tractors. There are four existing electric charging stations on-street, and 150 stations off-street. In 2011, 200 more stations are scheduled for installation, most of them off-street, despite the fact that there are only approximately 25 electric cars registered in the city. All the stations can be used free of charge. The local energy company covers the cost of the electricity. There is a possibility in the future that the price for charging a car will be included in the price of parking.

Fuel-efficient vehicles used to receive free parking, but now there is a charge even though these vehicles are not charged in the congestion zone.

Off-Street Parking Regulations

Stockholm Parkering is a city-owned company that was established in 1977 to manage off-street parking facilities like park-and-ride, handle accessory parking issues and oversee some on-street parking spaces. The company has grown to 130 employees and controls 17,000 parking spaces in the city center—more than half of the public city center off-street supply. All other spaces are managed by private companies like Q-Park—the largest private parking company in Sweden—and the German company EuroPark. The cost to rent an off-street parking space is approximately 1,200 SEK per month, compared to 700 SEK per month for an on-street residential permit. As part of its contract, Stockholm Parkering transferred 40 million SEK (€4 million) to the City of Stockholm in 2009 and 45 million SEK (€4.5 million) in 2010.

In 2009, Stockholm Parkering gave the city 10% of revenue—normally it is 5–7%. For this reason, Stockholm Parkering has been lobbying the city to get rid of on-street parking spaces, because their off-street facilities have low occupancy rates.

The company also constructs parking garages on private grounds and then manages the spaces. Developers unable to meet parking requirements for new or refurbished buildings contact Stockholm Parkering to either help find available parking spaces off-site or pay for the construction of a new facility. There are no rules about the proximity of the parking allocation to the development. Since Stockholm Parkering has an oversupply of space, it is in the developer's interest to approach them about finding available spaces to rent. Stockholm Parkering can arrange space-sharing in their facilities. Rented spaces are not reserved, allowing for better use management.

Stockholm Parkering may also assist in building the needed spaces because it has a relationship with private building contractors. The parking regulations are listed in the table below:

TYPE OF LAND USE	STANDARD
Housing	0.14 spaces/room
Offices	4–6 spaces/1000 m ² office space above ground
Hotel	20–30 spaces/100 hotel rooms (depends on category)
Other Uses	20 spaces/1000 m ² space above ground

Parallel and angled on-street parking in a residential area.



Enforcement

Securitas and Svensk Bevakningstjänst handle all the parking enforcement activities for the City of Stockholm. The city asked that each company use no less than 200 wardens. The companies have been increasing the number of wardens since 2007. Before 2001, there were 140 public wardens who had civil servant positions. In 2001, the wardens were moved to the private companies until the city took them back from 2004 until 2007. There was some attrition of wardens after the return to privatization in 2007 because the benefits offered by the companies are not as good as those from the city. The salaries are the same, but vacations are shorter.

In the period of 2001 to 2004, parking wardens monitored street parking, while patrolling on bicycles. Now they mostly do their work by foot and automobile. Securitas has 50 to 60 wardens

on foot between 9 a.m. until 5 p.m. every day. After 5 p.m., enforcement is mostly managed by wardens in cars. About nine parking enforcement vehicles, with two wardens in each, monitor the streets around the clock. The 120 wardens at Securitas issue approximately 2,000 fines per day. In 2008, there were approximately 1,200 fines on an average day. Wardens on foot issue 25 to 30 fines on average day, while wardens in cars issue 25 to 40 per day. Most wardens go by car to assess complaints, especially if a vehicle is parked in a bus lane or at a bus stop. Parking is not permitted in bus lanes most of the time. Securitas is working to improve bus flow by better enforcing parking regulation.

The company's performance is measured by how many cars are parked correctly. Two times a year, Securitas surveys how many cars are parked legally. They aim to have 75% of vehicles parked properly. A 2008 survey found that only 59% of

Parking fines in Stockholm

COST OF FINE	TYPE OF VIOLATION
900 SEK (€90) (The most expensive fine used to be 700 SEK pre-January 2009).	Parking where none is allowed at all, such as in a disabled space
550 SEK (€55)	Parking is prohibited (allowed to stop, but not park)
475 SEK (€48)	Illegally parked in a P&D bay or parking lot/garage

autos are actually parked legally. To continue the enforcement services contract with the city, Securitas must meet the agreed-upon target.

Cars may be parked for a maximum of 24 hours, and then they must be moved. Parking space use may be renewed by moving the car and purchasing a new P&D ticket. Wardens check the valves on all four tires to determine if a car has been moved. There is a six-minute grace period in which a warden must wait to issue a ticket. The time is registered in the hand-held device. The price of fines is listed in the preceding table. The Swedish federal limit for fines is between 75 SEK and 1,000 SEK. Individual municipalities can decide how much a penalty should cost within this framework.

All the parking wardens use a parking information system called PARIS, which is a software platform that gets questions answered from all involved parties about payments and permits. Parking wardens send a question from a hand-held PDA using a car's license plate number or a scanned P&D ticket barcode to PARIS, which then forwards the question to a computer at EasyPark, TeleP, Mobill, and the residential parking permits division. A response is generated and then sent back to the PDA via PARIS. A warden can then determine whether issuing a fine is necessary.

SOURCES FOR STOCKHOLM

City Traffic Department. (2007). "Parkeringsövervakning Stockholms Stad." Parking Control.

City Traffic Department (2008). "Betaltjänster för parkering." Pay for Parking Services.

Interview with Traffic Office, Permits Division, July 2009.

Interview with Stockholm City Traffic Department, July 2009.

Interview with Stockholm Parkering, July 2009.

Interview with Stockholm City Planning Administration, July 2009.

Interview with EasyPark, July 2009.

Interview with Securitas Sverige, July 2009.

CASE STUDY:

Strasbourg, France

CITY OVERVIEW

Population: City proper 272,975 inhabitants; metro area 467,375 inhabitants

Population Density: 3,488 inhabitants/km² (9,030/mi²)

Parking Supply: 7,850 on-street paid; 10,300 in 16 semi-public parking garages; 4,400 in P&R

Curbside Fees: **RED ZONE:** 1.60/hour curbside | €1.00 -1.60/hour off-street

ORANGE ZONE: 1.30/hour curbside | €1.20/ hour off-street, in some garages first 30 min free

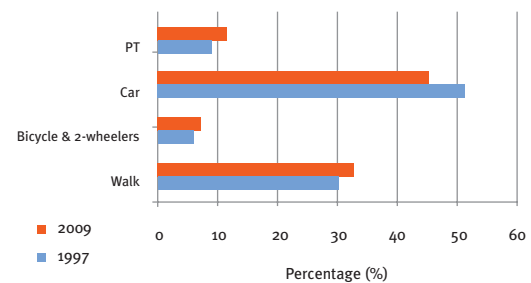
GREEN ZONE: 0.50/ hour curbside | €2.70 – 3.00/day park-and-ride (Includes round-trip tram ticket for up to 7 people. Monthly public transit pass allows free access to P&R).

Policy Goals: Residential Parking Prioritization, Public Transit Promotion, Quality of Life Improvements

Since the early 1990s, Strasbourg, France has been experimenting with policies that decrease car traffic. The city's multifaceted approach has included the pedestrianization of the downtown, the building of public transportation infrastructure, increased bicycle infrastructure, the expansion of inner-city paid parking, and P&R facilities at peripheral transport nodes. In 1988 Strasbourg became the first city to have its entire historic city center classified as a World Heritage site by UNESCO. Strasbourg is the seat of several European institutions including the European Parliament and the Council of Europe.

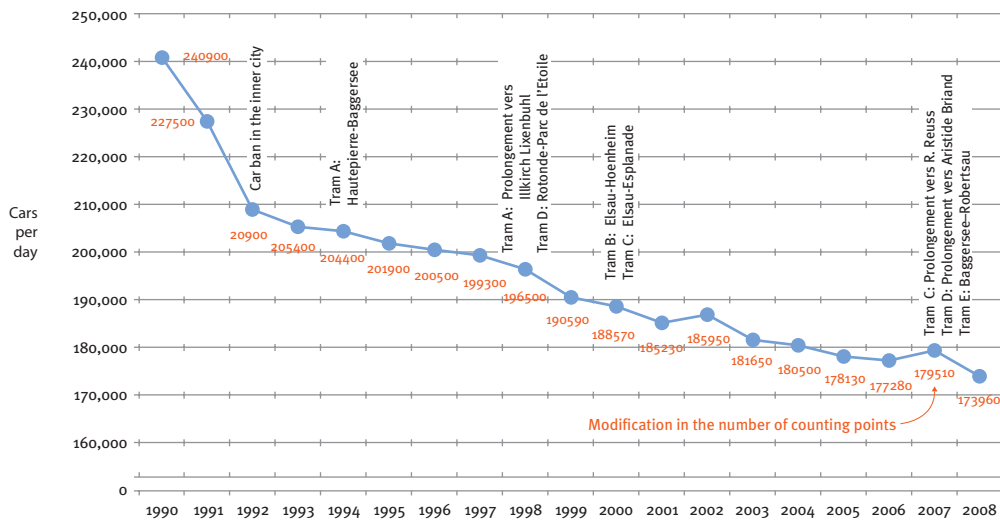
Strasbourg's efforts to control car use through parking, bicycle promotion, public transit improvements, and pedestrianizations have produced tangible results. The evolution of the modal share over a 12-year period shows a marked decrease in car use and an increase in less polluting modes. In 1997 the modal share in Strasbourg was 52% car, 10% public transit, 7% two-wheelers (including bicycle), and 31% walking. By 2009, the modal share was 46% car, 12.5% public transit, 8.2% bicycles and motorized two-wheelers (motorized two-wheelers were a negligible 0.6%), and 33.4% walking (see Figure 1). A walking survey focused on the inner city revealed that there was an 11.5% increase in walking from 2007 to 2008—the year that the parking-controlled zone was increased by 2,500 spots in Strasbourg's inner city.

Figure 1 :
Modal split 1997 and 2009. Source: CUS



Over 18 years there has been a 28% decrease in the number of vehicles entering Strasbourg's city limits. After the enlargement of the inner city parking-controlled zone in 2007, there was an additional 3.2% decrease in traffic entering the inner city. The enlargement of the tram network resulted in parking-related reforms, like the relocation of on-street parking to off-street facilities underneath pedestrianized streets, the building of P&R facilities at the ends of tram lines and the expansion of paid parking zones. Figure 2 shows how this reduction in traffic occurred in conjunction with the building of Strasbourg's tram network and the tram's nine corresponding P&R facilities.

Figure 2
Evolution of Strasbourg's average daily vehicle traffic (1990 to 2008). Source: CUS



On- and Off- Street Parking

Strasbourg's three-zone color-coded pricing scheme—applicable to both on- and off-street parking—is designed so that inner-city curbside parking is the most expensive and the peripheral public off-street lots are the least expensive. Successful price harmonization between on- and off-street parking over an 18-year period was possible through negotiations and specialized PPP contracts. Rates apply every day (except Sundays and holidays) from 9 a.m. to 12 p.m. and from 2 p.m. to 7 p.m. In large blue zones around the city, parking is free but drivers must display a parking disc, and stay is limited to 90 minutes.

In 2010, the pay-and-display zone was increased by 5,600 spots in Strasbourg, making the total 13,500 spots (Figure 3, following page). It is envisioned that the new zones will encourage commuters to park at one of the nine P&R facilities and take the tram into the city. The City has held several public meetings on these foreseen extensions and debate has been vigorous.

In 2007, P&D machines generated a surplus of €1.7 million. It is not legal for the city to earmark revenue from parking for particular purposes. The national government set the fine for non-payment of a P&D ticket at a cost of €11. All money collected from parking fines belongs to the national

government, not the city.

The Municipality, Communauté Urbain de Strasbourg (CUS), has contracted out several of its parking-related management and operation tasks. A private company, Parcus, was hired to install, operate, and manage the P&D machines. The city buys the machines, imposes the fees, and sets the hours of operation. The city pays a flat rate every month, regardless of how much P&D revenue is generated.

Park-and-ride

The building of P&R facilities has been a key strategy to increase public transit ridership and reduce the number of cars driving into the greater Strasbourg area. As Figure 5 shows on the following page, there has been a steady increase in usage of P&R facilities since 2004, with the exception of the time period 2007 to 2008 when there was a 13% reduction in the number of cars. This reduction could either mean that trips into the inner city are increasingly entirely car free, or that people from Strasbourg's outskirts are in general traveling less into Strasbourg's inner city. Nevertheless, CUS's official goal is to use P&R to compel drivers to leave their cars in the suburbs for inbound trips. P&R user surveys have shown that around 90% of P&R users were formerly "exclusive" car drivers who had never or rarely taken



ABOVE: Strasbourg's most frequently used P&R Facility.
Source: CUS

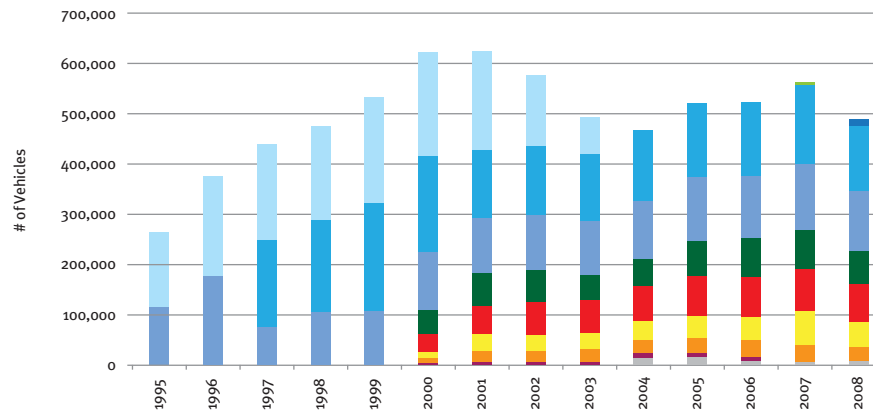
RIGHT: **Figure 3**
Map of P&D Zones.
Source: CUS



	MINIMUMS	MAXIMUMS
Residential	1 spot/ dwelling unit	2 spots/ dwelling unit
Non- residential	0.5 spots/ 100 m2	2 spots/ 100 m2

ABOVE: **Figure 4**
Off-street Parking
Regulations.
Source: CUS

RIGHT: **Figure 5**
Strasbourg P&R Usage
(1995 to 2008)



public transit. In 2003, the city eliminated one P&R facility that was too close to the city center and no longer at the end of a tramline.

The cost of parking at all P&R facilities is €2.70 per day (except Rotonde, which is €3). A ticket includes a round-trip tram ticket for up to seven people. A monthly public transit pass allows free access to all P&R facilities. The cost of parking all day at a P&R facility is on average the same as two hours of parking in the center of the city.

Women make up 60% of P&R users, particularly during the week, and most P&R users park to run errands in the inner city. In 2006, 4% of tramway users originated from the P&R facilities.

Residential Parking

Residents in any of the seven zones are entitled to a residential permit, which cost €10 per month or €120 per year. This one-year permit is limited to one car per household. In an effort to encourage car sharing, car-sharing members get a residential permit, enabling members to park at lower rates.

Currently, for both residential and non-residential developments, there is a 50% reduction in parking requirement minimums for centrally located neighborhoods or neighborhoods less than 500 meters from a public transportation stop (tram, train station, or bus stop).

As of 2010, newly built non-residential buildings are no longer required to include parking spots if there is space in nearby facilities. When building permits are granted, construction projects clustered in an area are analyzed and there is an attempt to consolidate unused spaces in parking facilities through space sharing. If a proposed development is located near public or private parking lots, a company can negotiate to reserve spots for its employees and reduce the number of spots it is required to build. In the long term, these changes to the parking requirements have the potential to add density to Strasbourg's urban fabric, particularly around public transit corridors.

In 2008, the city of Strasbourg initiated the building of an eco-quarter. One of the features of the new quarter will be strictly imposed parking maximums.



Figure 6:
Strasbourg's Grand
Rue before tram
implementation.
Source: CUS



Figure 7:
Strasbourg's Grand
Rue after tram
implementation.
Source: CUS



Figure 8: Homme
de Fer before tram
implementation.
Source: CUS



Figure 9: Homme
de Fer after tram
implementation.
Source: CUS



Figure 10: 1,623 bicycle parking spots in seven Parking Facilities.
Source: CUS

REPURPOSING CURBSIDE PARKING FOR WALKING AND CYCLING

Pedestrianization

When constructing the tram, Strasbourg remade itself into a walking, transit, and cycling city. Much of the city center was pedestrianized and other streets were calmed with raised zebra crossings and enlarged sidewalks. Over the 13 years that the tram was built (1994–2007) streets were beautified by adding trees and street furniture. Throughout this process, on-street parking spaces were removed and replaced with four off-street parking lots, totaling 1,980 spots. All four lots were funded and managed through public-private partnerships (PPPs). Figures 6 through 9 show how in two districts of the city, removal of curbside spots resulted in underground lots and pedestrian zones integrated with tram stations.

Bicycle Parking

Strasbourg is France's bicycling capital with almost 500 kilometers of dedicated cycling paths, a total of 1,623 bicycle parking spots located in seven off-street parking facilities (Figure 10), and 21 locked bicycle kiosks—called Véloparcs—at tram stations. Four of Strasbourg's inner-city parking lots offer free protected bicycle parking,



358 streets have had contra-flow bike lanes installed, thereby reducing space devoted to parking.



Poster advertising Public Discussion on Paid Parking Extension. Source: CUS

a successful result of the city's negotiation of the PPP contracts. Demand for guarded bicycle parking is high, and all of the city's guarded lots operate at or near capacity.

Communication Campaigns

The previous mayoral administration, under Mayor Keller, ran a sustainable transportation campaign entitled Ecomobilité, which relied heavily on posters, brochures, and media publications to challenge car dependence. Part of that campaign included the creation of the color-coded parking zones. The current mayor, Roland Ries, is running an active awareness-raising campaign entitled, "Priority to our Quality of Life," a large part of which include public discussions and information pamphlets on the reasons for the planned paid parking zone expansion.

SOURCES FOR STRASBOURG

"Communauté Urbaine de Strasbourg: Plan de Déplacements Urbains, Juin 2000." ["Urban Community of Strasbourg: Urban Transport Plan, June 2000."].

Interview with R. Auriol & T. Kolmer [Communauté Urbaine de Strasbourg, CUS], November 2009.

"Observatoire des Déplacements: Bilan 2008 Sur la Communauté Urbaine de Strasbourg" (2009). ["Observations of Transport: 2008 Status of the Urban Community of Strasbourg"] Accessed online November, 2009. URL: <http://www.strasbourg.eu>.

"Parkings-relais 10 ans de progression... et de nouvelles perspectives." (2006) ["P&R 10 Years on... and New Perspectives."] Dimension Villes & Territoires. Adeus, No. 52.

CASE STUDY:

Zurich, Switzerland

CITY OVERVIEW

Population: 381,129

Metropolitan area: 1.68 million

Population Density: 3,930/km² (10,180 /mi²)

Total Parking Supply: 270,000

On-Street Fees: 0.50 to 5 CHF

Policy Goals: Congestion Mitigation, Public Space Reclamation, Public Transit Promotion, Emissions Reduction

Zurich has been pursuing a restrictive parking policy in response to limited road capacity, air quality issues, and noise pollution. Total NO₂ emissions, for instance, are considered when determining the amount of parking allowed. The city's traffic problems can be traced back to the 1960s and 1970s when the mobility plan sought to accommodate more cars on the road. The first parking meters were introduced in the 1960s as a result. There were eight or ten parking meters, mostly on commercial streets with high turnover.

The city changed its priorities after consulting with professors from ETH Zurich and the engineering firm Basler & Hoffman on how to improve conditions for public transit, pedestrians, and bikes. When parking was restricted on one street, it spilled over to the surrounding area. The city decided to create neighborhood-based plans. The prices for parking in the residential areas are high and normally the same as in the center. Car transport has been given less priority with direct actions, such as changing traffic light signalization from green waves to red waves. Green waves allow consecutive traffic lights to turn green at

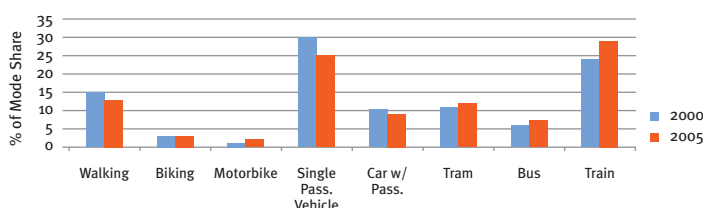


Multi-modal interchange station that has bike parking, tram stops, electric bus stops, and pedestrian amenities in a residential neighborhood.

the same time, allowing cars to speed through, whereas red waves force cars to stop at each light. Of the 790-kilometer street network, 447 kilometers are dedicated to public transit and 340 kilometers to bike infrastructure. No matter where a person is in the city, there is always a tram or bus stop within 300 meters. In residential areas, on-street parking was removed for cars and replaced with bike parking.

There are nearly 270,000 total parking spaces in the city—220,000 are located on private land, approximately 50,000 on public land, and about 15,000 private spaces are publicly accessible. The city concurrently focused resources heavily on tram development after citizens voted in 1977 to

Figure 1:
Zurich mode split trend





Former curbside parking was converted to bicycle parking.



European blue disc affixed to the windshield of a car.



Paid parking in a residential neighborhood near ETH Zürich.



Two-hour limited paid parking in a residential neighborhood.

approve a 200 million CHF (€130 million) referendum to make the investment. Public transit makes up the largest mode share in the city. Between 2000 and 2005, public transit's modal share went up by 7%, while the automobile's declined by 6% (Figure 1).

Parking Zones: Blue and White

Zurich has two types of regulated on-street parking zones: blue and white. Blue zones allow free parking up to 90 minutes using the European parking disc, which may be purchased at police stations, tourist offices, and banks. There are numerous blue zones around the city, with time limits that vary zone by zone. Residents can purchase a parking permit online for use in a blue zone for 20 CHF (€13.25) per month or 240 CHF (€160) for a year-long pass. The annual permit offers no discount. Owning a residential parking permit does not guarantee permit-holders will find parking whenever they need it. Residents are encouraged to form a car-sharing community with neighbors to share a vehicle.

White zones have white stripes and require paying for visitor parking, which are adjusted every three or four years. Daily permits are available for special cases—for vendors working at a street festival, say—and can be purchased online, just like residential permits. The parking rate has a marginal increase every 30 minutes as shown in steps in Figure 2. As of December 2010, the exchange rate was 1 EUR = 1.3082 CHF.

The P&D scheme in Zurich is hyper-localized with prices and privileges varying by time of day and

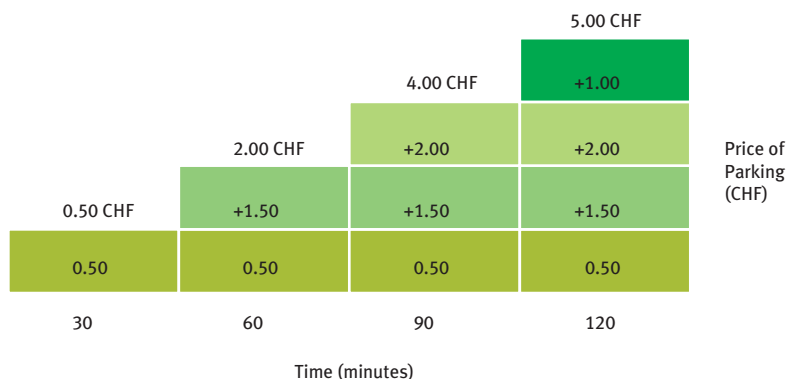


Figure 2:
Parking price
increases over time

location across the entire city block-by-block, rather than in geographic clusters. The parking surplus from the fees goes directly to the city treasury. Tickets for parking may be purchased at P&D machines using a credit card or coins, and the ticket must be displayed on a car's dashboard.

Parking Supply Cap

A policy called the Historischer Parkplatz Kompromiss—literally the historic parking compromise—was established in 1996 that put a cap on the parking supply. If a space is created off-street in the capped area, an on-street space must be removed to keep the supply equalized. The policy has allowed for on-street improvements to be made and the creation of new public plazas.

Parking facilities built under public plazas are usually privately operated with the exception of three facilities that are overseen by the city. Private developers get a concession to manage

Figure 3:
Zurich parking supply in Kreis 1 (1990 & 2009)

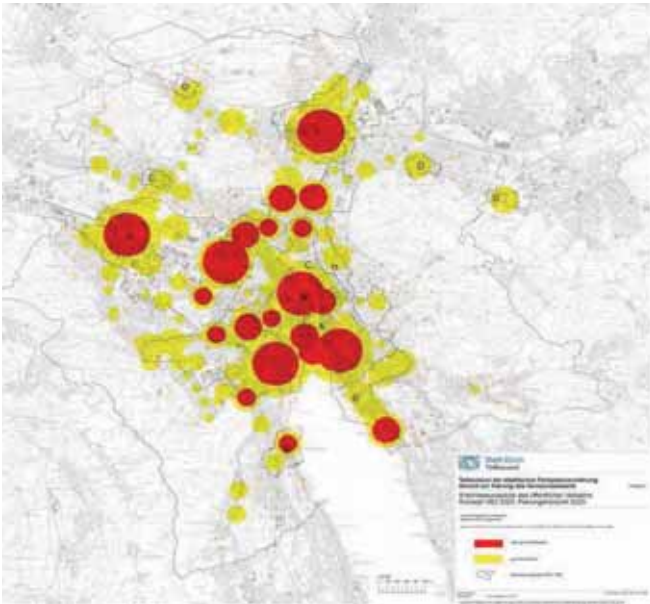
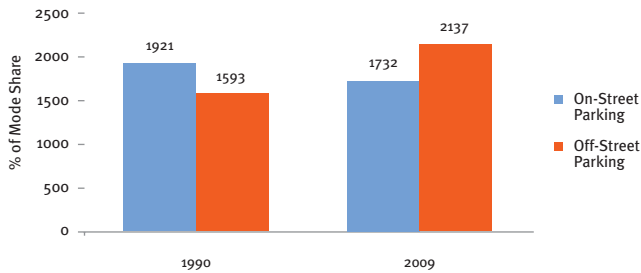


Figure 4: Access to transit at three adjacent city locations

the facilities on public ground. City Parkhaus, and Globus Parkhaus are facilities underneath two large stores near the central station. The department stores used their own money to build the underground parking spaces.

Figure 3 illustrates how the parking supply has shifted in Kreis 1 (the city is divided into 11 districts, called kreis) from on-street to off-street in the last two decades in the area where the Globus Department Store is located. The supply increased slightly from 3,653 to 3,730. The entire city follows the same trend.

Off-Street Parking Regulations

According to Zurich local laws, inside the city center no new parking can be built unless the City agrees to remove an equal number of on-street parking spaces. Outside the city center, new developments can include parking. The city’s building ordinance has greater restrictions than

Figure 5: Parking requirements for different land uses in Zurich

LAND USE TYPE	PARKING REQUIREMENT
Residential	1 space/120 m ²
Commercial	
First 500 m ² per unit	1 space/120 m ²
Over 500 m ² per unit	1 space/210 m ²
Retail	
First 2000 m ² per unit	1 space/100 m ²
Over 2000 m ² per unit	1 space/160 m ²
Restaurants, cafes, bars	1 space/40 m ²

the province—in Switzerland, these are called cantons—on how much parking can be included in a construction project. Access to public transit prompts a reduction in the building requirement with those developments closest to a bus or tram stop requiring less parking.

Figure 4 illustrates the accessibility to transit of three different locations:

- Red: very good access to public transit
- Yellow: good access to public transit
- Border line emphasizing the capacity gaps

Although the map shows the less connected areas, most of the city is generally well served by some mode of public transportation. Figure 5 is a list of parking requirements in Zurich, by land use.

A small office of 400 m² would require four parking places. Hospitals, senior homes, schools, hotels, sports facilities, manufacturing, and storage areas are evaluated on a case-by-case basis, in accordance with the principles of the parking regulation. The planning authority is responsible for setting the benchmarks for special uses. The parking requirement can be reduced in office buildings by allowing sharing of spaces amongst employees and others in the area.

The city’s parking ordinance recognizes the connection between parking management and overall transportation policy, especially with regard to accessory parking standards in new and refurbished developments near public transit. Locations with good public transit access must comply with a reduction in the parking minimum and maximum. The city can also reduce the standard depending on air quality in the area and nearby road capacity. Figure 6 and the accompanying map illustrate parking requirement reductions as a percentage of building square meters.



Before Parking Removal on Rennweg.
Source: Stadt Zürich



After Parking Removal on Rennweg.
Source: Stadt Zürich

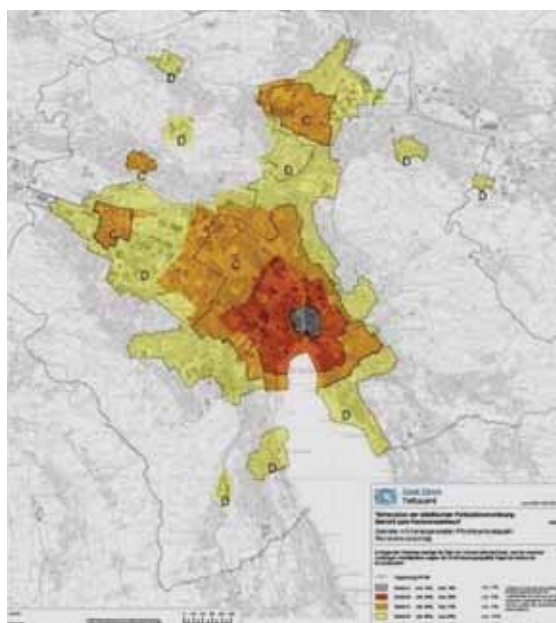
Traffic-contingent trip-caps are set for developments outside the supply cap zone. This measure assigns a limit on the number of trips that can be made to a new development by car, which was first applied to the commercial center known as SihlCity. Car-free developments are allowable and encouraged with the submission of a mobility plan for the site based on a November 2010 referendum. Builders must then assure that all other visitors will make a trip by walking, biking, tram, motorcycle, or commuter rail. The car trip-cap is based on road capacity and air quality regulations. To comply with the cap, the amount of parking must be limited.

Enforcement

Parking wardens are employees of the city, specifically the police department—they are called “hilfspolizei,” or accessory police. There is no private enforcement of on-street parking regulations. The wardens wear normal dress clothes rather than uniforms. A parking fine can cost between 50 and 100 CEF (€33–66).

Street Design

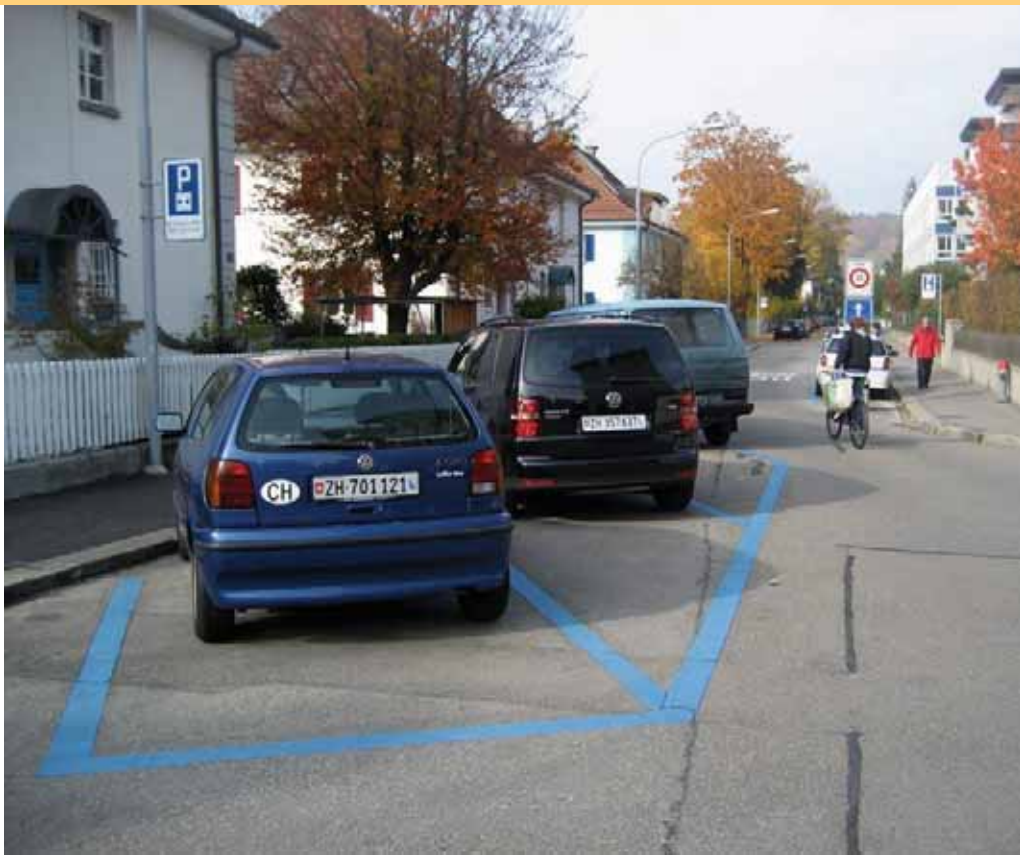
The civil engineering department in Zurich is responsible for the planning, design, and maintenance of public space. Well-designed physical infrastructure and urban spaces support lingering and alternative modes. Rennweg is a street near the city’s central rail station that was transformed



AREA	MINIMUM (%)	MAXIMUM (%)	*MAXIMUM ± (%)
A	10	10	10
B	25	45	50
C	40	70	75
D	60	95	105
Remaining Areas	70	115	130

*Related to clean air regulations and road capacity

Figure 6:
Accessory parking requirements based on access to transit.
Source: City of Zurich



TOP: These parked cars near ETA TU Zurich create a chicane in the road.

Parking spaces oriented in a way that promotes traffic calming on a residential street.

BOTTOM: A combination of curbside barriers, including parking, are used in a street design for slow traffic near the bustling commercial street Langstrasse.

into a shared space after parking was removed.

Zurich launched a federal program in 1991 to establish “Tempo 30” zones, which aimed to redesign streets to make them more livable by lowering the default traffic speeds to 30 kph. In Tempo 30 zones, there is usually no pedestrian crossing since the streets are considered so safe that pedestrians can cross at any point. Parking orientation can be a key element of slowing car traffic.

Alternating curbside parking with about three cars in each cluster forces traffic to weave slowly down a street by following the curved road created by the parking cars.

Parked cars can also be intermixed with permanent physical barriers, two-wheeler parking, plantings, and garbage bins to create calmed streets. .

SOURCES FOR ZURICH

Andy, Fellmann, Ruedi Ott & Erich Willi (2009). “Der Historische Kompromiss von 1996: Erläuterungen zu Entstehung und Umsetzung.” Department of Mobility & Planning. Historic Parking Compromise: Explanations of Development and Implementation.

City of Zurich (2007). “Mobilitätsstrategie der Stadt Zürich Teilstrategie Parkierung.” Mobility strategy of the city.

Interview with Member of Swiss Parliament and former Planning Director in Zurich, October 2009.

Interview with Director of Mobility and Planning for the City of Zurich, October 2009.

Interview with Fussverkehr Schweiz (Pedestrian Advocacy NGO), October 2009.

Interview with Daniel Saunter, Sociologist in Urban Mobility Research, October 2009.

Ruedi Ott (2007). “Raum- und Verkehrsentwicklung.” Presentation. Spatial and Transport Development.



Conclusion

In most cities around the world, parking policy is either non-existent, poorly coordinated, or used to make driving more convenient. A growing number of European cities, by contrast, are using parking policy to meet goals like improving air quality, reducing traffic congestion, making streets more liveable, reducing greenhouse gas emissions, and freeing up road space for bike lanes and public space. The case studies in this report highlight that expanding the supply of free, cheap, or excessive parking—once viewed as necessary to economic vitality and freedom of mobility—has been reassessed across Europe. Limiting the provision of parking to levels that the roads can support and the air quality norms can sustain is growing more common. Using pricing to ensure turnover at the curb, and allocate scarce parking space to those who need it most, is becoming the norm. In general, good parking management is acknowledged as integral to lively and competitive cities. Cities that share these goals can learn a lot from European best practices.

Four main approaches are used to effectively manage parking: economic mechanisms, regulatory mechanisms, physical design, and quality of service contracting.

- **Economic mechanisms:** Many European cities not only vary on-street parking charges to maintain 85% occupancy rates, but the most progressive cities are harmonizing on-street and off-street parking fees. This minimizes cruising and rationally allocates parking to those who need it most. The most progressive cities are also ring-fencing or earmarking parking revenues to support transit services or bike sharing.
- **Regulatory mechanisms:** While internationally most cities force developers to build a minimum amount of parking, in Europe these minimums are quite low, and they are particularly low around transit stations. A few leading European cities have replaced minimums with caps and maximums on new parking construction to avoid generating new car trips, and thus reduce CO₂ emissions. More cities are also regulating where parking is allowed in ways that improves the quality of public space and discourages car use.

- **Physical design:** In Europe, streets are being designed to minimize the adverse impact on pedestrians of vehicles entering parking facilities. Parking is being used to slow traffic on local streets and protect bike lanes from higher-speed traffic on arterials. Extensive use is made of bollards to prevent the encroachment of parking vehicles on pedestrian space.
- **Quality of Service Contracting:** Outsourcing certain aspects of parking management to a private third party has shown to improve parking management and increase the cost recovery from parking fees and fines. As governments move to more austere times, setting up performance-based contracts to handle functions such as fee collection and enforcement can help meet parking-related policy targets most efficiently.

Innovations in technology are also creating new possibilities for regulating and managing parking. Most of Europe is moving to multi-space meters, which have more flexibility in terms of the allocation of spaces and pricing, and tend to have lower maintenance costs.

Many European cities now also offer pay-by-phone parking payment services. The cost of collecting parking fees and losses from theft and vandalism can be minimized by contracting out to a pay-by-phone service provider. Such services are also more convenient, as customers can remotely buy more parking time, rather than running back to replenish a meter. The service can also send an SMS alert when paid time is nearly expired.

The next wave of parking-fee-collection technology is in-vehicle meters that are linked to a GPS system. A few trials are underway to use GPS technology to vary parking charges based on location, time of day, and day of week, to optimize parking system performance.

The examples in this report highlight some of the most innovative approaches to parking management in the world. They will hopefully inspire cities in other regions to try even bolder efforts to harness parking policy—an often overlooked and undervalued municipal policy lever—to achieve broader social goals.

Appendix A:

Munich Minimum Parking Requirements

RESIDENTIAL <ul style="list-style-type: none"> • Children and youth housing (Kinder- und Jugendheim) • Housing for students, daily care personnel, workers, etc. • Care center housing (Pflegeheim) 	1 space/apartment 1 space/20 beds 1 space/5 beds 1 space/15 beds
OFFICE AND ADMINISTRATIVE CENTERS <ul style="list-style-type: none"> • Areas with significant visitor traffic 	1 space/40 m ² of usable area 1 space/30 m ²
RETAIL <ul style="list-style-type: none"> • Stores with up to 400 m² • Stores over 400 m², large retailers • Shopping center 	1 space/50 m ² 1 space/30 m ² 1 space/20 m ²
GATHERING / EVENT VENUES <ul style="list-style-type: none"> • Prayer house 	1 space/10 visitors 1 space/30 seats
SPORTS VENUES <ul style="list-style-type: none"> • Sports center • Fitness center • Sauna (commercial) 	1 space/300 m ² sports area 1 space/20 m ² , at least 3 spaces 1 space/15 m ² sauna area
RESTAURANTS, ACCOMMODATION, HOSPITALS <ul style="list-style-type: none"> • Restaurant • Hotels, pensions, and other guest accommodation establishments • Motel • Youth hostel • Hospital 	1 space/10 m ² (20 m ² in some cases) of dining room area 1 space/2 bedrooms 1 space/room 1 space/10 beds 1 space/4 beds
SCHOOLS <ul style="list-style-type: none"> • Primary, promotion, real, municipal, state, state-approved business school, high school, other general education schools, specialized secondary schools, vocational and Berufsfachschule • Special education for the disabled • College • Training workshops, professional secondary schools, specialist academies, colleges and similar 	1 space/classroom 1 space/15 students 1 space/10 students 1 space/10 trainees/students

Appendix B: Additional Resources

Amsterdam

City of Amsterdam Parking:

<http://www.bereikbaaramsterdam.nl>

iAmsterdam: <http://www.iamsterdam.com>

Monitoring Department:

<http://www.stadstoezicht.amsterdam.nl/>

Environmental and Building Department:

<http://www.dmb.amsterdam.nl>

City Authority for Infrastructure, Traffic and Transport: <http://www.ivv.amsterdam.nl>

Milieudefensie, FOE Netherlands:

<http://www.milieudefensie.nl/>

Antwerp

General Parking Information:

<http://www.parkereninantwerpen.be/>

Barcelona

B:SM, Area Verde: www.areaverde.bsmsa.cat

RACC Foundation: <http://www.racc.es>

Bicicleta Club de Catalunya:

<http://www.bacc.info/>

Bike Parking: <http://www.aparcabicis.info>

Copenhagen

City of Copenhagen Parking:

<http://www.kk.dk/parkering.aspx>

Center for Parkering:

<http://www.parking.dk/parking>

Statistics Denmark: <http://www.dst.dk>

Danish Cycling Federation: <http://www.dcf.dk>

London

Controlled Parking Zones:

<http://www.cpz.org.uk/>

Westminster City Parking:

<http://www.westminster.gov.uk/services/transportandstreets/parking/>

Islington Parking:

<http://www.islington.gov.uk/transport/road-sandparking/parking/default.asp>

London Councils:

<http://www.londoncouncils.gov.uk/>

Munich

Inzell Initiative:

http://www.inzellinitiative.de/_engl.Version/foren_eng/parken/parken_eng.htm

City Parking Zones:

http://www.muenchen.de/verticals/Traffic_Transport/Cars_and_Traffic/230140/603parkingzones.html

Paris

Mairie de Paris: <http://www.paris.fr/Urbanism>

GART: <http://www.gart.org>

Yves Contassot: <http://yvescontassot.eu/>

Réseau Vert : <http://reseau.vert.free.fr/>

Vélorution: <http://www.velorution.org>

Stockholm

City of Stockholm Parking:

<http://www.stockholm.se/parkering>

Stockholm Parkering:

<http://www.stockholm-parkering.se/engparkingengeneral.htm>

Residential Parking Permits:

<http://www.stockholm.se/boendep>

EasyPark: <http://easypark.se/>

Securitas Sverige:

<http://www.securitas.com/se/sv/>

Strasbourg

Residential Parking: <http://www.strasbourg.eu/>

Park & Ride:

<http://www.cts-strasbourg.fr/en/Services/Parkride.aspx>

Zurich

City of Zurich Mobility Portal:

<http://www.stadt-zuerich.ch/mobilitaet>

Zürich Off-Street Parking Facilities:

<http://www.pls-zh.ch/>

Appendix C:

Parking Management and Technology Vendors

COMPANY	HQ	PRODUCTS	COMMENTS	CONTACT
VINCI Park	Nanterre, France	On/Off-street parking solutions, financing and operation	Provider / operator of parking solutions, VINCI Group is an Infrastructure Building & Operating Company	UK: +44 (0) 1908 223 500; France: 01 41 91 45 00
Q-Park	Leeds, UK	Risk-bearing operations Supervision of parking regulations. Technical maintenance and administration. Season ticket management and permits.	Provider / operator of parking solutions	Tel: +44 (0)870 442 0104 Email: info@q-park.co.uk
PARKEON	Milan, Madrid, Poole (GB), Moorestown (U.S.), Paris, Besancon (FR), Kiel (DE)	Parking solutions: control, sales, operations Parking services: maintenance, consulting, e-payment Parking products: Strada, Stelio, Varioflex, Parkfolio	Integrated parking management services: solutions for cities (on-off street), shopping centers, airports, and rail stations, ticketing machines, parking terminals.	+49 (0) 431 3059 0
APCOA	Uxbridge, UK	On-street parking enforcement Off-street parking management	Airport, rail station, and parking lots	–
Spot Scout	N/A	Internet-based market for parking information for garage, private, residential, and on-street.	Searching, posting, and reserving parking spaces on-line: private, on- and off-street	garages@spotscout.com
StreetSmart	—	Automated Parking Solutions: meters (individual), IT system for collection, charging, enforcement, etc. Integral provider of hardware and software solutions, as well as communications and financial integration.	No posted examples or locations, other than 'test site,' Decatur, Georgia, U.S.	001 203 222 0203 Linda Harris City of Decatur 404-371-8386 Linda.Harris@decaturga.com Julie Hairston A. Brown-Olmstead Associates 404-659-0919 Julie@newaboa.com Eric Groft StreetSmart Technology LLC 404-665-3142 egroft@streetsmarttechnology.com
Park Line	The Hague, NL	Park-line parking (cashless payment for on-street parking with the mobile phone), digital permits(the replacement of paper permits by digital permits), and garage parking (access to and cashless payment of garage parking by means of the Park-line card)	RFID solutions for parking management	sales@park-line.com
Allmobile	Zurich	Move & park: ICT (information communications technology) for truck parking in Europe SETPOS (Secure European Truck Parking Operational Services): pilot project for secure truck parking sites	Truck parking solutions	mail@allmobile.com +41 (0)44 286 66 33

COMPANY	HQ	PRODUCTS	COMMENTS	CONTACT
Interparking Group	Brussels	Parking garage financing, building, and operation. Parking cards linked to a credit card can be used for paying, shopping, and receiving coupons/bonus.	Emphasis on city integration, european networking and security, as well as upgrading existing facilities, customer-approach, and extras.	info@interparking.com +32 2 549.58.11
NSL Services Group	London	Managing car parks	Manage over 500 car parks. Was formed in 2007 after the de-merger of National Car Parks into two separate businesses. Also provide many other services.	0844 870 7070 solu- tions@nslservices.co.uk
ACS	Madrid, Spain	Construction and operation related to high-ways, railways, hospitals, transfer stations, parking garages, and other facilities.	Won a concession to construct three underground car parks in Madrid, concession period of 40 years. Parking is not the company's primary focus.	Avda. Pío XII 102 28036 Madrid (Madrid) Spain Tel : +34 91 343 92 00 Fax : +34 91 343 94 56 infoacs@grupoacs.com www.grupoacs.com
OHL	Madrid, Spain	Initially the company had three main business lines: toll roads, parking garages, and seaports. Now the four core business lines are: motorway infrastructure, airports, seaports, and railways.		OHL Concesiones, S.L. Paseo de la Castellana, 259 D Torre Espacio Castellana 28046 Madrid - SPAIN Tel: +34 91 348 41 00 Fax: +34 91 348 45 79 info@ohlconcesiones. com www.ohlconcesiones. com
FCC (Fomento de Construcciones y Contratas, S.A.)	Madrid, Spain	Management, operation, control and main-tenance of on-street parking; construction, operation and management of under-ground car parks; vehicle tow-away and impoundment services; development and implementation of software applications for handling traffic fines.	The FCC Group manages ap-proximately 140,000 on-street parking spaces and 12,300 underground parking spaces in the 83 cities where it provides these services.	Balmes, 36 8007 - Barcelona Tel: 934964900 Fax: 934878892
Saba	Barcelona, Spain	Saba has been operating in all areas of the parking business since 1966. The compa-ny's business activities are focused on the following areas: administrative concession, facility ownership, facility management, meter-controlled parking zones, property operations.	Saba forms part of Abertis, an in-ternational group that manages mobility and telecommunica-tions infrastructures across five business areas.	marketing@saba.es, Tel. 93 230 56 00 - Fax 93 230 56 04

Appendix D: Pay-by-phone Vendors

COMPANY	HQ	PRODUCTS	LOCATION	CONTACT	PRICES
Park & Phone	Basingstoke, UK	Payment method for on-street parking based on a mobile phone account linked to a credit card number	Tower Hamlets, UK	info@paymentinnovations.com +44 (0)8702 243 253	0.2 - 0.35 GBP per transaction
mPark	Milwaukee, U.S.	Payment method for on-street parking based on a mobile phone account linked to a credit card number	Oklahoma City, Las Vegas, Pasadena, Newport Beach, Los Angeles, Palm Beach, Lynchburg, and UK, Ireland, Australia, Germany	info@mparkusa.com General Enquiries support@mparkusa.com Service Queries 1-866-219-8726 General & Service Enquiries	up to 0.35 USD per transaction
Parkmobile	Germany (München), U.S., Belgium, UK, Greece, Netherlands, Canada	Payment method for on-street parking based on a mobile phone account linked to a credit card number	Köln, Hamburg, Lübeck, und Neustadt an der Weinstraße	Tel: +49 (0)89 64282236 Fax: +49 (0)89 69379427 kontakt@parkmobile.com	Registration: 2.5 EUR, 0.1 EUR / transaction, 0.2 EUR / SMS
ParkNOW!	Whitestone, NY, U.S.	Mobile Parking	Decatur, GA, U.S., Bethesda, MD, U.S., Hudson, NY, U.S.	Tel: (718) 747-3805 Customer Service: (866) 951-7275 Fax: (718) 767-8825 E-mail: info@goparknow.com	
Cellopark	N/A	Payment method for on-street parking based on a mobile phone account linked to a credit card number		support@cellopark.biz	
Verrus	U.S., UK, Canada			North America & International General: 604 642 4286 Email: info@verrus.com Suite 201 1028 Hamilton Street Vancouver, BC V6B 2R9 www.verrus.com	

Appendix E: Reference List

- Ajuntament de Barcelona. (2009). Dades bàsiques de mobilitat. Retrieved from <http://w3.bcn.es/fitxers/mobilitat/dadesbasiques20092010completer.822.pdf>
- Ajuntament de Barcelona. (2009). L'Àrea Verda es divideix en 22 zones. [map].
- Retrieved from <http://www.areaverda.bsmsa.cat/que-es-larea-verda/mapa-zones-residents/>
- Ajuntament de Barcelona. Tarifes de l'Àrea Verda. Retrieved from <http://www.areaverda.bsmsa.cat/funcionament-i-tarifes/tarifes-de-larea-verda/>
- Anderson, S., & Palma, A. (2004). The economics of pricing parking. University of Virginia Journal of Urban Economics, 55 (1).
- Arringa, D.S. (2009). Parking Management as a Contribution to Sustainable Urban Mobility: A Policy Analysis of the Munich Case. München: Chair of Urban Design and Regional Planning, Technische Universität München.
- Asociación Española de Aparcamientos y Garajes [ASESGA]. (2008). Libro Blanco del Sector del Aparcamiento y Garaje en España.
- Beatley, T. (2000). Green urbanism: learning from European cities. Washington, D.C.: Island Press.
- Borough of Islington. (2006). Islington's Local Implementation Plan Appendix E: Islington Parking Policy Statement. Sustainable Transport Strategy 2006–2016.
- Borough of Islington. [Cost of a residential parking permit]. Retrieved from http://www.islington.gov.uk/Transport/RoadsAndParking/Parking/parking_permits/details/resident-permit-detail-Dec.asp
- Borough of Islington. Controlled Parking Zones. Retrieved from <http://www.islington.gov.uk/Transport/RoadsAndParking/Parking/ParkingYourVehicle/ParkingRestrictions/>
- Bundesministerium für Verkehr, Innovation und Technologie. (2007). Verkehr in Zahlen-Ausgabe. 64-70. Retrieved from http://www.bmvit.gv.at/verkehr/gesamtverkehr/statistik/downloads/vizo7_kap4.pdf
- Button, K.J. (2006). The political economy of parking charges in 'first' and 'second- best' worlds Transportation Policy. 13 (6), 470-478.
- Chalkley, D. (2009). Park Right. Westminster City Council Parking Services.
- City of Paris. (2009). Prix du stationnement. Retrieved from <http://www.paris.fr/portail/deplacements>
- City of Westminster. Motorcycle parking costs in Westminster. Retrieved from <http://www.westminster.gov.uk/services/transportandstreets/parking/wheretopark/vehicletype/motorcycle/>
- City of Westminster Parking Services. (2008). Enforcement Code of Practice, Version 1.6.
- City of Zurich. (2007). Mobilitätsstrategie der Stadt Zürich Teilstrategie Parkierung.
- City Traffic Department. (2007). Parkeringsövervakning Stockholms Stad. Parking Control.
- City Traffic Department. (2008). Betaltjänster för parkering. Pay for Parking Services.
- Communauté Urbaine de Strasbourg. (2000). Plan de Deplacements Urbains, Juin 2000.
- Communauté Urbaine de Strasbourg. (2009). Observatoire des Déplacements: Bilan 2008 Sur la Communauté Urbaine de Strasbourg. Retrieved from <http://www.strasbourg.eu>
- Conseller de Política Territorial i Obres Públiques. (1992). Resolució del Conseller de Política Territorial i Obres Públiques de 12 de novembre de 1992. (DOGC No. 1690 de 04/01/1993). Retrieved from <http://www3.amb.cat/norma Urb/URBANISTIQUES/1-5-4.pdf>
- COST Action 342. (2006). Parking Policies and the Effects on Economy and Mobility. Technical Committee on Transport.
- Darvill, A. (2009). Parking Charges (Review Following Public Consultation). London Borough of Richmond upon Thames. Environment and Sustainability Overview and Scrutiny Committee.
- Dasgupta, M., et al. (1994). The Impact of Transport Policies in Five Cities. Transport Research Laboratory.
- Dimension Villes & Territoires. (2006). Parkings-relais 10 ans de progression... et de nouvelles perspectives. Adeus, 52.
- Drivers facing £250-a-year tax to park at work despite pledge to end 'war on motorists. (2010, August 24). Daily Mail Online. Retrieved from <http://www.dailymail.co.uk/news/article-1305362/Drivers-facing-250-tax-park-work-despite-end-war-motorists-pledge.html#ixzzoxbWxYyko>
- Enerdata. (2009). Paris Case Study. China Council for International Cooperation for environment and Development. Phase IV. Energy efficiency and Urban Development Task Force.
- Eurostat. (2003). Are we moving in the right direction. European Environment Agency. Statistical yearbook on candidate countries, Office for Official Publications.
- Feeney, B.P. (1989). A review of the impact of parking policy measures on travel demand. Transportation Planning and Technology, 13(4), 229-244.
- Fellmann, A., Ott, R., & Willi, E. (2009). Der Historische Kompromiss von 1996: Erläuterungen zu Entstehung und Umsetzung. Department of Mobility & Planning.
- Gantelet, E., & Begon, C. (2008) The Impact of Car Parking Policies on Greenhouse Gas Emissions. Association for European Transport.

- Gantelet, E., & Sarecto, C.B. (2008). The Impact of Car parking Policies on Greenhouse Gas Emissions. European Transport Proceedings. Retrieved from <http://www.etcproceedings.org/paper/the-impact-of-car-parking-policies-on-greenhouse-gas-emissions>
- GAPA. (2005). Parking in Antwerp. Presented at the Interreg IIIC-Project City Parking in Europe Partner Conference, Berlin.
- GAPA. (2008). Parkeerbeleidsplan 2008-2012, 33-34.
- Gemeentelijk Autonoom Parkeerbedrijf Antwerpen (2008). URL: <http://www.parkereninantwerpen.be/parkeren/bezoekers/smart-park/smart-park>
- Gehl, J., & Gemzoe L. (1996). Public Spaces Public Life. Copenhagen: The Danish Architectural Press.
- Gehl, J., & Gemzoe, L. (2003). New City Spaces (3rd Ed.). Copenhagen: The Danish Architectural Press.
- Gehl, J., & Gemzoe, L. (2006). New City Life. Copenhagen: The Danish Architectural Press.
- iAmsterdam. Parking in Amsterdam. Retrieved from <http://www.iamsterdam.com/en/visiting/touristinformation/gettingaround/parking/parkinginamsterdam>
- Interview with Alderman Ludo Van Campenhout. (2009, July).
- Interview with B:SM. (2009, September).
- Interview with Bicicleta Club de Catalunya (BACC). (2009, September).
- Interview with C. Weis-Hiller, Referat für Stadtplanung und Bauordnung. (2009, July).
- Interview with Camden Council. (2009, September).
- Interview with Center for Innovation in Transport (CENIT). (2009, September).
- Interview with Center for Parkering. (2009, July).
- Interview with City of Amsterdam. (2009, July).
- Interview with City Surveillance Service (Dienst Stadtoezicht). (2009, July).
- Interview with Cyclist Foundation. (2009, July).
- Interview with Cynthia Van der Linden, GAPA. (2009, July).
- Interview with Daniel Saunter, Sociologist in Urban Mobility Research. (2009, October).
- Interview with Director of Mobility and Planning for the City of Zurich. (2009, October).
- Interview with EasyPark. (2009, July).
- Interview with EcoRys Research and Consulting. (2009, July).
- Interview with European Parking Association. (2009, September).
- Interview with Fussverkehr Schweiz [Pedestrian Advocacy NGO]. (2009, October).
- Interview with Green Left Party. (2009, July).
- Interview with Groupement des Autorités Responsables de Transport (GART). (2009, July).
- Interview with Islington Council. (2009, September).
- Interview with J. Mühlhaus. (2009, September).
- Interview with K. Sonntag & M. Glöckner from Green City. (2009, July).
- Interview with London Councils (2009, September).
- Interview with London Councils. (2009, September).
- Interview with Mairie de Paris. (2009, July).
- Interview with Member of Swiss Parliament and former Planning Director in Zurich. (2009, October).
- Interview with Milieudéfense, Friends of the Earth Netherlands. (2009, July).
- Interview with of Copenhagen (2009, July).
- Interview with R. Auriol & T. Kolmer [CUS]. (2009, November).
- Interview with RACC Automovil Club. (2009, September).
- Interview with Réseau Vert. (2009, July).
- Interview with Saba Abertis. (2009, September).
- Interview with Securitas Sverige. (2009, July).
- Interview with Stockholm City Planning Administration. (2009, July).
- Interview with Stockholm City Traffic Department. (2009, July).
- Interview with Stockholm Parkering. (2009, July).
- Interview with Traffic Office, Permits Division. (2009, July).
- Interview with Vélorution. (2009, July).
- Interview with Westminster Council. (2009, September).
- Interview with Yves Contassot. (2009, July).
- Jones, D. (2010, February). Amsterdam businesses get €3m for electric car. Power and Energy. Retrieved from <http://www.ngpowereu.com/news/amsterdam-electric-cars/>
- Jourard, R., et al. (1996). Air quality and urban space management. The Science of the Total Environment, 189/190, 57-67.
- Knopflacher, Hermann. (2009). The value of parking organization for economy, society and environment. Technical University of Vienna. Institute of Transportation, Research Center of Transport Planning & Traffic Engineering.
- Kreisverwaltungsreferat, Landeshauptstadt München. (2003). MOBINET Abschlussbericht 2003: 5 Jahre Mobilitätsforschung im Ballungsraum München. München: Kreisverwaltungsreferat, Landeshauptstadt München.
- Le Mairie de Paris. (2007). Direction de la Voirie et des Déplacements. Elaboration du Plan de déplacements de Paris (PDP). Paris Transport and Travel.

- Le Mairie de Paris. (2009). La politique du stationnement à Paris. Direction de la Voirie et des Déplacements. Service des Déplacements.
- Le Mairie de Paris. URL: http://www.paris.fr/portail/pratique/Portal.lut?page_id=5779&document_type_id=5&document_id=4812&portlet_id=12654
- Lester, N. (2007). Transport and environment services for London. London Councils.
- London Borough of Richmond upon Thames. (2009) CO2 Emissions Based Parking in Richmond upon Thames. Retrieved from http://www.richmond.gov.uk/co2_emissions_based_parking_leaflet.pdf
- Loose, W. (2009, June). Car Sharing Station in Public Street Space. Intelligent Energy Europe. Momo Project. Retrieved from <http://www.uitp.org/pdf/factsheet6stationsinpublicspace.pdf>
- MOBINET: Mobility in the Conurbation Munich. Retrieved from <http://www.mobinet.de/Fachinformation/english/allgemein/startframeset.html>
- Münchner Verkehrs- und Tarifverbund GmbH (MVG). (2009). Münchner Verkehrs- und Tarifverbund. Retrieved from http://www.mvv-muenchen.de/en/home/mvv_network/transportnetworkmaps/parkride/index.html
- Office of the Deputy Prime Minister. (2004). The Building Regulations 2000. Creating Sustainable Communities.
- Ott, R. (2007). Raum- und Verkehrsentwicklung. Spatial and Transport Development.
- Parkeon. (June 2008). Parkeon Celebrates the Golden Anniversary of the Parking Meter. Retrieved from <http://www.parkeon.com/de/Press-Release/Parkeon-celebrates-the-golden-anniversary-of-the-parking-meter.html>
- Parking Kbh. Pay and Display Zones. Retrieved from <http://www.parking.dk/parking/tourists-and-visitors/>
- Polak, J.W. & Axhausen, K.W. (1990). Parking search behaviour: overview of current research and future prospects. (Working paper) Transport Studies Unit, Oxford University, 540.
- Pollution Reduction Options Network. Parking Policy in Amsterdam (NL) Fact Sheet. (2008). Retrieved from <http://www.umwelt.nrw.de/umwelt/pdf/pronet/factsheets/13.pdf>
- Richmond upon Thames Liberal Democrats. (2010, August). CO2 Based Charges. Retrieved from http://www.richmond.libdems.org.uk/news/002936/co2_based_parking_charges.html
- Rodríguez, A.L. (2006, May). Movilidad y convivencia de la moto en Barcelona. Presentation at XIII Fórum Barcelona de Seguridad Vial, Barcelona. Retrieved from <http://www.bcn.es/infotransit/xiiiiforum/ponencias/ponenciaAngelLopez.pdf>
- Rye, T., et al. (2006). Expansion of a Controlled Parking Zone (CPZ) and its Influence on Modal Split: The Case of Edinburgh. Transportation Planning and Technology, 29 (1), 75-89.
- Shoup, D.C. (2005). *The High Cost of Free Parking*. Chicago: American Planning Association.
- Steierwald, G., et al. (2005). *Stadtverkehrsplanung*. Berlin: Springer
- Steierwald, G., Künne, H.D., & Vogt, W. (2005) *Stadtverkehrsplanung*. Berlin: Springer.
- Tapsfield, J. (2010, August 23). Workplace parking levies may be imposed by councils. The Independent Retrieved from <http://www.independent.co.uk/news/uk/politics/workplace-parking-levies-may-be-imposed-by-councils-2059468.html>
- Tapsfield, J. (2010, August 23). Workplace parking levies may be imposed by councils. The Independent Retrieved from <http://www.independent.co.uk/news/uk/politics/workplace-parking-levies-may-be-imposed-by-councils-2059468.html>
- Topp, H. H. (1994). Zur Rolle des Parkens in der Verkehrsberuhigung. Straßenverkehrstechnik, 375-379.
- Weinberger, R., et al. (2010). U.S. Parking Policies: An Overview of Management Strategies. Institute for Transportation and Development Policy.
- Young, W., et al. (1991). A review of urban car parking models. Transport Reviews, 11 (1), 63-84.
- Parking Rate Survey. Retrieved from <http://www.colliers.com/content/globalcolliersparkingratesurvey2009.pdf>



ITDP

Institute for Transportation
& Development Policy

9 East 19th Street, 7th Floor, New York, NY 10003 USA

Tel: +1-212-629-8001 • Fax: +1-646-380-2360 • Email: mobility@itpd.org

www.itdp.org