Parking Guidebook for Beijing

1 March 2015

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ADB

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1. Introduction

Study scope

Increased car ownership in Beijing has resulted in a higher demand for parking spaces. Rather than taking a restrictive approach to parking as a means to reduce car travel and ownership, the government is trying to increase parking supply in an effort to solve parking problems.

Simply increasing parking supply is not a solution as it leads to more traffic and lost opportunities for high-value uses like offices, retail and residences. Each parking space takes up 30m^2 to 35m^2 and car drivers need between two to five different parking spaces every day. Therefore it is crucial for the success of Beijing to start managing parking holistically and implement and enforce parking systems and policies that have proven their success elsewhere. The parking problems are not unique to Beijing and lessons can be learned from other cities that have experienced increased motorization.

This report studies Beijing's existing parking policies and systems and studies several parking locations, residential, commercial, office and mixed use areas, both on-street and off-street, documenting existing parking practices in Beijing. An analysis of problems identifies the main parking issues and Chinese and international best practices described. Recommendations are given for on-street parking, including parking zones, price, policies, technology, enforcement, design, operation models, costing & financing. For off-street parking recommendations are presented for parking maximums, caps and parking sharing. Furthermore recommendations for communication on parking reform are offered.

The parking recommendations for Beijing as described in this report are based on desk research and surveys and analysis of the existing parking conditions and behavior in Beijing and solutions follow international best practice. The parking recommendations presented will help Beijing:

- achieve more rational and efficient use of on-street and off-street parking spaces
- provide drivers with available parking spaces, directions and multiple payment options
- reduce cruising, improve traffic flows and reduce congestion
- achieve organized and safe streets for walking and cycling
- improve accessibility and livability for its residents, increase business revenues and improve attractiveness to tourists
- gain a stable, long term revenue stream from parking that can be used to fund sustainable transport development
- reduce air and noise pollution and CO2 reduction
- stimulate the use of public transport.

Objective

The objective of this study is to provide detailed insights into Beijing's parking issues and offer recommendations to improve on-street and off-street parking policies and systems. The study is financed by the Asian Development Bank, with some input provided by the Beijing Transport Research Institute (BTRC).

Personnel and time frame

The work was carried out between August and December 2014. A large team worked on the project including Bram van Ooijen, Yang Li, Shaokun Liu, Xiaomei Duan, Zoltan Gyarmati, Yipeng Du, Judit Ponta, Yusen Wang, Zhitao Li, Chen Dan, Shuling Li and Karl Fjellstrom.

Definitions

On-street, off-street and setback parking areas are defined as follows:

- On-street parking: parking on the curb side lanes of roads.
- Off-street parking: parking away from the public road in parking lots, buildings and garages.
- Setback: space between building facade and property line, or between the building facade and the edge of the public walkway.

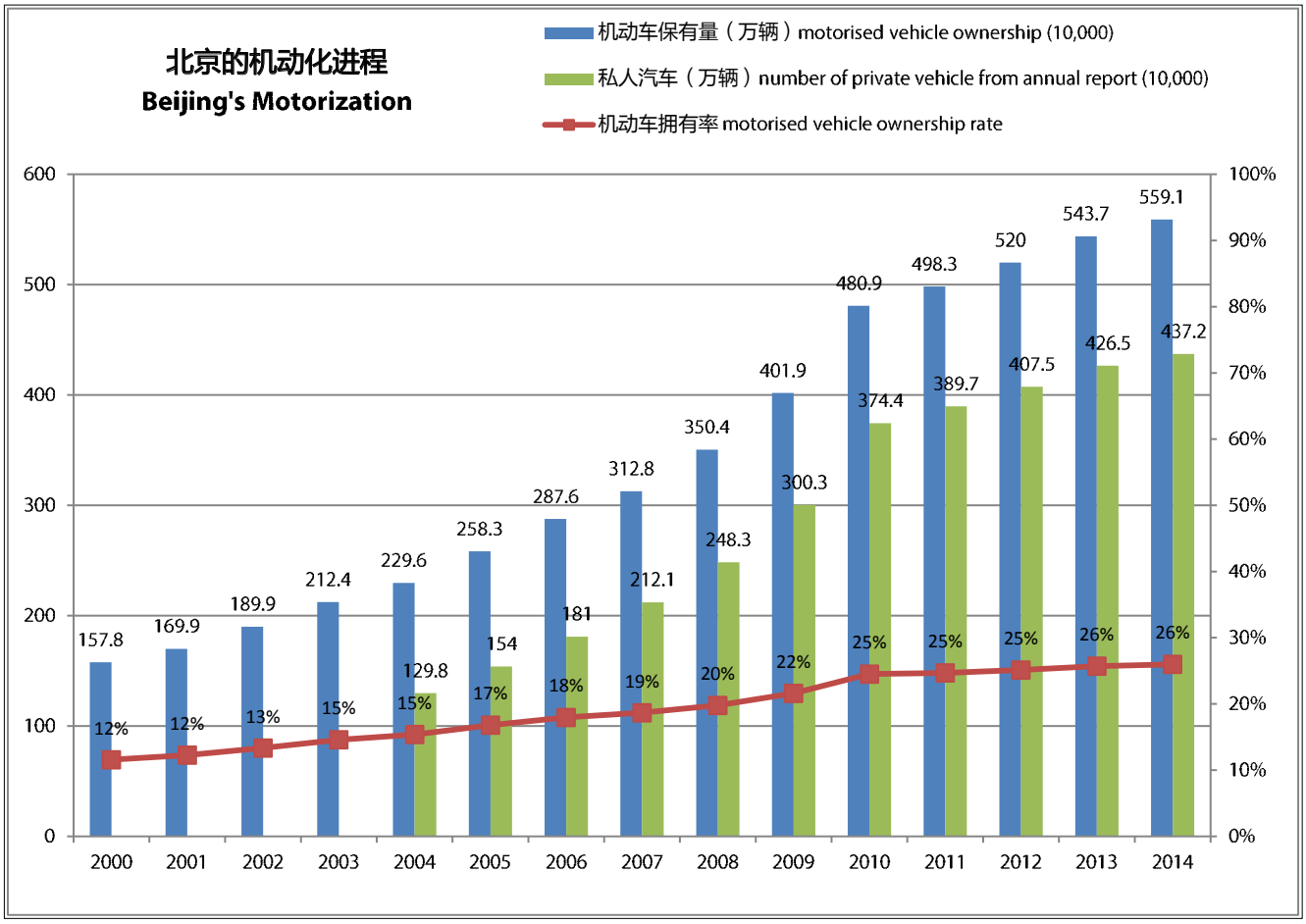
2. Current Parking Policies & Systems

2.1 Background

With 21.5 million residents by the end of 2014, Beijing is one of the world's biggest cities. Following vast investments in roads and parking spaces, the share of car traffic in Beijing's modal split has risen drastically, creating more demand for parking spaces. Of all Chinese cities, Beijing has the largest number of cars registered with 4.37 million cars, of which 3.17 million belong to individuals. As of July 2014, 6,156 parking locations with 1,643,141 parking spaces were in operation. Beijing's rapid construction of parking spaces saw 73,205 new parking spaces (4.7% of total supply) compared to one quarter earlier. The growth in parking supply is still lower than the growth in vehicle ownership and the vast amount of parking spaces Beijing already has, have had negative effects on the city's traffic, land resources, public spaces and air pollution.

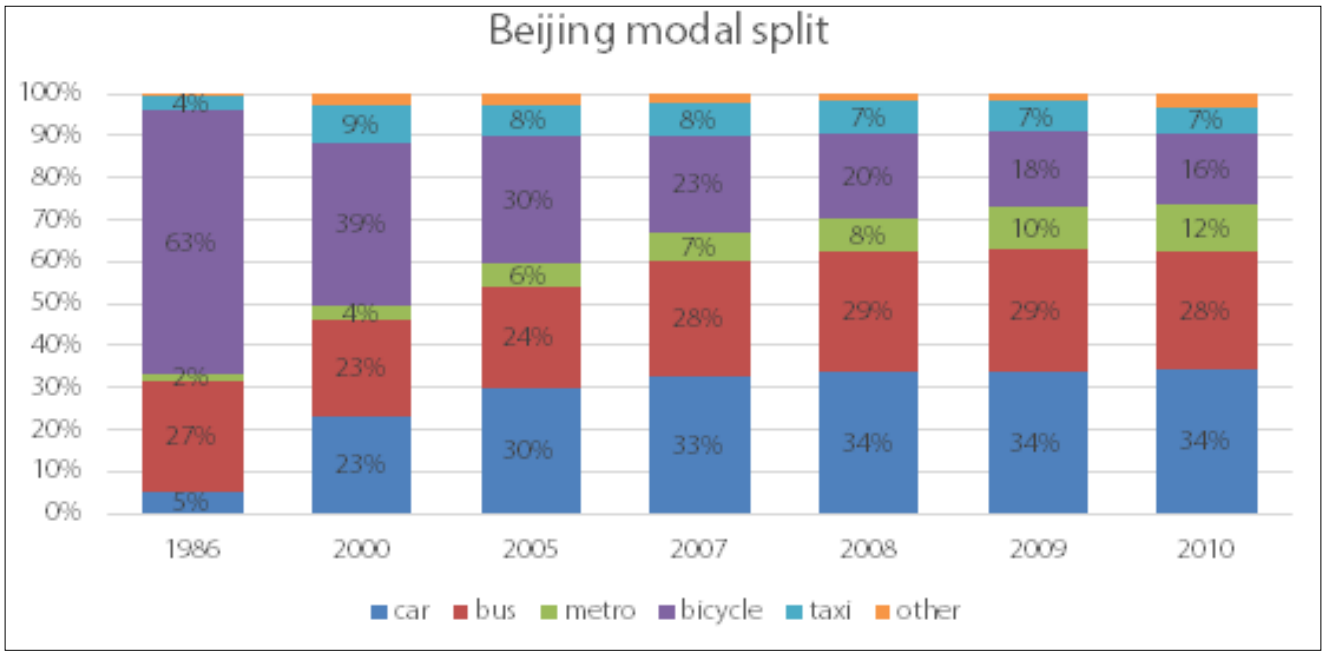
Car traffic is one of the main causes of air pollution

Source: iFeng news (2014)



Growing motorization in Beijing is putting pressure on road capacity and contributing to air pollution

Sources: 1. Beijing Traffic Management Bureau (2014), Traffic Management Data from 2000, http://www.bjjtgl.gov.cn/publish/portal0/tab803/; 2. Annual report of Beijing Statistics Bureau, http://www.bjstats.gov.cn/xwgb/tjgb/ndgb/



Modal split figures for Beijing show a dramatic increase in car traffic.
Source: modified from original version Beijing Transportation Research Center

2.2 Parking policy evolution

In the past ten years Beijing issued a series of policies to solve parking problems and guide and coordinate parking planning, construction and management. The most important ones are described following.

Beijing Urban Master Plan (2004-2020), Beijing city government – input from Planning Bureau, 2004

According to Beijing's 2004-2020 Urban Master Plan, traffic problems are intended to be solved with public transport priority, by enhancing the attractiveness of public transport, and by policies to guide car traffic away from central areas, where restrictions on car use are encouraged.

Parking supply restrictions and parking price differentiation are chosen as tools to steer traffic away from central areas, especially in the old city center. Full use of existing parking facilities is encouraged. Somewhat contradictively, city governments' budgets were assigned to develop 200 public parking lots and build Park+Ride (P+R) facilities at metro stations, in order to lure drivers into using public transport in the city center. This results in prime metro-adjacent real estate being devoted to low value parking, and generates only a single peak hour trip in each direction on an already-overcrowded metro system. Parking demand management was mentioned as well.

Beijing Transportation Development Program 2004-2020, Communications Commission, 2005

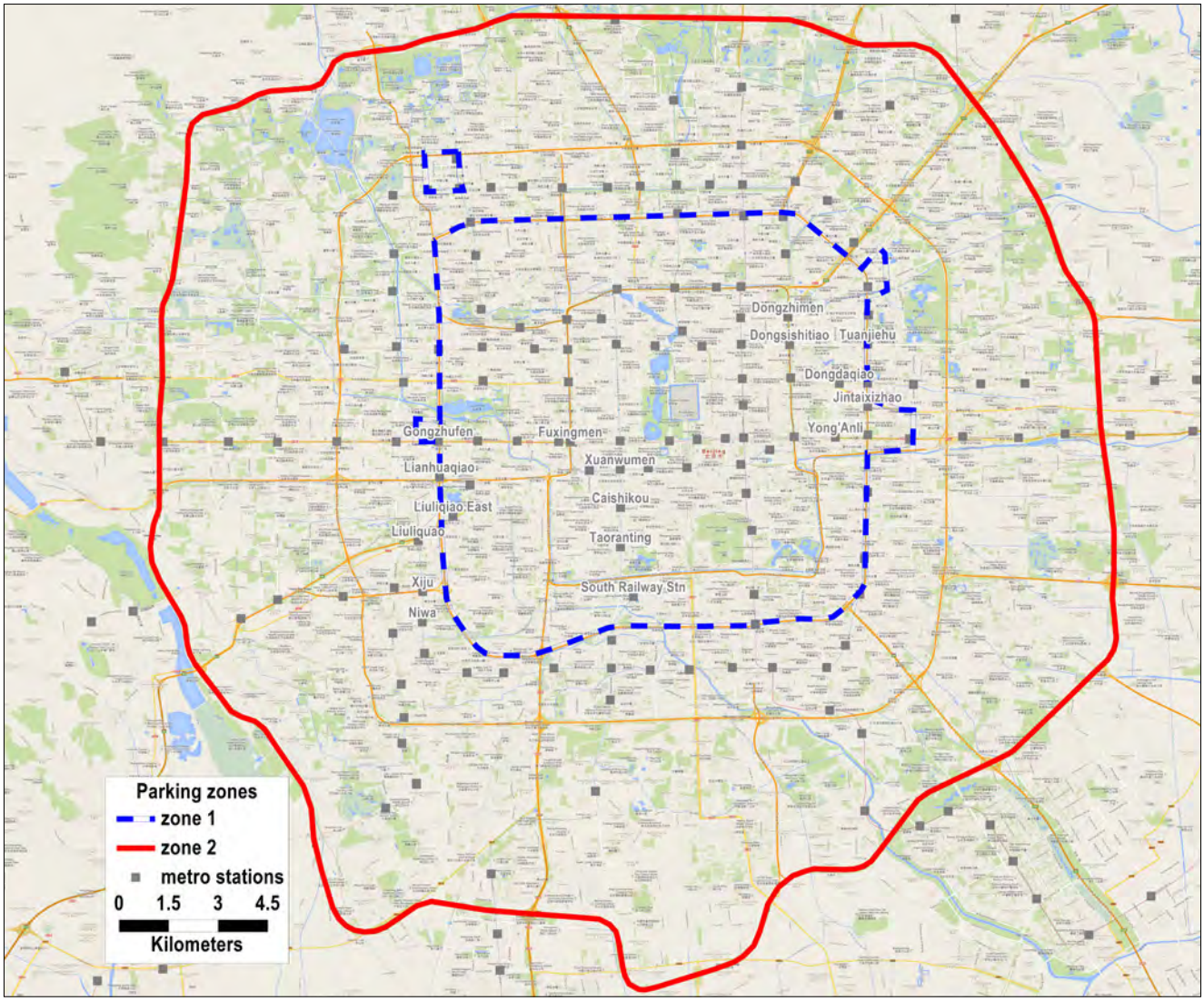
The Beijing Transportation Development Program, developed by the Communications Commission, proposed a vast expansion of parking supply. The goal for 2010 was to have built one parking space for every car in Beijing, a policy dubbed '1 car 1 space', which flies in the face of international best practices on using parking as a traffic demand management tool. Moreover the Communications Commission stipulated that by 2010 10% of all cars should be able to use public, government-owned parking spaces, with the others developed by developers (in residential areas) and private investors in off-street parking.

In the old city center though, a parking cap and differentiated parking prices were to be implemented to limit car use. Parking guidance systems were to be built in the entire city center to improve parking information services. The main focus for the central areas was put on the improvement of public transport. In new developments away from the city center, more off-street parking would be allowed, following a guideline of 1.2-1.3 parking spaces per car.

Current parking price standard (values represent maximum prices)

Maximum parking prices			Parking price standard					
			Day time (7:00-21:00)				Night time (21:00-7:00)	
			On-street		Off-street		Outdoor (RMB/2hr)	Indoor (RMB/30 min)
			1st hour (RMB/15 min)	After 1st hour (RMB/ 15 min)	Outdoor (RMB/15 min)	Indoor (RMB/15 min)		
Non-residential area	Public hourly parking	Zone 1	2.5	3.75	2	1.5	1	2.5
		Zone 2	1.5	2.25	1.25	1.25		
		Zone 3	0.5	0.75	0.5	0.5		
	Outdoor public parking lots					<150RMB/month, 1,600RMB/year		
	Indoor public parking lots (monthly/yearly)					Market price		
	P+R					2RMB/time		
	Independently operating parking facility					Market price		
Residential area	Outdoor parking lots hourly parking					1RMB/2hrs		
	Outdoor parking lots long-term parking					<150RMB/month, 1,600RMB/year		
	Indoor, hourly parking					<1RMB/30mins		
	Indoor, monthly/yearly parking					Market price		

Source: Development and Reform Commission (2010), http://www.bjpc.gov.cn/zcfg10/201106/t813591.htm



Current parking zones in Beijing

Source: based on Development and Reform Commission (2010), http://www.bjpc.gov.cn/zcfg10/201106/t813591.htm

Beijing's 11th Five Year Traffic Development Plan - Transportation Development and Construction, Communications Commission, 2006

With the issuing of Beijing's "11th Five Year Plan" an important role was seen for the market to implement off-street parking. The market should accelerate its construction, with the government providing 10% of the parking need, following the '1 car 1 space' approach which risked locking in car dependent development for decades to come. The government would focus on building P+R facilities around metro stations, parking guidance systems, strengthening orderly on-street parking, and better enforcement and regulations. Differentiated off-street parking standards were suggested according to parking zones and types of buildings and land use. There would be strict control on parking supply and higher prices in the central areas (within the fourth ring road) and higher supply and lower prices in the outlying areas of Beijing.

Beijing's 12th Five Year Traffic Development Plan - Transportation Development and Construction, Communications Commission, 2012

The 12th Five Year plan again focused on public transport priority, 50,000 public parking spaces and on adding parking supply in residential areas (200,000 spaces) and 21,000 additional P+R facilities at metro stations. For areas with large, perceived parking shortages, the use of green space for parking and parking sharing was encouraged. Differentiated off-street parking standards for different zones were promoted. The use of modern technology was suggested for on-street parking. For parking prices, guidelines were initiated: on-street parking more expensive that off-street, central areas more expensive than outlying areas, and on-ground parking higher prices than underground.

2.3 Parking prices

Parking prices are set by the Beijing Development and Reform Commission, as shown in the table on the previous page. The prices reflect maximum prices and operators are free to charge less than this standard. Some of the parking provisions are market-priced, without interference from the government standards.

2.4 Parking standards

The Beijing Planning Commission develops the parking standards for new developments. The current standards, implemented in 2003, are shown in the table following.

Updates on this parking standard are underway, but not yet publicized. Rumors are these standards will rise to an average of 0.8 parking spaces/unit with over 1 parking spaces/unit outside the 5th ring road.

To encourage private investment in the provision of off-street parking, the city government started subsidizing the construction of independently operating parking lots (not related to other developments). Since 2012, 2,000 RMB/parking space is provided from city government budgets. District government can subsidize operation and maintenance costs. Since 2014, 5,000 RMB/parking space is provided for mechanical parking.

2.5 Stakeholders and tasks

By January 2014 the city government administration, with Mayor's approval, laid out the roles and responsibilities of all of Beijing's parking-related government departments. As of now, the government departments involved in parking are described below with their authorities and roles.

Beijing Communication Commission

- Develop city-wide parking policies and planning. Input from Planning Commission and signed off by city government;
- Supervise city-wide on-street and off-street parking operators, in cooperation with districts' parking management departments;
- Implement parking management center, collecting data on parking.

District governments

Every district has a parking management department under the district government and Beijing Communication Commission. Their tasks are:

- Comply with city-wide instructions for implementation of policies and projects;
- Plan new, paid on-street parking (to be

Current parking standards for new developments

Building type			Unit	Parking standard	
				Car	Bike
Residential	Ordinary housing	Within 3rd ring road	unit	0.3	
		Outside 3rd ring road	unit	0.5	
	Serviced apartment		unit	1	
	Villa		unit	2	
Office			100 m^2	0.65	20
Restaurant			100 m^2	0.7	40
Retail	>10,000 m^2 floor area		100 m^2	0.65	40
	<10,000 m^2 floor area			0.45	40
Hotel	High-end		Room	0.6	
	Medium-end		Room	0.4	
	Low-end		Room	0.2	
Hospital	City level		100 m^2	0.65	40
	District level			0.45	40
Exhibition hall			100 m^2	0.7	45
Cinema			100 seats	3	45/1,000 m^2
Theatre (Music house)			100 seats	10	45/1,000 m^2

Source: Beijing Planning Commission (2003), Beijing area construction project planning and design guidelines

approved by Traffic Police) and plan and finance new off-street parking. Contract parking operators for both;
- Supervise on-street and off-street parking operators, in cooperation with the Communication Commission;
- Implement formal (paid & unpaid) parking on streets inside residential areas and blocks;
- Implement district's parking management center, collecting data on parking.

Beijing Municipal Development and Reform Commission

- Give approval for the implementation of off-street parking not related to buildings;
- Prepare parking prices (on-street & off-street), signed off by the city government;
- Check if parking prices charged by private operators are clearly shown to drivers and conform the official parking price policy;
- Prepare implementation of parking zones, where paid parking is introduced. Input from Communication Commission and signed off by the city government.

Traffic Police

- Enforcement of illegal parking on streets where no parking is allowed;
- Approve implementation of formal (paid & unpaid) on-street parking spaces, following an internal traffic impact analysis;
- Cancel existing formal on-street parking, if necessary (e.g. for improved traffic conditions). Public hearing needed;
- Enforce illegal on-street parking operation;
- Enforce illegal private claims to on-street parking spaces (using obstacles).

Beijing Planning Commission

- Set the off-street parking standards for new buildings. More off-street parking supply is encouraged in the city center for external, public use.
- Approve the number and design of off-street

Private claims to parking spaces

Illegal parking spaces drawn on bike lane in Guomao

parking in new buildings and enforcement of compliance to standards.

- Assist the Communications Commission in developing city-wide parking policies and planning.

Urban Management Office

- Enforce illegal parking on sidewalks;
- Enforce illegal private claims to parking spaces (using obstacles) on all spaces, except streets and residential areas (see picture above);
- Enforce actual operation of approved off-street parking spaces;
- Enforce operation of paid, off-street, public parking that is not registered at the Communications Commission and Industrial & Commercial Bureau;
- Enforce appropriate operation of off-street parking according to standards for maintenance, safety, cleaning, vending, etc.;
- Enforce 24 hour operation of paid, publicly accessible off-street parking.

Commission of Housing and Urban-Rural Development

- Enforce illegal private claims to parking spaces (using obstacles) in residential areas.

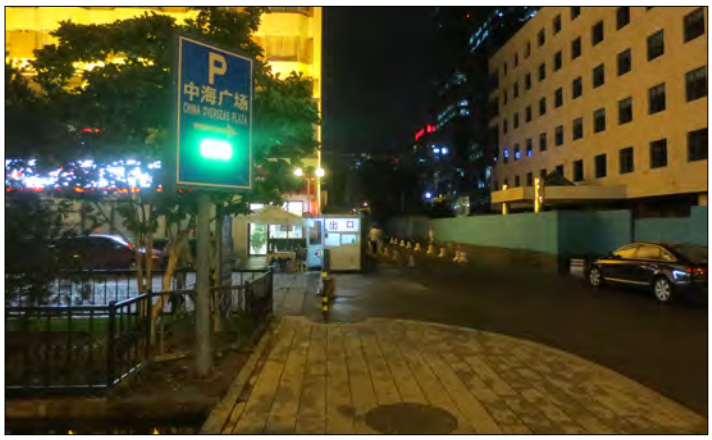
Industrial & Commercial Bureau

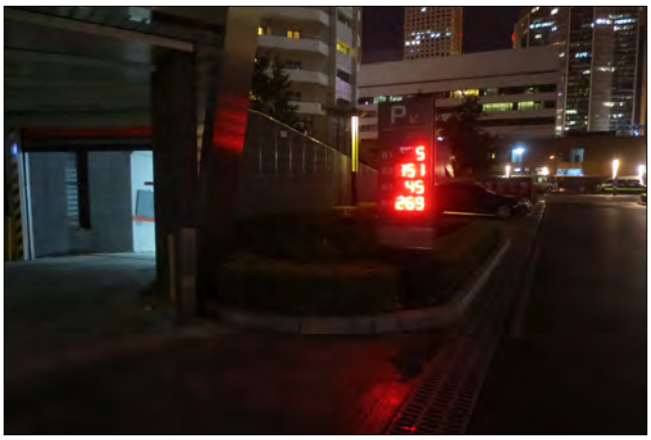
- Approve paid, off-street, public parking operation.

2.6 Existing 'parking system'

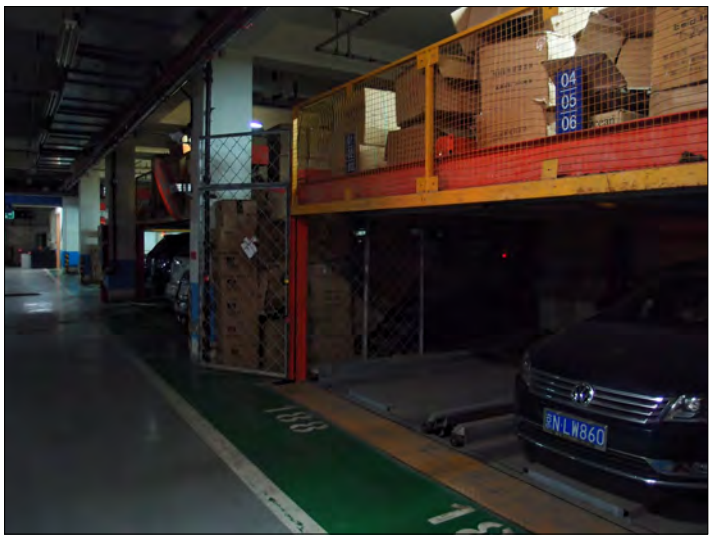
Different on-street parking systems are implemented in Beijing and the assessment below only applies to the areas surveyed.

In the surveyed areas in Guang'anmen the on-street parking system is very primitive. Parking guards control all on-street parking spaces and drivers pay parking guards cash up front for the time they expect to park. No refunds are provided for shorter parking. A receipt (发票) can be obtained on request. Individual parking guards have a fixed revenue target, set by their supervisors, and all revenues above this target are pocketed by the guards. Most guards are willing to give discounts for all-day, monthly and yearly





The real-time occupancy board directing drivers to Zhonghai Guangchang's off-street parking garage (pictured left) only shows a vacancy of 30 spaces, where the real-time occupancy sign at the garage itself (pictured right) shows a total of 470 vacant spaces. The pictures were taken at the same time.



Mechanical parking used for storage.

Parking guards charge for legal parking on the right side of the street, but also for illegal parking on the left.

Parking guards give discounts to achieve 100% occupancy and maximum revenue. They leave no parking spaces open and encourage illegal parking for which they charge drivers

A parking guard writes a receipt and is paid in cash by the driver. Parking revenue and data on parking use are unknown to the government.

parking, thereby ignoring the official price policies. As a result, **the government receives no data from the parking operators on parking demand, occupancies and turnover and therefore has no data to base parking policies and parking prices on.**

In the surveyed areas in Guomao, except for taxi stops, no formal on-street parking whatsoever is in place, although illegal on-street parking is common.

For off-street parking more advanced systems are in place, but this varies from building to building. The most advanced off-street parking garages identified in the site visits have real-time parking vacancy boards at the entrance of the premises and some are connected to the real-time parking vacancy boards that are found on the streets. Although no surveys were done into this, several of these were found to show incorrect information, with actual vacancies much higher than vacancies shown on the boards.

In one off-street parking garage found, lights above each parking space indicate with green and red lights whether the parking space is occupied. This reduces circling inside the garage.

Some parking garages were found to have two or three level mechanical parking, reducing the required floor space for off-street parking provision. Many of these were not in use though. Possibly explanations are dysfunctional systems or ample supply at more convenient on-ground spaces in the garage.

Payment in off-street parking garages is done in cash, or in some instances with an RFID card, when exiting the parking garage. Fees are time-based and calculated through a parking building-specific RFID card that is swiped when entering and exiting.

In most garages found, private parking spaces can be rented yearly, with spaces reserved for specific cars only, indicated by plaques with license plate numbers.

3. Beijing Case Studies

This section describes the case studies done in different parts of Beijing. The selected sites, survey methodology, case study descriptions and results are presented.

3.1 Case study site selection

The team visited sites in many parts of Beijing and selected study areas for detailed surveys in areas with different land uses (commercial, office, residential – high-end, mid-end and hutong – and mixed land use) to document parking issues that are representative for a large part of Beijing. All-day surveys, both for on-street and off-street were held at different locations in Beijing and shown below.

Two main areas studied are Guang'anmen (Xicheng district) and Guomao (Chaoyang district). Guomao is chosen as it is the central business district of Beijing with large investment in new developments and extensive traffic congestion. Following BTRC's suggestion, Guang'anmen was chosen since parking reform is under planning in this area and recommendations for Beijing could be included in this project.

Other areas selected are the Cheniandian mechanical parking, Liufang metro station.

Parking surveys were carried out during weekdays in September and October 2014.

3.2 Survey methodology

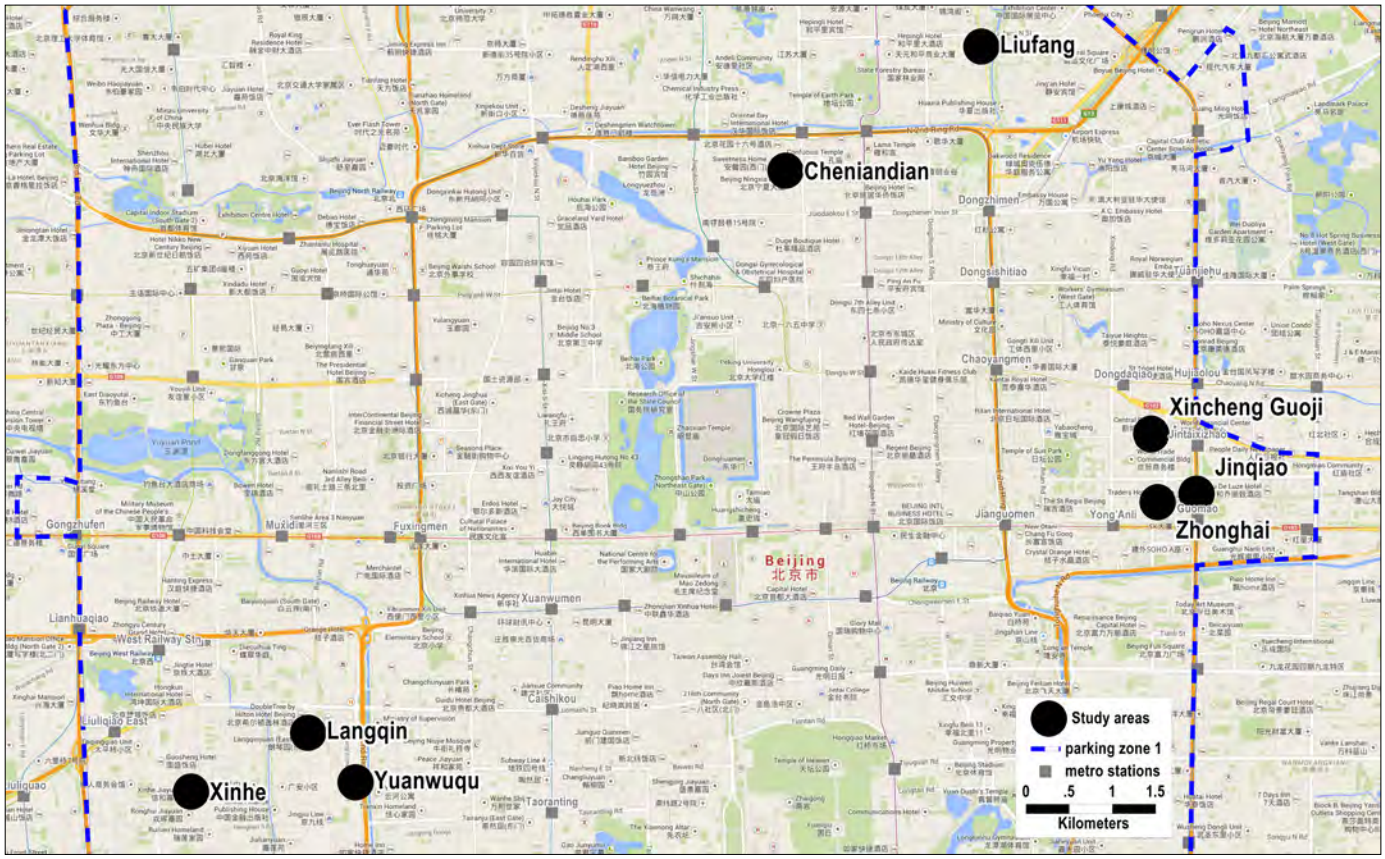
3.2.1 On-street parking

Goal of the surveys is to document existing parking practices. Studied are:

- parking demand – documentation of the number of cars parking on different streets throughout the day;
- parking supply - documentation of the number of officially marked on-street and setback parking supply per street section
- parking location – documentation of the location of parked cars, distinguishing between on-street, sidewalk and setback;
- parking occupancies, turnovers and durations are derived from the survey data above.

Step 1: prepare routes and survey forms

All streets surveyed are divided up into 1 hour-routes for each surveyor. Each route then is divided up into sub-sections, with the border of



Selected sites for case studies

each sub-section at an intersection, landmark or shop.

Step 2: conducting the on-site surveys

Surveyors walk the same route every hour and for each sub-section document the license plates of all vehicles (last four digits). The location of every parked vehicle is documented, distinguishing between parking on-street (between the curbs), on the sidewalk and on the setback. Surveys start at 7.00am and start the last round at 9.00pm, finishing around 10pm.

Simultaneously, existing on-street and setback parking supply for each section is documented.

Step 3: survey data analysis

From the parking demand and supply the occupancy is retrieved for every hour and every street section.

From the license plate documentation the parking duration of each car is documented and bundled per street section. The turnover per parking space is obtained by comparing the parking duration and parking supply. The parking location is documented and presented per street section.

Output

The surveys provide insights into the parking behavior on every street section. The average parking time is found, giving insights into the effectiveness of the parking price. For instance, the severance of illegal parking (on sidewalks and most setbacks) is found for each street section. Moreover, shortages and surpluses of vacant parking spaces are mapped and help in reorganizing and balancing parking supply and demand.

3.2.2 Off-street parking

Goal of the surveys is to document existing parking practices. Studied are:

- parking demand – documentation of the number of cars parking throughout the day;
- parking supply - documentation of the number of officially marked parking spaces
- parking occupancies, turnovers and durations are derived from the survey data above.

Step 1: preparing locations

To be of value to other drivers, off-street parking buildings selected for the survey need to be publicly accessible and of reasonable size.

Step 2: conducting the survey

For each off-street parking location, surveyors are assigned to every entrance/exit and document all incoming and outgoing cars. The time (5 minute intervals) and license plate (last four digits) of every car entering and exiting the off-street parking lot are documented, including the note whether the car was entering or exiting. The license plates of cars already in the parking lots are documented before the survey starts. Parking supply is documented as well.

Step 3: survey data analysis

From the parking demand and supply the occupancy of the off-street parking location is retrieved throughout the entire day. Parking duration for each car is obtained from the license plate documentation. The turnover per parking space is obtained by comparing the parking duration and parking supply.

Output

The parking duration, occupancy and vacancy is derived from the survey results. Off-street parking vacancy is important to accommodate excess demand that currently parks on sidewalks and setbacks.

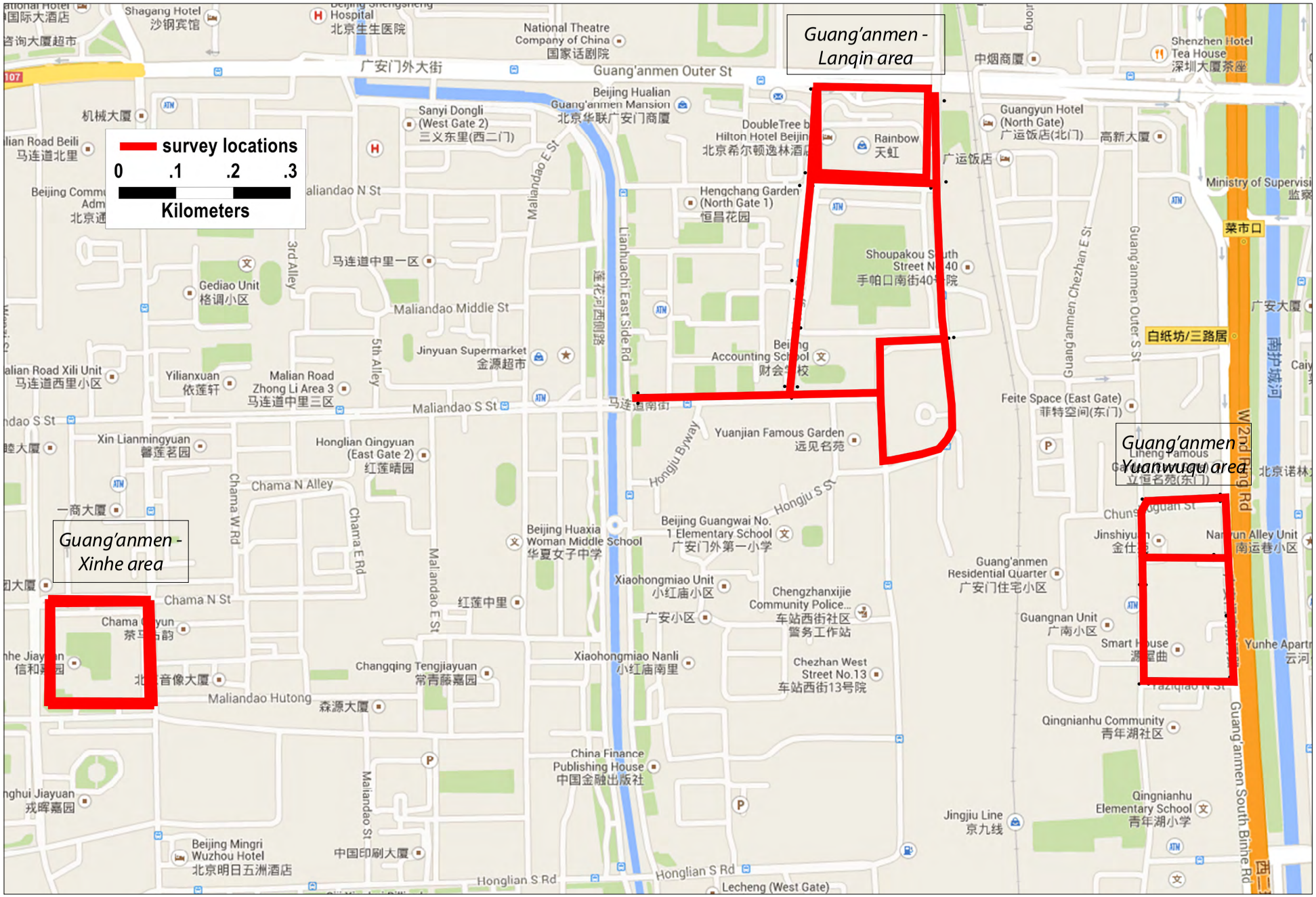
3.3 Case study results

The Guang'anmen area is described first, followed by Guomao (page 78) and Cheniandian and Liufanf areas (page 85).

3.3.1 Guang'anmen

Three areas in Guang'anmen were studied. The Langqin area (page 19) is a residential area with a large shopping mall and office tower named Langqin Guoji. The Yuanwuqu area (page 48) is an office and residential area with ground-floor shops. The Xinhe area (page 71) is a residential community with ground floor shops and one office tower and tea market.

Three selected sites in Guang'anmen area

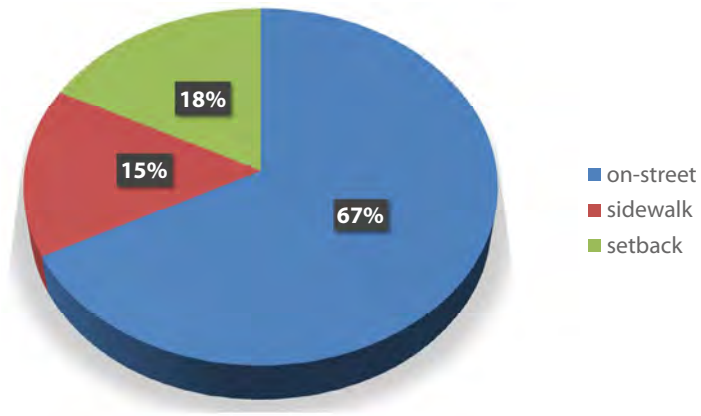


Langqin area survey summary

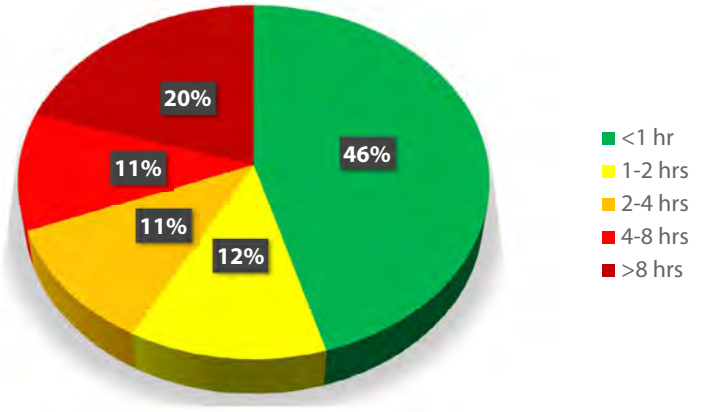
The Langqin area is located in the north of Guangwai Jiedao, bounded by Guangwai Dajie, Shoupakou Nanjie, Hongju Beijie and Hongju Jie. The on-street survey from 7.00am-10.00pm shows that the parking demand in the area does not change much throughout the day, with the peak parking demand between 8-9pm. There are 217 formal parking spaces, which are priced and operated, and 76 priced setback parking spaces. The total parking demand is higher than the formal on-street parking supply, for two reasons: (1) on-street parking spaces are not formalized on many streets, although the existing street design, available space and current use allow for on-street parking operation; (2) many vehicles park illegally on sidewalks (15% of demand) and setbacks (18% of demand).

The average parking duration is 5.02 hours, which is too high for on-street parking which is rather intended for short-term parking of maximum 2-3 hours. If overnight parking would be taken into account, this number would be even higher. Of all vehicles parked, 42% is parked for over 2 hours, of which 20% for over 8 hours. Average turnover of parking spaces is fairly low at 4.04 cars/parking space during survey hours.

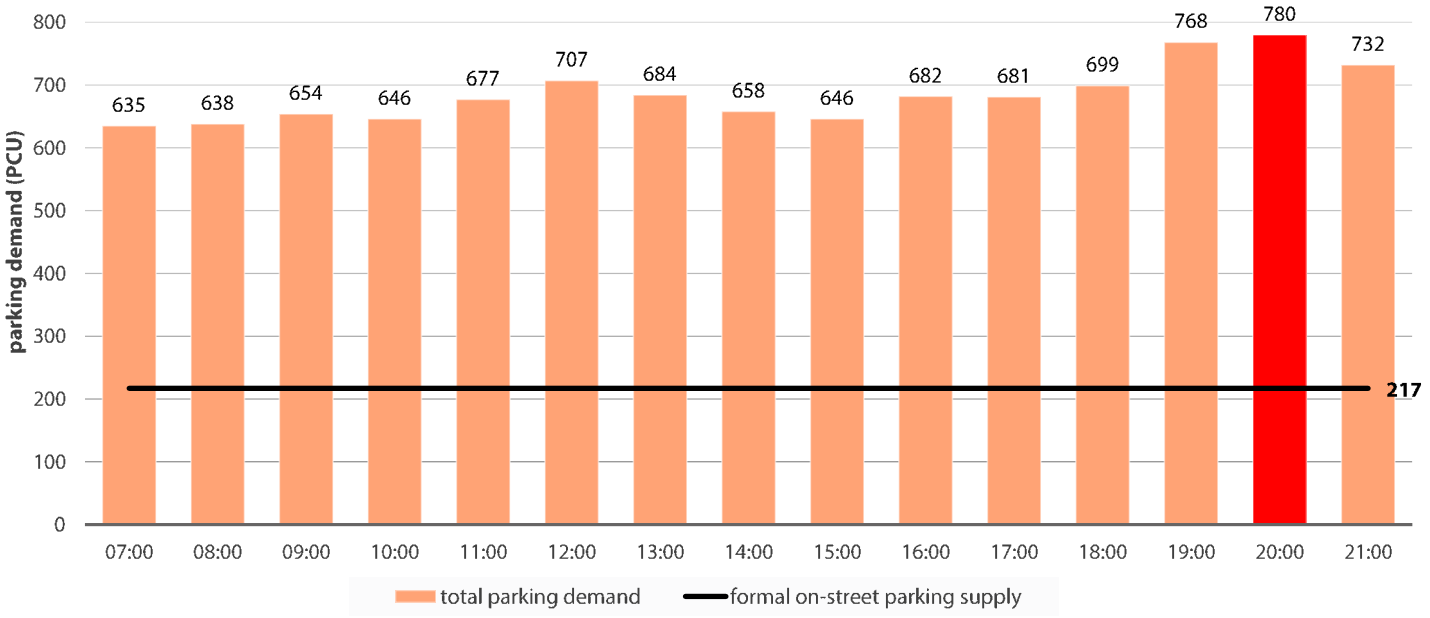
Of all surveyed street sections, 9 sections have paid parking following official prices (although discounts can be negotiated with parking guards, especially for long-term parking), 1 section uses different prices, 2 sections have no parking fee and illegal parking occurs at the other 8 sections.



One third of all drivers park on sidewalks and setbacks



42% of drivers park on-street for over 2 hours



The highest on-street parking demand of 780 vehicles (PCU) occurs at 8pm

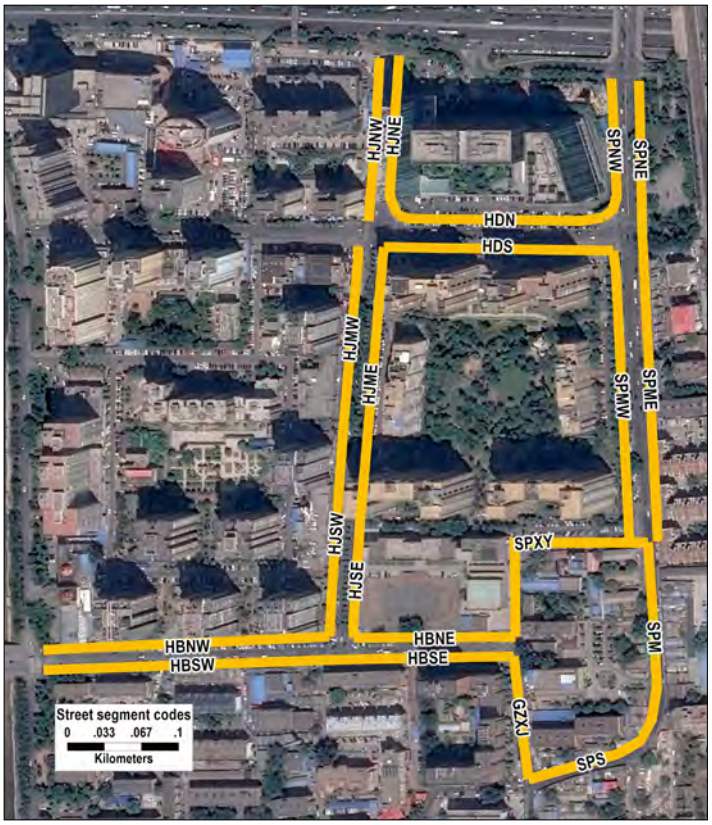
Street name	Code	Page in report	On-street parking supply [spaces]	Setback parking supply [spaces]	Avg. occupancy of parking spaces-incl. sb&sw parking [% of spaces occupied]	Avg. turnover of parking spaces [#cars/parking space/day]	Maximum parking demand [cars]	Time of maximum parking demand	Avg. parking duration [hours]	Setback&Side walk parking [% of total demand]
Hongju Jie	HJNW	24	19	0	75%	4.1	20	12:00	3.87	18%
Hongju Jie	HJNE	25	12	0	137%	7.9	37	9:00	4.10	24%
Hongju Dong Jie	HDN	26	17	0	124%	7.4	27	10:00	4.16	13%
Hongju Dong Jie	HDS	27	0	50	136%	4.8	93	20:00	4.23	69%
Hongju Jie	HJME	28	19	0	57%	2.3	16	9:00	4.62	4%
Hongju Jie	HJMW	29	20	0	55%	1.6	31	11:00	5.50	50%
Shoupakou Nan Jie	SPNW	30	0	0			6	16:00	1.47	4%
Shoupakou Nan Jie	SPMW	31	0	0			70	21:00	5.01	52%
Shoupakou Nan Jie	SPME	32	0	0			38	21:00	5.67	16%
Shoupakou Nan Jie	SPNE	33	0	0			7	10:00	5.44	85%
Hongju Bei Jie	HBSE	34	31	0	120%	3.4	58	20:00	5.66	13%
Guang'anmen Chezhan Xi Jie	GZXJ	35	0	26	109%	2.4	47	20:00	5.94	86%
Shoupakou Nan Jie	SPS	36	0	0			5	20:00	4.93	18%
Shoupakou Nan Jie	SPM	37	0	0			31	12:00	4.14	6%
Shoupakou Xi Yi Xiang	SPXY	38	0	0			8	20:00	6.90	0%
Hongju Bei Jie	HBNE	39	51	0	90%	2.1	60	20:00	5.91	1%
Hongju Jie	HJSW	40	24	0	95%	4.7	65	19:00	5.31	35%
Hongju Bei Jie	HBNW	41	0	0			87	20:00	6.74	1%
Hongju Bei Jie	HBSW	42	0	0			104	20:00	6.07	7%
Hongju Jie	HJSE	43	24	0	106%	3.7	37	20:00	4.81	0%
Total or Average			**217**	**76**		**4.0**		**20.00**	**5.0**	

Parking profile in the Guang'anmen Langqin area

The parking price in the area is not consistent, with some streets with a charge, some without, cheaper setback parking and free illegal parking with no enforcement. Moreover, if a street is charged for, the price can be negotiated with the parking guard. As a result, setback parking, which is cheaper, is very full and illegal, free parking is widespread. Inconsistent parking prices encourage people to drive around searching for free or cheaper parking.

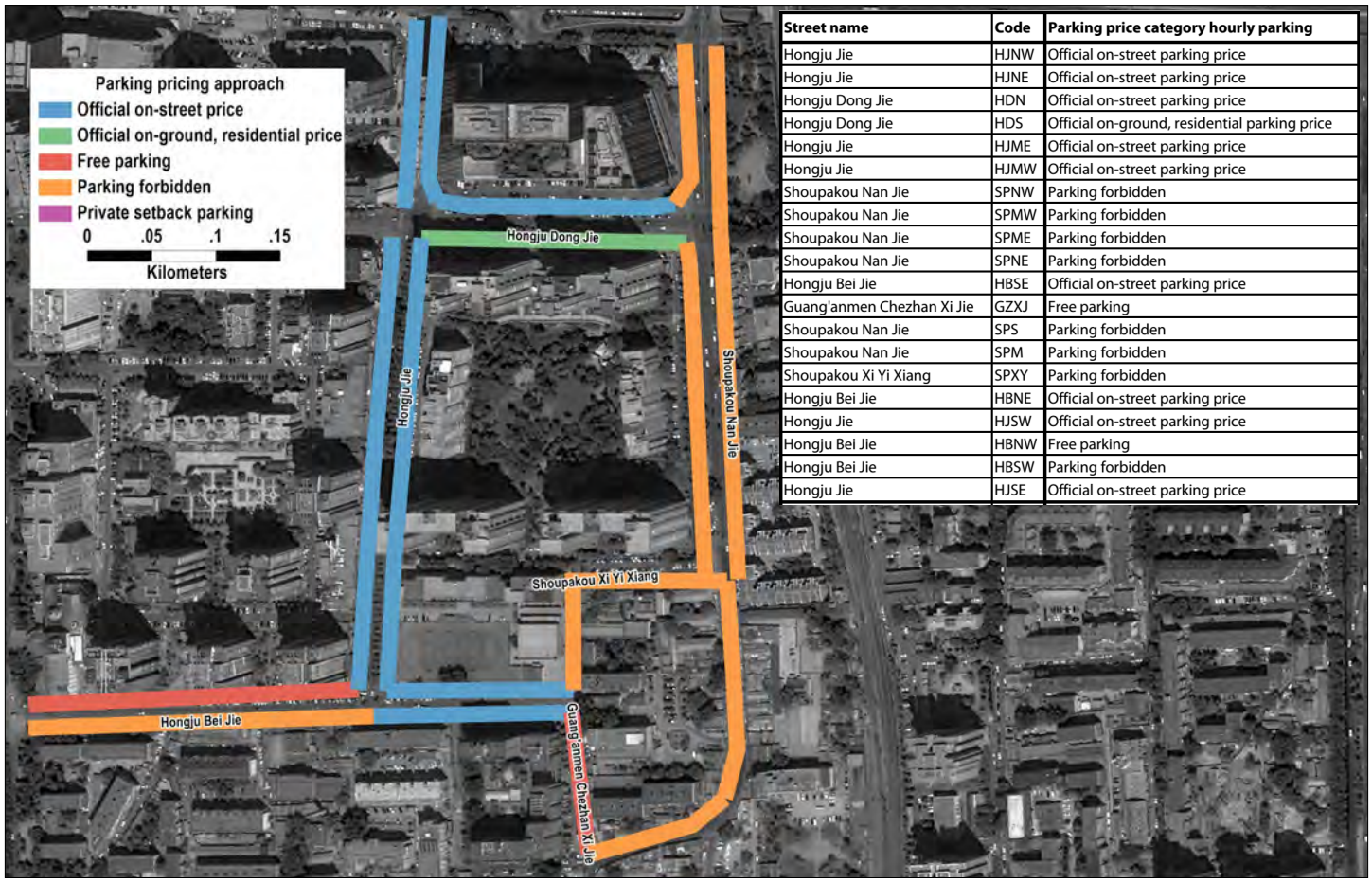
Interviews with parking guards reveal that those on Hongju Jie work for a state-owned company from which they buy formal receipts from their employer for 4,000 RMB, with which they generally last two weeks, since few drivers ask for a formal receipt. They receive a small salary and may pocket all parking revenue exceeding their target. On Hongju Dongjie the parking guard, working for a different company, states he receives a higher salary but needs to pass along all parking revenue to his company.

They both charge for hourly parking according to the official price but eagerly offer discounts for longer-term or monthly parking. Both mention that Traffic Police does not enforce parking on sidewalks and setbacks and they can therefore not charge those drivers.



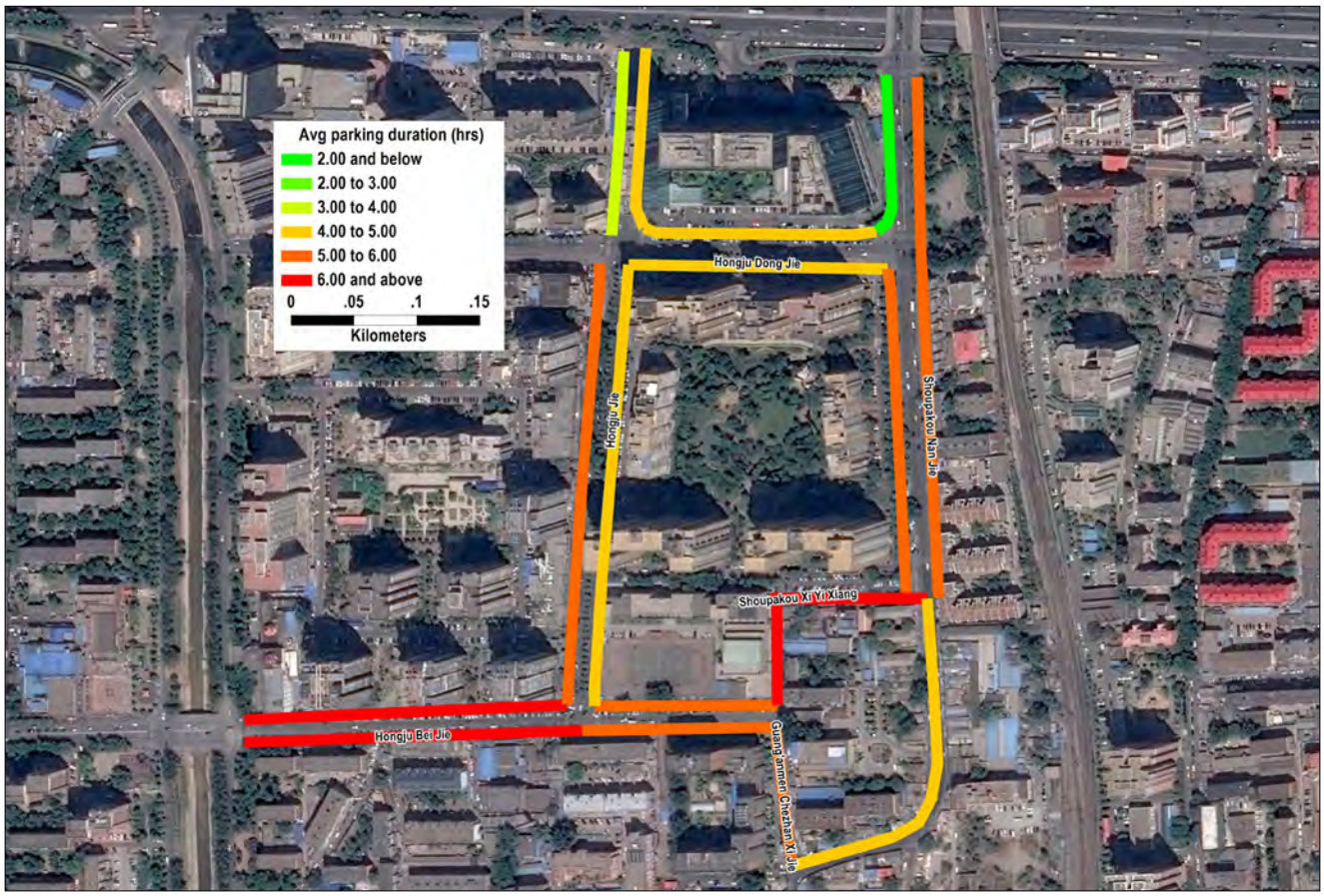
Street codes (referred to in parking profile table (above) and street-by-street survey description)

Above: supply of formal on-street and setback spaces/100m



Street name	Code	Parking price category hourly parking
Hongju Jie	HJNW	Official on-street parking price
Hongju Jie	HJNE	Official on-street parking price
Hongju Dong Jie	HDN	Official on-street parking price
Hongju Dong Jie	HDS	Official on-ground, residential parking price
Hongju Jie	HJME	Official on-street parking price
Hongju Jie	HJMW	Official on-street parking price
Shoupakou Nan Jie	SPNW	Parking forbidden
Shoupakou Nan Jie	SPMW	Parking forbidden
Shoupakou Nan Jie	SPME	Parking forbidden
Shoupakou Nan Jie	SPNE	Parking forbidden
Hongju Bei Jie	HBSE	Official on-street parking price
Guang'anmen Chezhan Xi Jie	GZXJ	Free parking
Shoupakou Nan Jie	SPS	Parking forbidden
Shoupakou Nan Jie	SPM	Parking forbidden
Shoupakou Xi Yi Xiang	SPXY	Parking forbidden
Hongju Bei Jie	HBNE	Official on-street parking price
Hongju Jie	HJSW	Official on-street parking price
Hongju Bei Jie	HBNW	Free parking
Hongju Bei Jie	HBSW	Parking forbidden
Hongju Jie	HJSE	Official on-street parking price

Above: parking prices vary within the area, encouraging drivers to circle, looking for the cheapest place to park.



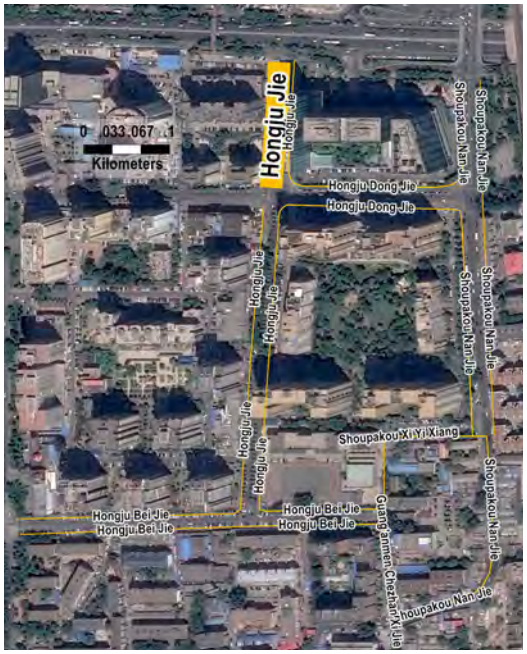
The average parking duration in the entire area is high and on-street parking spaces used for longer than the desired 2-3 hours, especially on Hongju Bei Jie

Overall parking demand is highest at 8pm, suggesting that most parking is residential and overnight, especially on Hongju Beijie and Shoupakou Nanjie. In the areas around Langqin Guoji, where more commercial and office activiteies are centered, parking demand tends to be higher during day-time.

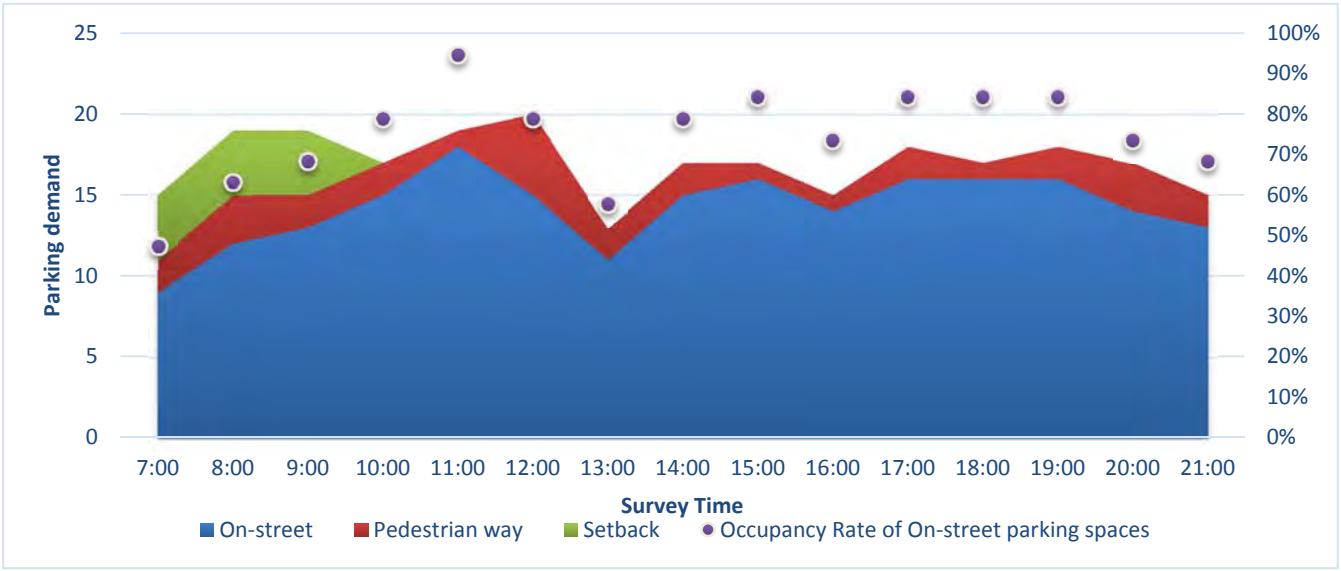
Above: illegal parking during the peak demand of 8pm. Especially Hongju Bei Jie and Shoupakou Nan Jie see high amounts of illegal parking. Formal on-street parking is currently lacking on Hongju Bei Jie, although road space would allow for it. On Shoupakou Nan Jie illegal parking mostly occurs on the sidewalk. This parking should be relocated to vacant on-street parking and underground parking in Langqin Guoji and Langqin Huayuan.

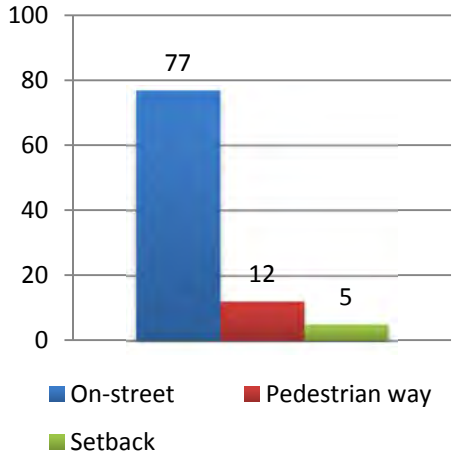
Above: on-street parking vacancy during peak parking time. With proper enforcement in place, drivers can find vacant on-street parking spaces on the streets shown above. Real-time parking guidance systems can assist.

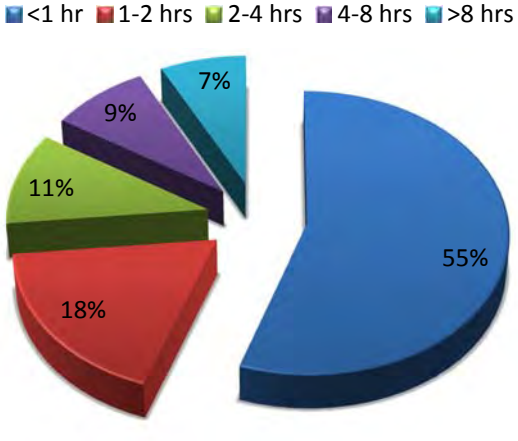
Hongju Jie (northwest) - HJNW



Indicator	value	unit
On-street supply	19	parking spaces
Average occupancy rate for on street parking spaces	75	%
Turnover rate for on street parking spaces in 14 hours	4.1	times
Maximum demand (including illegal parking)	20	cars
Peak parking time	12:00	mid-day

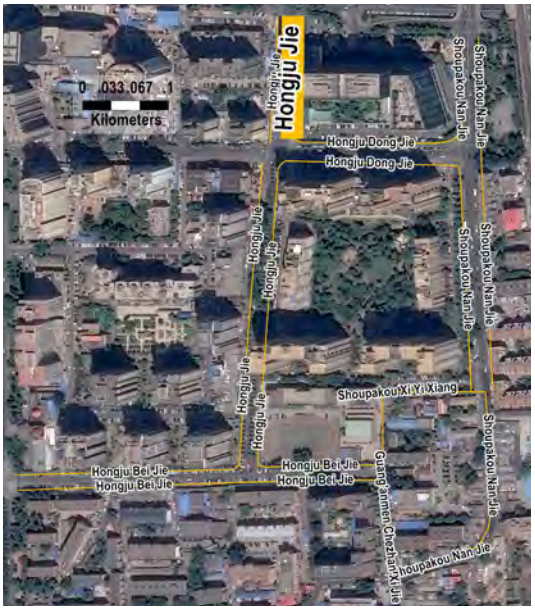




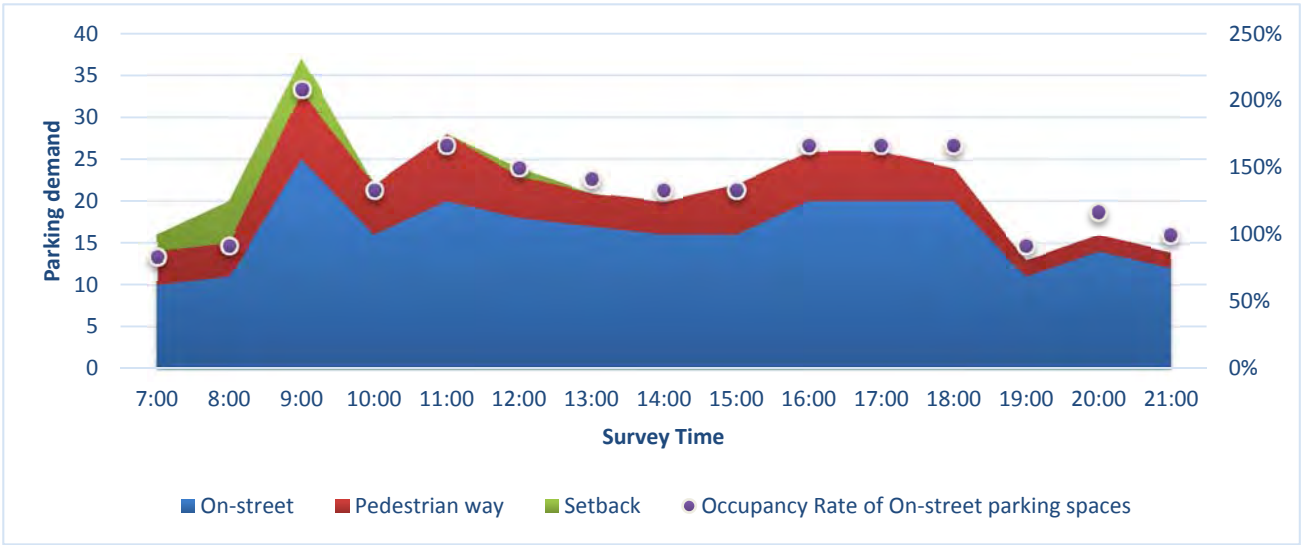


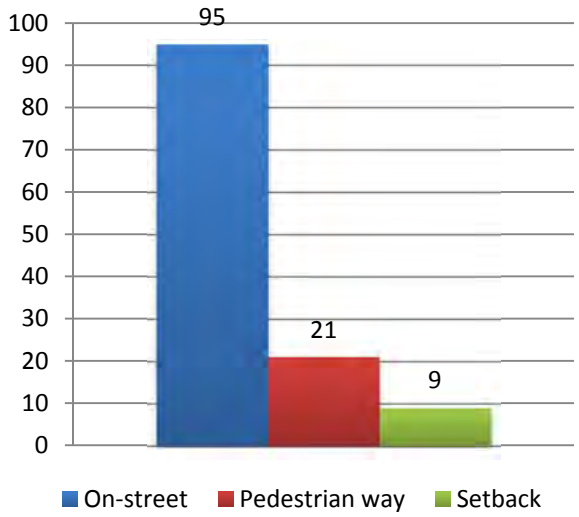
- 18% of vehicles parked illegally on sidewalk and setback, despite vacancy in on-street parking supply and adjacent off-street parking lot in Langqin Guoji. 27% of vehicles park over 2 hours.

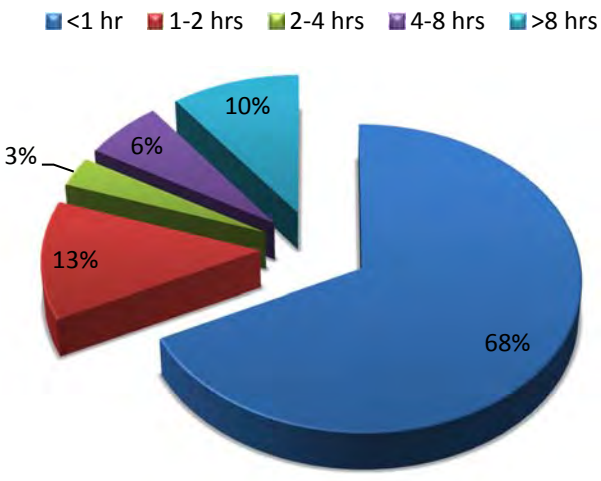
Hongju Jie (northeast) - HJNE



Indicator	value	unit
On-street supply	12	parking spaces
Average occupancy rate for on street parking spaces	137	%
Turnover rate for on street parking spaces in 14 hours	7.9	times
Maximum demand (including illegal parking)	37	cars
Peak parking time	9:00	AM



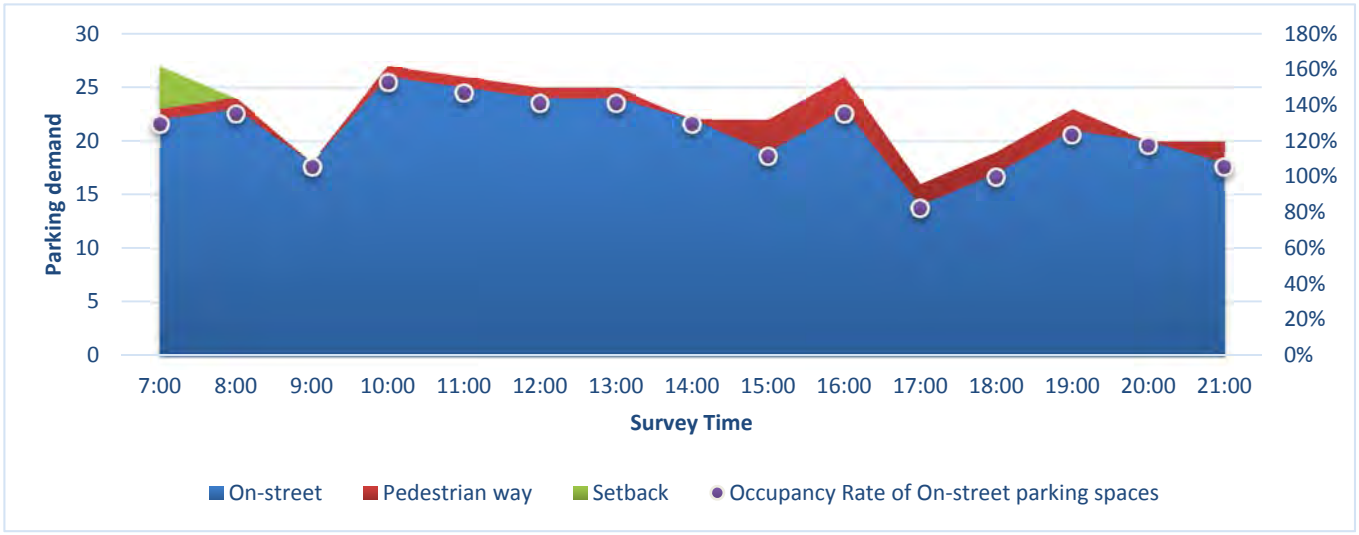


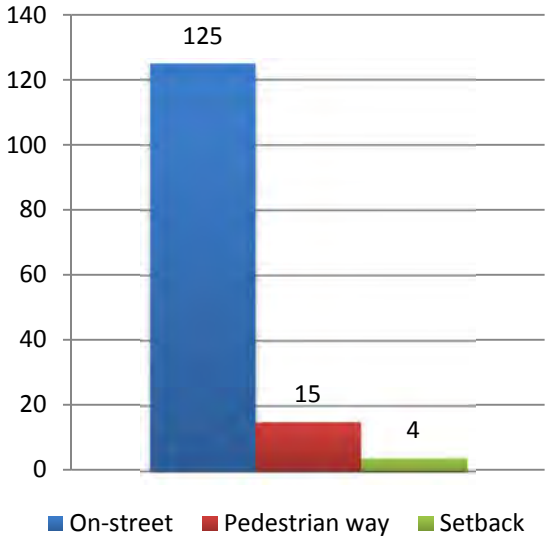


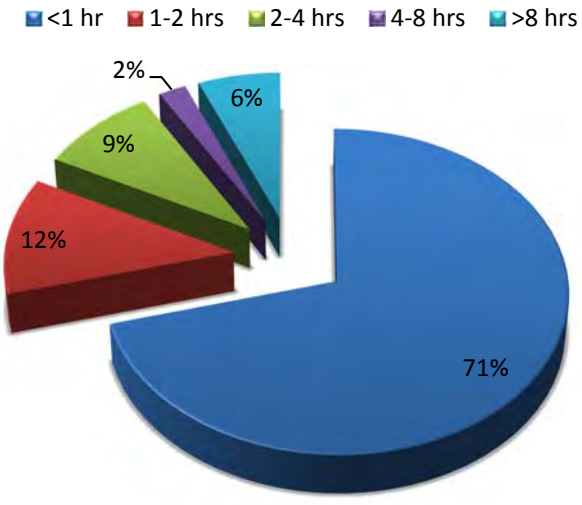
- 22% of vehicles parked illegally on sidewalk and setback, despite vacancy in adjacent off-street parking lot in Langqin Guoji.

Hong Ju Dongjie (north) - HDN

Indicator	value	unit
On-street supply	17	parking spaces
Average occupancy rate for on street parking spaces	124	%
Turnover rate for on street parking spaces in 14 hours	7.4	times
Maximum demand (including illegal parking)	27	cars
Peak parking time	10:00	AM

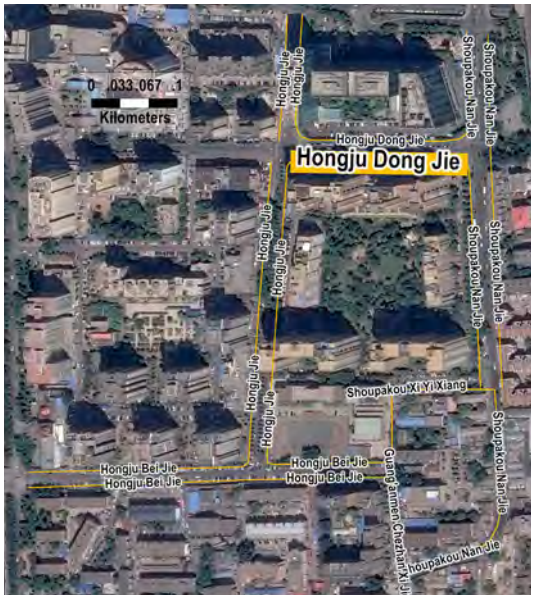




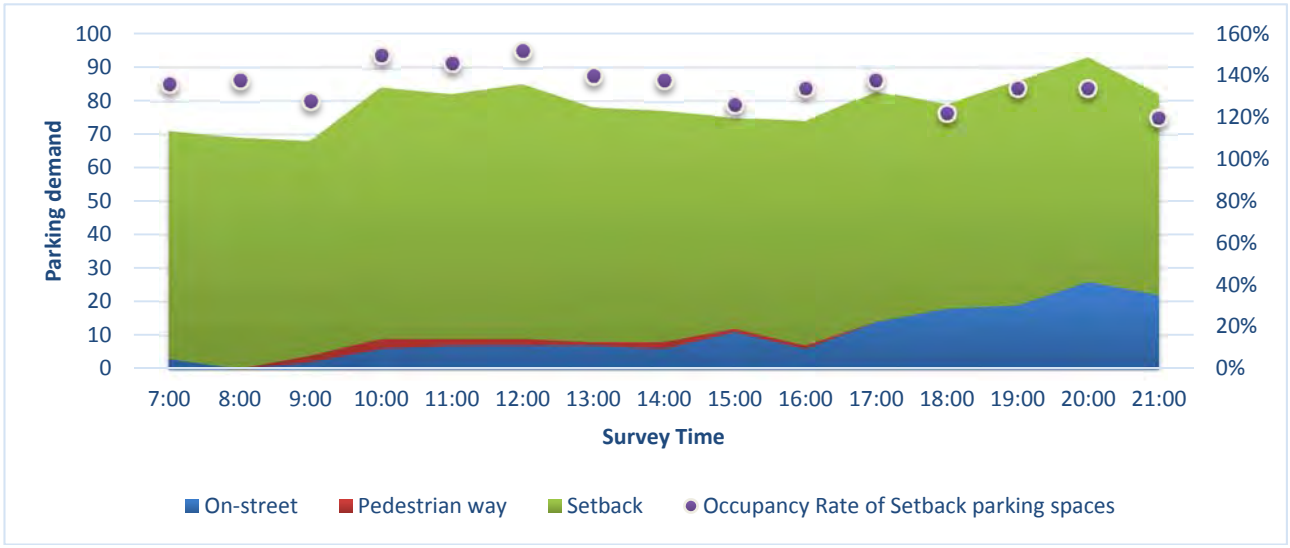


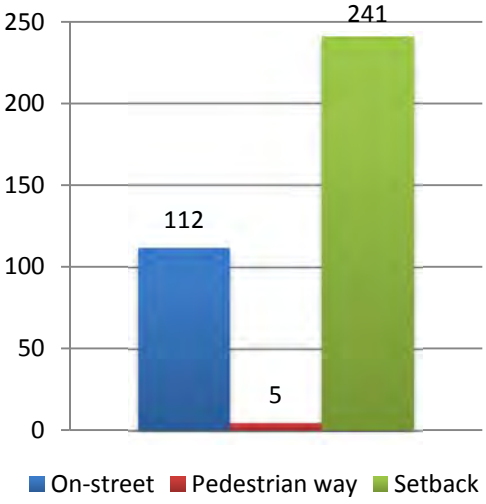
- More parking spaces could be implemented if existing space is used better. 13% of vehicles park illegally on sidewalk and setback, despite vacancy in on-street parking supply and adjacent off-street parking lot in Langqin Guoji.

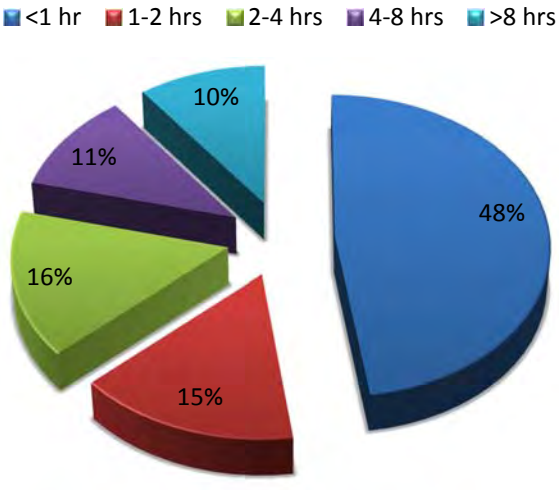
Hongju Dong Jie (south) - HDS



Indicator	value	unit
Setback supply	50	parking spaces
Average occupancy rate for setback parking spaces	136	%
Turnover rate for setback parking spaces in 14 hours	4.8	times
Maximum demand (including illegal parking)	93	cars
Peak parking time	8:00	PM

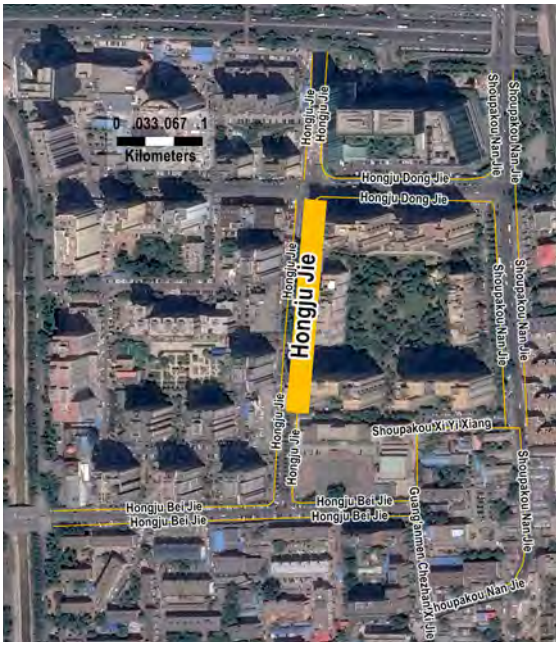




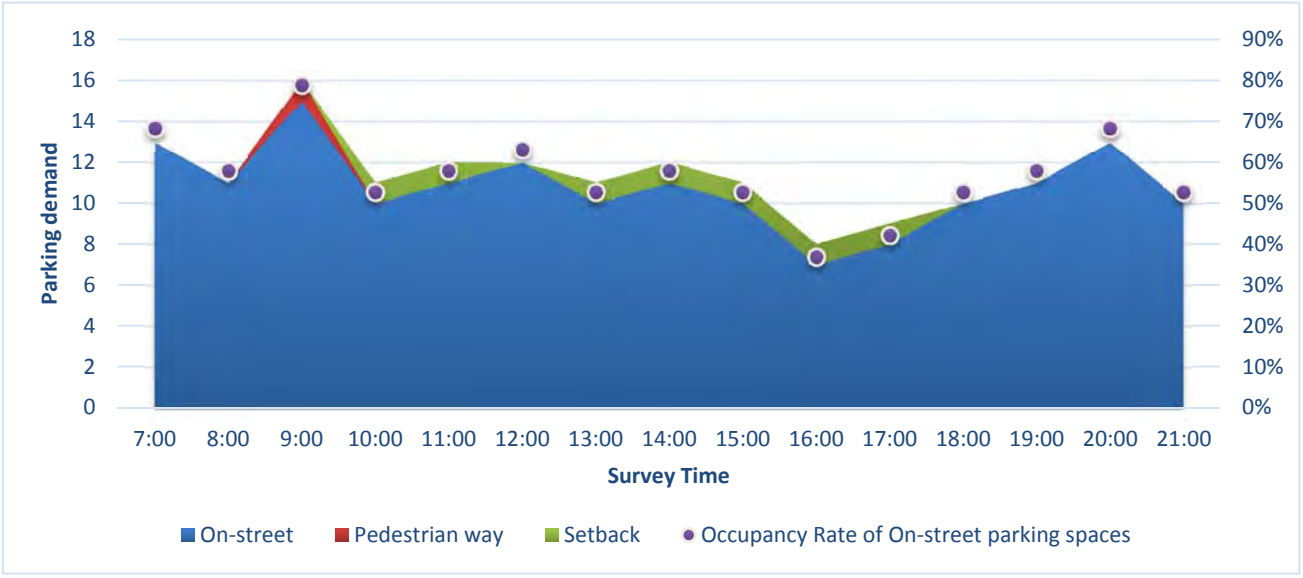


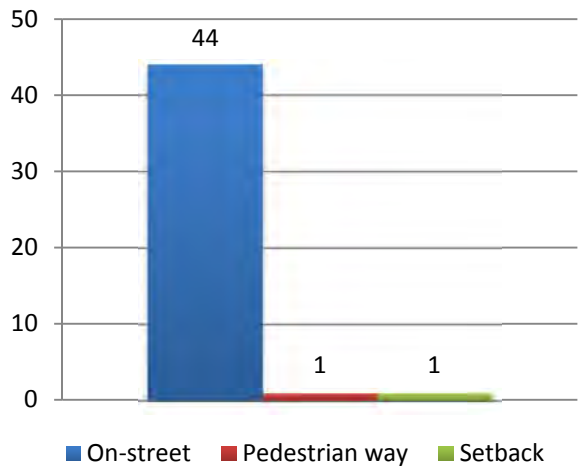
- Occupancy of setback parking is high and cars block shop entrances. 37% of vehicles park over 2 hours and the setback parking price is much lower than on-street. With vacancy in the adjacent off-street parking lot in Langqin Guoji, the setback parking is proposed to be eliminated.

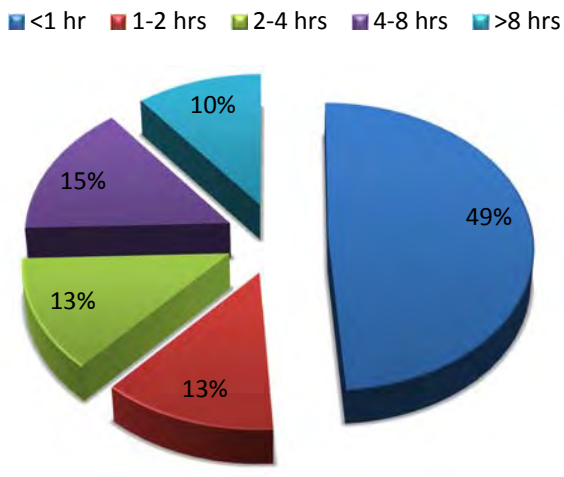
Hongju Jie (middle east) - HJME



Indicator	value	unit
On-street supply	19	parking spaces
Average occupancy rate for on street parking spaces	57	%
Turnover rate for on street parking spaces in 14 hours	2.3	times
Maximum demand (including illegal parking)	16	cars
Peak parking time	9:00	AM

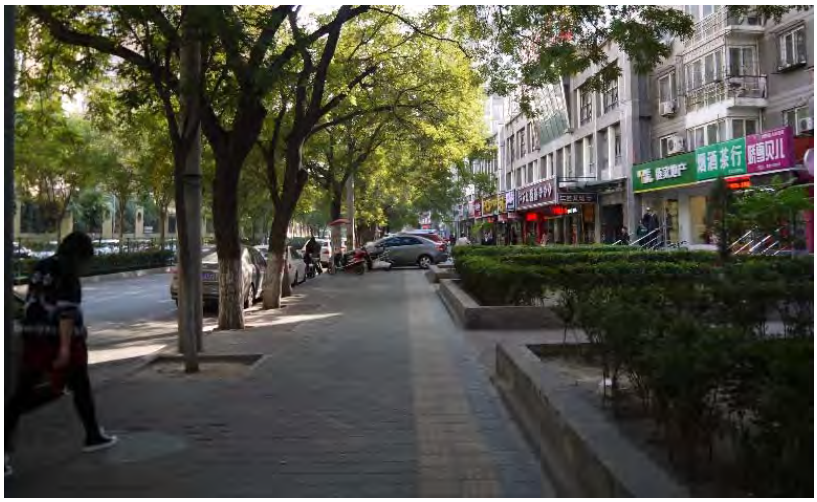


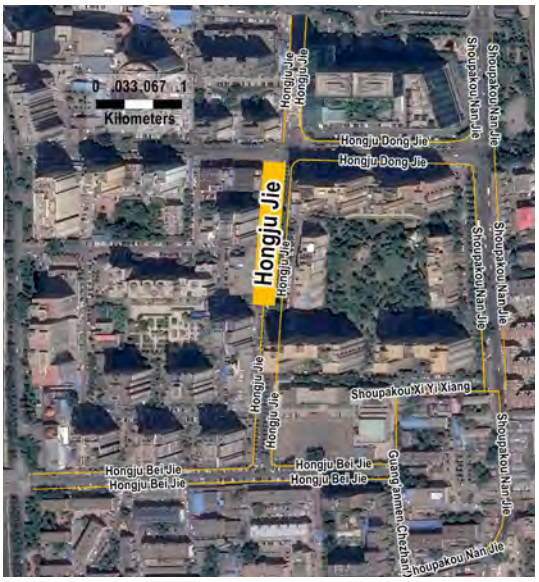




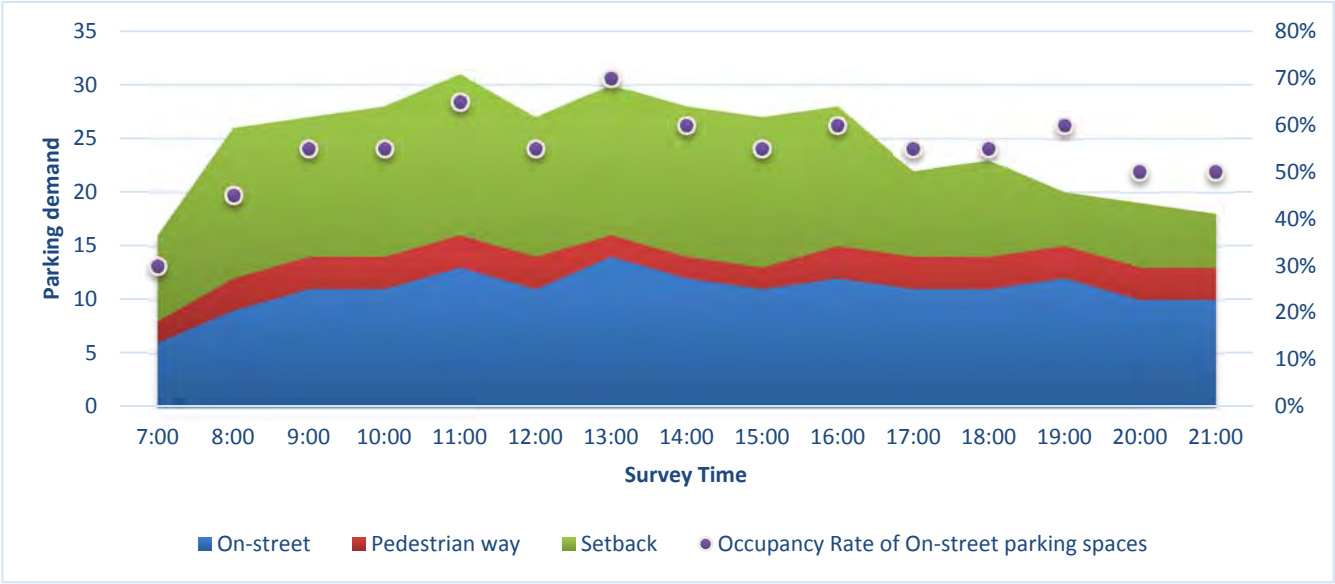
- Parking demand never exceeds supply and parking mostly occurs on-street, but 38% of vehicles park over 2 hours.

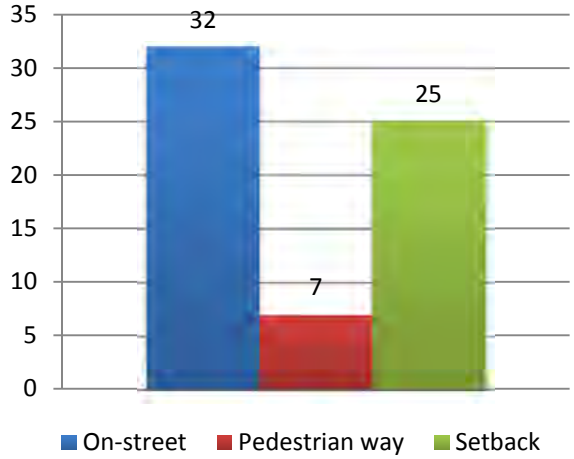
Hongju Jie (middle west) - HJMW

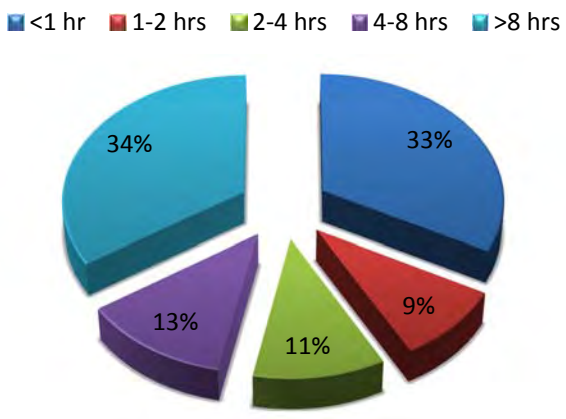




Indicator	value	unit
On-street supply	20	parking spaces
Average occupancy rate for on street parking spaces	55	%
Turnover rate for on street parking spaces in 14 hours	1.6	times
Maximum demand (including illegal parking)	31	cars
Peak parking time	11:00	AM



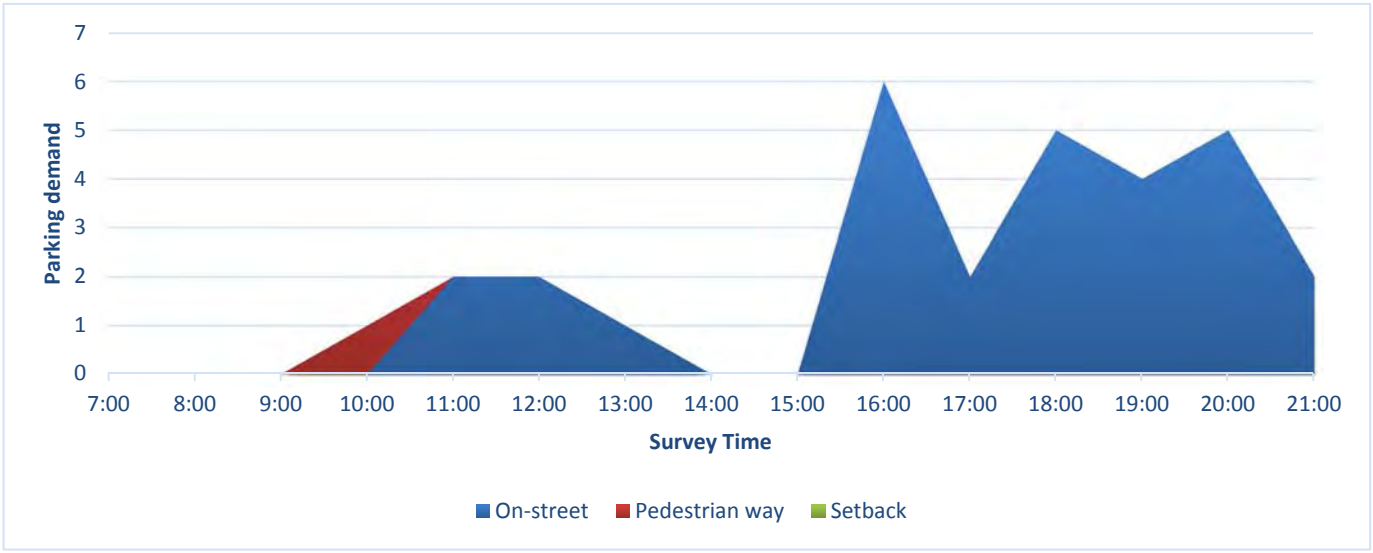


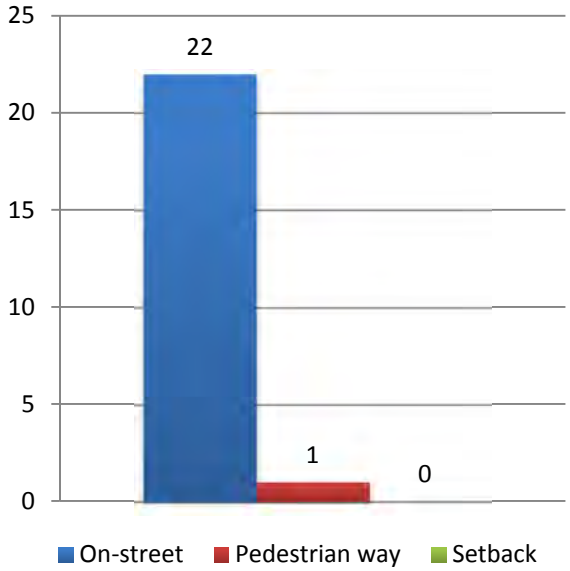


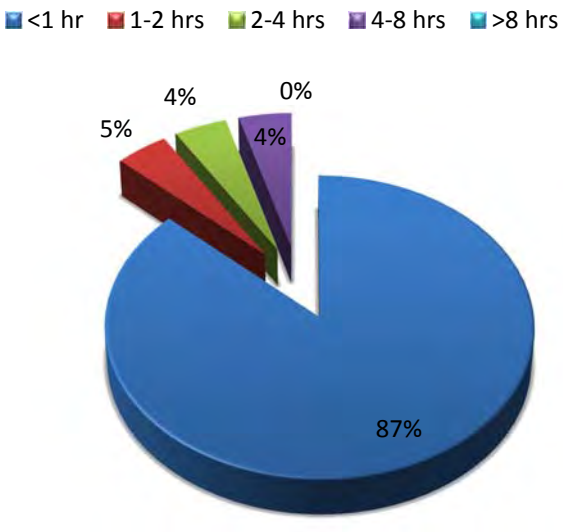
- Parking demand never exceeds supply, but half of the cars park on the setback and sidewalk where no parking fee is charged. Enforcement of illegal parking would force drivers to park on-street. 57% of cars park over two hours.

Shoupakou Nan Jie (northwest) - SPNW

Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	6	cars
Peak parking time	4.00	PM

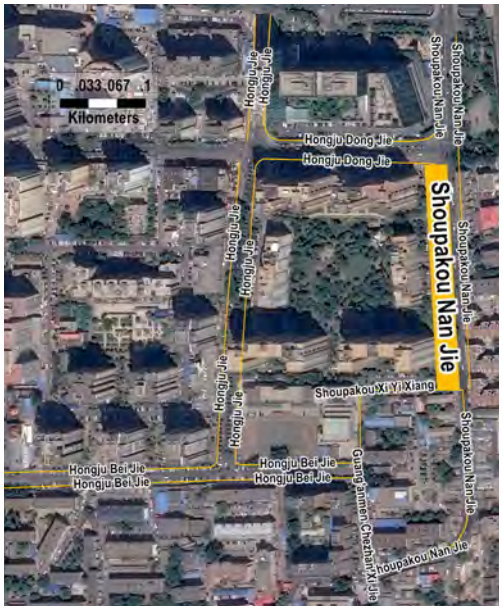




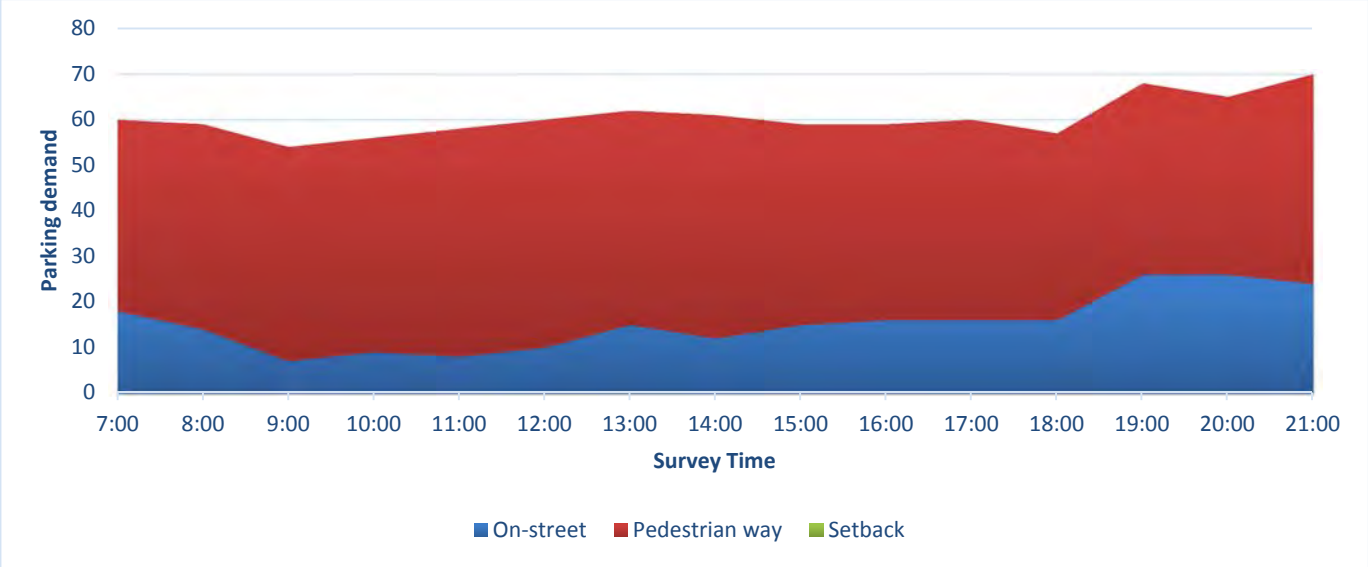


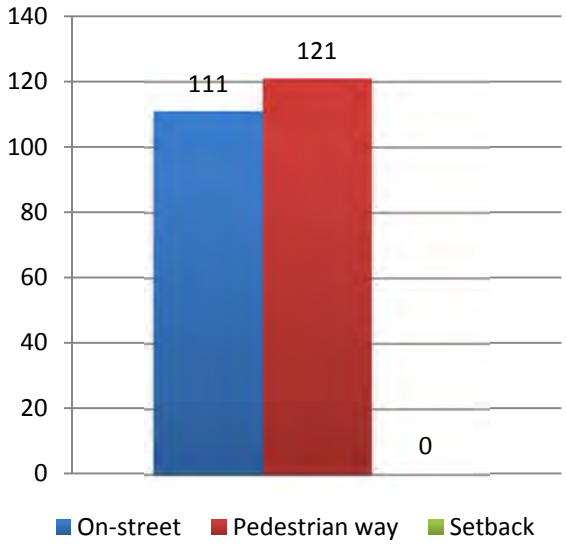
- Parking demand is low and mostly (92%) short-term. Separated bike lanes will force drivers to park elsewhere.

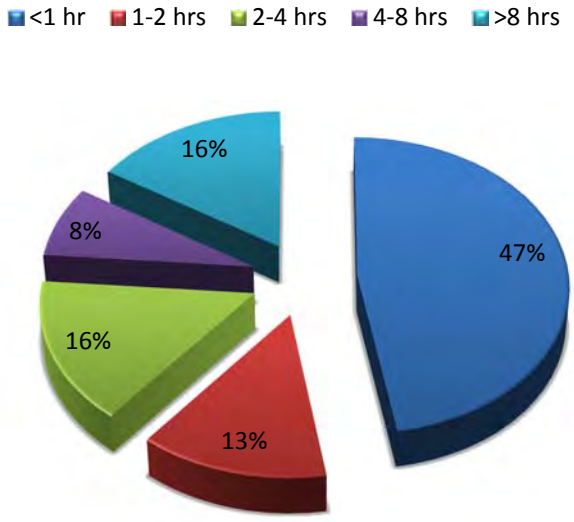
Shoupakou Nan Jie (middle west) - SPMW



Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	70	cars
Peak parking time	9:00	PM

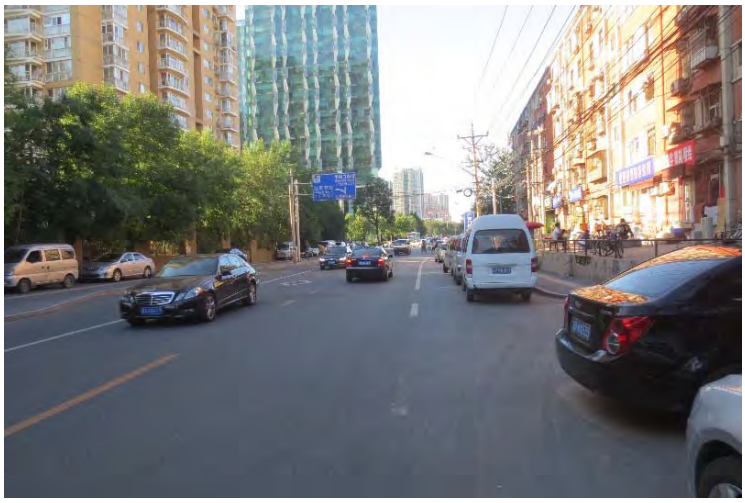


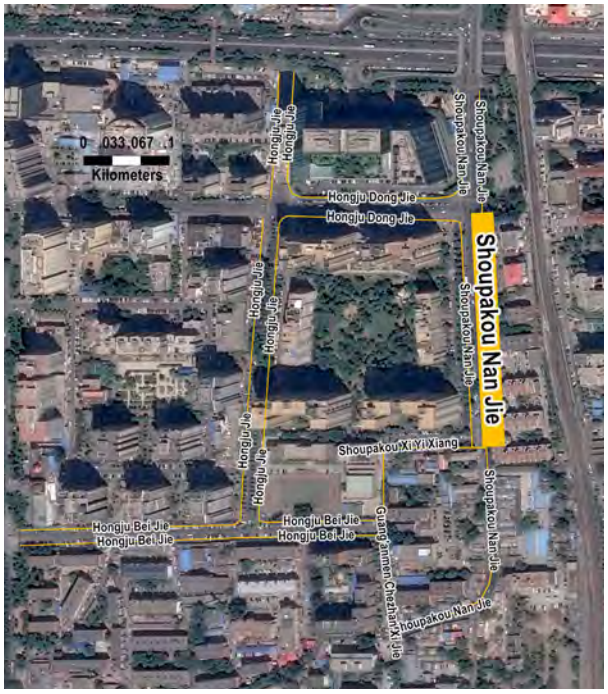




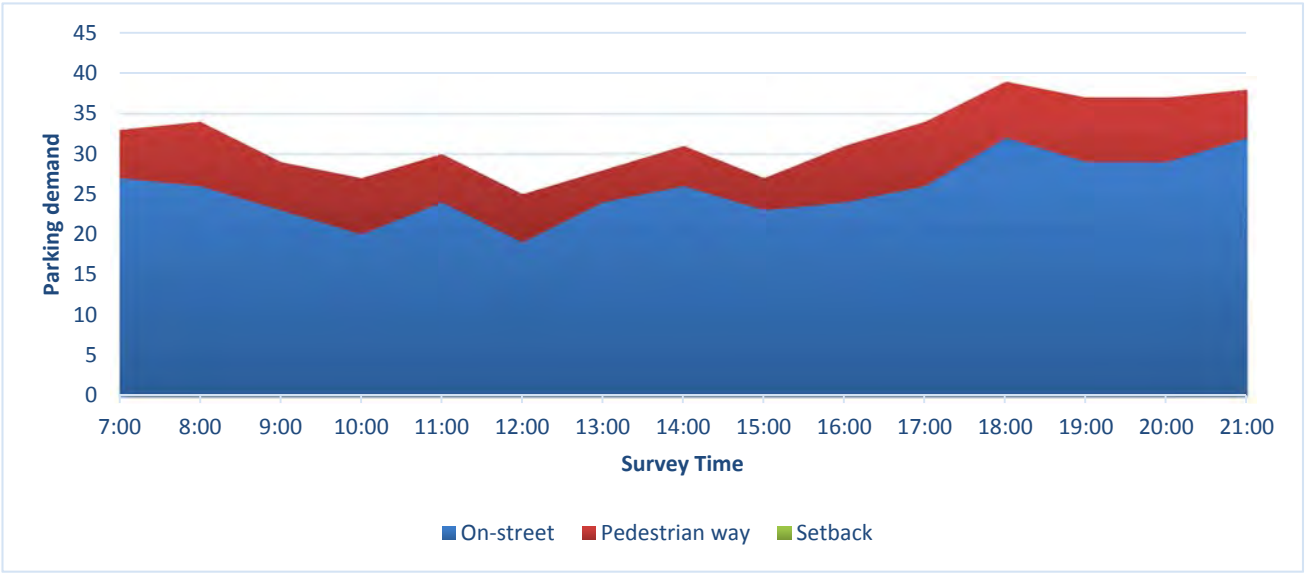
- Parking demand is high and no formal on-street parking exists. 52% parks on the sidewalk and 40% for over 2 hours. Formal on-street parking and better use of adjacent off-street parking in Langqin Huayuan residences and Langqin Guoji office building will solve this issue.

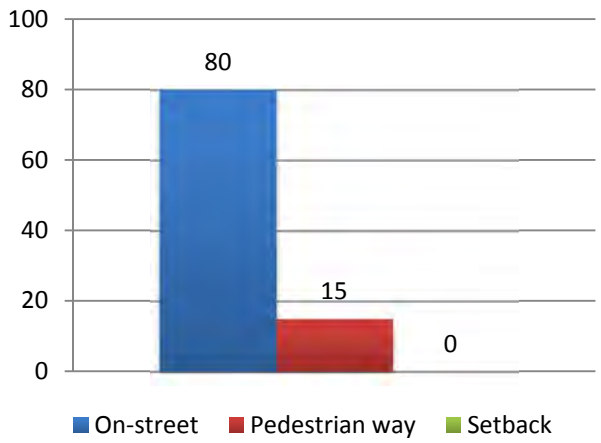
Shoupakou Nan Jie (middle east) - SPME

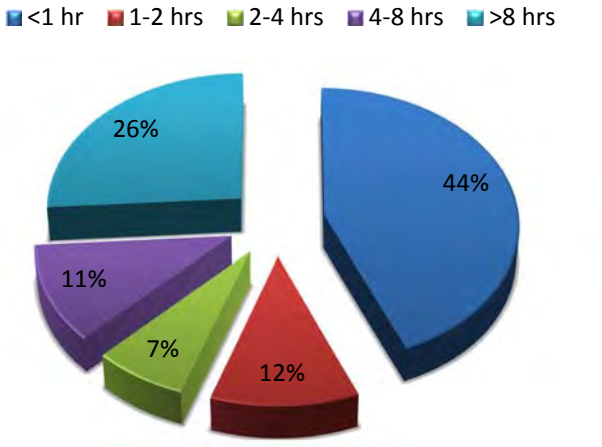




Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	38	cars
Peak parking time	9:00	PM

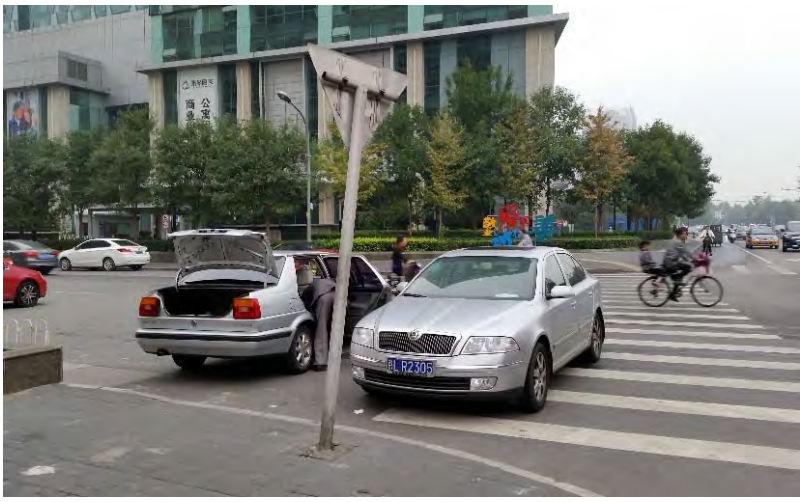


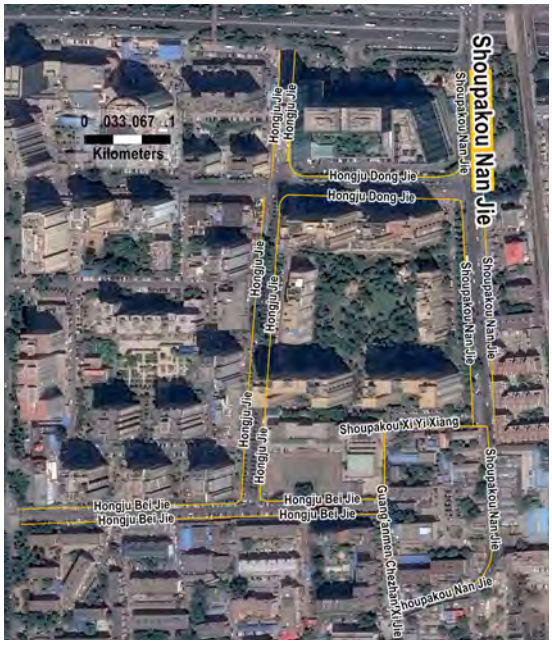




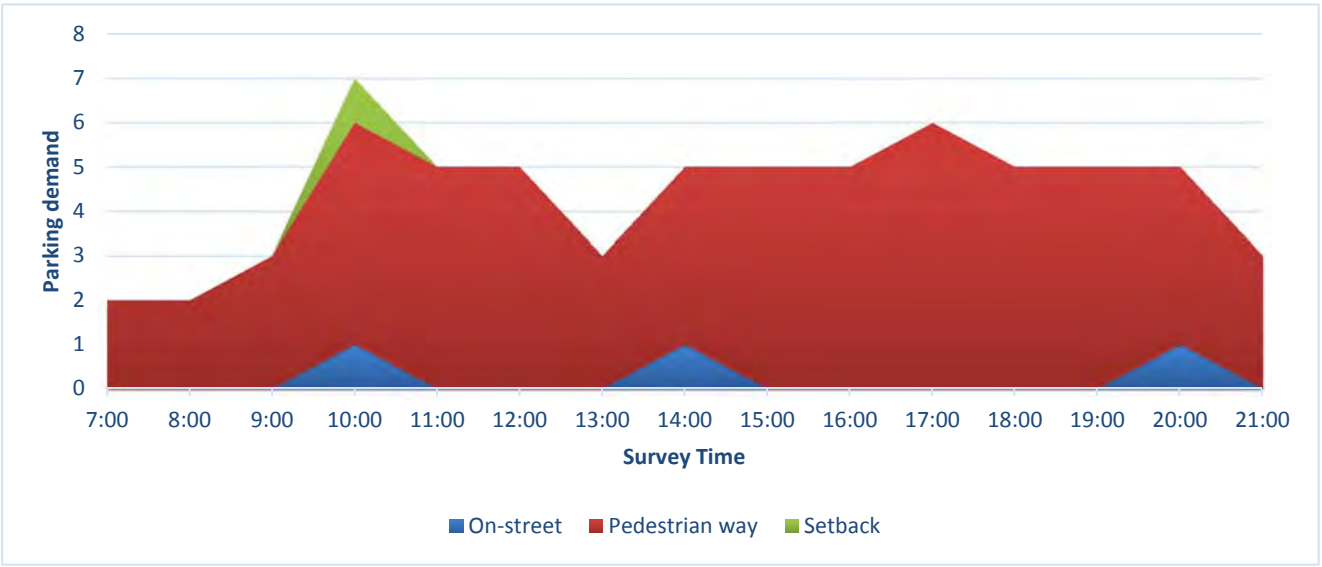
- Parking demand is high and no formal on-street parking exists. 44% parks for over 2 hours. Formal on-street parking and better use of adjacent off-street parking in Langqin Huayuan residences and Langqin Guoji office building will solve this issue

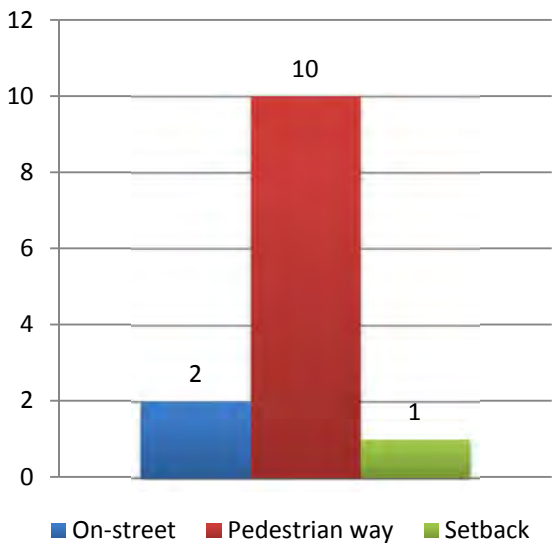
Shoupakou Nan Jie (northeast) - SPNE

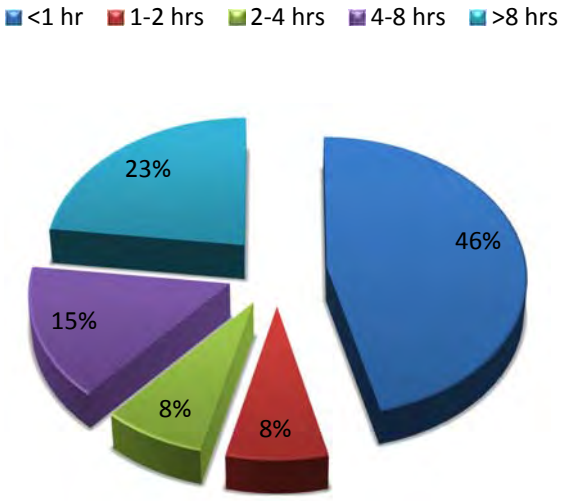




Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	7	cars
Peak parking time	10:00	AM

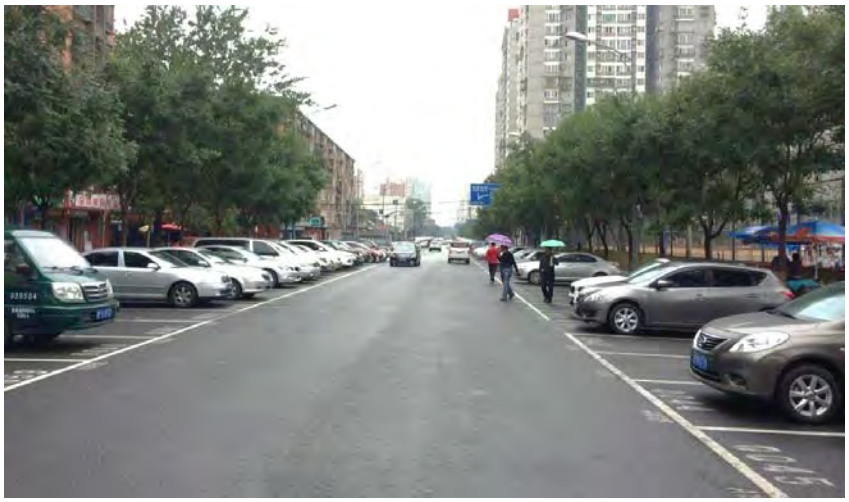


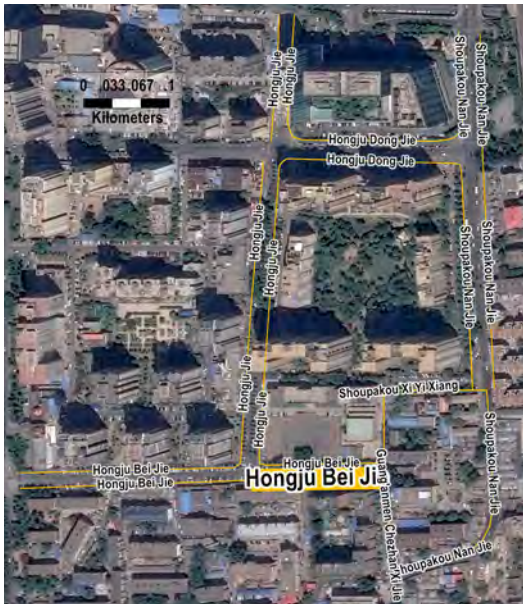




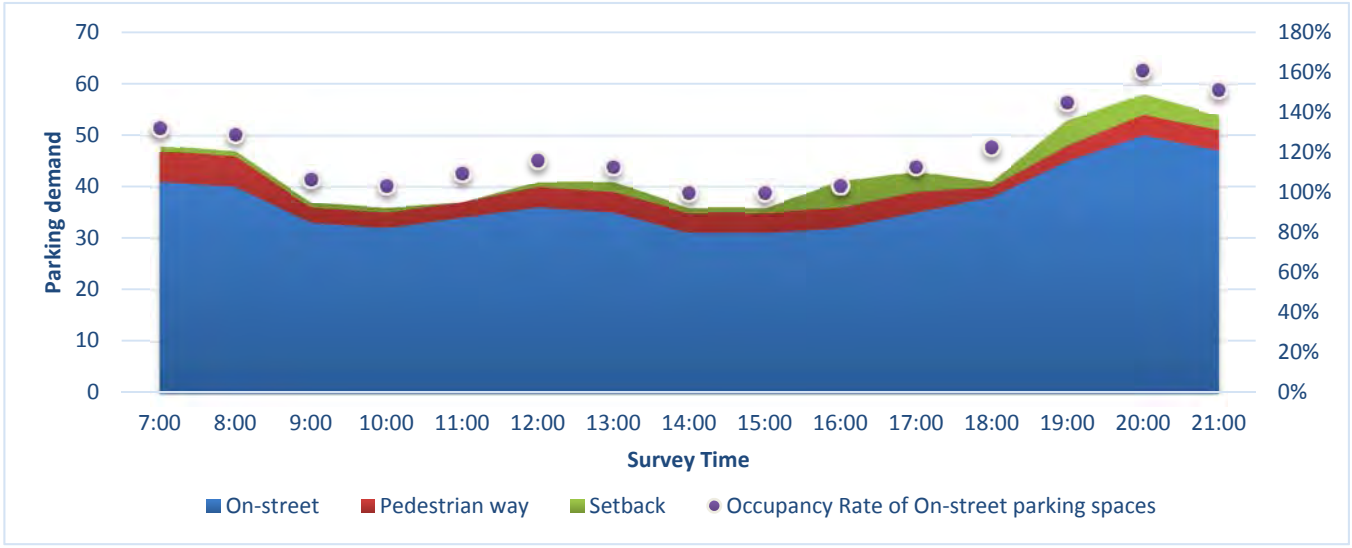
- Parking demand is low but mostly (77%) on the sidewalk. Separated bike lanes will force drivers to park elsewhere.

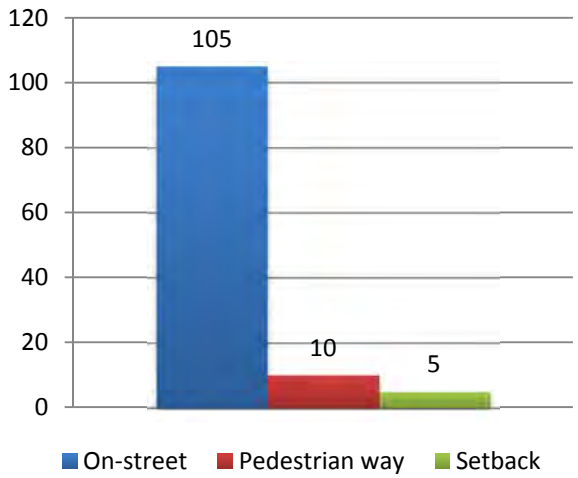
Hongju Bei Jie (southeast) - HBSE

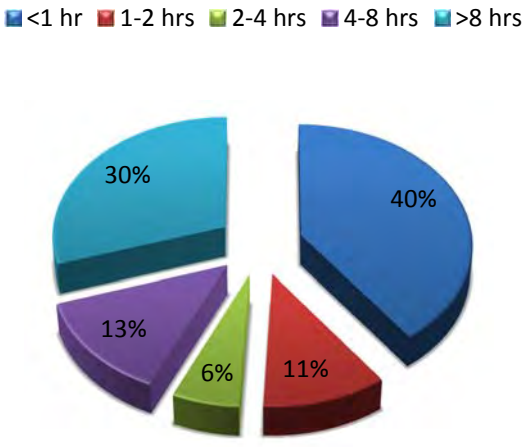




Indicator	value	unit
On-street supply	31	parking spaces
Average occupancy rate for on street parking spaces	120	%
Turnover rate for on street parking spaces in 14 hours	3.4	times
Maximum demand (including illegal parking)	58	cars
Peak parking time	8:00	PM

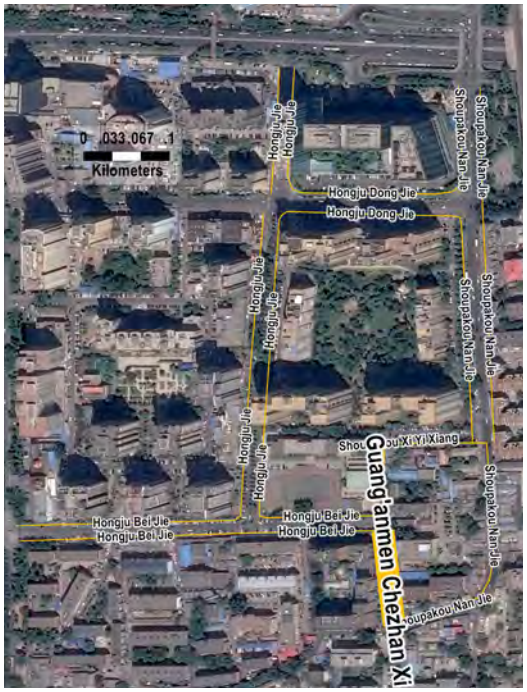




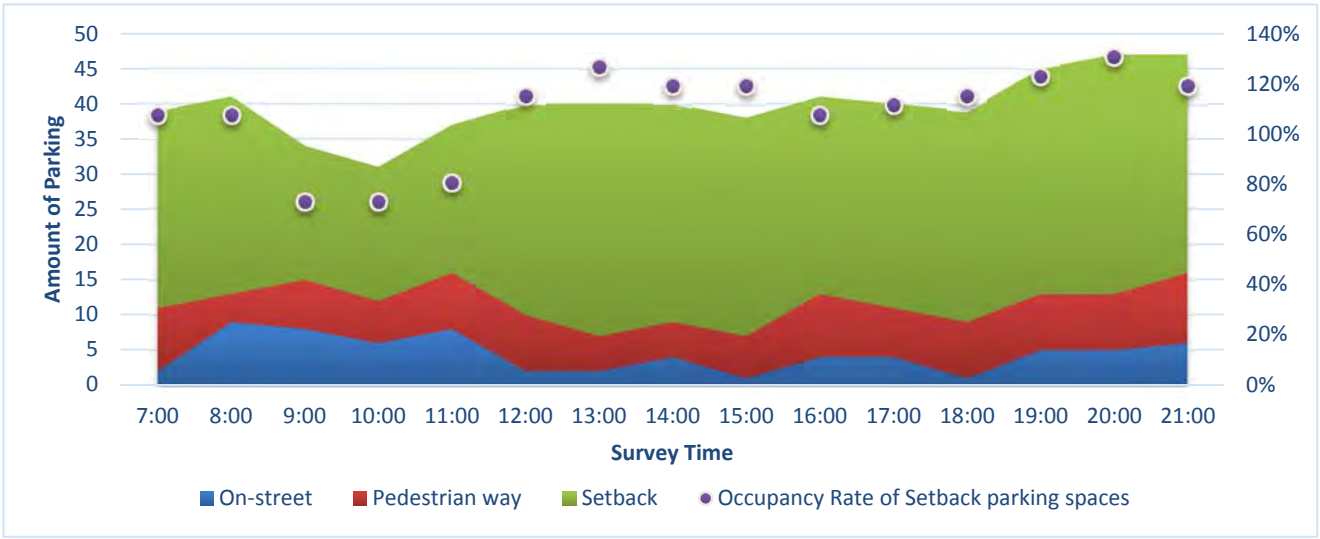


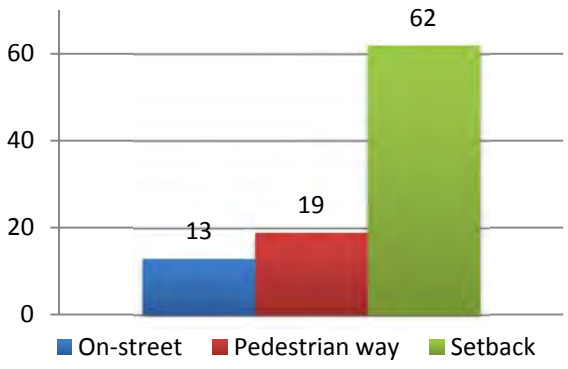
- Parking demand and on-street space can be used more efficiently for more parking supply. 49% of vehicles is parked over two hours and turnover is low (3.4 cars/parking space).

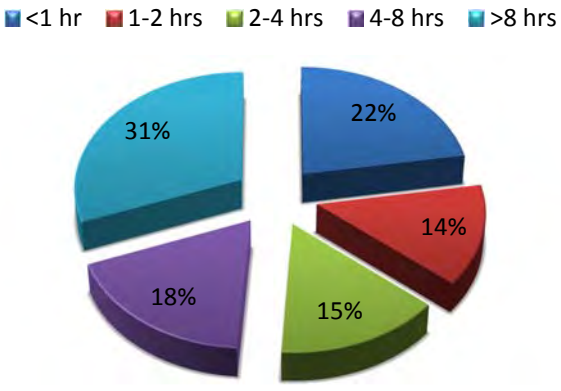
Guang'anmen Chezhan Xi Jie - GZXJ



Indicator	value	unit
Setback supply	26	parking spaces
Average occupancy rate for setback parking spaces	109	%
Turnover rate for setback parking spaces in 14 hours	2.4	times
Maximum demand (including illegal parking)	47	cars
Peak parking time	8:00	PM

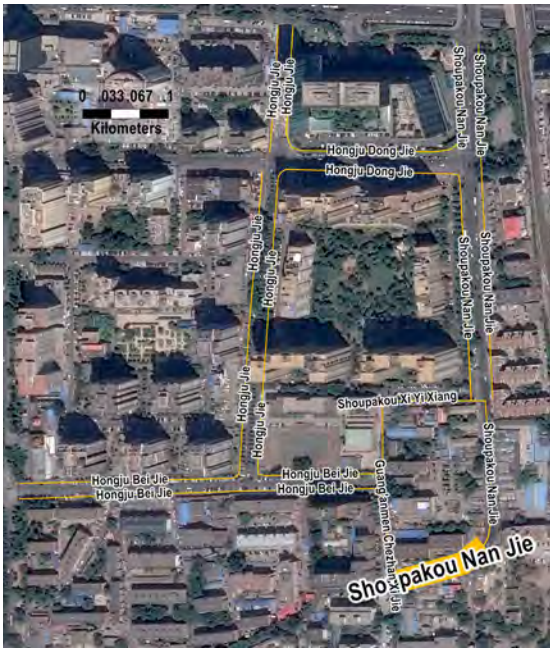




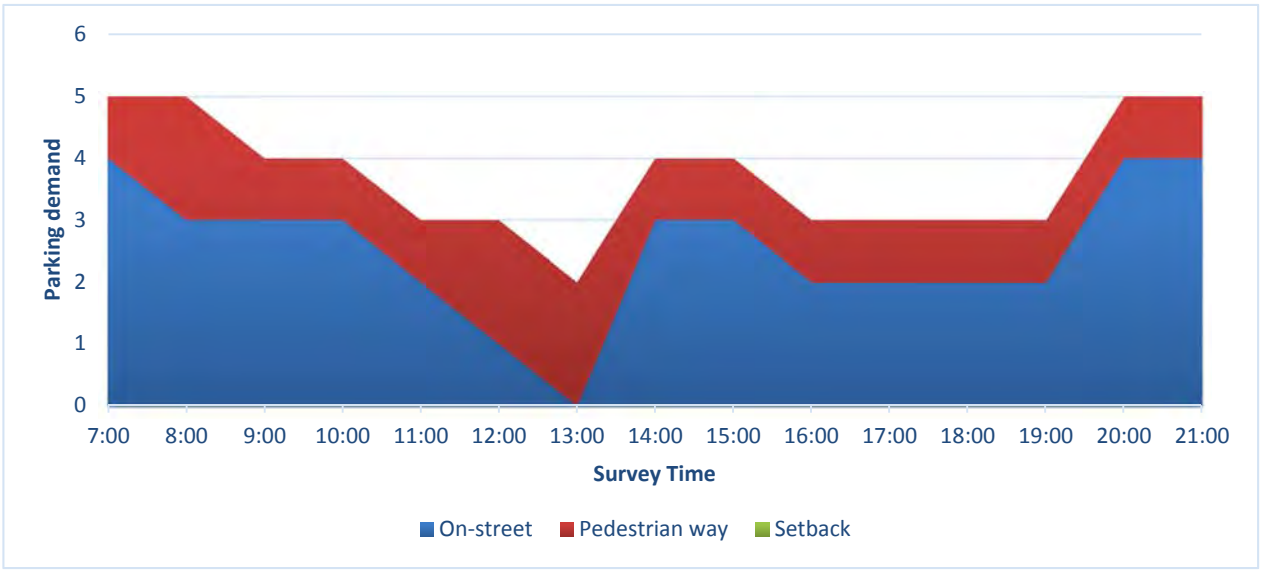


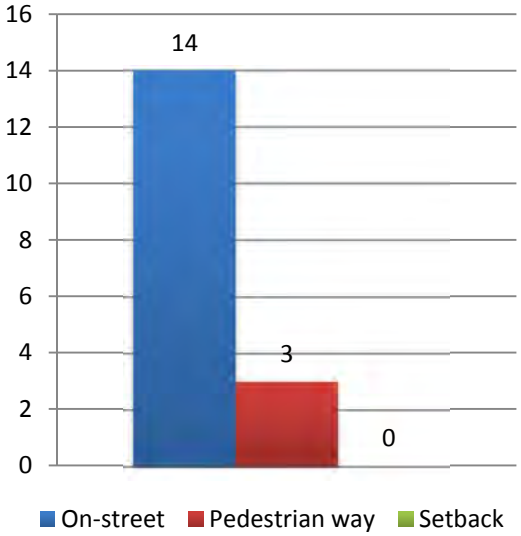
- Parking mostly occurs on the setback, but given that the ground floor use is of low-value and a continuous sidewalk is still provided, this setback parking can remain. 64% of vehicles is parked over two hours and turnover is very low (2.4 cars/parking space).

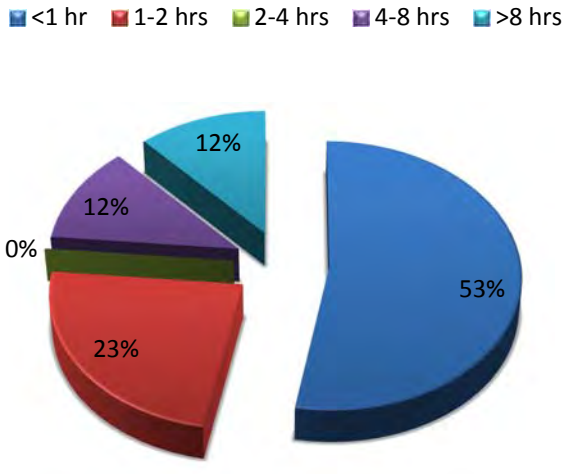
Shoupakou Nan Jie (south) - SPS



Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	5	cars
Peak parking time	8:00/8:00	AM&PM

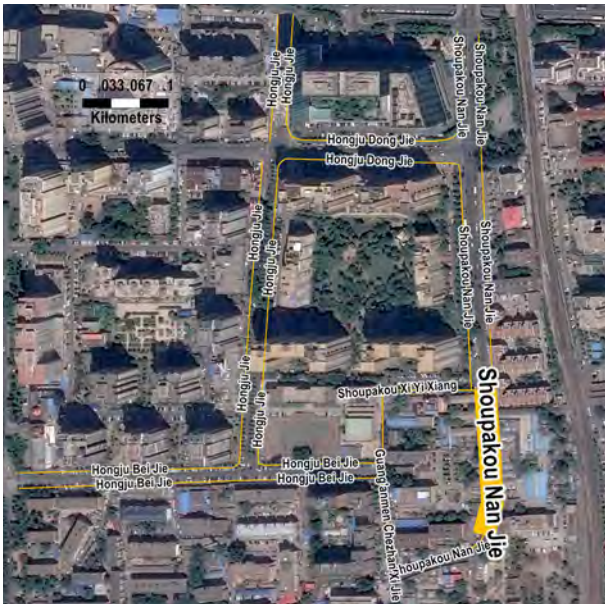




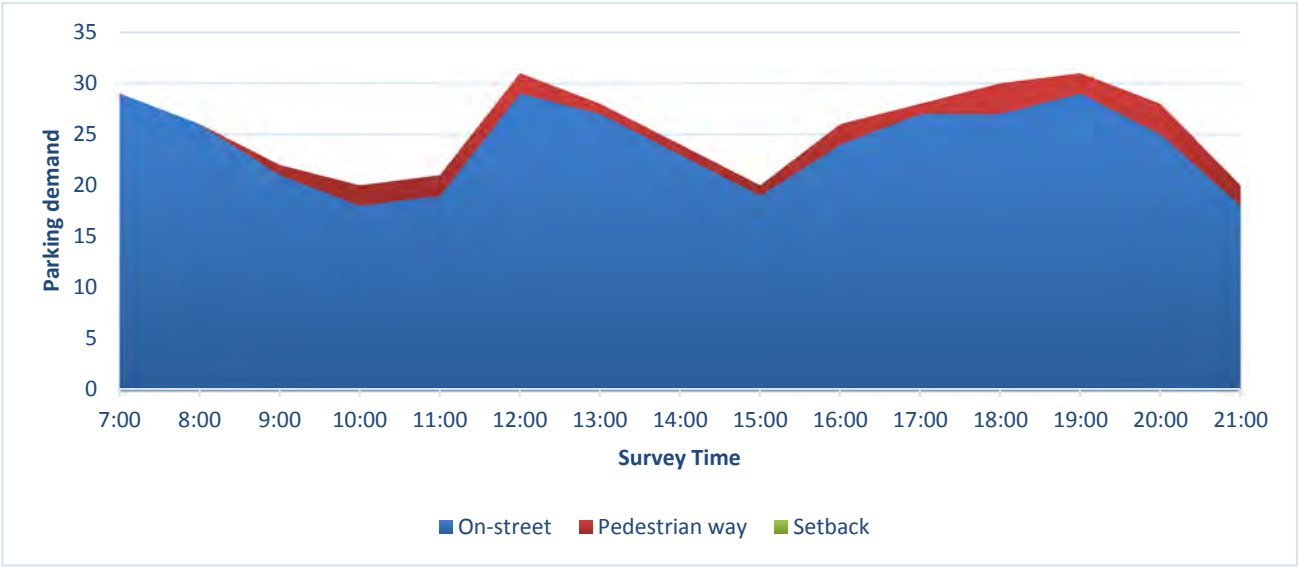


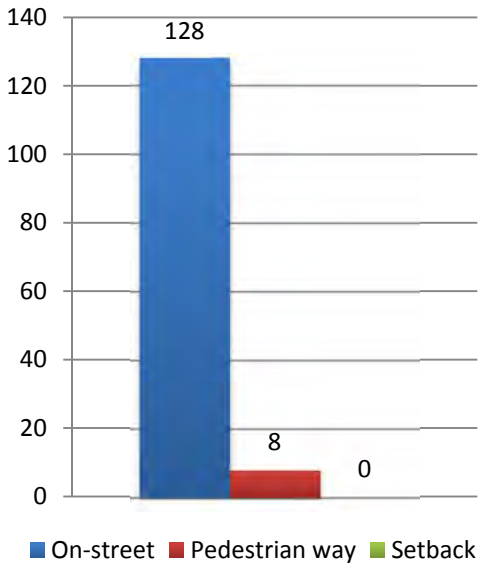
- Parking on this street is illegal and parking demand is low. Only 24% of vehicles is parked over 2 hours.

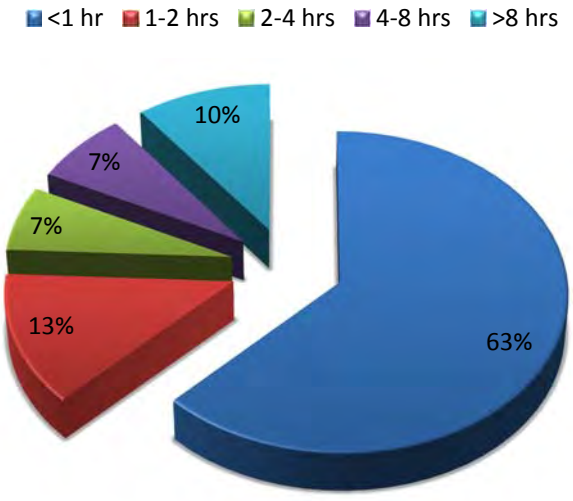
Shoupakou Nan Jie (middle) - SPM



Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	31	cars
Peak parking time	12:00/7:00	Mid-day and PM

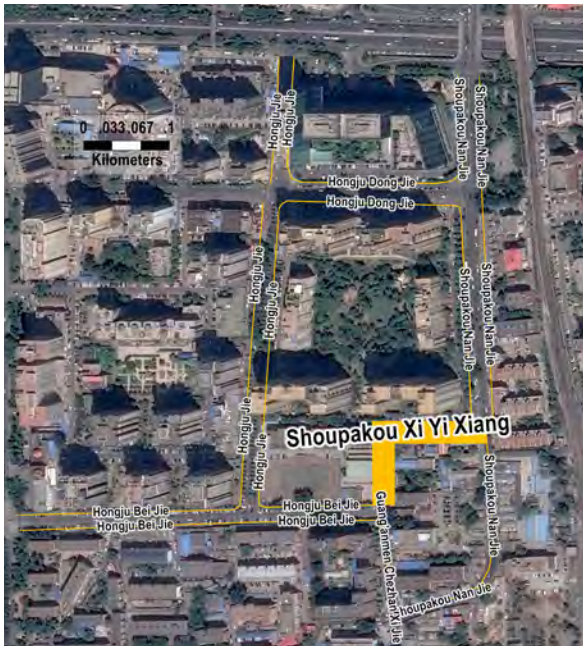




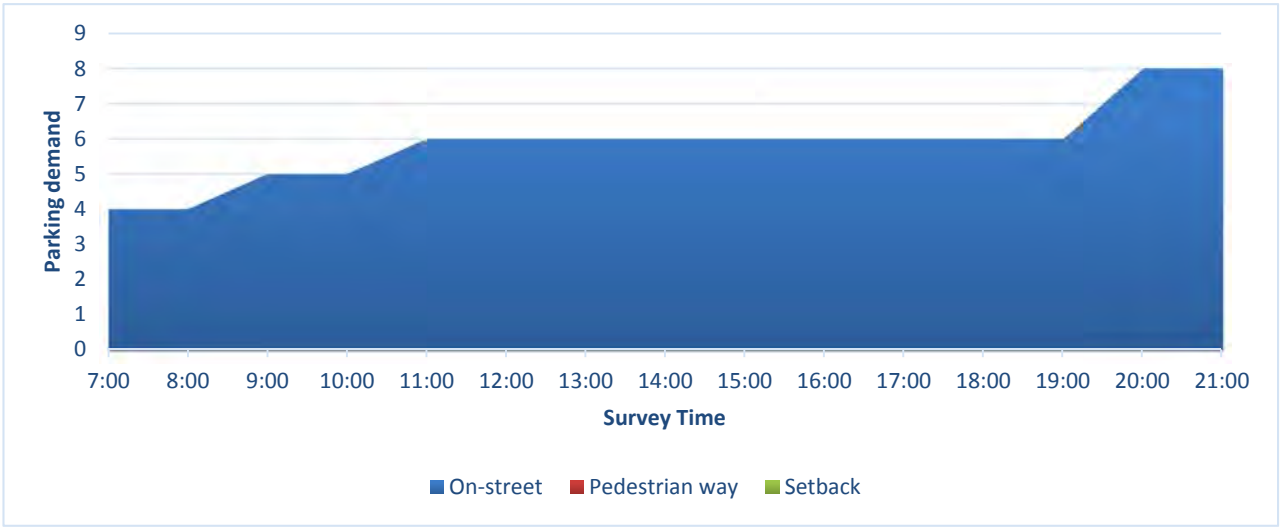


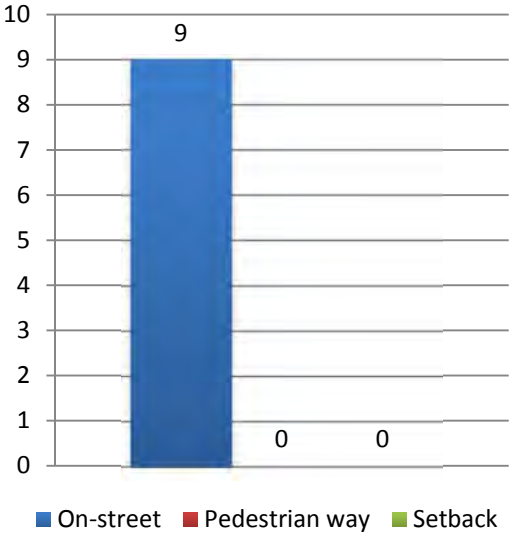
- Parking demand is high and no formal on-street parking exists. 94% parks on-street and only 14% for over 2 hours. Formal on-street parking will solve this issue.

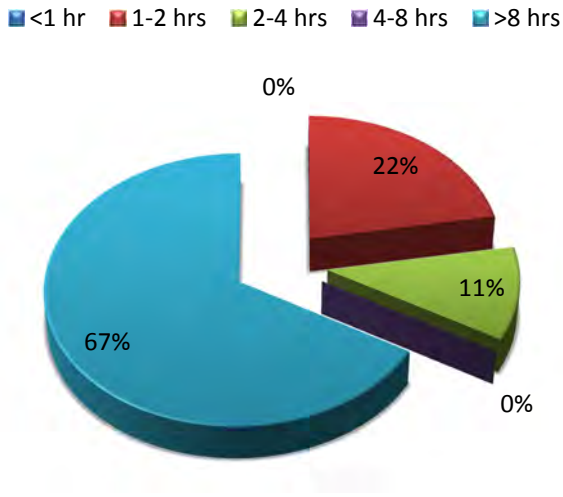
Shoupakou Xi Yi Xiang - SPXY



Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	8	cars
Peak parking time	8:00	PM

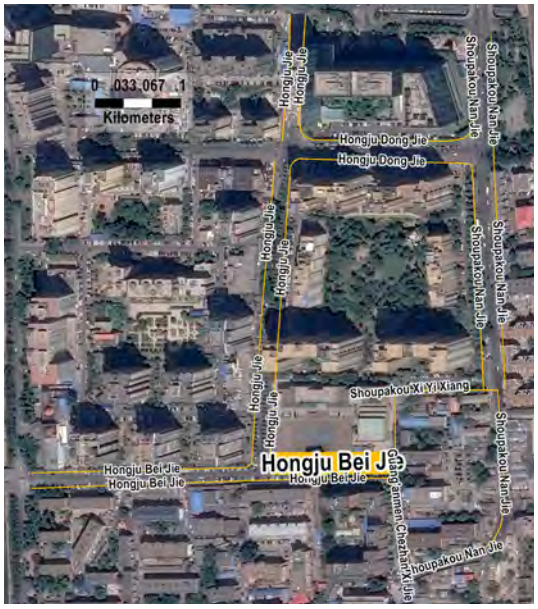




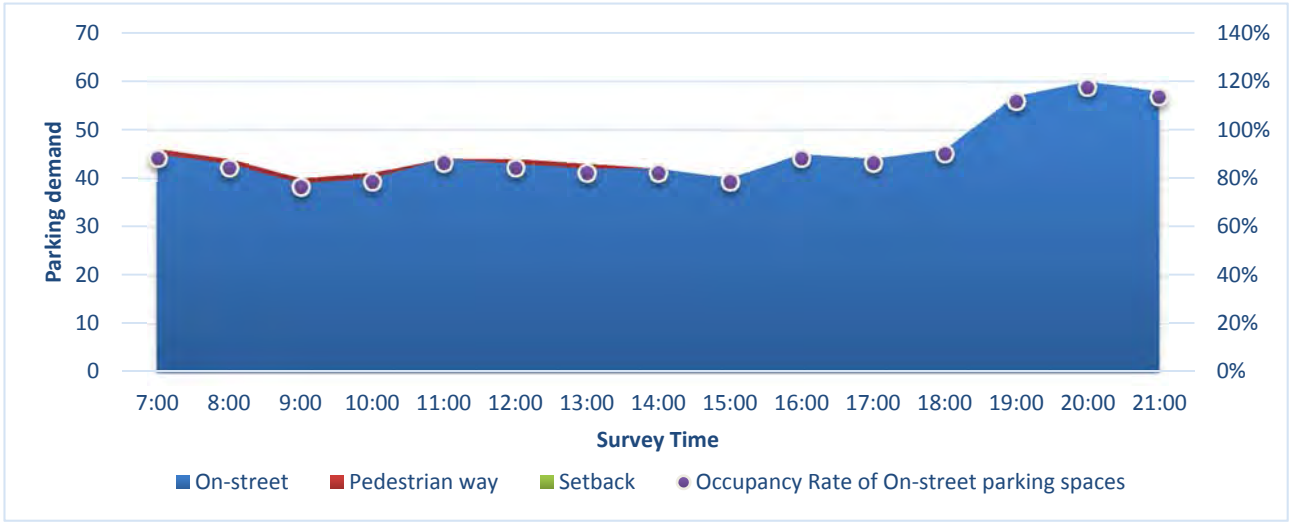


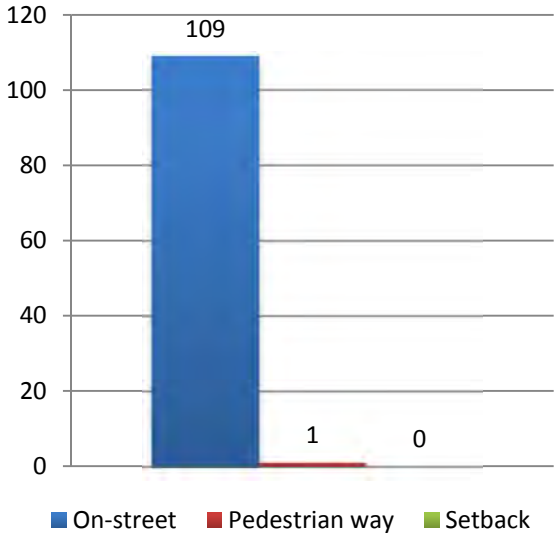
- Parking demand in this street is very low and mostly consist of tricycles. The existing situation can be maintained.

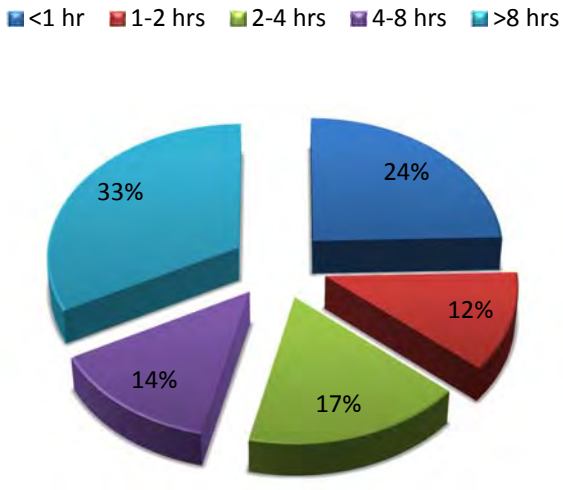
Hongju Bei Jie (northeast) - HBNE



Indicator	value	unit
On-street supply	51	parking spaces
Average occupancy rate for on street parking spaces	90	%
Turnover rate for on street parking spaces in 14 hours	2.1	times
Maximum demand (including illegal parking)	60	cars
Peak parking time	8:00	PM

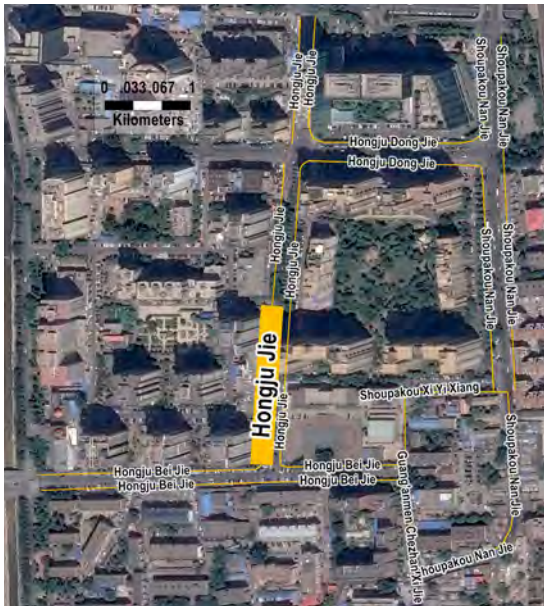




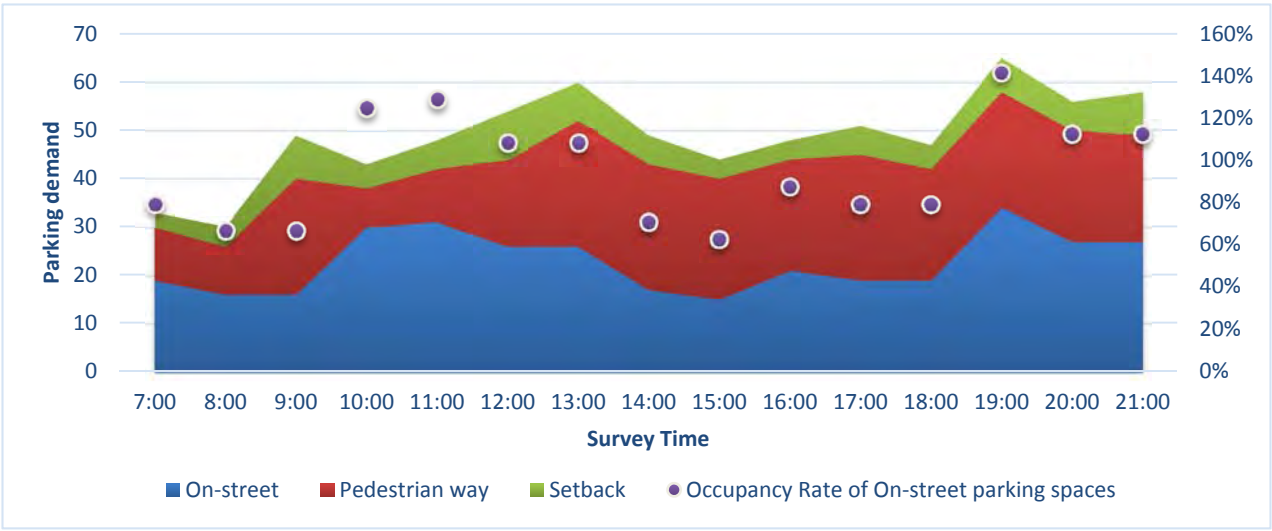


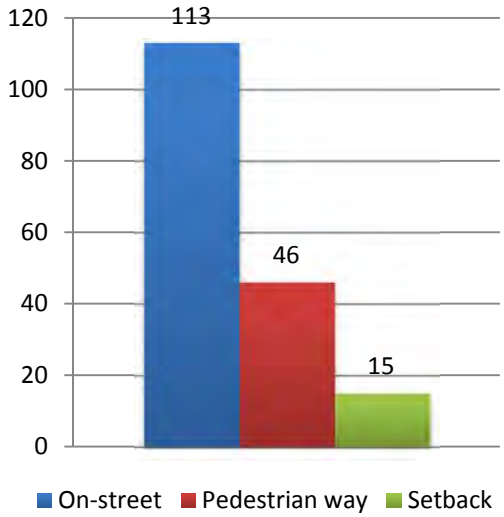
- Parking demand and on-street space can be used more efficiently for more parking supply. 64% of vehicles is parked over two hours and turnover is very low (2.1 cars/parking space).

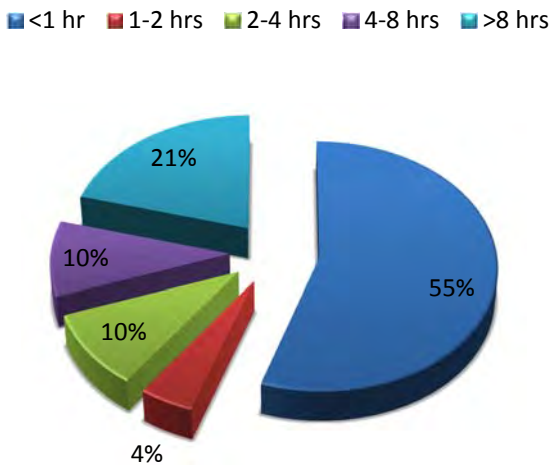
Hongju Jie (southwest) - HJSW



Indicator	value	unit
On-street supply	24	parking spaces
Average occupancy rate for on street parking spaces	95	%
Turnover rate for on street parking spaces in 14 hours	4.7	times
Maximum demand (including illegal parking)	65	cars
Peak parking time	7:00	PM

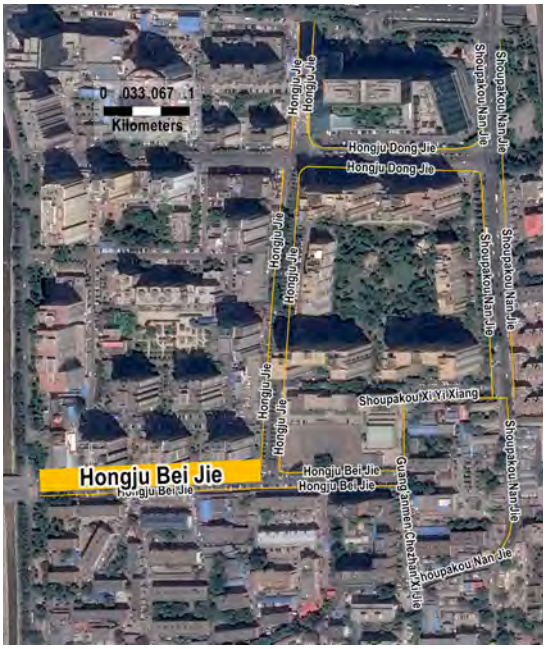




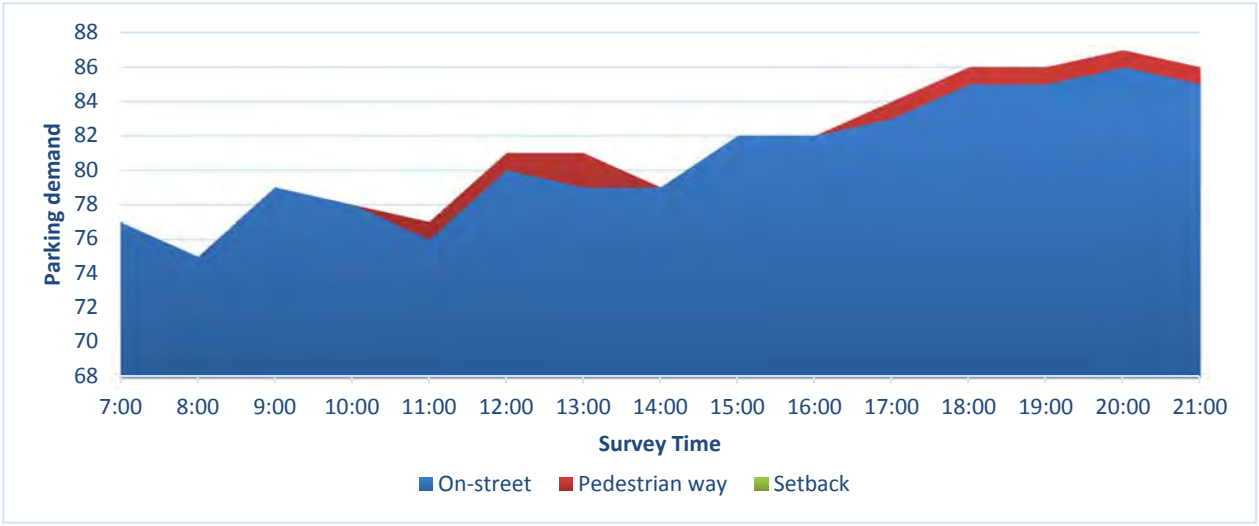


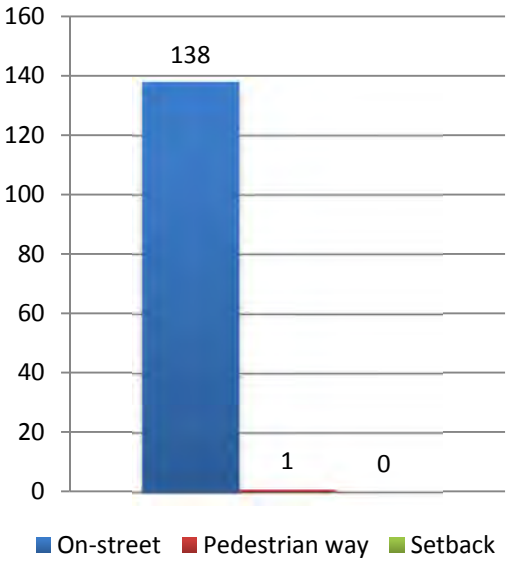
- 31% of drivers parks for over four hours. Many drivers park on the sidewalk and setback (35%) even when on-street occupancy is under 60% and many spaces vacant.

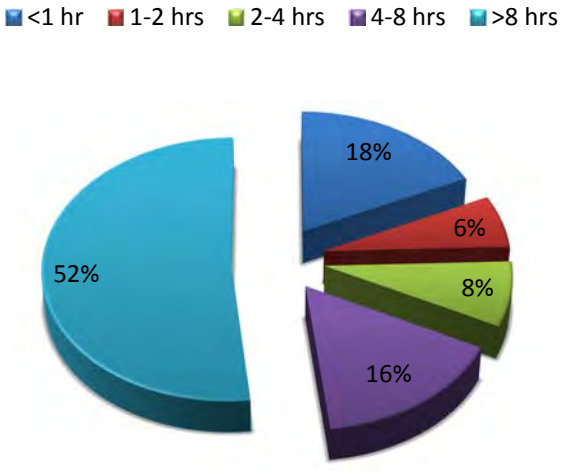
Hongju Bei Jie (northwest) - HBNW



Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	87	cars
Peak parking time	8:00	PM

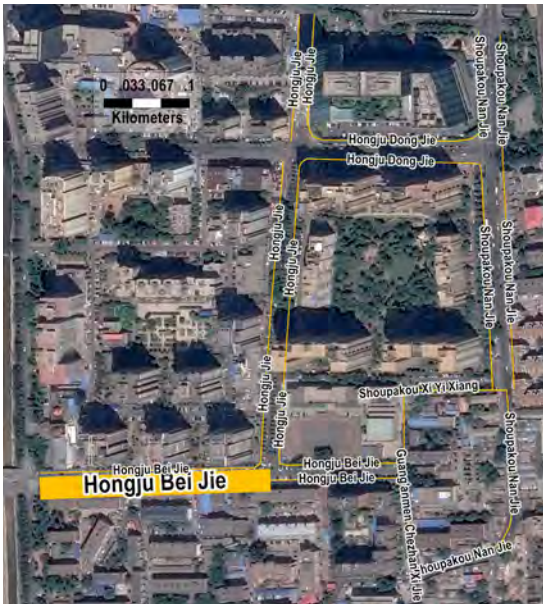




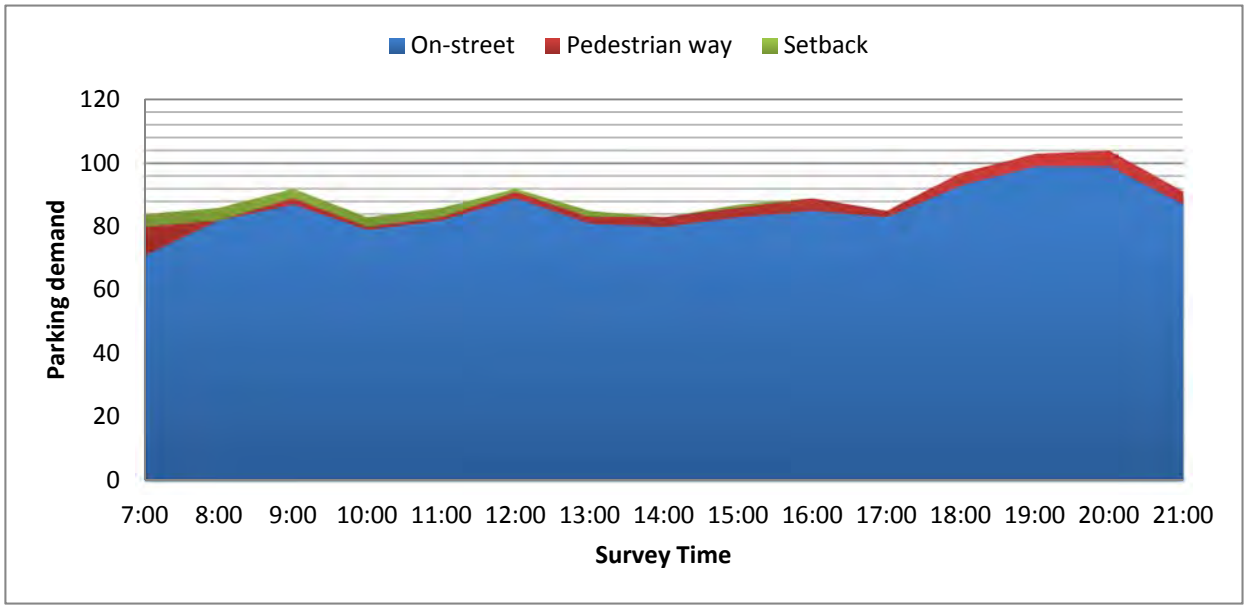


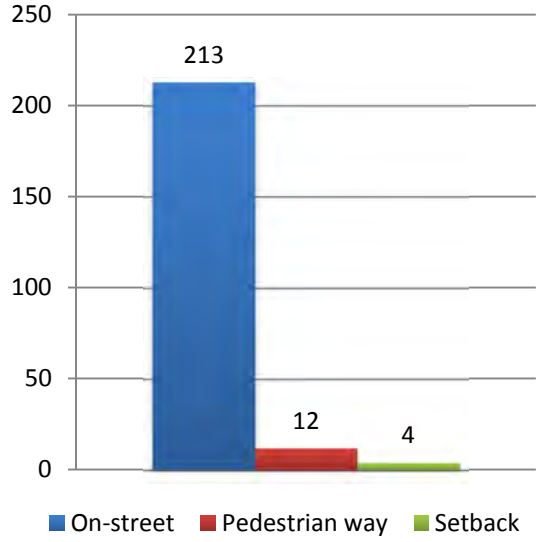
- On-street parking on this street is illegal but not enforced. Road space is available and already used for parking. The majority of cars (51%) is parked for more than 8 hours though, leaving little space for short-term parking.

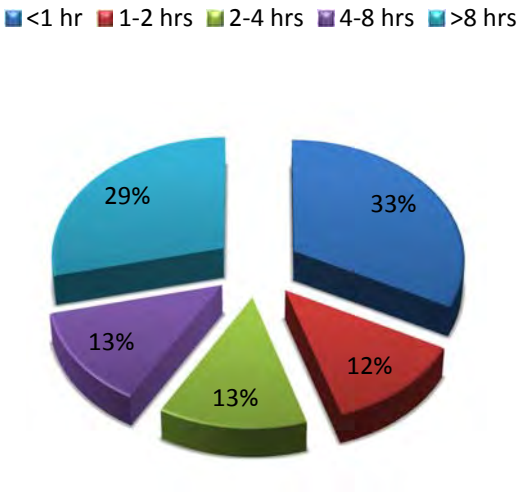
Hongju Bei Jie (southwest) - HBSW



Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	104	cars
Peak parking time	8:00	PM

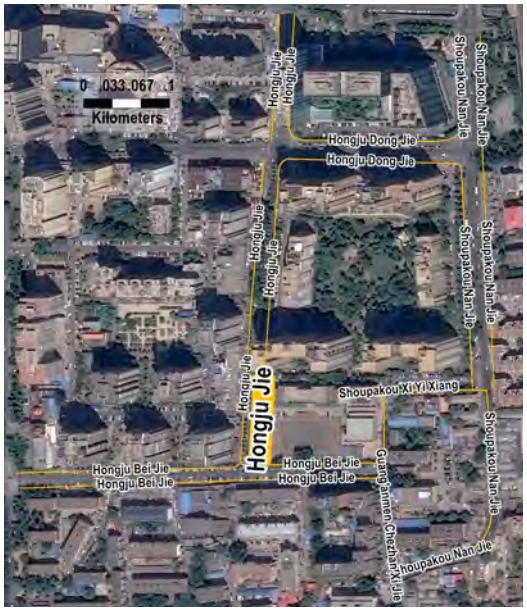




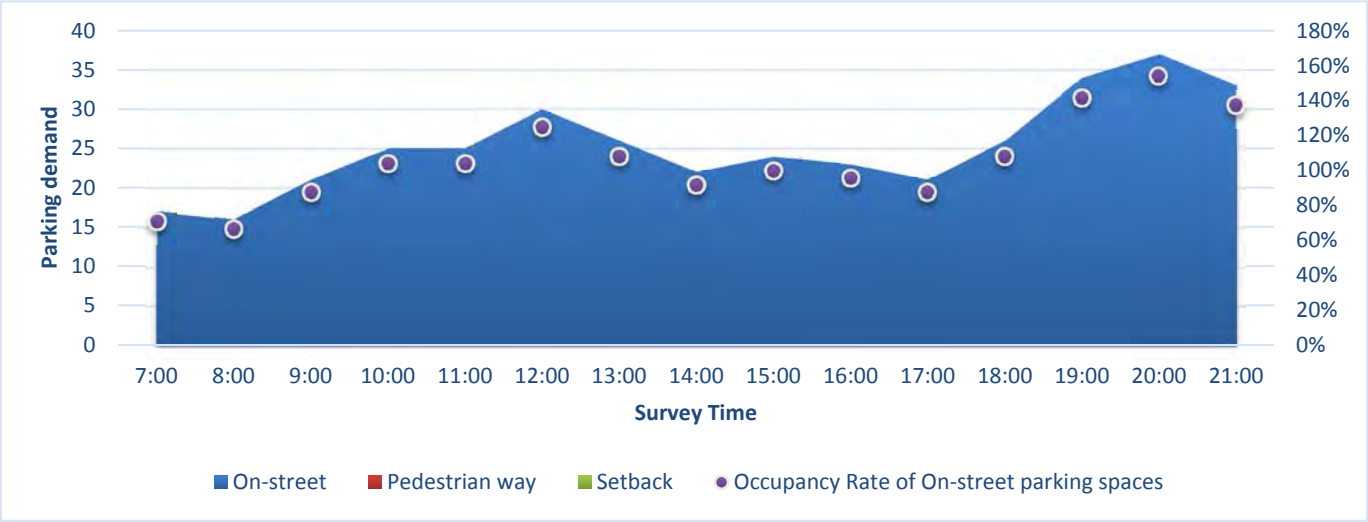


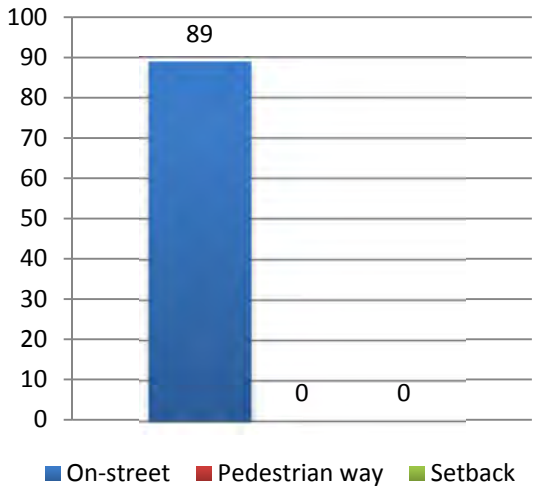
- On-street parking on this street is illegal but not enforced. Road space is available and already used for parking. The majority of cars (55%) is parked for more than 4 hours.

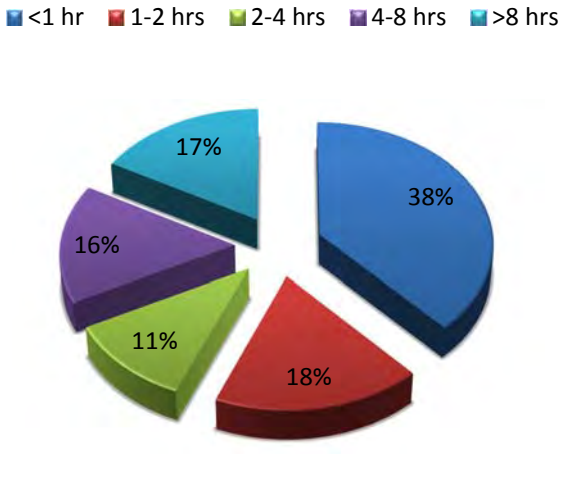
Hongju Jie (southeast)- HJSE



Indicator	value	unit
On-street supply	24	parking spaces
Average occupancy rate for on street parking spaces	106	%
Turnover rate for on street parking spaces in 14 hours	3.7	times
Maximum demand (including illegal parking)	37	cars
Peak parking time	8:00	PM







- All cars parked on this section park on-street. Much of the street has no formalized on-street parking, although road space permits and the entire section is lined by walls. 44% of drivers park over two hours and turnover is low at 3.7 cars per parking space during survey hours.

Langqin Guoji development (off-street parking at offices, mall, hotel)

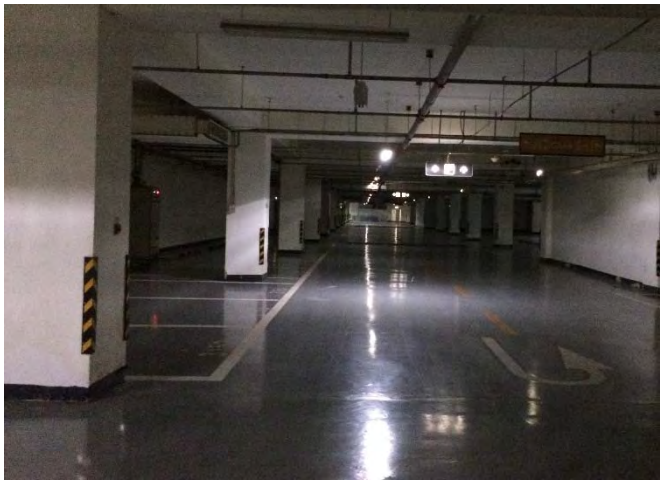
Site information:

- Address: 1 Shoupakouqiao Nan Jie (bound by Guang'an Dajie, Hongju Dongjie, Shoupakou Nanjie, Hongju Jie)
- Land use: office, retail (Tianhong Mall) and hotel (Hilton Double Tree)
- Site area: 19,703 m^2
- FAR: 7.04
- Year of opening: 2006

*Source: Baidu (December 2014) at: http://baike.baidu.com/link?url=Xde77PDUqT_9ZC8__GulZ4kK1GT6YvpluZ3sskV9sraSE6iyrYjzAP6had4XlyZtMYYCvpNOYhb-B4e77RgeH_*

Setback parking results in poor appearance and ruins the pavement.

B2 underground parking has vacancy, even during busiest hour.



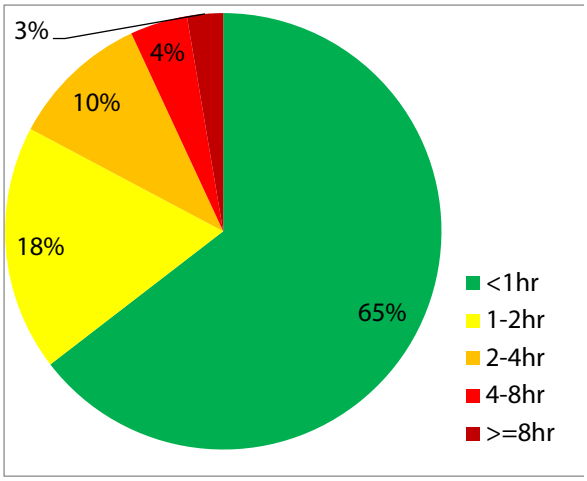
B3 underground parking is closed and empty.

B3 underground parking is used for storage.

Parking price:

Time	Underground	Mall setback	Hilton setback
7:00-21:00	1.5 RMB/ 15 min	2 RMB/ 15 min	2 RMB/ 15 min
21:00-7:00	2.5 RMB/0.5 hr	1 RMB/ 15 min	1 RMB/ 2 hrs
Monthly	1200-1300RMB	*N/A*	*N/A*

Parking duration (underground&setback):



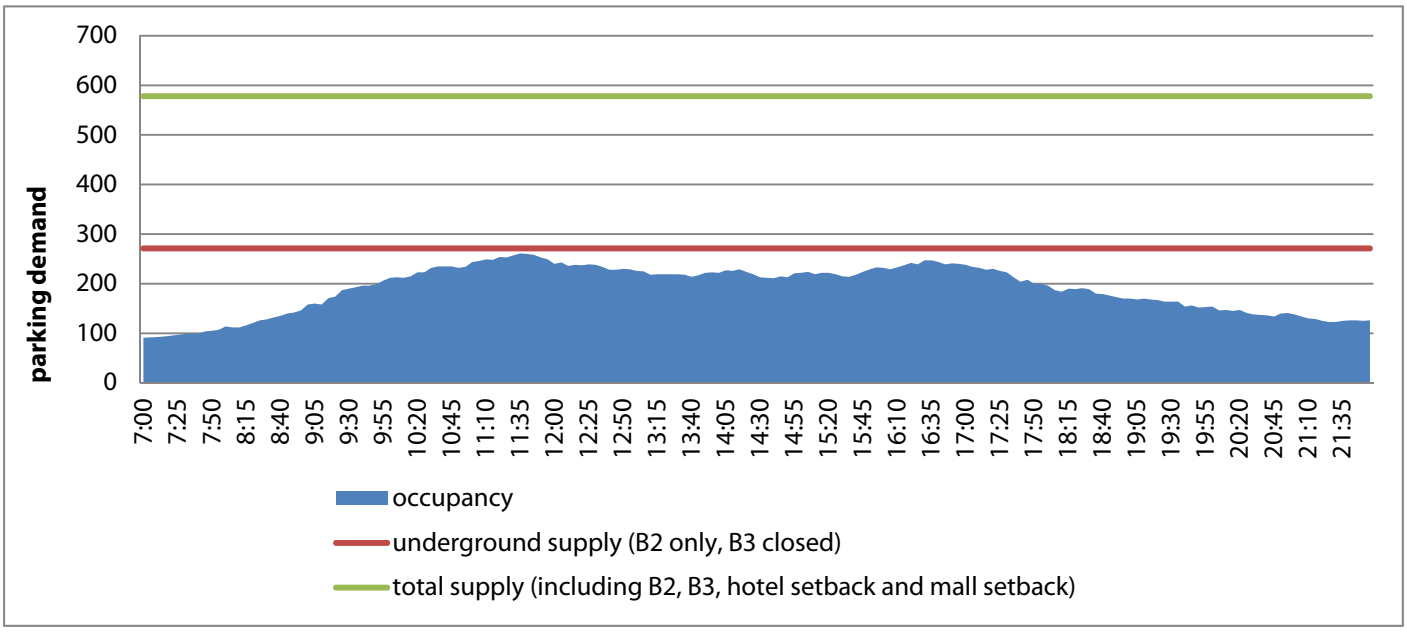
The majority (65%) of parking in the underground and setback parking is under 1 hour. Only 7% parks over 4 hours.

Parking survey results:

The underground parking lot has two floors of parking (B2&B3). The lower floor (B3) is not in use and sits empty. Parking occupancy is highest at 45% at 11.35am. Even with B3 underground parking closed, current parking supply meets demand during peak hours. Turnover per parking space is also low at 1.99.

Indicator	value	unit
B2 underground supply	271	parking spaces
Total supply (incl. setback, Hilton parking, B2&B3 underground)	578	parking spaces
Average occupancy rate for underground parking spaces	18.7	%
Turnover rate for underground parking spaces in 14 hours	1.99	cars/parking space
Maximum demand (total)	261	cars
Peak parking time	11:35	AM

Parking occupancy (total site):



Langqin area parking analysis

The Langqin area faces high parking demand on streets and illegal parking on streets, sidewalks and setbacks is frequent. The table below shows for each section the parking demand, existing parking balance (i.e. shortage or vacancy of parking spaces), the proposed on-street parking supply (as described on the next page) and the parking balance in the proposed on-street parking system.

Some streets will have a shortage of parking spaces, where others will have vacancy. At the same time, numerous off-street parking spaces in the nearby Langqin Guoji development are vacant.

This proves there is no shortage of parking spaces, but the parking demand is distributed unevenly.

Proper parking enforcement will force drivers to make better use of existing vacancy and real-time parking guidance systems can help direct drivers to vacant spaces. No additional off-street parking facilities are required.

There are a couple of other issues not taken into account that prove there is no shortage of parking spaces in the area:

- no other off-street parking facilities, such as the Langqin Huayuan residential development, were studies, but additional vacancies are expected in the area, which can serve drivers parking further away from Langqin Guoji. Public access to off-street parking, with parking sharing, is essential.
- When implementing a paid on-street parking system drivers, parking demand will drop for several reasons. Some drivers will decide to shift travel mode and sell or relocate their car. Especially long-term parking will be affected and move to off-street parking or areas outside the paid parking zones, where parking is cheaper or free of charge and with no time limits imposed. International experience shows this drop in parking demand within the zone to be around 20-25%. Actual on-street demand in the Langqin area will therefore be lower.

The proposed on-street parking system first of all makes better use of existing road space and legalizes parking on most street sections that are already used for parking illegally. The proposed streets with on-street parking are shown in the graph below. The total number of parking spaces is shown as well. Additional bike lanes are included too (graph right), without reducing the road capacity for car traffic.

Street name	Code	On-street parking supply [spaces]	Setback parking supply [spaces]	Demand at area's max. demand time [cars]	Balance (at area's max. demand) [spaces]	Proposed on-street parking supply [spaces]	Proposed setback parking supply [spaces]	Type of parking	Balance for proposed supply (area's max. demand) [parking spaces]
Hongju Jie	HJNW	19	0	17	2	22	0	Parallel	5
Hongju Jie	HJNE	12	0	16	(4)	21	0	Parallel	5
Hongju Dong Jie	HDN	17	0	20	(3)	31	0	Parallel	11
Hongju Dong Jie	HDS	0	50	93	(43)	50	0	Parallel	(43)
Hongju Jie	HJME	19	0	13	6	29	0	Parallel	16
Hongju Jie	HJMW	20	0	19	1	25	0	Parallel	6
Shoupakou Nan Jie	SPNW	0	0	5	(5)	0	0	No parking	(5)
Shoupakou Nan Jie	SPMW	0	0	65	(65)	43	0	Parallel	(22)
Shoupakou Nan Jie	SPME	0	0	37	(37)	44	0	Parallel	7
Shoupakou Nan Jie	SPNE	0	0	5	(5)	20	0	Parallel	15
Hongju Bei Jie	HBSE	31	0	58	(27)	42	0	Perpendicular&parralel	(16)
Guang'anmen Chezhan Xi Jie	GZXJ	0	26	47	(21)	0	26	Angled	(21)
Shoupakou Nan Jie	SPS	0	0	5	(5)	18	0	Parallel	13
Shoupakou Nan Jie	SPM	0	0	28	(28)	29	0	Parallel	1
Shoupakou Xi Yi Xiang	SPXY	0	0	8	(8)	0	0	No parking	(8)
Hongju Bei Jie	HBNE	51	0	60	(9)	59	0	Perpendicular	(1)
Hongju Jie	HJSW	24	0	56	(32)	35	0	Parallel	(21)
Hongju Bei Jie	HBNW	0	0	87	(87)	93	0	Perpendicular	6
Hongju Bei Jie	HBSW	0	0	104	(104)	95	0	Parallel	(9)
Hongju Jie	HJSE	24	0	37	(13)	31	0	Parallel	(6)
Total or Average		**217**	**76**	**780**	**(487)**	**687**	**26**	**Total balance:**	**(67)**
								Langqin Guoji vacancy:	**377**
								Total vacancy:	**310**

Parking demand and proposed supply show there is only a small shortage of on-street parking spaces that can easily be absorbed by off-street vacancy in Langqin Guoji. Note: red values in between brackets are negative.

Above and below: location (graph above) and capacity (graph below) of the proposed on-street parking spaces.

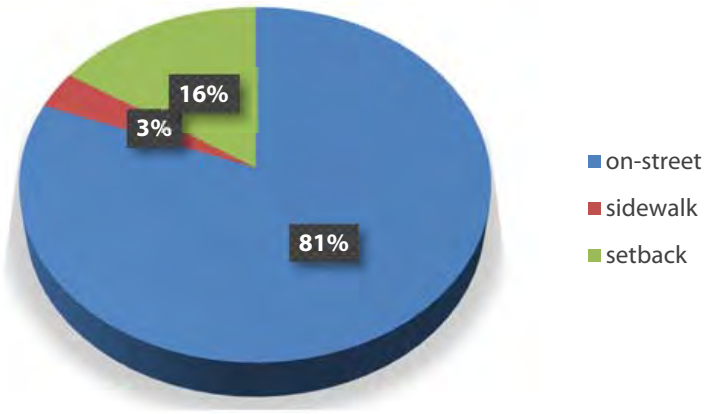
Above: proposed bike lane network

Yuanwuqu area survey summary

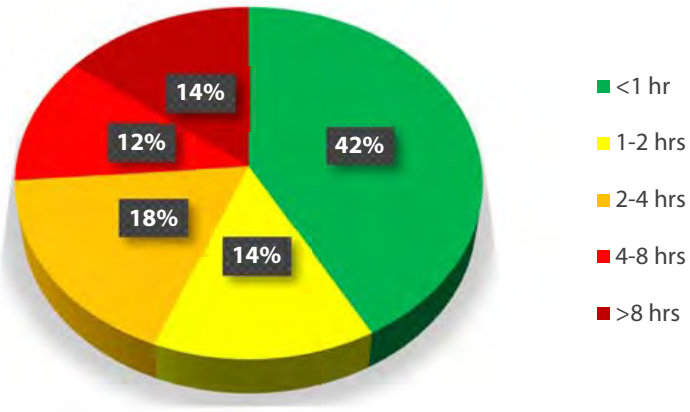
The Yuanwuqu area is located in the east of Guangwai Jiedao, bounded by Chunshuguan Jie, Guang'anmenwai Nan Jie, Yaziqiao Bei Jie and Guang'anmen Nan Binhe Lu. The on-street survey from 7.00am-10.00pm shows that the parking demand in the area does not change much throughout the day, with the peak parking demand between 1-2pm. There are 235 formal on-street parking spaces, which are priced and operated, and 87 formal setback parking spaces. The total parking demand is higher than the formal on-street parking supply, for two reasons: (1) on-street parking spaces are not formalized on many streets, although the existing street design, available space and current use allow for on-street parking operation; (2) vehicles park illegally on sidewalks (3% of demand) and setbacks (16% of demand).

The average parking duration is 4.14 hours, which is too high for on-street parking which is rather intended for short-term parking of maximum 2-3 hours. If overnight parking would be taken into account, this number would be even higher. Of all vehicles parked, 44% are parked for over 2 hours, of which 14% for over 8 hours. Average turnover of parking spaces is fairly low at 3.6 cars/parking space during survey hours.

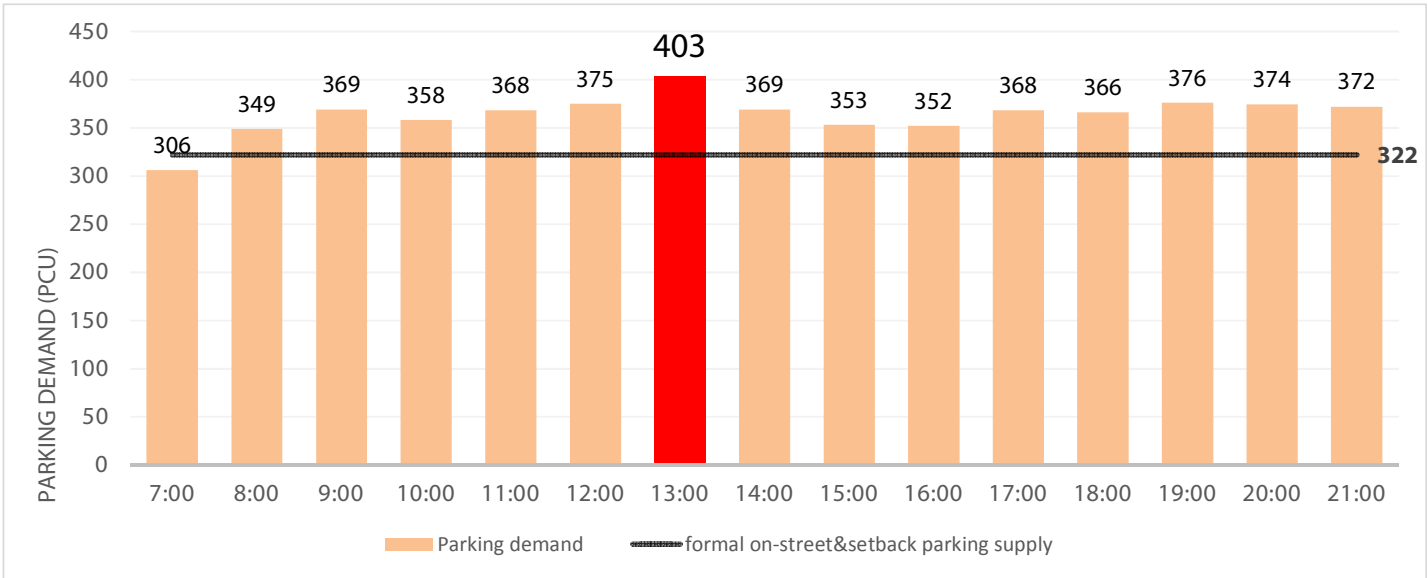
Most street sections have paid parking following official prices (although discounts can be negotiated with parking guards, especially for long-term parking), but 3 sections have private setback parking, 1 section is free and on 2 parking is forbidden. Illegal parking is common due to poor enforcement.



81% of drivers park on-street. 16% parks on the setback, mostly along Guang'anmen Nan Binhe Lu. Sidewalk parking only accounts for 3% of demand.



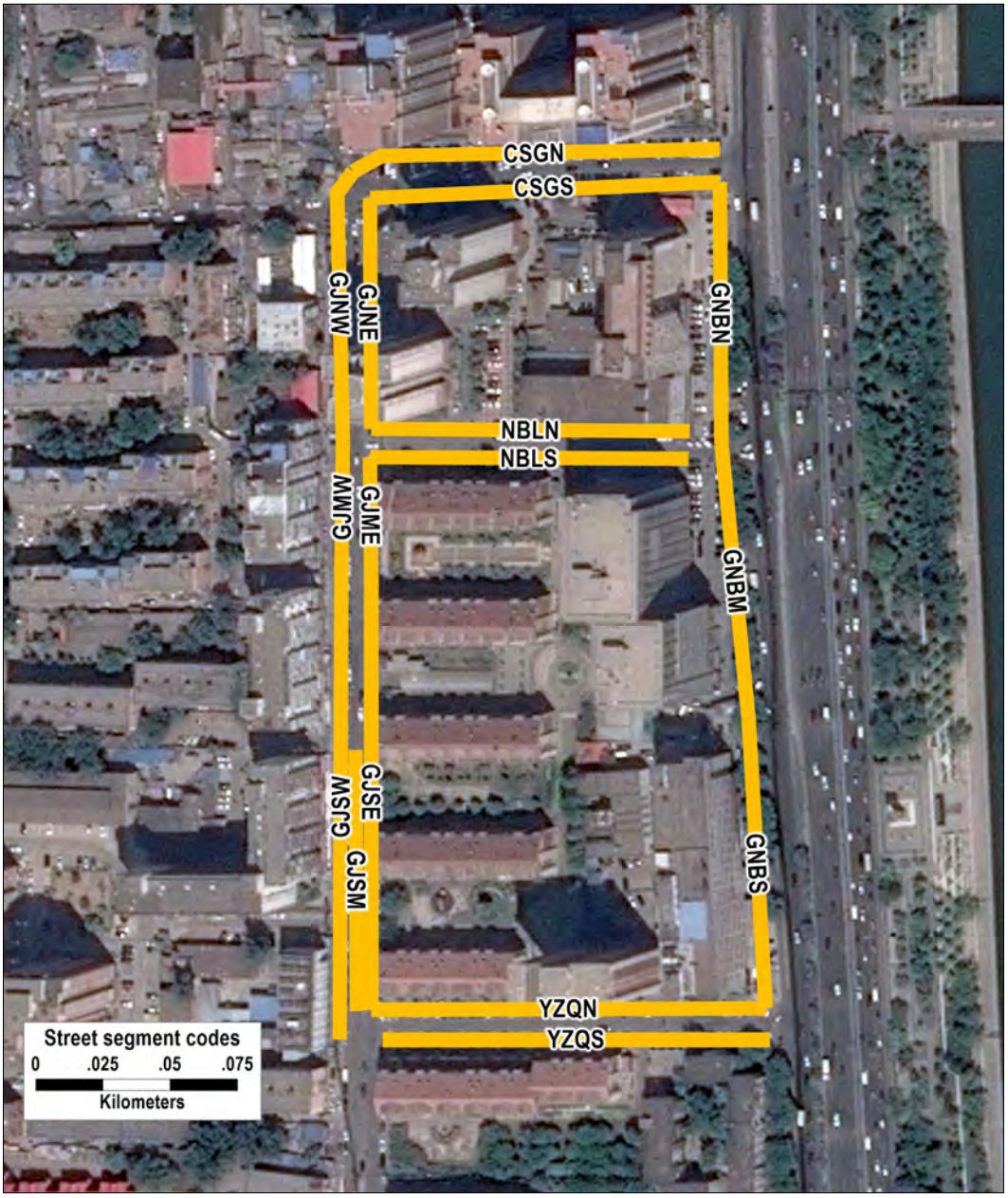
44% of vehicles are parked for over two hours, of which 26% are parked for over 4 hours.



The highest on-street parking demand of 403 vehicles (PCU) occurs at 1pm

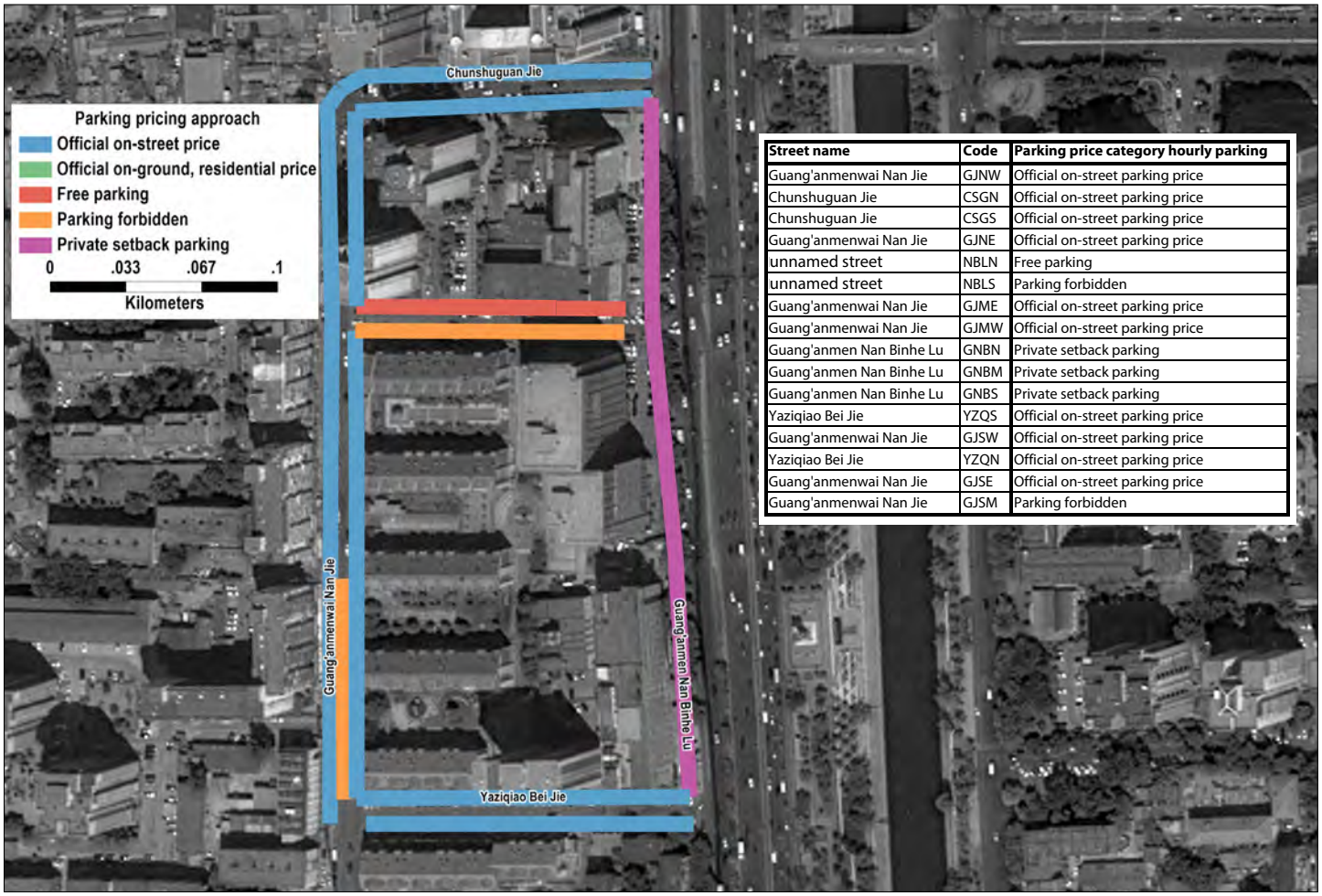
Street name	Code	Page in report	On-street parking supply [spaces]	Setback parking supply [spaces]	Avg. occupancy of parking spaces-incl. sb&sw parking [% of spaces occupied]	Avg. turnover of parking spaces [#cars/parking space/day]	Maximum parking demand [cars]	Time of maximum parking demand	Avg. parking duration [hours]	Setback& Sidewalk parking [% of total demand]
Guang'anmenwai Nan Jie	GJNW	53	21	0	123%	4.5	31	19:00	5.21	0%
Chunshuguan Jie	CSGN	54	39	0	157%	4.2	69	8:00	5.74	0%
Chunshuguan Jie	CSGS	55	21	0	162%	4.3	38	7:00	5.42	0%
Guang'anmenwai Nan Jie	GJNE	56	24	0	94%	3.2	26	17:00	4.76	0%
unnamed street	NBLN	57	2	0	7%	0.5	7	19:00	2.52	96%
unnamed street	NBLS	58	0	5	80%	4.8	6	9:00	3.42	0%
Guang'anmenwai Nan Jie	GJME	59	12	0	72%	3.3	10	11:00	3.04	0%
Guang'anmenwai Nan Jie	GJMW	60	15	0	56%	2.6	11	21:00	3.04	0%
Guang'anmen Nan Binhe Lu	GNBN	61	0	48	56%	3.4	53	13:00	2.98	85%
Guang'anmen Nan Binhe Lu	GNBM	62	0	17	91%	6	29	12:00	2.35	70%
Guang'anmen Nan Binhe Lu	GNBS	63	0	17	58%	1.7	18	13:00	5.25	88%
Yaziqiao Bei Jie	YZQS	64	24	0	121%	3.1	37	9:00	5.43	23%
Guang'anmenwai Nan Jie	GJSW	65	14	0	194%	4.9	33	14:00	5.56	7%
Yaziqiao Bei Jie	YZQN	66	43	0	84%	2.3	41	20:00	5.21	0%
Guang'anmenwai Nan Jie	GJSE	67	20	0	135%	4.5	35	13:00	4.72	2%
Guang'anmenwai Nan Jie	GJSM	68	0	0			21	20:00	1.52	0%
Total or Average			**235**	**87**	**99%**	**3.6**		**13.00**	**4.14**	

Parking profile in the Guang'anmen Yuanwuqu area



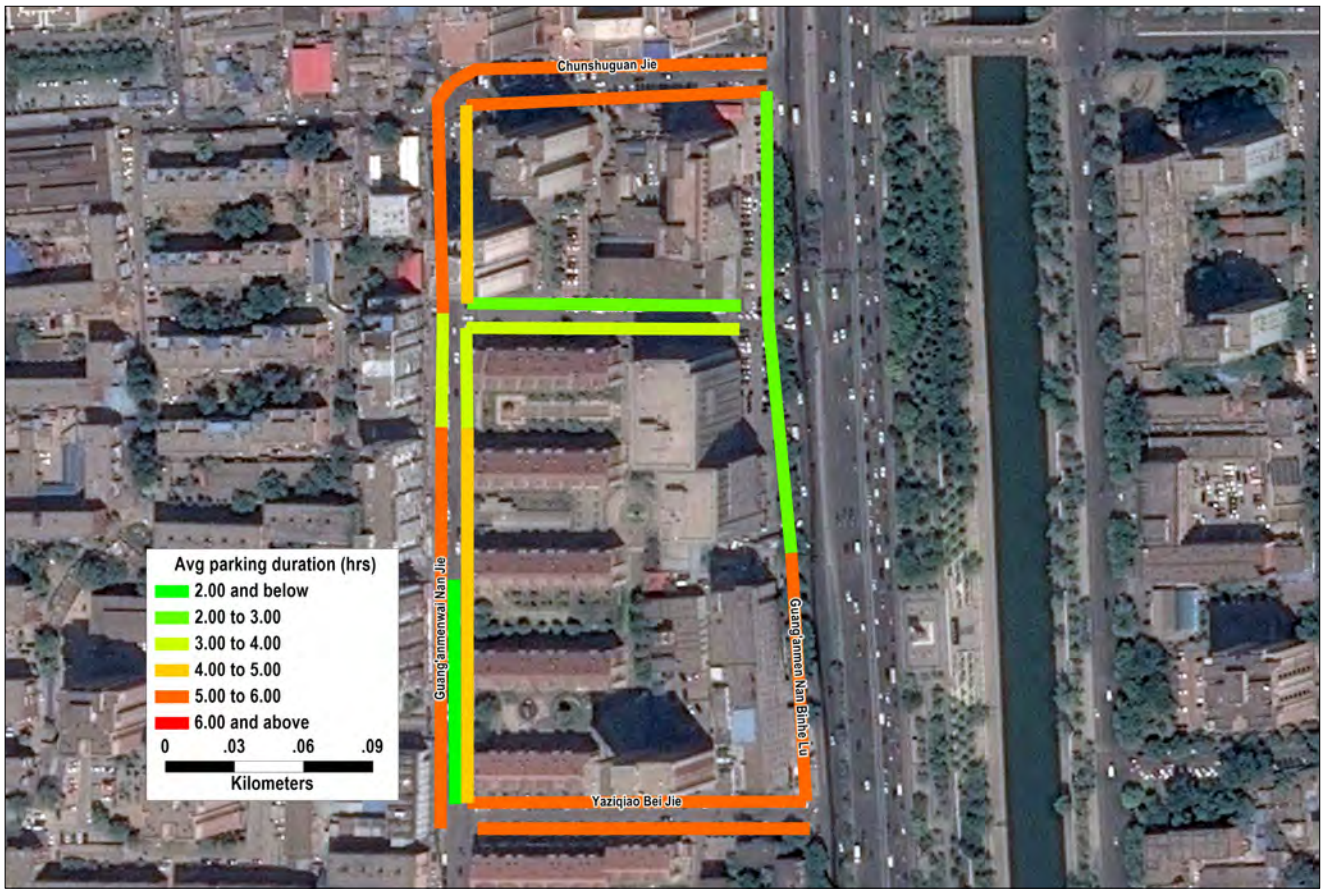
Right: street codes (referred to in parking profile table (above) and street-by-street survey description)

Above: supply of formal on-street and setback spaces/100m

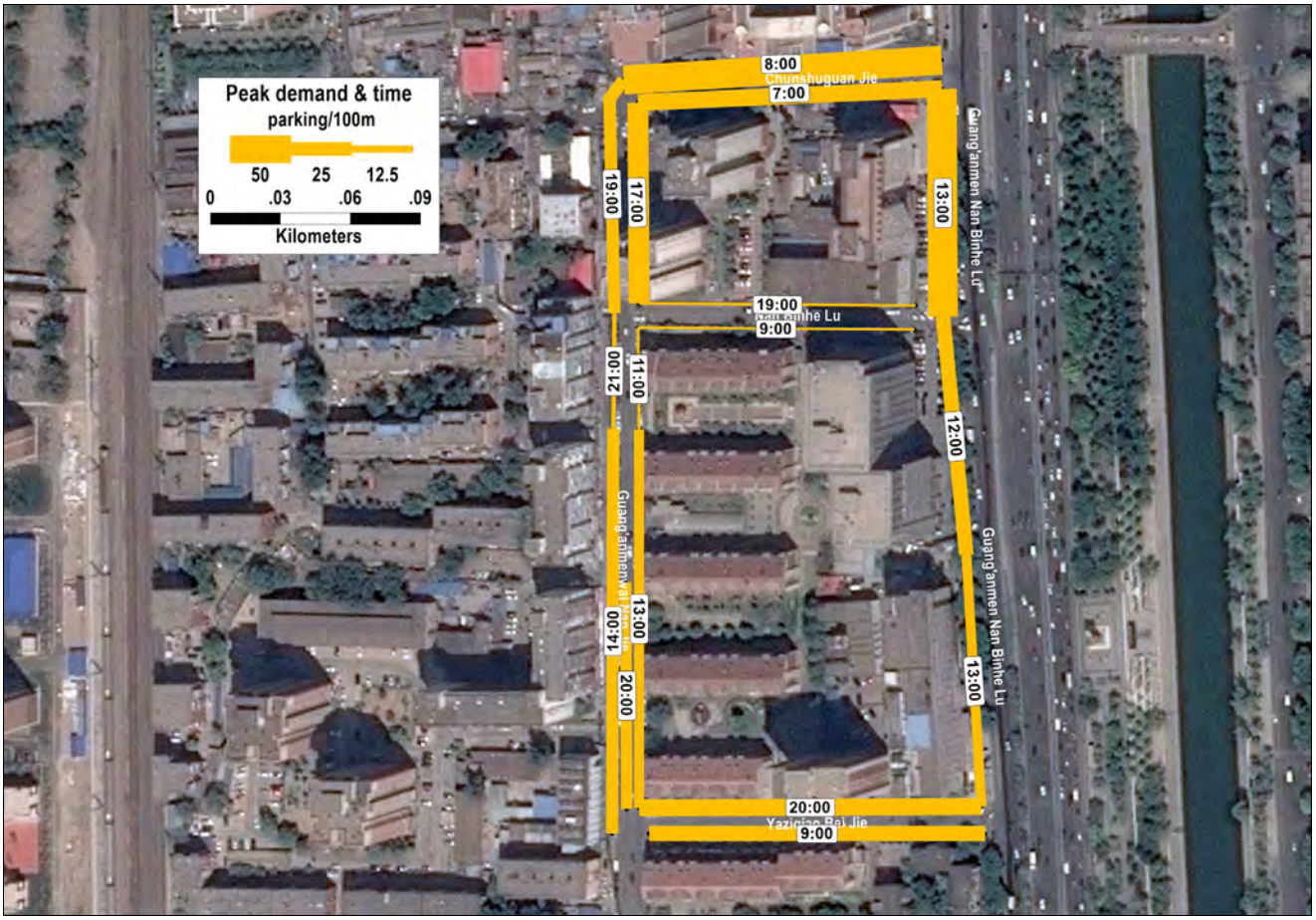


Street name	Code	Parking price category hourly parking
Guang'anmenwai Nan Jie	GJNW	Official on-street parking price
Chunshuguan Jie	CSGN	Official on-street parking price
Chunshuguan Jie	CSGS	Official on-street parking price
Guang'anmenwai Nan Jie	GJNE	Official on-street parking price
unnamed street	NBLN	Free parking
unnamed street	NBLS	Parking forbidden
Guang'anmenwai Nan Jie	GJME	Official on-street parking price
Guang'anmenwai Nan Jie	GJMW	Official on-street parking price
Guang'anmen Nan Binhe Lu	GNBN	Private setback parking
Guang'anmen Nan Binhe Lu	GNBM	Private setback parking
Guang'anmen Nan Binhe Lu	GNBS	Private setback parking
Yaziqiao Bei Jie	YZQS	Official on-street parking price
Guang'anmenwai Nan Jie	GJSW	Official on-street parking price
Yaziqiao Bei Jie	YZQN	Official on-street parking price
Guang'anmenwai Nan Jie	GJSE	Official on-street parking price
Guang'anmenwai Nan Jie	GJSM	Parking forbidden

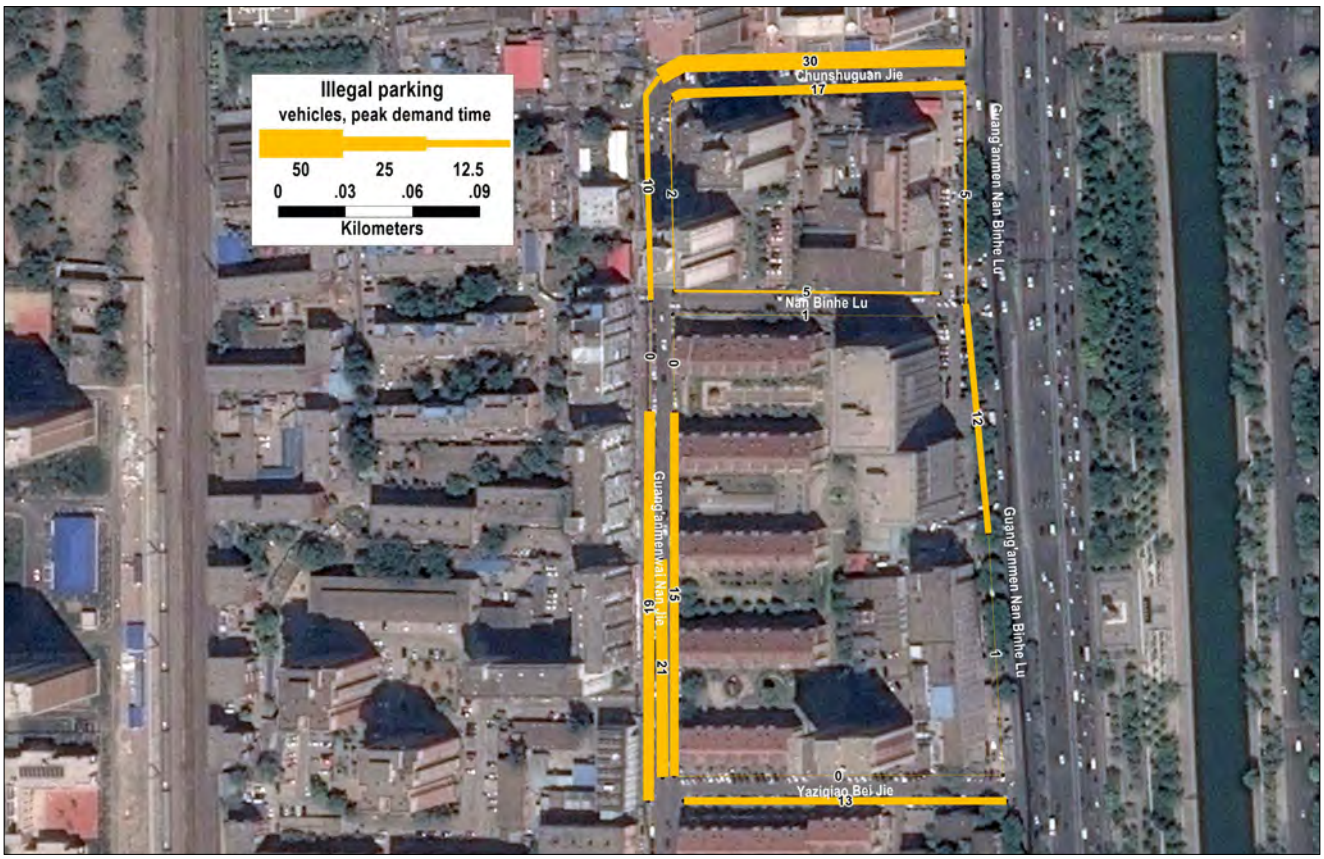
Above: parking prices vary within the area, encouraging drivers to circle, looking for the cheapest place to park.



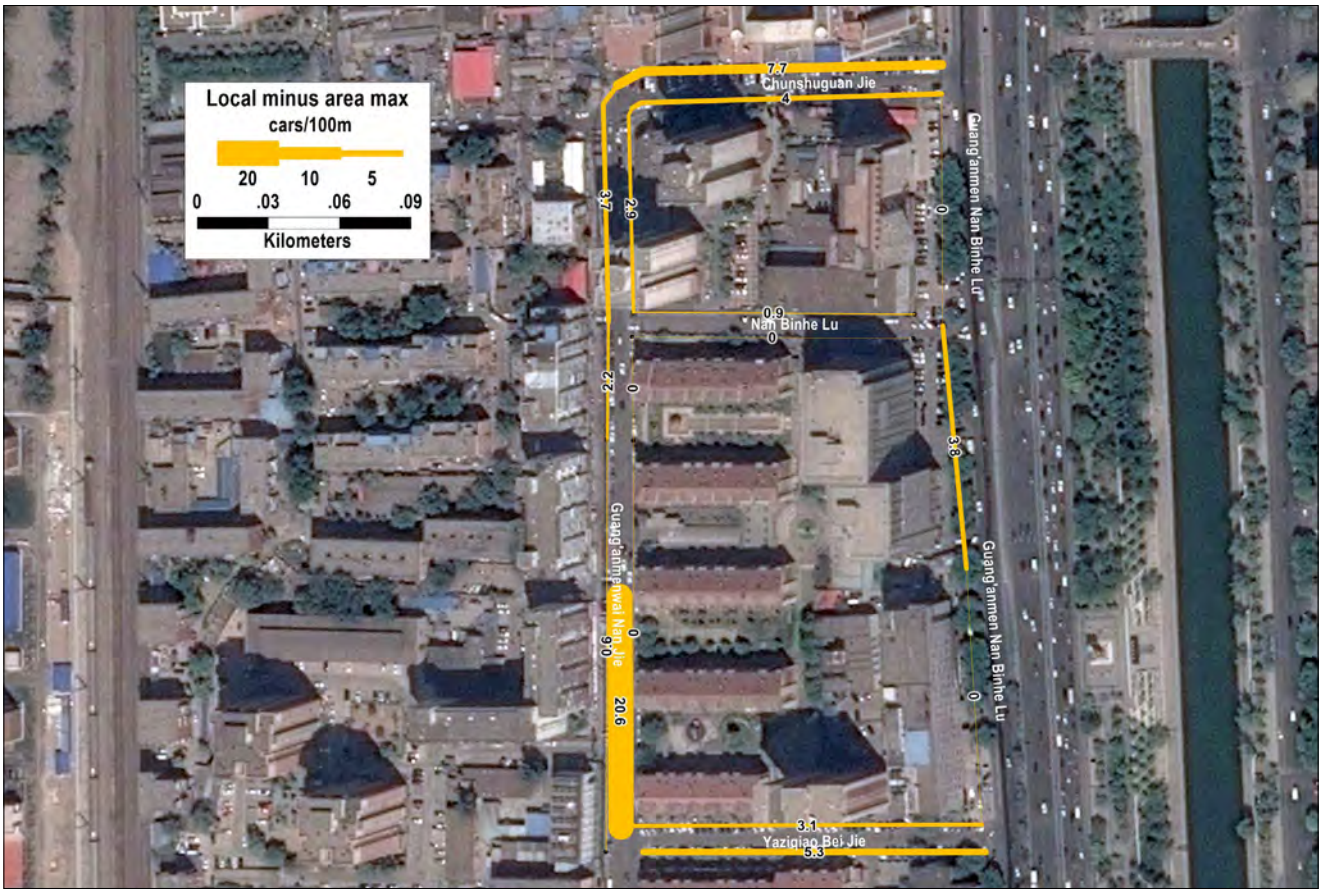
The average parking duration on many streets in the area is high and on-street parking spaces used for longer than the desired 2-3 hours.



Overall parking demand is highest at 1pm, suggesting that most is employee parking, especially on Guang'anmen Nan Binhe Lu and Chunshuguan Jie.



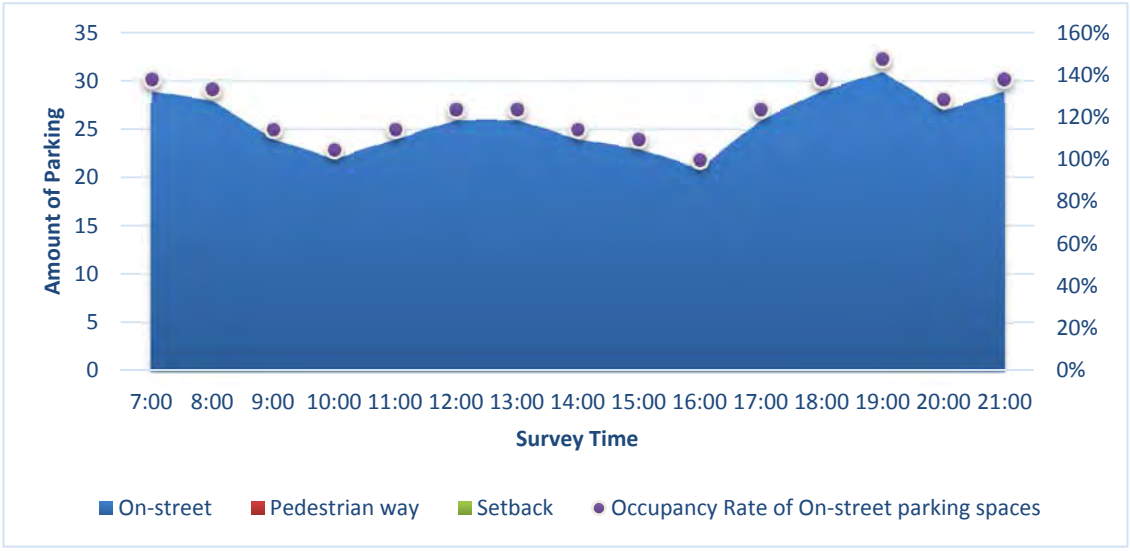
Above: illegal parking during the peak demand of 1pm. Especially Chunsguguan Jie and the southern end of Guang'anmen Wai Nan Jie see high amounts of illegal parking. This parking should be relocated to vacant on-street parking (see below) and underground parking in Yuanwuqu residential area and Guidu Guoji Zhongxin (Guidu international center).

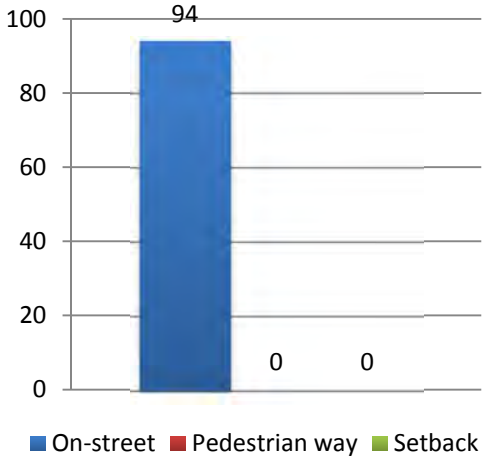


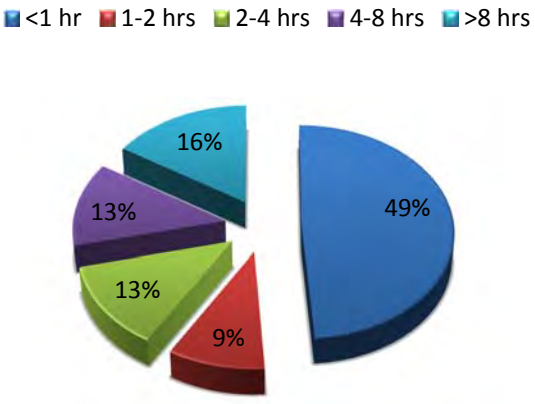
Above: on-street parking vacancy during peak parking time. With proper enforcement in place, drivers can find vacant on-street parking spaces on the streets shown above. Real-time parking guidance systems can assist.

Guangwai Nan Jie (northwest) - GJNW

Indicator	value	unit
On-street supply	21	parking spaces
Average occupancy rate for on street parking spaces	123	%
Turnover rate for on street parking spaces in 14 hours	4.5	times
Maximum demand (including illegal parking)	31	cars
Peak parking time	7:00	PM



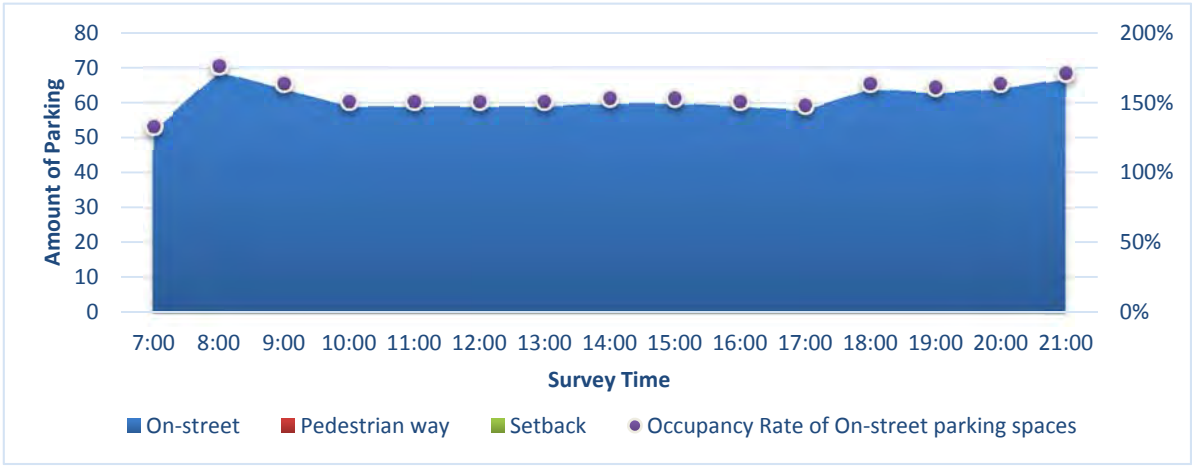


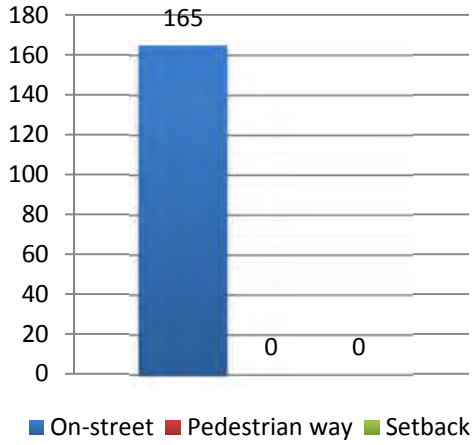


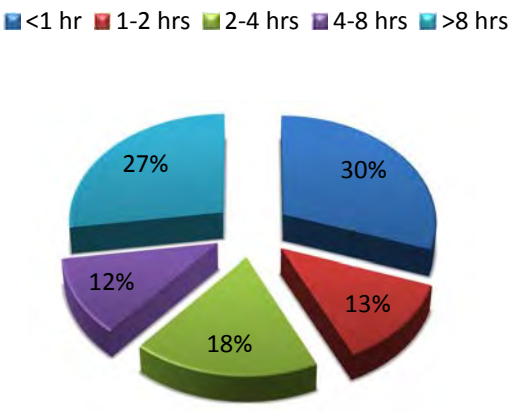
- Parking demand is high in this street, with an occupancy of over 100% for the entire day. All cars are parked on-street but 49 % of parking demand is less 1 hour, 29% parks is more than 4 hours.

Chunshuguan Jie (north) - CSGN

Indicator	value	unit
On-street supply	39	parking spaces
Average occupancy rate for on street parking spaces	157	%
Turnover rate for on street parking spaces in 14 hours	4.2	times
Maximum demand (including illegal parking)	69	cars
Peak parking time	8:00	AM



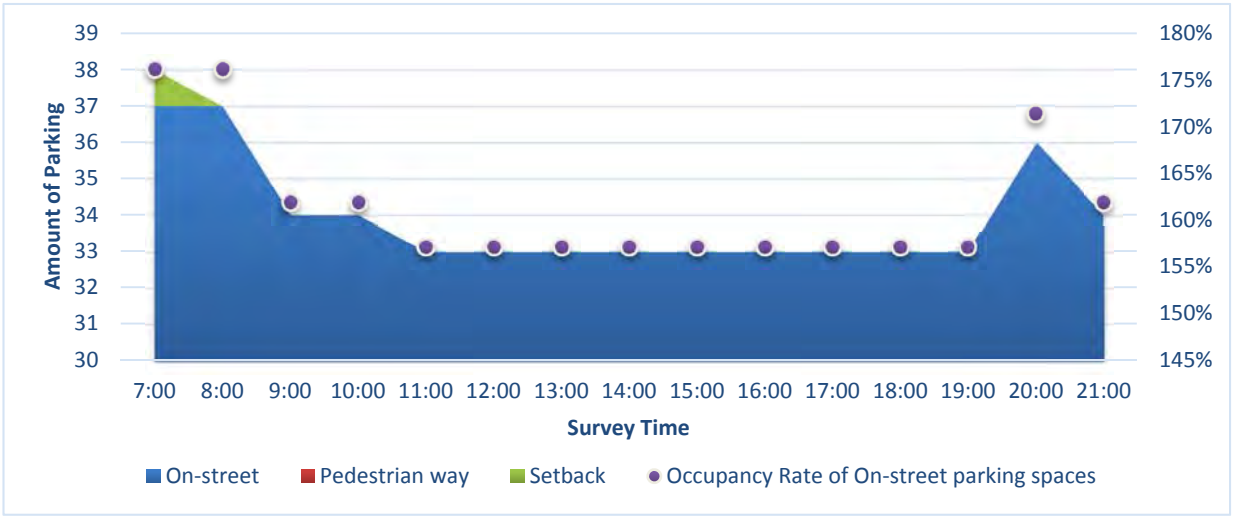


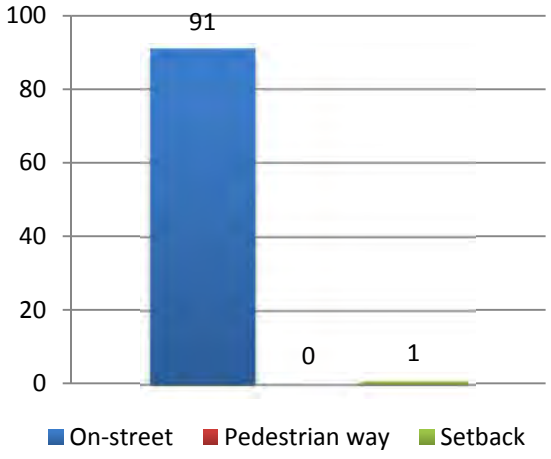


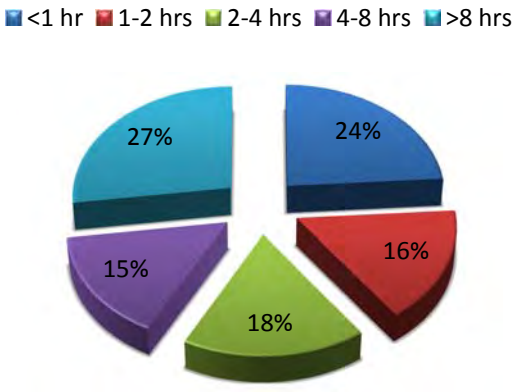
- Parking demand is high in this street, with an occupancy of over 100% for the entire day. All cars are parked on-street but 39 % of parking is over 4 hours. The parking guard mentions that parking is paid for monthly for employees in surrounding buildings.

Chunshuguan Jie (south) - CSGS

Indicator	value	unit
On-street supply	21	parking spaces
Average occupancy rate for on street parking spaces	162	%
Turnover rate for on street parking spaces in 14 hours	4.3	times
Maximum demand (including illegal parking)	38	cars
Peak parking time	7:00	AM



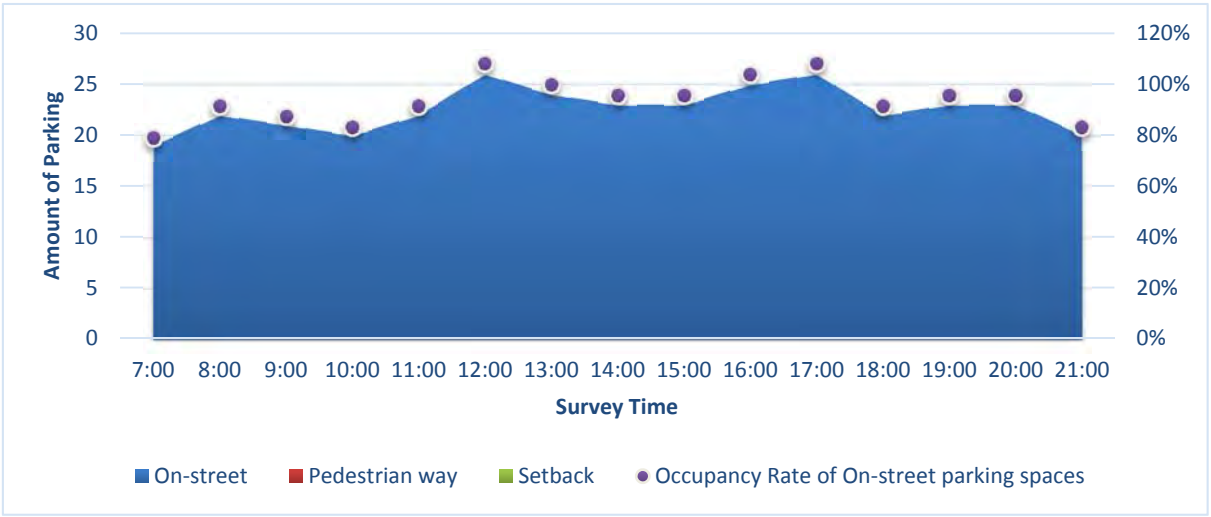


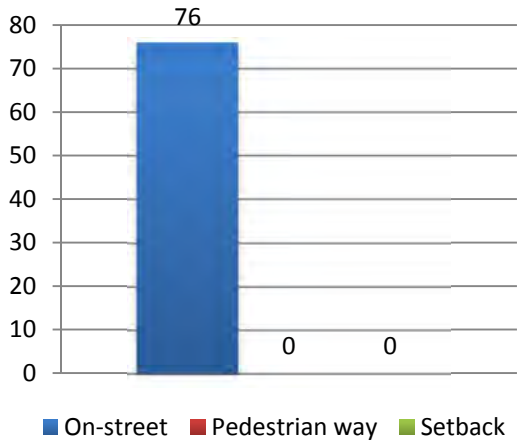


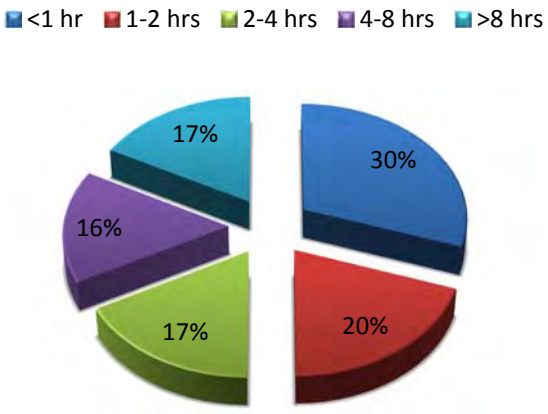
- Parking demand is high in this street, with an occupancy of over 150% for the entire day. All cars are parked on-street but 42 % of parking is over 4 hours. The parking guard mentions that parking is paid for monthly for employees in surrounding buildings, but the high night time parking demand also suggests the use for residential parking.

Guangwai Nan Jie (northeast) - GJNE

Indicator	value	unit
On-street supply	24	parking spaces
Average occupancy rate for on street parking spaces	94	%
Turnover rate for on street parking spaces in 14 hours	3.2	times
Maximum demand (including illegal parking)	26	cars
Peak parking time	12:00/5:00	mid-day/PM



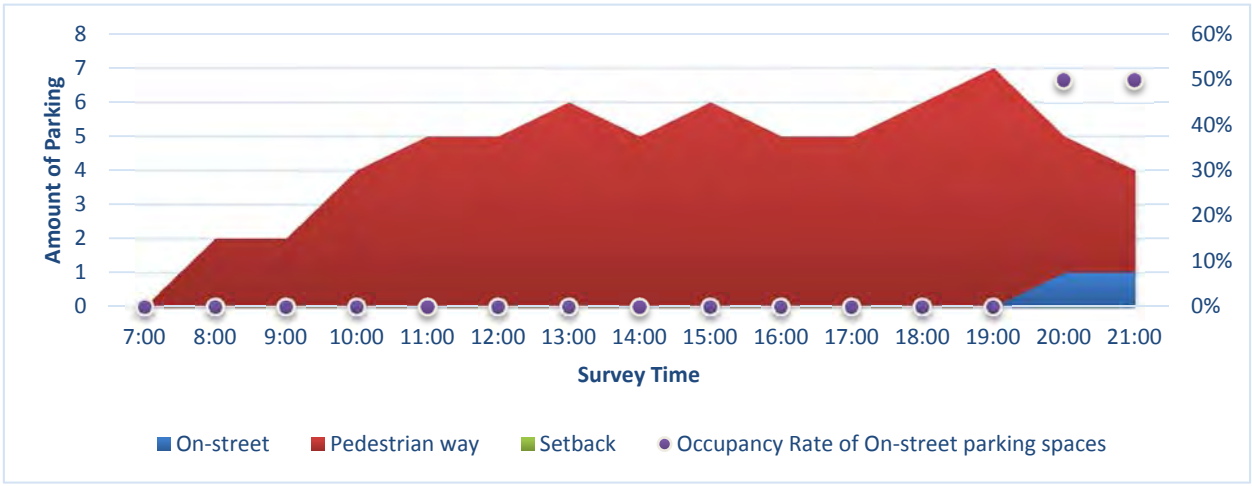


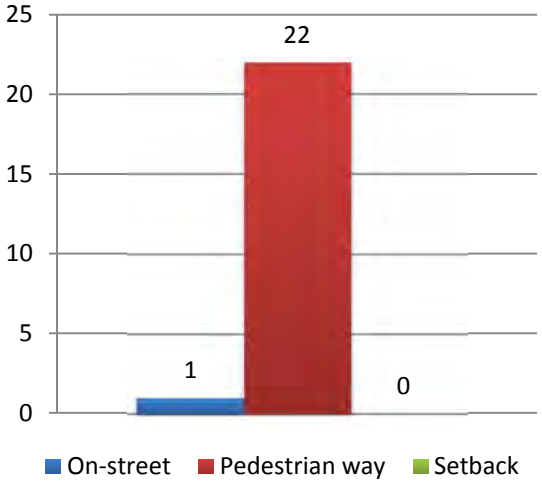


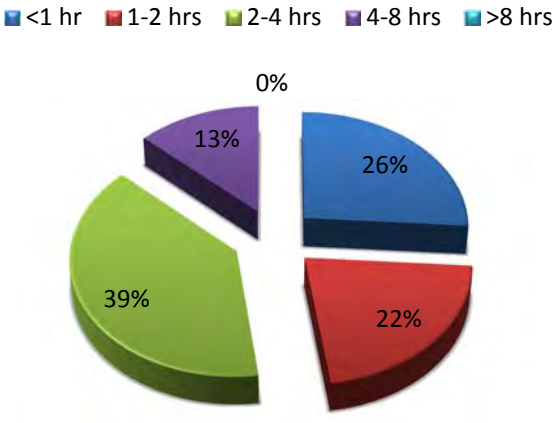
- Parking demand is high in this street, with an occupancy nearing 100% for most of the day. All cars are parked on-street but 50 % of parking is over 2 hours, of which 33% over 4 hours. Turnover is low at 3.2 cars per parking space during survey hours.

Unnamed street (north) - NBLN

Indicator	value	unit
On-street supply	2	parking spaces
Average occupancy rate for on street parking spaces	7	%
Turnover rate for on street parking spaces in 14 hours	0.5	times
Maximum demand (including illegal parking)	7	cars
Peak parking time	7:00	PM





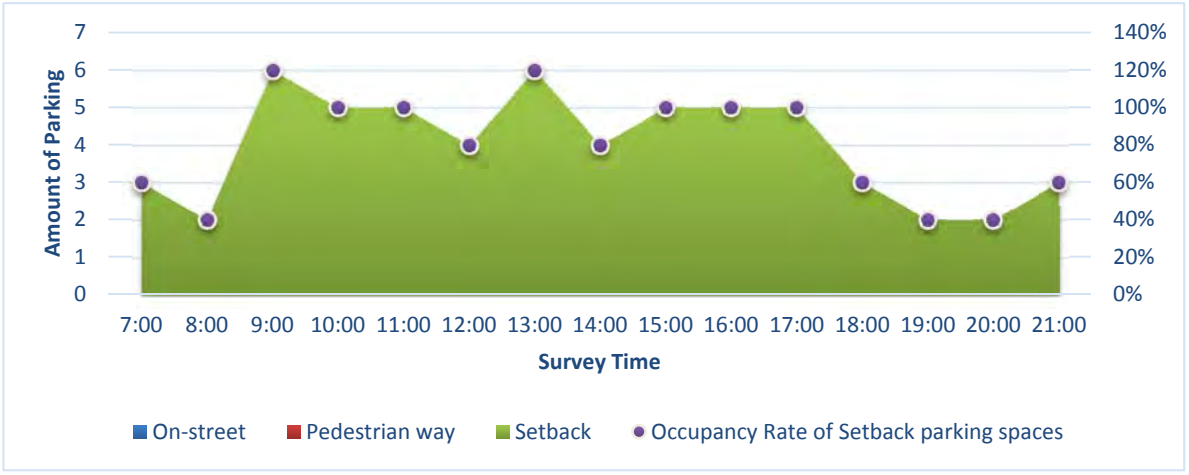


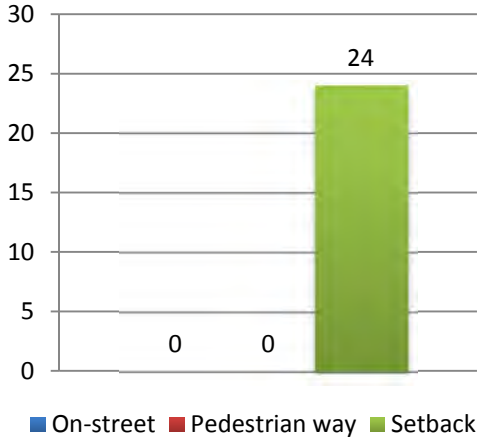
- Parking demand is low on this street and nearly all parking (93%) is illegal on the sidewalk. Bollards can guide drivers to park on the sidewalk.

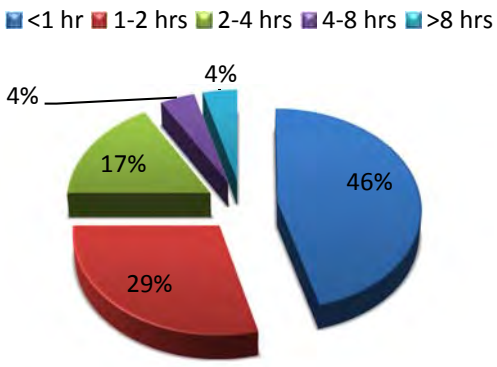
* Note: "Unnamed street is referred to in some graphics as "Nanbinhe Lu". This street name is incorrect (it is actually unnamed), but the associated data is correct.

Unnamed street (south) - NBLS

Indicator	value	unit
On-street supply	5	parking spaces
Average occupancy rate for on street parking spaces	80	%
Turnover rate for on street parking spaces in 14 hours	4.8	times
Maximum demand (including illegal parking)	6	cars
Peak parking time	9:00/1:00	AM/PM





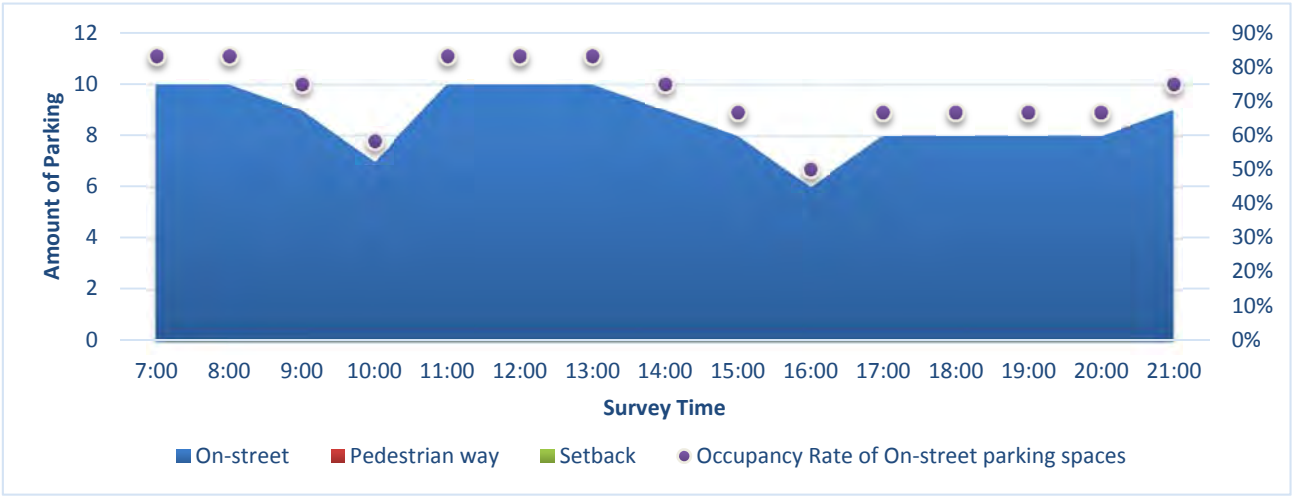


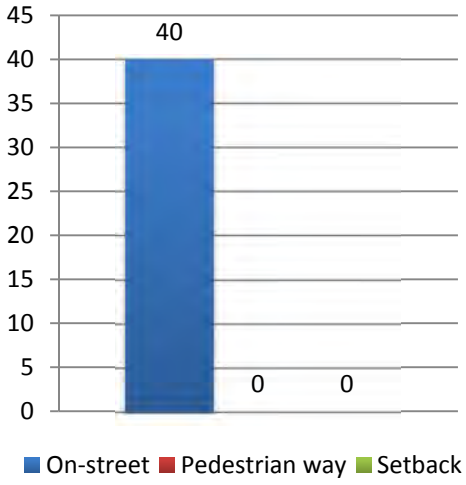
- Parking demand is low on this street and all parking is on the setback. Parking is mostly short-term (75% under two hours).

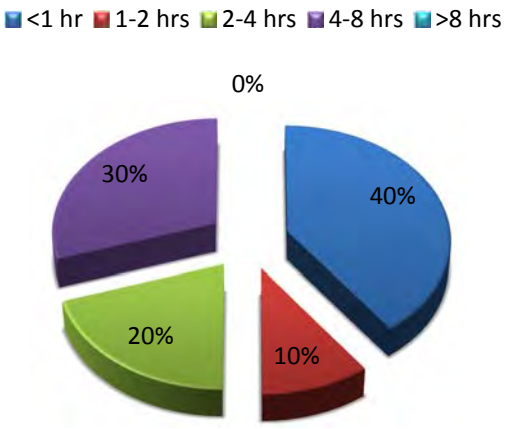
* Note: "Unnamed street is referred to in some graphics as "Nanbinhe Lu". This street name is incorrect (it is actually unnamed), but the associated data is correct.

Guangwai Nan Jie (middle east) - GJME

Indicator	value	unit
On-street supply	12	parking spaces
Average occupancy rate for on street parking spaces	72	%
Turnover rate for on street parking spaces in 14 hours	3.3	times
Maximum demand (including illegal parking)	10	cars
Peak parking time	7:00/11:00	AM/PM



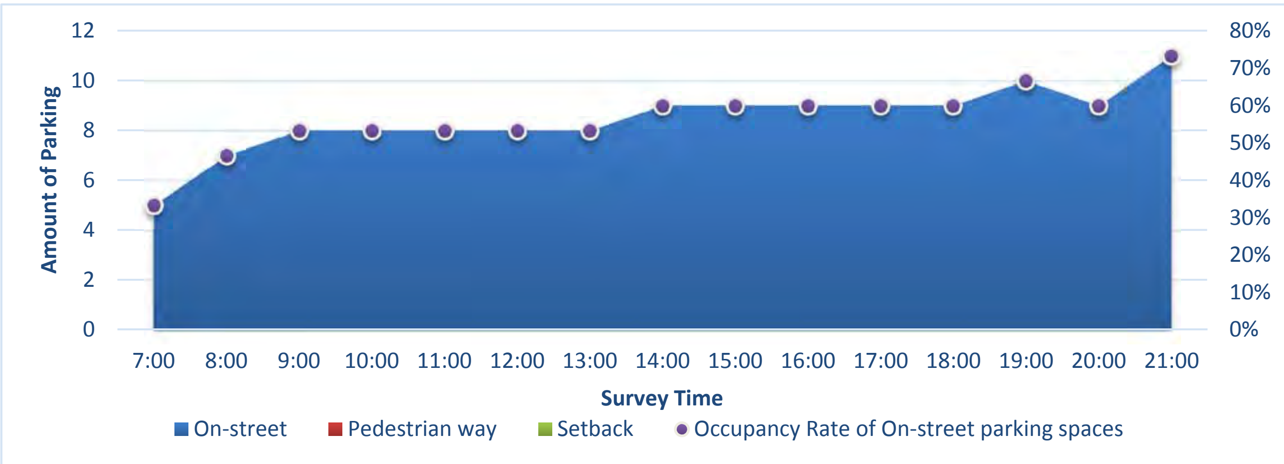


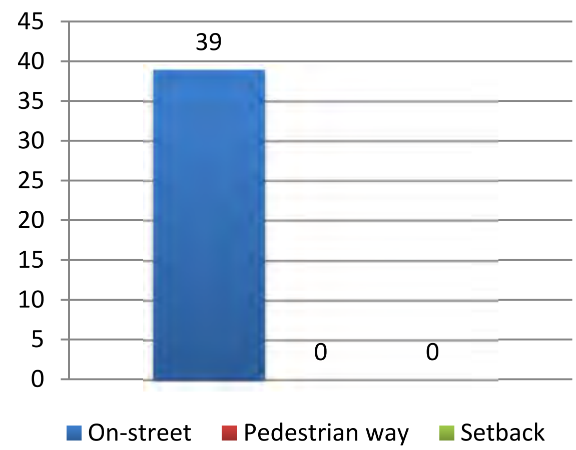


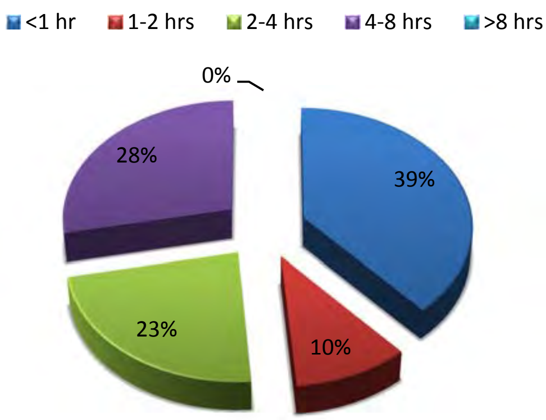
- Parking supply is sufficient to meet demand all day, with an average occupancy of 72%. All cars are parked on-street but 30% of all cars still park over 4 hours and turnover is low at 3.3 cars per parking space during the surveyed hours.

Guangwai Nan Jie (middle west) - GJMW

Indicator	value	unit
On-street supply	15	parking spaces
Average occupancy rate for on street parking spaces	56	%
Turnover rate for on street parking spaces in 14 hours	2.6	times
Maximum demand (including illegal parking)	11	cars
Peak parking time	9:00	PM



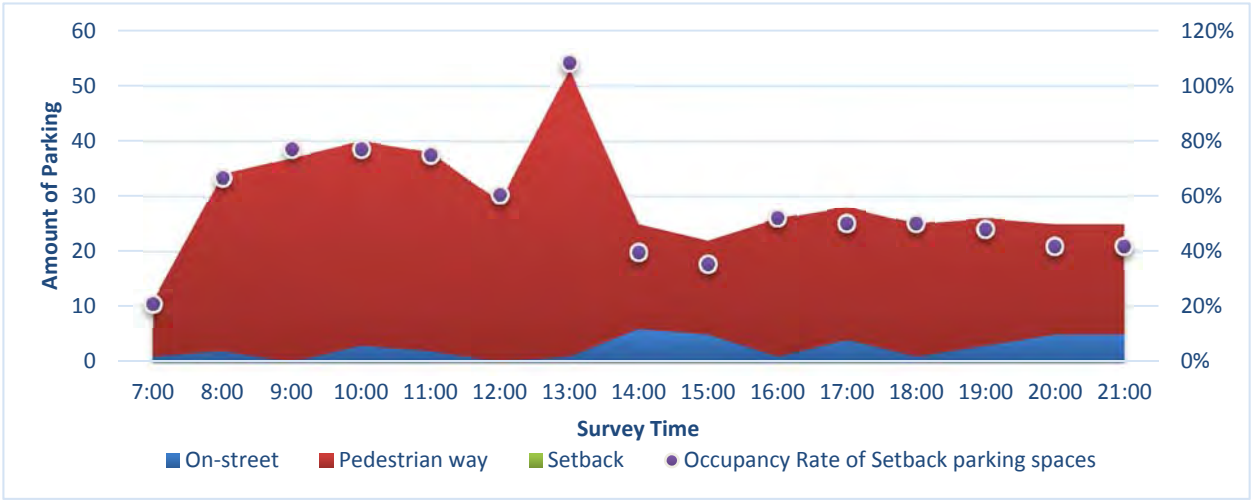


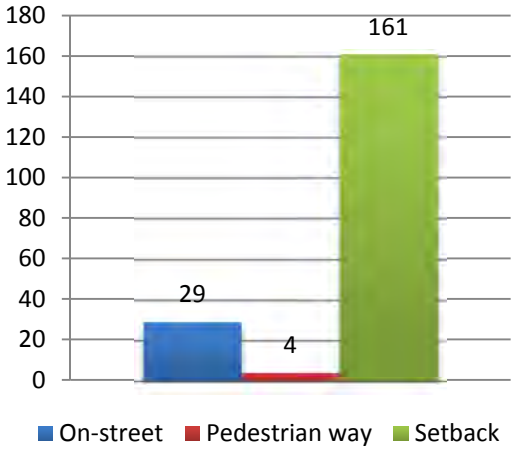


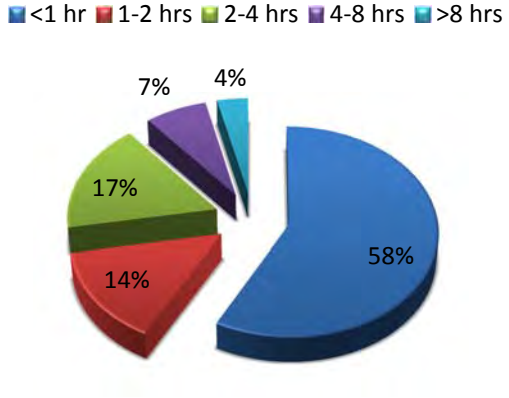
- Parking supply is sufficient to meet demand all day, with an average occupancy of only 56%. All cars are parked on-street but 30% of all cars park over 4 hours and turnover is low at 3.3 cars/parking space during the surveyed hours.

Guang'anmen Nan Binhe Lu (north) - GNBN

Indicator	value	unit
Setback supply	48	parking spaces
Average occupancy rate for setback parking spaces	56	%
Turnover rate for setback parking spaces in 14 hours	3.4	times
Maximum demand (including illegal parking)	53	cars
Peak parking time	1:00	PM

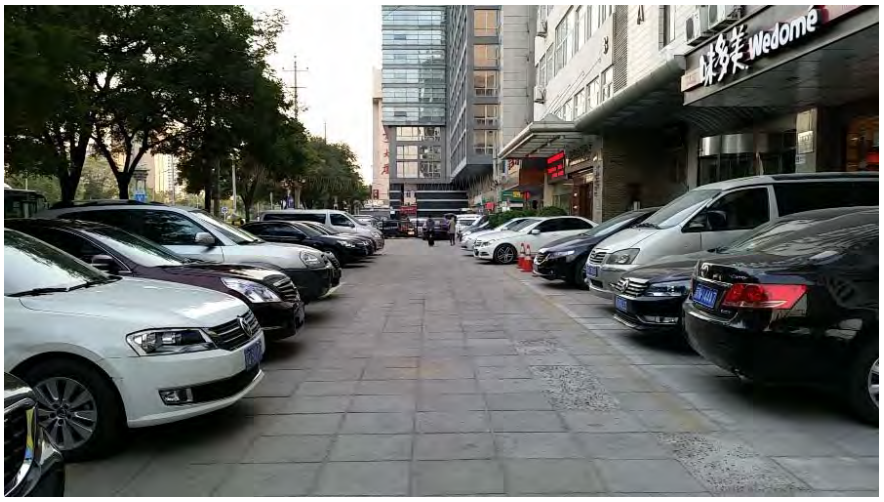




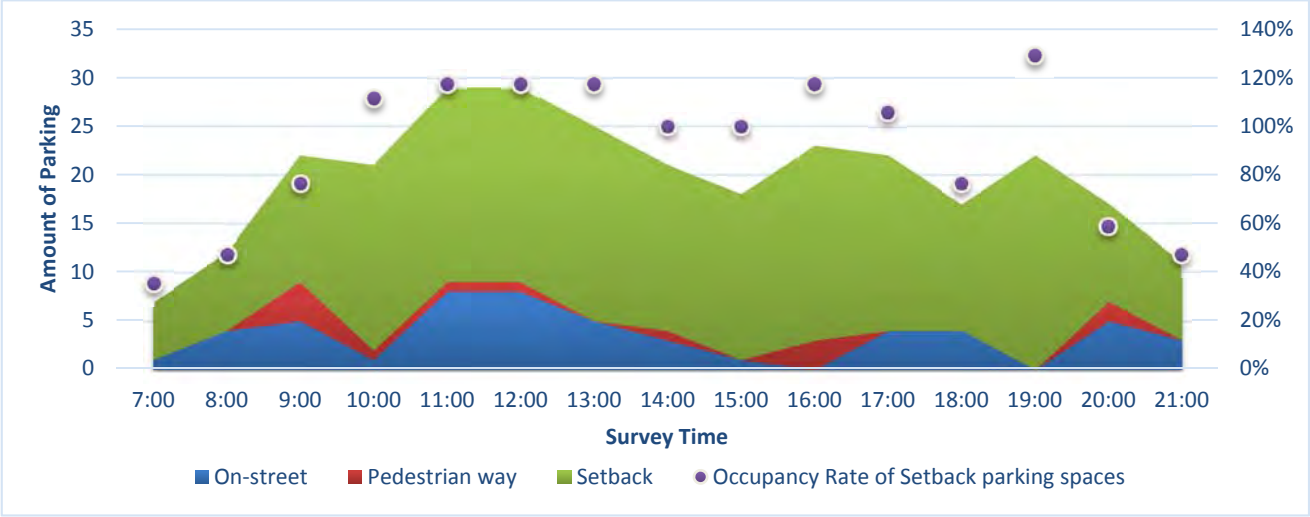


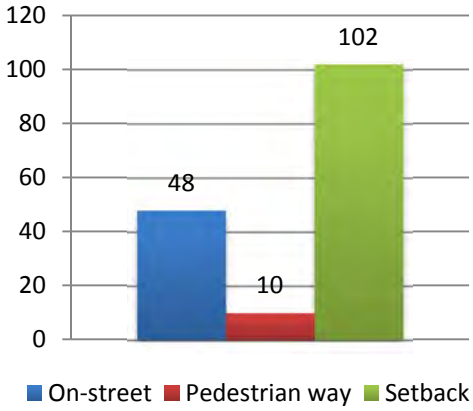
- Nearly all cars (83%) are parked on the setback, but most parking (72%) is under two hours. The setback parking is organized and has an occupancy of only 56%.

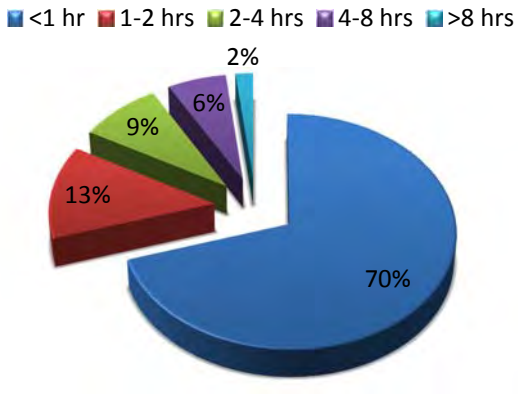
Guang'anmen Nan Binhe Lu (middle) - GNBM



Indicator	value	unit
Setback supply	17	parking spaces
Average occupancy rate for setback parking spaces	91	%
Turnover rate for setback parking spaces in 14 hours	6.0	times
Maximum demand (including illegal parking)	29	cars
Peak parking time	11:00/12:00	AM/mid-day



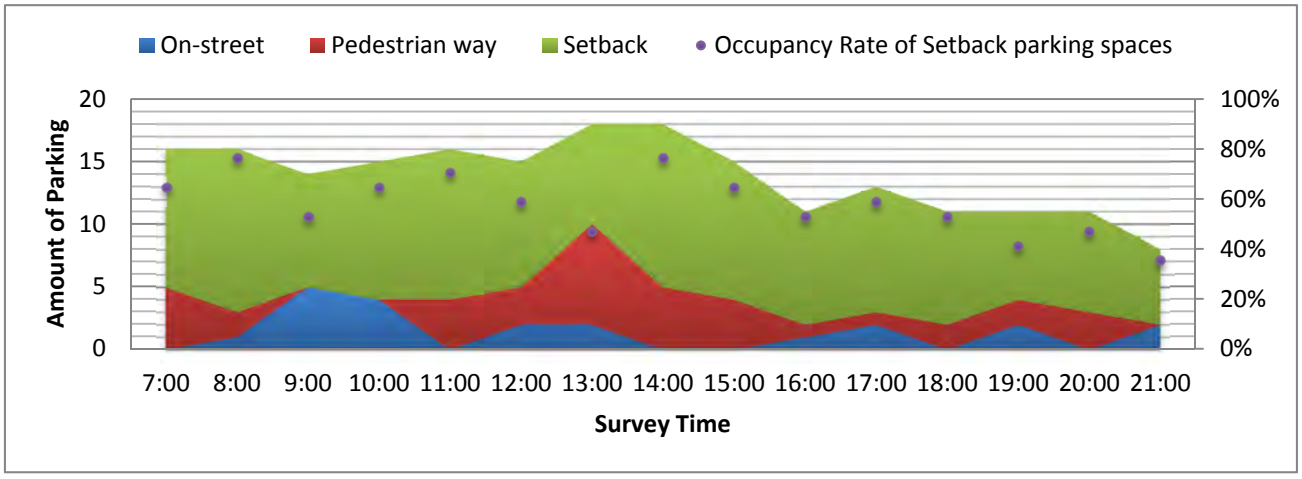


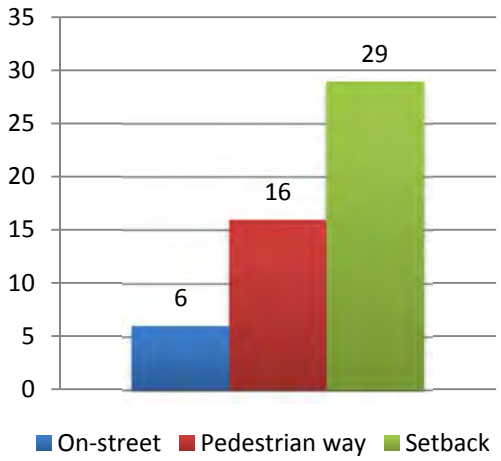


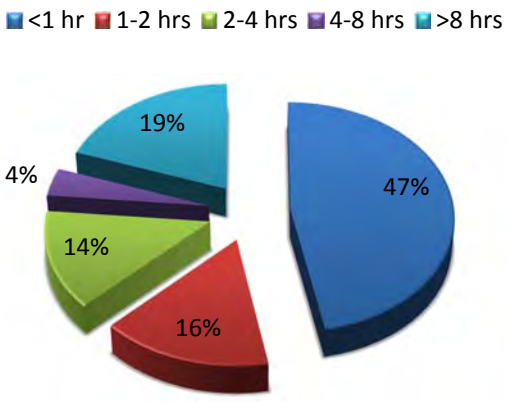
- Most cars (64%) are parked on the setback and 83% of parking is under two hours. The setback parking has an average occupancy of 91% and turnover is high at 6 cars/space during survey hours.

Guang'anmen Nan Binhe Lu (south) - GNBS

Indicator	value	unit
Setback supply	17	parking spaces
Average occupancy rate for setback parking spaces	58	%
Turnover rate for setback parking spaces in 14 hours	1.7	times
Maximum demand (including illegal parking)	18	cars
Peak parking time	1:00/2:00	PM



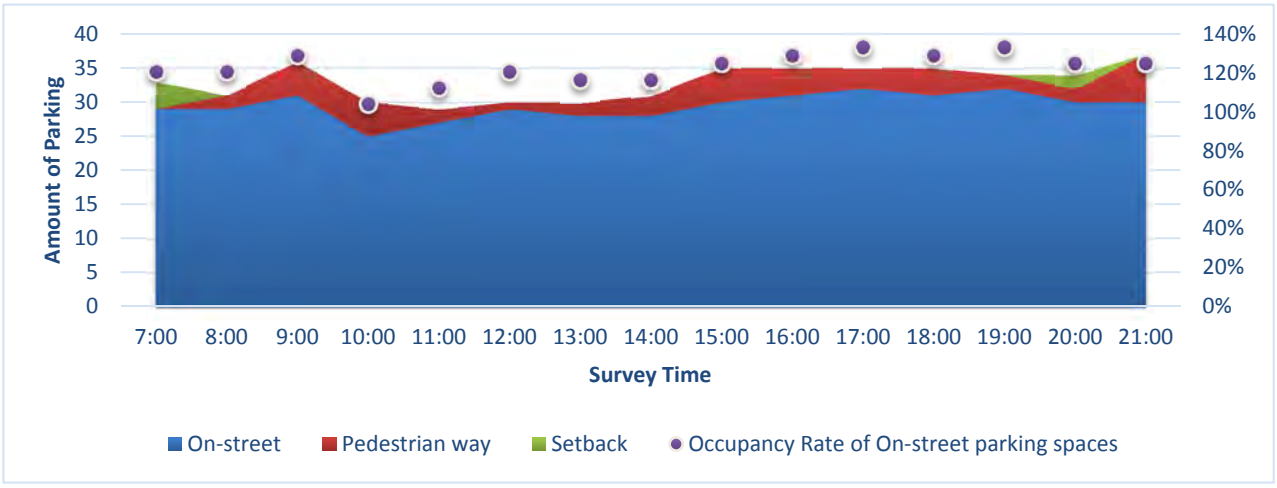


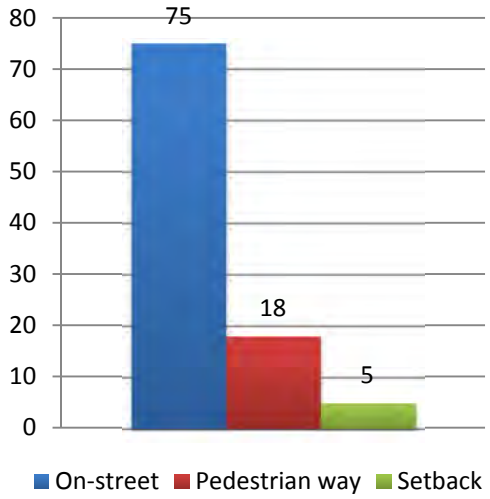


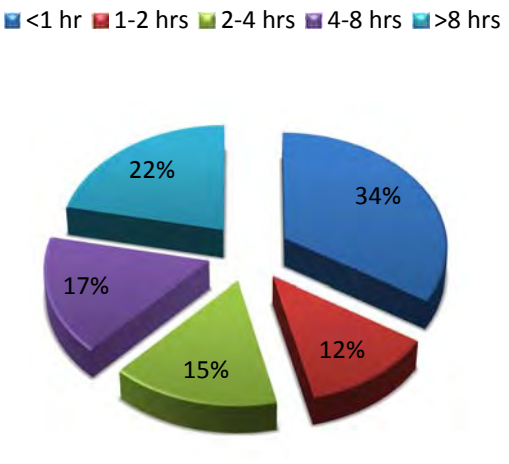
- Cars are mostly parked on the setback (57%) and sidewalk (31%) even though the setback parking has an occupancy of 58%. Turnover is extremely low at 1.7 cars/space during survey hours.

Yaziqiao Bei Jie (south) - YZQS

Indicator	value	unit
On-street supply	24	parking spaces
Average occupancy rate for on-street parking spaces	121	%
Turnover rate for on-street parking spaces in 14 hours	3.1	times
Maximum demand (including illegal parking)	37	cars
Peak parking time	9:00	PM



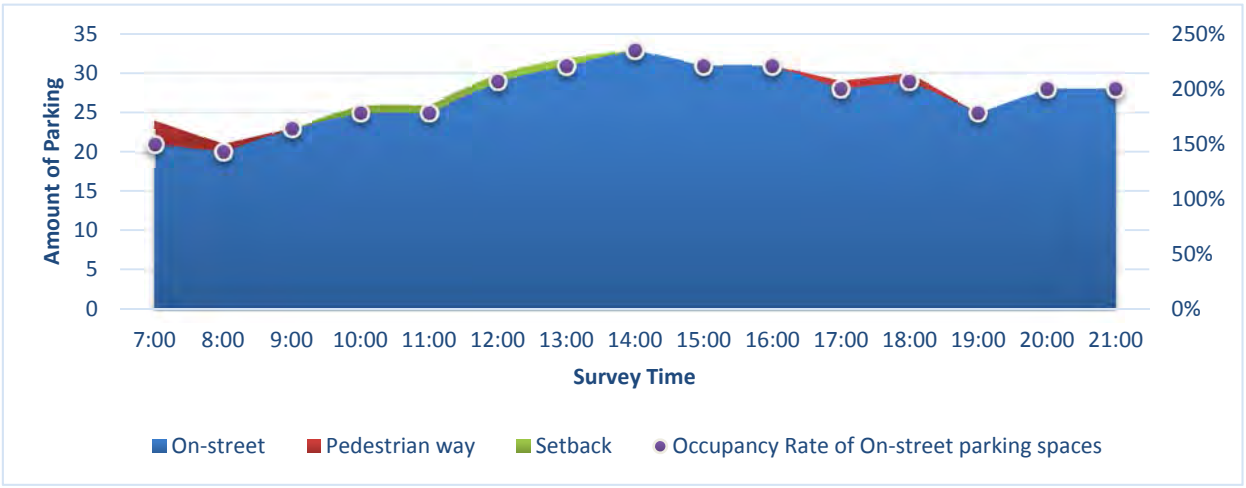


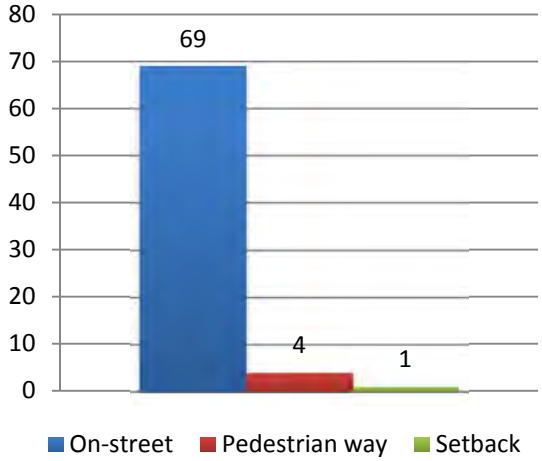


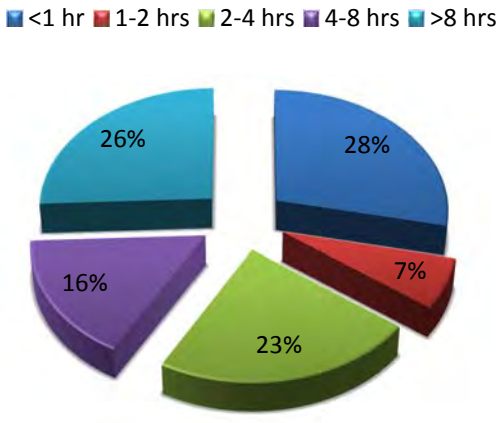
- Parking demand is high on this section with an average occupancy of 121%. Cars are mostly (77%) parked on-street, turnover is low at 3.1 cars/space and 54% of drivers park over 4 hours.

Guangwai Nan Jie (southwest) -GJSW

Indicator	value	unit
On-street supply	14	parking spaces
Average occupancy rate for on street parking spaces	194	%
Turnover rate for on street parking spaces in 14 hours	4.9	times
Maximum demand (including illegal parking)	33	cars
Peak parking time	2:00	PM



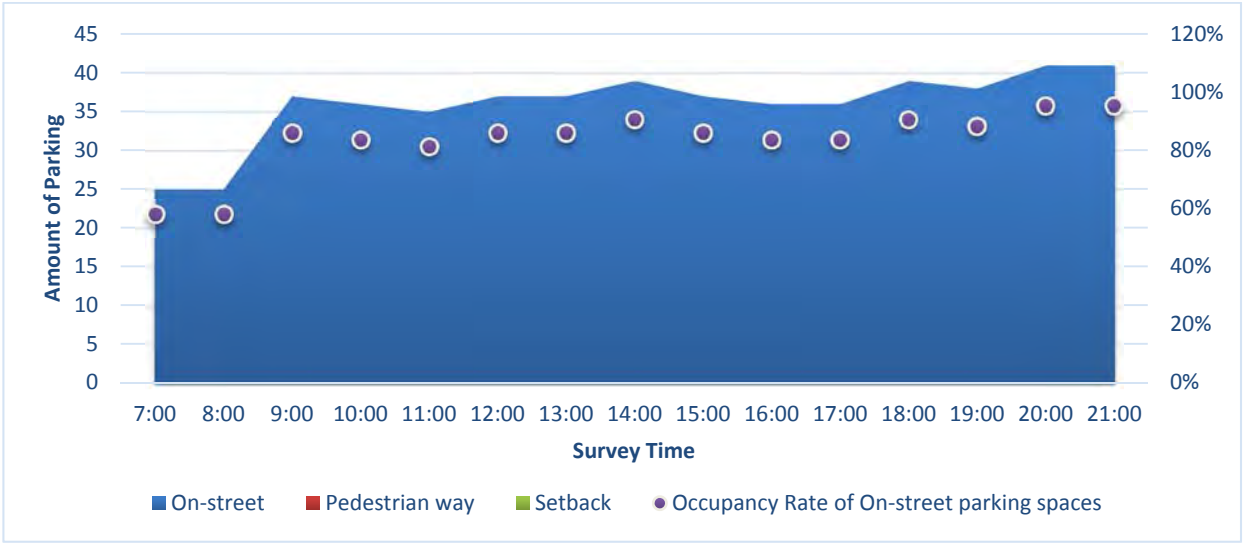


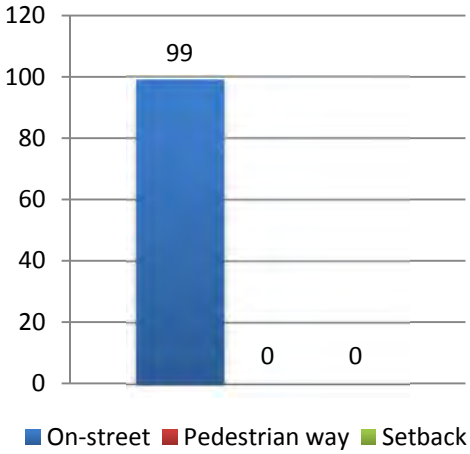


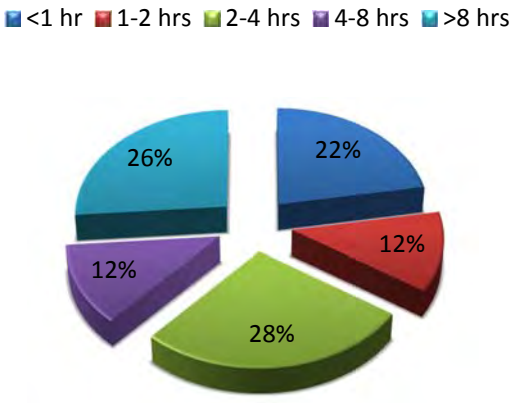
- Parking demand is very high on this section, with occupancies exceeding 194% at all times, due to double parking. Turnover is high at 4.9 cars/space but most parking (64%) is over two hours. Nearly all parking (93%) is on-street.

Yaziqiao Bei Jie (north) - YZQN

Indicator	value	unit
On-street supply	43	parking spaces
Average occupancy rate for on street parking spaces	84	%
Turnover rate for on street parking spaces in 14 hours	2.3	times
Maximum demand (including illegal parking)	41	cars
Peak parking time	8:00/9:00	PM



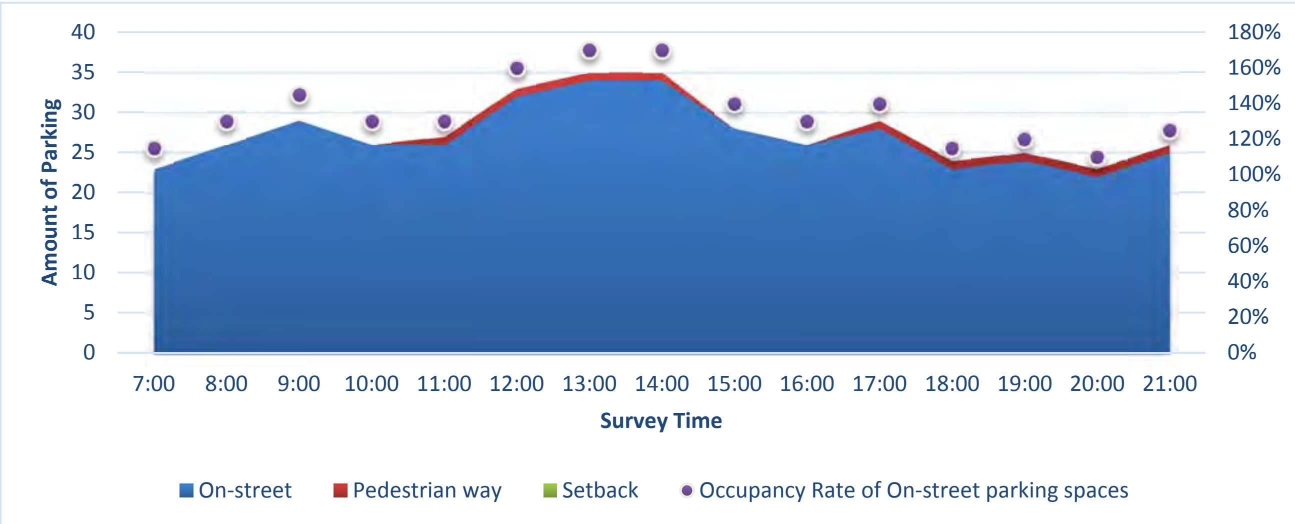


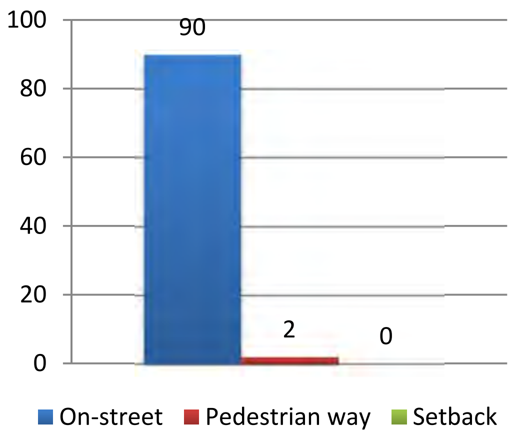


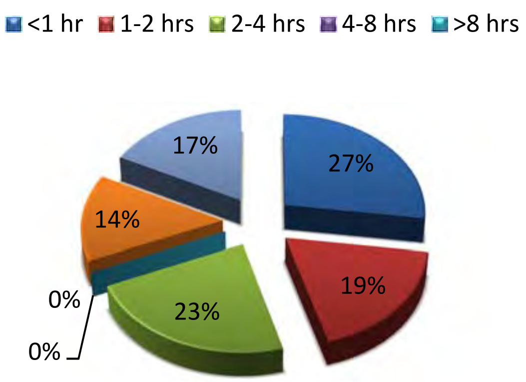
- Parking demand is high in this street, most of time the occupancy is more than 100%. 22% parking is less 1 hour, 38% parking is more than 4 hours.

Guangwai Nan Jie (southeast) - GJSE

Indicator	value	unit
On-street supply	20	parking spaces
Average occupancy rate for on street parking spaces	135	%
Turnover rate for on street parking spaces in 14 hours	4.5	times
Maximum demand (including illegal parking)	35	cars
Peak parking time	1:00/2:00	PM



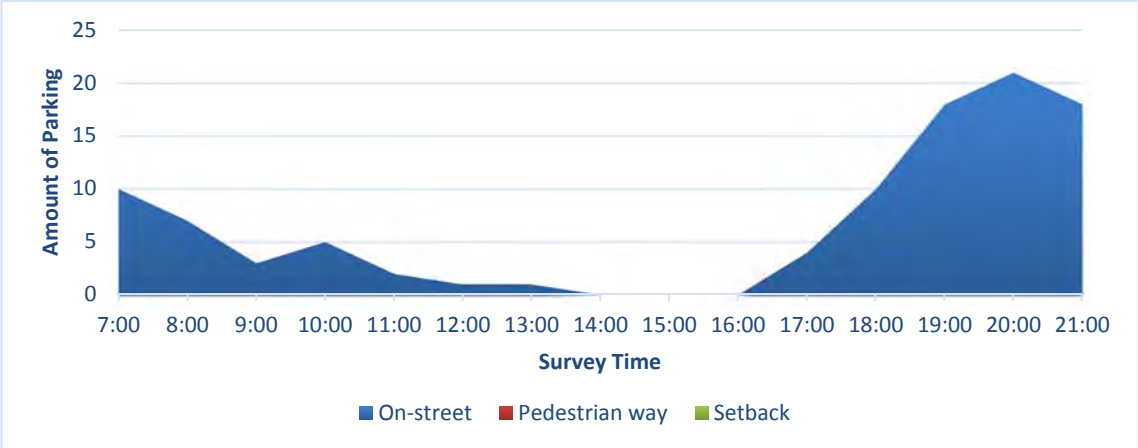


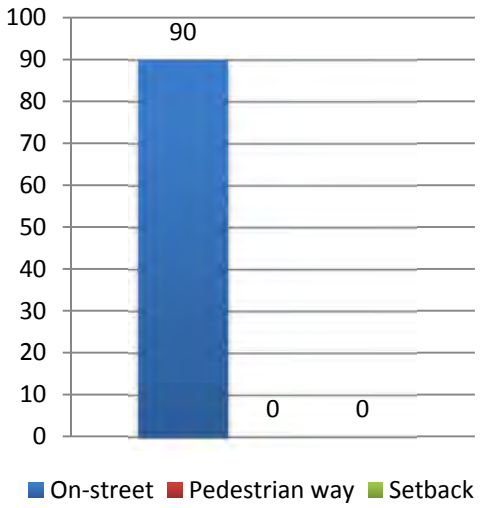


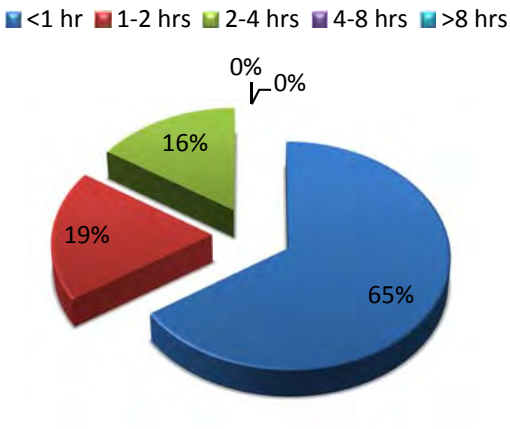
- Parking demand is very high on this section, with occupancies exceeding 100% at all times, due to double parking, with an average occupancy of 135%. Turnover is moderately high at 4.5 cars/space and all parking is on-street.

Guangwai Nan Jie - GJSM

Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	21	cars
Peak parking time	8:00	PM







- Due to high parking demand and a road that is too wide for its traffic demand, two lanes of illegal parking in the middle of Guangwai Nan Jie is common, especially at night. During day time, parking duration is short 84% parking under two hours.

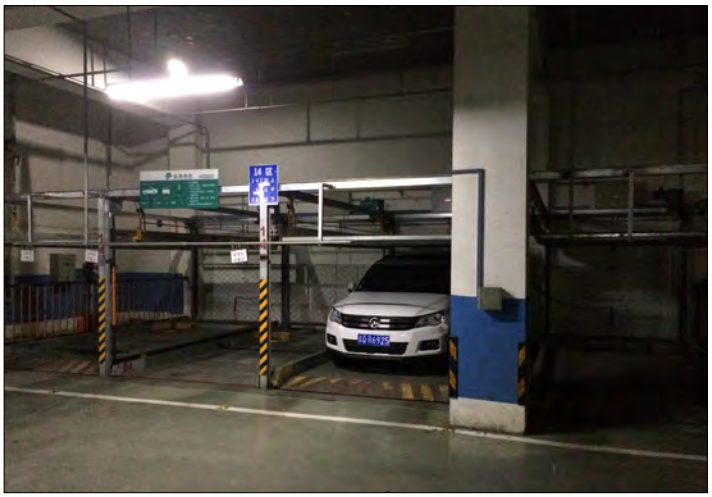
Yuanwuqu area parking analysis

The Yuanwuqu area faces high parking demand on streets and illegal parking on streets, sidewalks and setbacks is frequent. The table below shows for each section the parking demand, existing parking balance (i.e. shortage or vacancy of parking spaces), the proposed on-street parking supply (as described on the next page) and the parking balance in the proposed on-street parking system.

Some streets will have a shortage of parking spaces, where others will have vacancy. The sum is a vacancy of 11 parking spaces during the peak demand time. This would be sufficient, but since an 85% occupancy is aimed for, more vacancy is required, which can easily be found in the off-street parking garages in adjacent developments, including Yuanwuqu, Guidu Guoji Zhongxin, Jinshie Yuan, Zhongtie Wuzi and Huaheng Dasha.

This proves there is no shortage of parking spaces, but the parking demand is distributed unevenly.

Proper parking enforcement will force drivers to make better use of existing vacancy and real-time parking guidance systems can help direct drivers to vacant spaces. No additional off-street parking facilities are required. Public access to these other off-street parking garages, with parking sharing, is essential. In fact, when implementing a paid on-street parking system, parking demand will drop by 20-25%, as described in the Langqin area parking analysis.



Above: off-street vacancy in the Yuanwuqu underground parking garages. Parking lifts are barely if ever used.

Street name	Code	On-street parking supply [spaces]	Setback parking supply [spaces]	Demand at area's max. demand time [cars]	Balance (at area's maximum demand) [spaces]	Proposed on-street parking supply [spaces]	Proposed setback parking supply [spaces]	Type of parking	Balance for proposed supply (area's max. demand) [parking spaces]
Guang'anmenwai Nan Jie	GJNW	21	0	26	(5)	22	0	Parallel	(4)
Chunshuguan Jie	CSGN	39	0	59	(20)	46	0	Perpendicular	(13)
Chunshuguan Jie	CSGS	21	0	33	(12)	44	0	Perpendicular	11
Guang'anmenwai Nan Jie	GJNE	24	0	24	0	24	0	Perpendicular	(0)
Nan Binhe Lu	NBLN	2	0	6	(4)	0	0	No parking	(6)
Nan Binhe Lu	NBLS	0	5	6	(6)	0	0	No parking	(6)
Guang'anmenwai Nan Jie	GJME	12	0	10	2	73	0	Perpendicular	63
Guang'anmenwai Nan Jie	GJMW	15	0	8	7	22	0	Parallel	14
Guang'anmen Nan Binhe Lu	GNBN	0	48	53	(5)	0	0	No parking	(53)
Guang'anmen Nan Binhe Lu	GNBM	0	17	25	(8)	0	0	No parking	(25)
Guang'anmen Nan Binhe Lu	GNBS	0	17	18	(1)	0	0	No parking	(18)
Yaziqiao Bei Jie	YZQS	24	0	30	(6)	20	0	Parallel	(10)
Guang'anmenwai Nan Jie	GJSW	14	0	32	(18)	47	0	Perpendicular	15
Yaziqiao Bei Jie	YZQN	43	0	37	6	47	0	Perpendicular	10
Guang'anmenwai Nan Jie	GJSE	20	0	35	(15)	71	0	Perpendicular	36
Guang'anmenwai Nan Jie	GJSM	0	0	1	(1)	0	0	Perpendicular	(1)
Total or Average		**235**	**87**	**403**	**-86**	**414**	**0**	**Total balance:**	**11**

Parking demand and proposed supply show there is only a small shortage of on-street parking spaces that can easily be absorbed by off-street vacancy in Yuanwuqu. Note: red values in between brackets are negative.

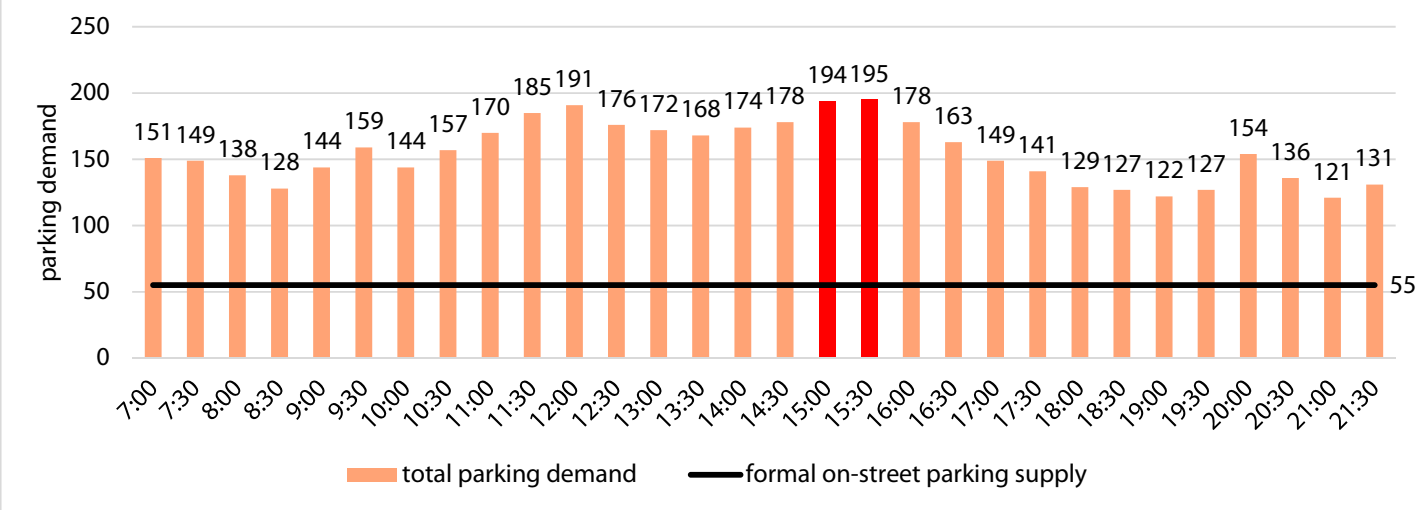
The proposed on-street parking system first of all makes better use of existing road space and legalizes parking on most street sections that are already used for parking illegally. The proposed streets with on-street parking are shown in the graph below. The total number of parking spaces is shown as well. Additional bike lanes are included too (graph right), without reducing the road capacity for car traffic.

Above: proposed bike lane network

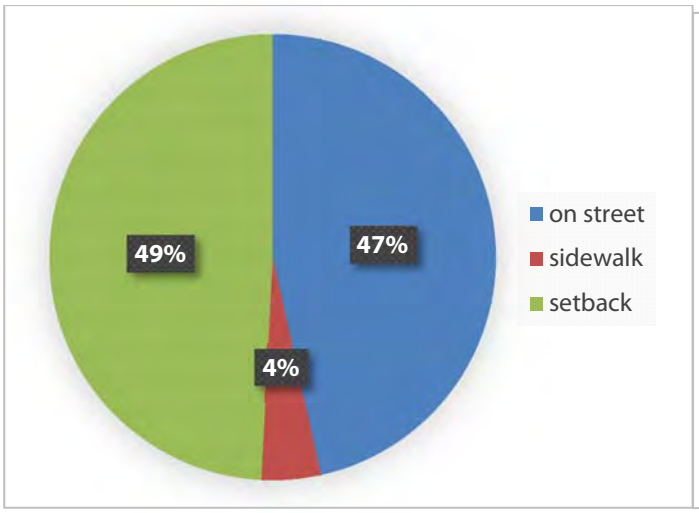
Left and below: location (graph left) and capacity (graph below) of the proposed on-street parking spaces.

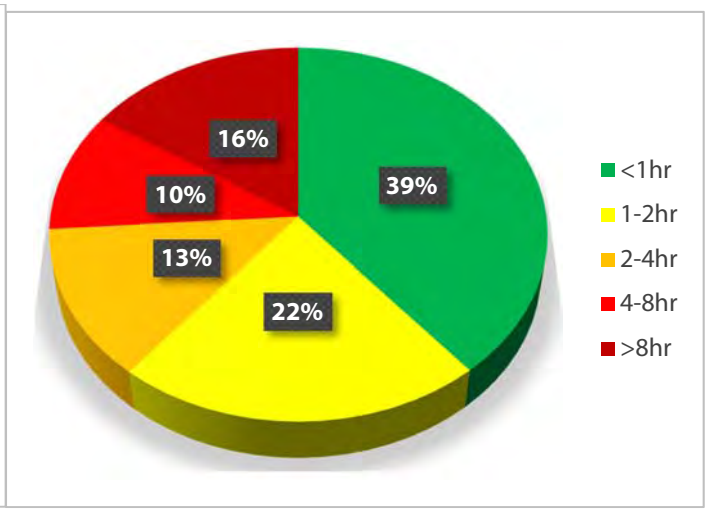
Xinhe area

Xinhe Jiayuan is a residential development in the west of Guangwai Jiedao and is surrounded by four streets: Chama Beijie, Malianidao Lu, Chama Jie and Chayuan Lu. The full-day on street survey shows high rates of illegal parking on streets, sidewalks and setbacks, and high parking demand on the setback outside the building on the east and south side where parking is formalized. Parking demand fluctuates throughout the day with the peak demand at 3.30pm. The underground parking has high vacancies though and can absorb all illegal and setback parking demand.



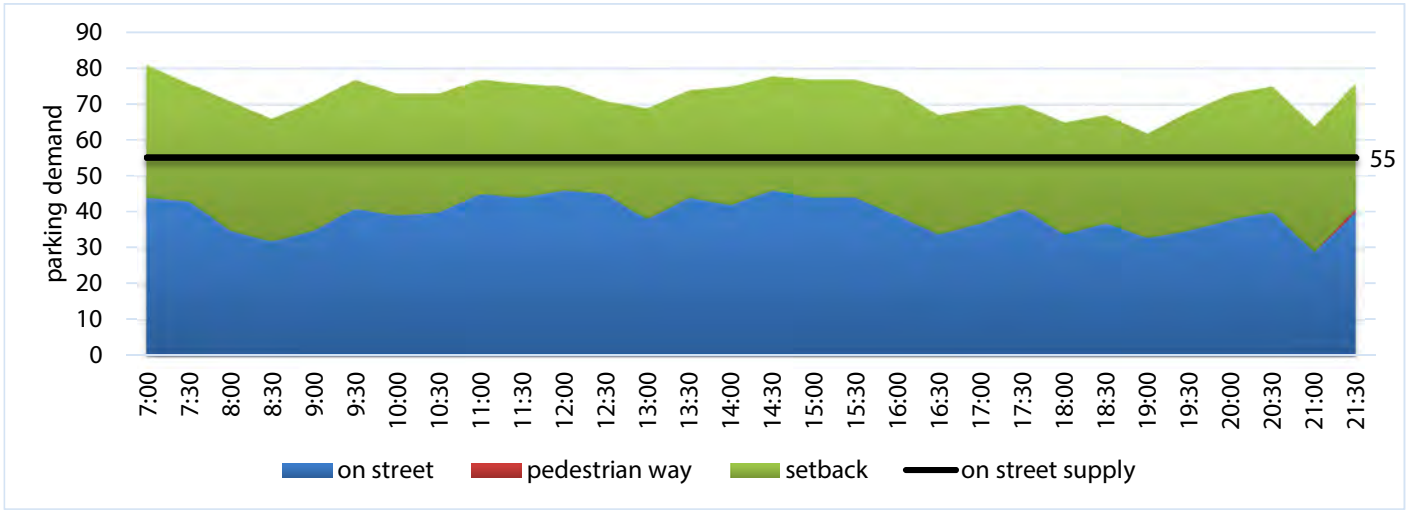
The survey in the streets around Xinhe Jiayuan finds that 49% of the cars park on the setback, 47% of all parked vehicles park on the street and 4% on the sidewalk. The survey also finds out that 61% of the cars park for less than 2 hours and the average parking duration is 2.51 hours, which indicates that most of the cars parking here are for short-term parking. Therefore, if better enforcement is conducted, setback parking and sidewalk parking could be removed. Nevertheless, there is still quite a few long-term parking that 16% of the cars park for more than 8 hours, which is too long for on street parking.

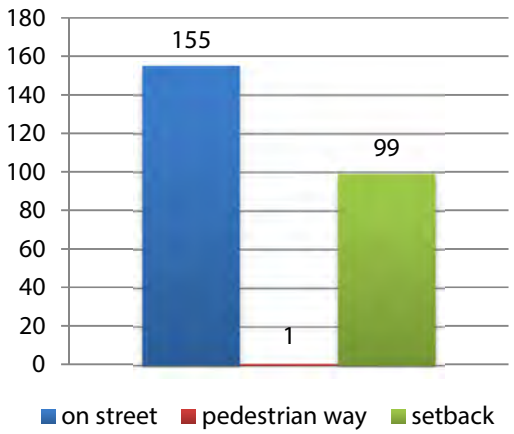


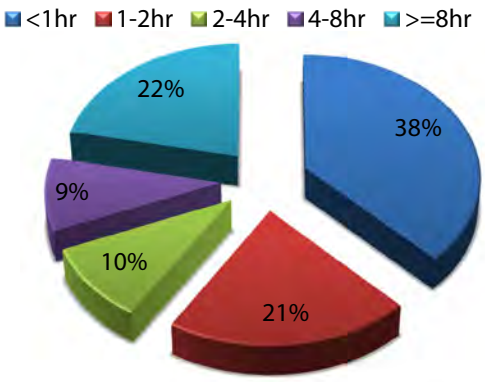


Chama Bei Jie (north side)

Indicator	value	unit
On-street supply	55	parking spaces
Average occupancy rate for on street parking spaces	23.3%	%
Turnover rate for on street parking spaces in 14 hours	4.29	times
Maximum demand (including illegal parking)	81	cars
Peak parking time	7:00	AM



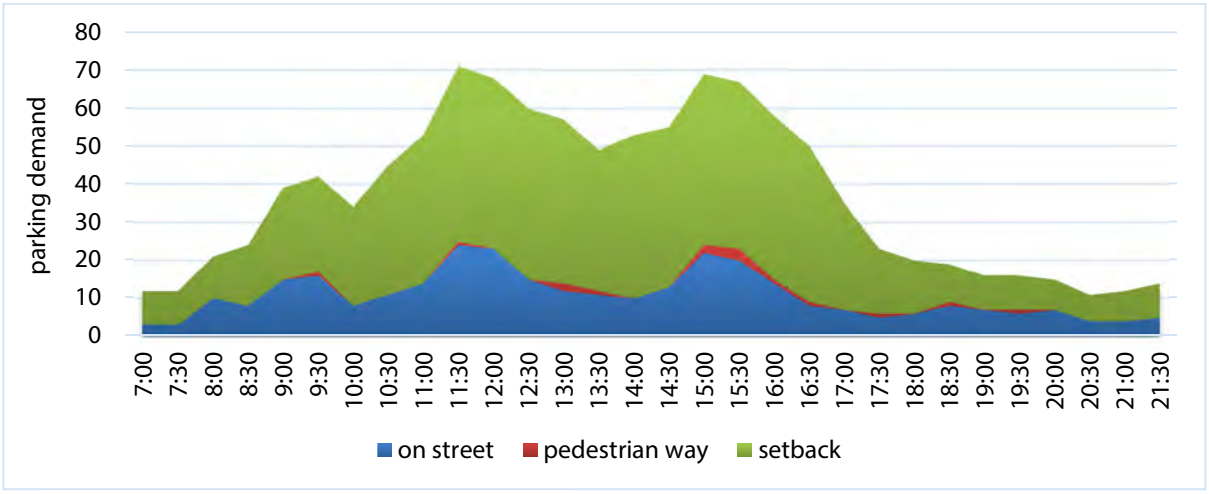


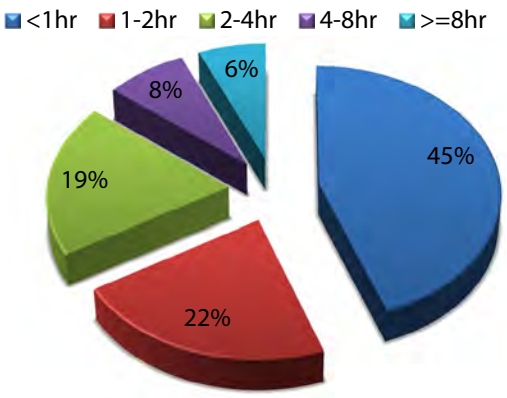


- 61% of drivers parks in the on-street parking system, where 39% parks on the formal setback parking. 31% of drivers park over four hour

Maliandao Lu (east side)

Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	71	cars
Peak parking time	11:30	AM

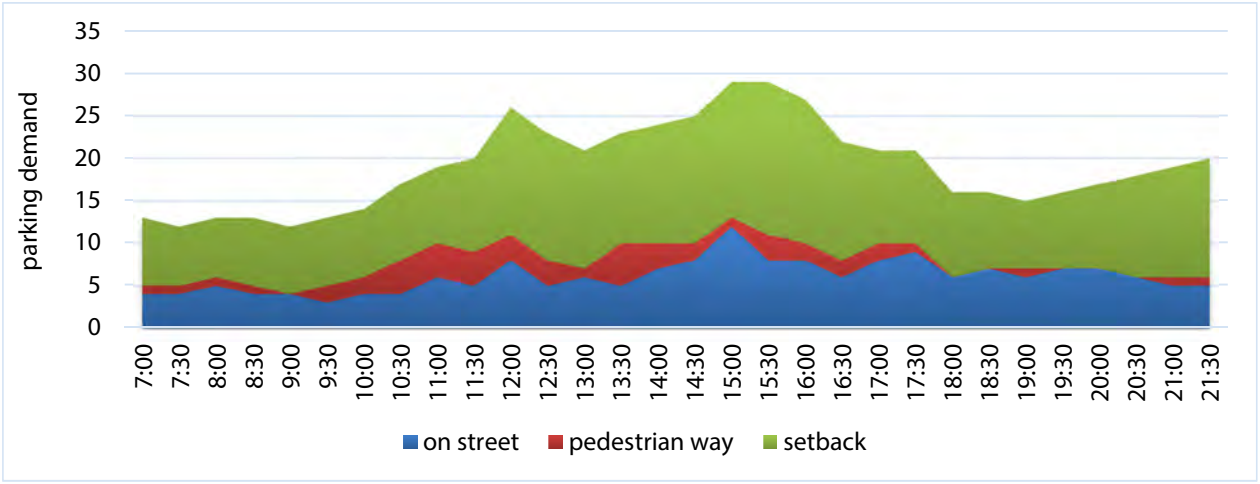


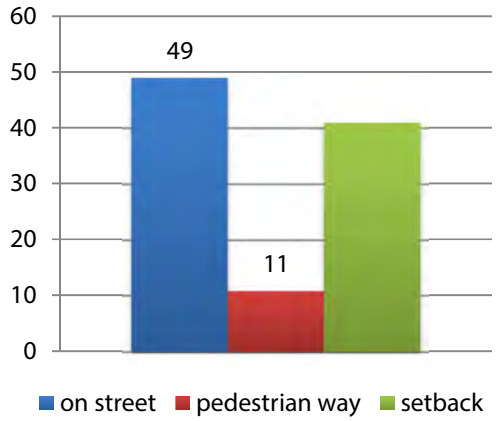


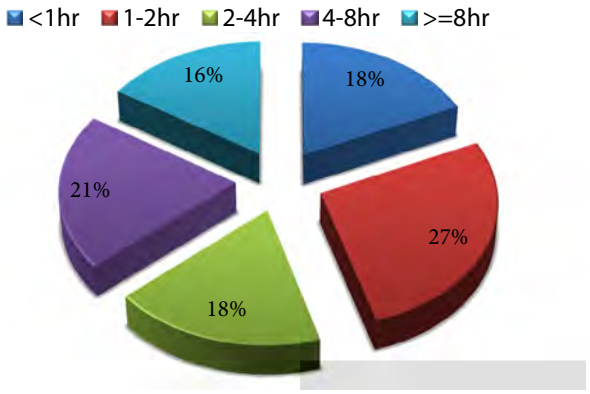
- There is no formal on-street supply on this section. Still 46% parks on-street. The setback has formal parking for cars, motorcycles and bikes. 67% of drivers park under 2 hours.

Chama Jie (south side)

Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	29	cars
Peak parking time	3:00 & 3:30	PM



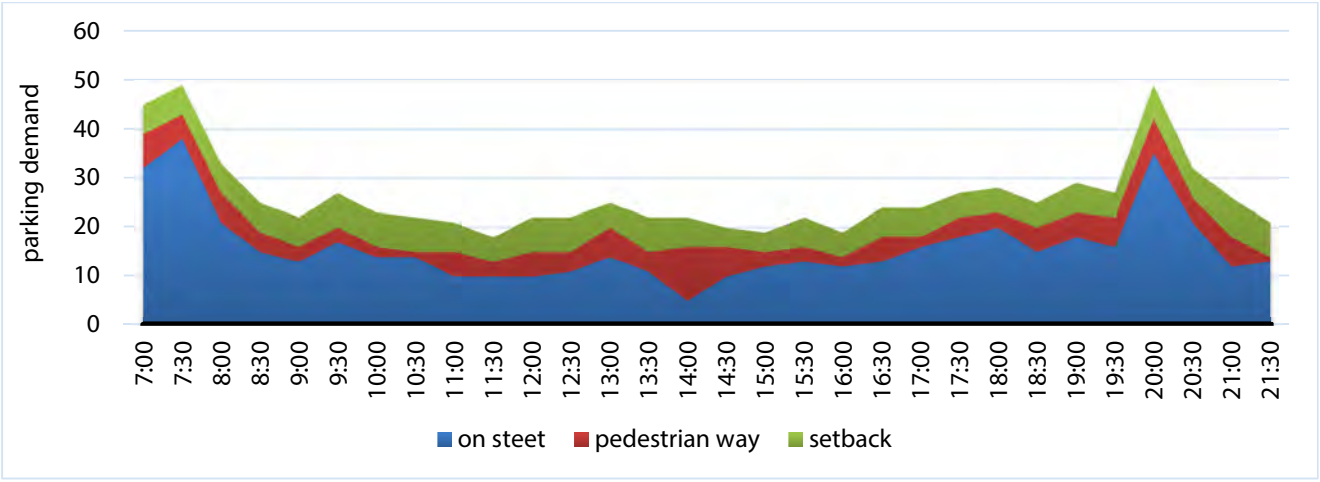


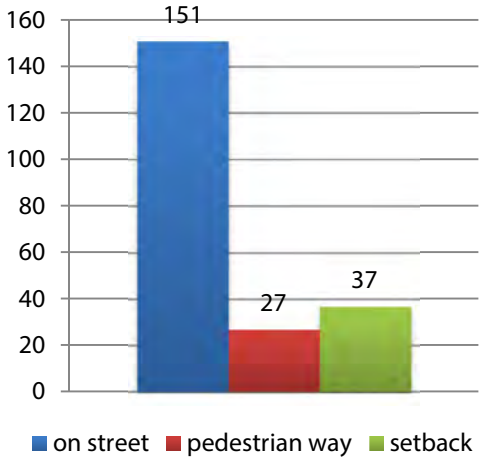


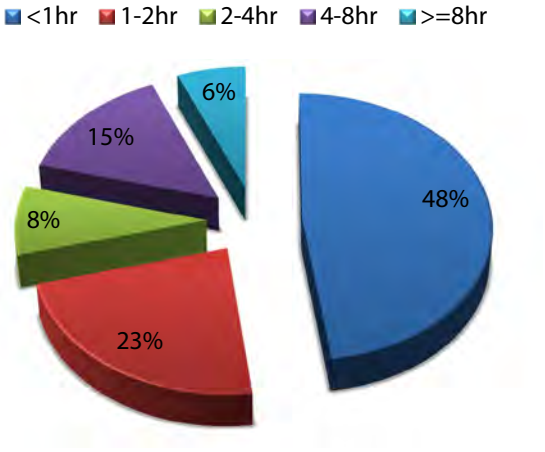
- There is no formal on-street supply on this section. Nonetheless 49% parks on-street; some on the bike lane and some taking up one mixed traffic lane in the middle of the street. At the busiest time 29 cars park on the street, sidewalk and setback combined. Drivers park long hours with 37% parking over 4 hours.

Chayuan Lu (west side)

Indicator	value	unit
On-street supply	0	parking spaces
Maximum demand (including illegal parking)	49	cars
Peak parking time	7:30am & 8:00pm	AM & PM

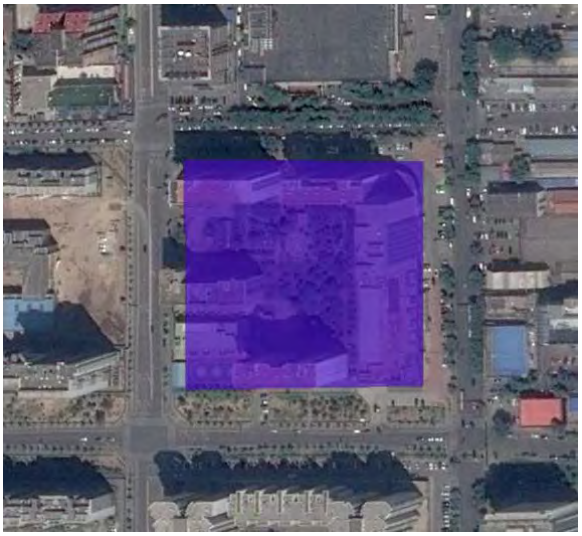


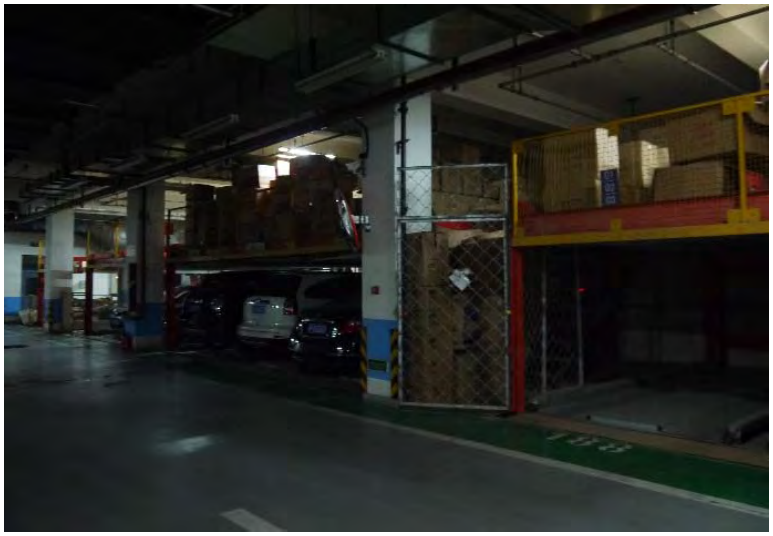




- There is no formal on-street supply on this section. Nonetheless 70% parks on-street, taking up one mixed traffic lane. At the busiest time 49 cars park illegally on the street, sidewalk and setback combined.

Xinhe Jiayuan (off-street parking at residential area)





Site information:

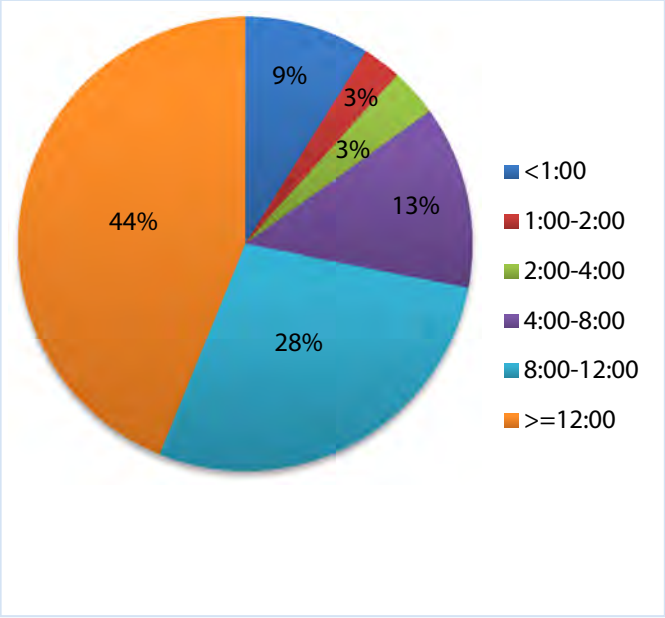
- Address: 15 Maliandao Lu, Guang'anmen
- Land use: Residential
- Households: 557 units
- Year of opening: 2006
- FAR: 3.2

Source:
http://baike.baidu.com/link?url=uc0V5n-KgCvX9A5DK6VPTCxpbH4BZGF2rp8g5s3an-0uls_KlS4DYUh9X3_0D5Mqv75cHQ5vPSoodYlUlrxJBa

Parking price:

Time	Ordinary parking	Mechanical (2nd level)
First hour	Free parking	Free parking
From 2nd hour	1 RMB/30min	1 RMB/30min
Monthly	600 RMB	450 RMB
Yearly	7,200 RMB	5,400 RMB

Parking duration:



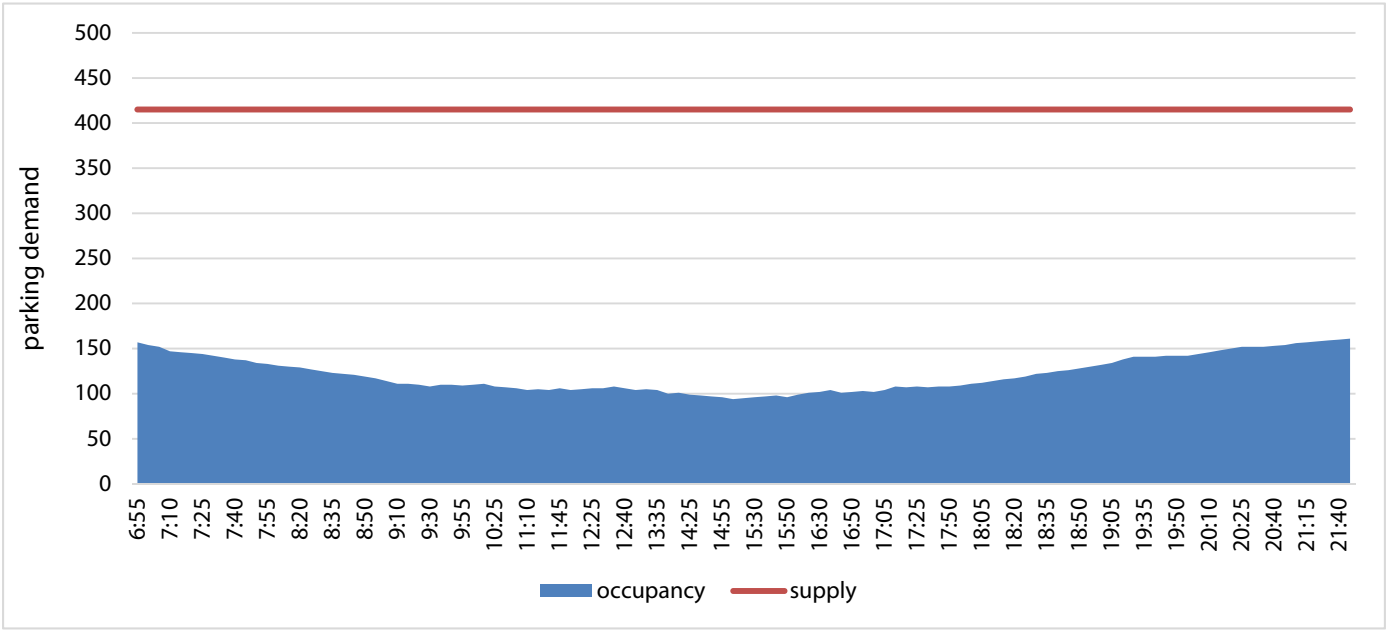
44% of drivers park over 8 hours. Only 15% parks under two hours.

Parking survey results:

The parking lot is busiest at 9.40pm when 160 cars are parked, reaching an occupancy of 39%. Because the parking lot has such large vacancies, the second level of mechanical parking in many places is used for storage of goods. Turnover is low at 2.2 cars/parking space during the survey hours between 7.00am and 10pm.

Indicator	value	unit
Underground supply	415	parking spaces
Average occupancy rate for underground parking spaces	29.3	%
Turnover rate for underground parking spaces in 14 hours	2.28	times
Maximum demand	160	cars
Peak parking time	9:40	PM

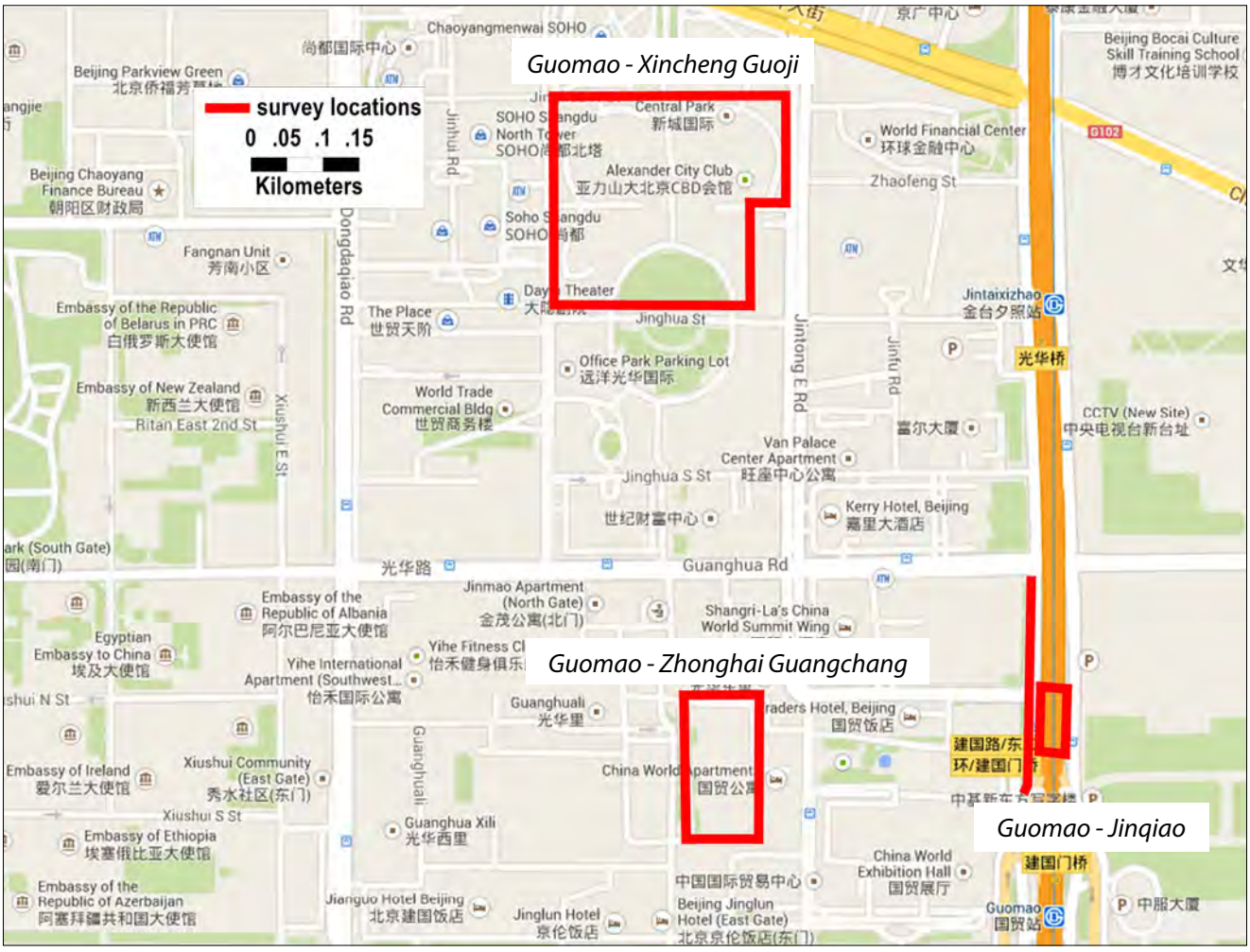
Parking occupancy:



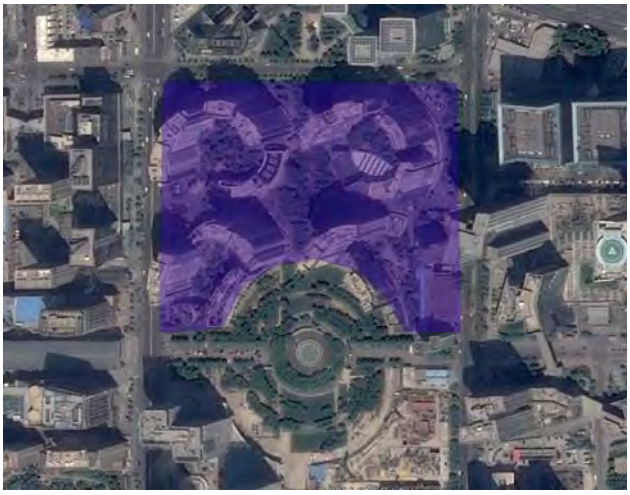
3.3.2 Guomao area

Guomao is the central business district of Beijing. All-day parking surveys were conducted at Xincheng Guoji (residential), Zhonghai Guangchang (office & mall) and Jinqiao (public parking) and presented in this section. The areas are shown in the graph below.

Below: Zhonghai Guangchang
Top right: Xincheng Guoji
Bottom right: Jinqiao public parking



Xincheng Guoji (off-street parking at residential, commercial)



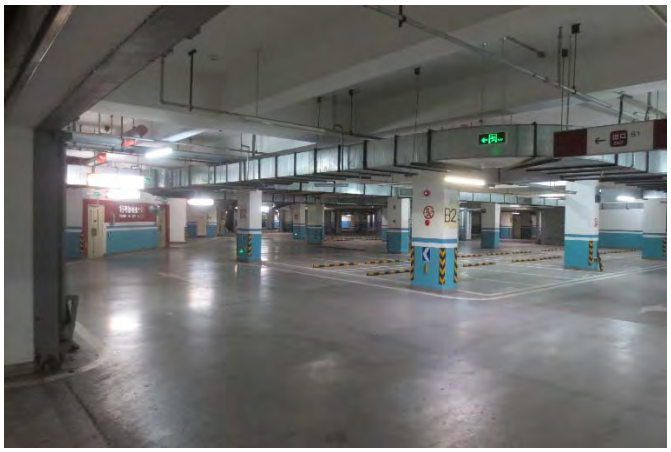
Site information:

- Address: bound by Jintong Xilu, Jinghua Beijie, Jintong Donglu and Jinghuajie
- Land use: High-end residential and commercial (serviced apartment & retail) mixed use
- Site area: 105,000 m^2, approximately 2,000 residential units
- FAR: 3
- Year of opening: staged: 2002, 2003, 2005, 2006

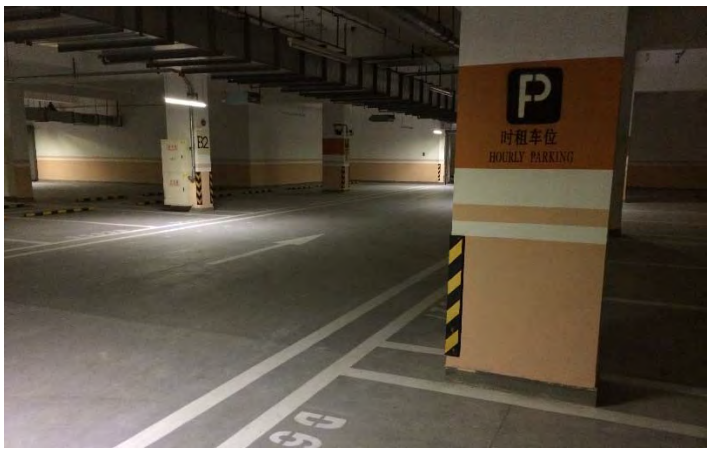
Source: http://house.focus.cn/votehouse/298/xiangqing/

Illegal parking on the setback affects urban design and reduces attractiveness to walking.

Despite a vast underground parking lot, parking was built on the setback.



Most of the 2,202 underground parking spaces are empty.

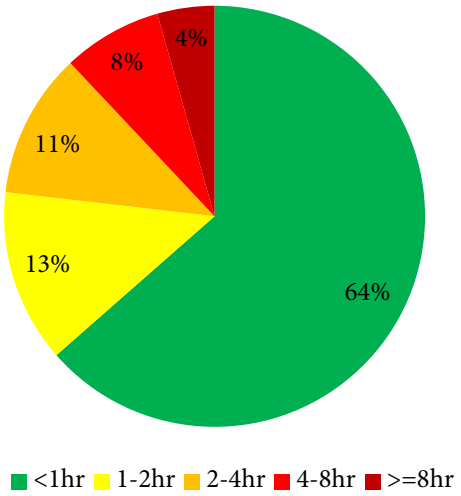


Hourly underground visitor parking is nearly empty.

Parking price:

Time	Residential underground	Commercial underground	Setback
7:00-21:00	1 RMB/ 15 min	1.5 RMB/ 15 min	1.5 RMB/ 15 min
21:00-7:00	1 RMB/0.5 hr	2.5 RMB/ 30 min	2.5 RMB/ 2 hrs
Monthly	1,200-1,300RMB	*N/A*	*N/A*

Parking duration:



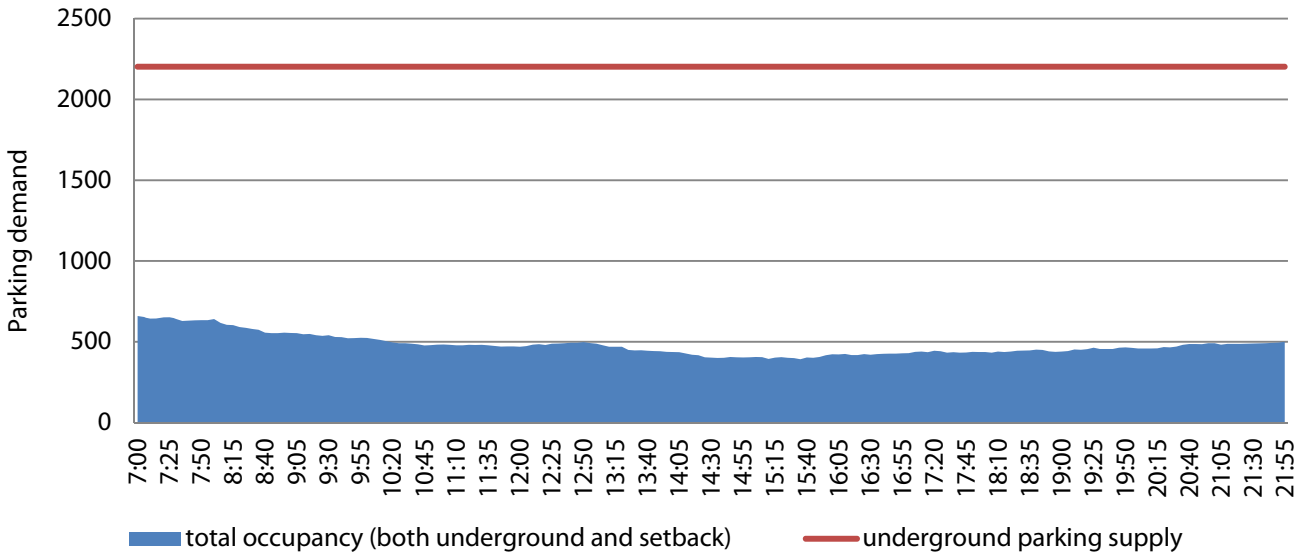
Parking is fairly long (28% parking over four hours) due to offices

Parking survey results:

The underground parking lot is busiest overnight and at 7.00am has its maximum occupancy of 29% and a large section of the garage is closed. Turnover is very low at 0.89 cars/parking space during the survey hours between 7.00am and 10pm. Due to the existence of ground-floor shops and cafes, most parking (64%) is under one hour but note that overnight parking is not included in this calculation. The 57 setback parking spaces should be removed, this parking demand shifted to underground parking and the setback parking used for public space.

Indicator	value	unit
Underground supply	2,202	parking spaces
Setback supply	157	parking spaces
Average occupancy rate for all parking spaces	20	%
Turnover rate for all parking spaces in 14 hours	0.89	times
Maximum demand	660	cars
Peak parking time	7:00	AM

Parking occupancy:



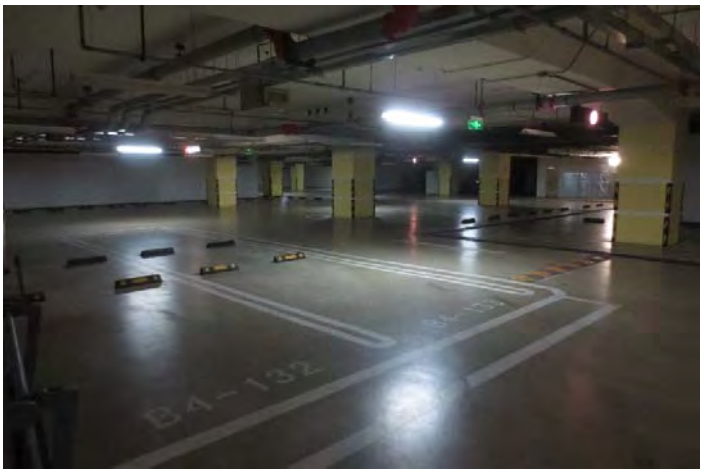
Zhonghai Guangchang (off-street parking at offices, mall)

Site information:

- Located in Guomao between Ganghuali and Guomao Gongyu, just north of Jianwai Da Jie
- Land use: Office and Retail
- Site area: 19,000 m^2
- Floor area: 151,000 m^2
- Year of opening: 2009

Setback parking on the back of the site serves as a site for deliveries and short-term parking and provides access to the underground parking garage.

Real-time occupancy signs on Jianwai Da Jie direct drivers to vacant parking at Zhonghai Guangchang. The number displayed is much lower than actual vacancy though.



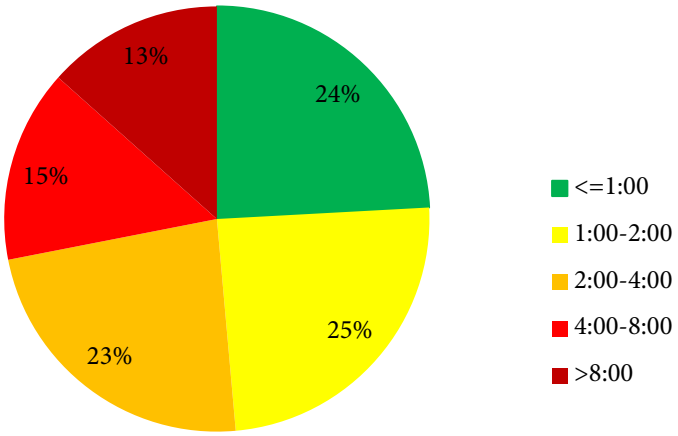
The lower floors of Zhonghai Guangchang are virtually empty.

Large funds are wasted on unused parking space

Parking price:

Time	Underground parking
7:00-21:00	2 RMB/ 15 min
21:00-7:00	1 RMB/2hrs
Monthly	unknown

Parking duration:



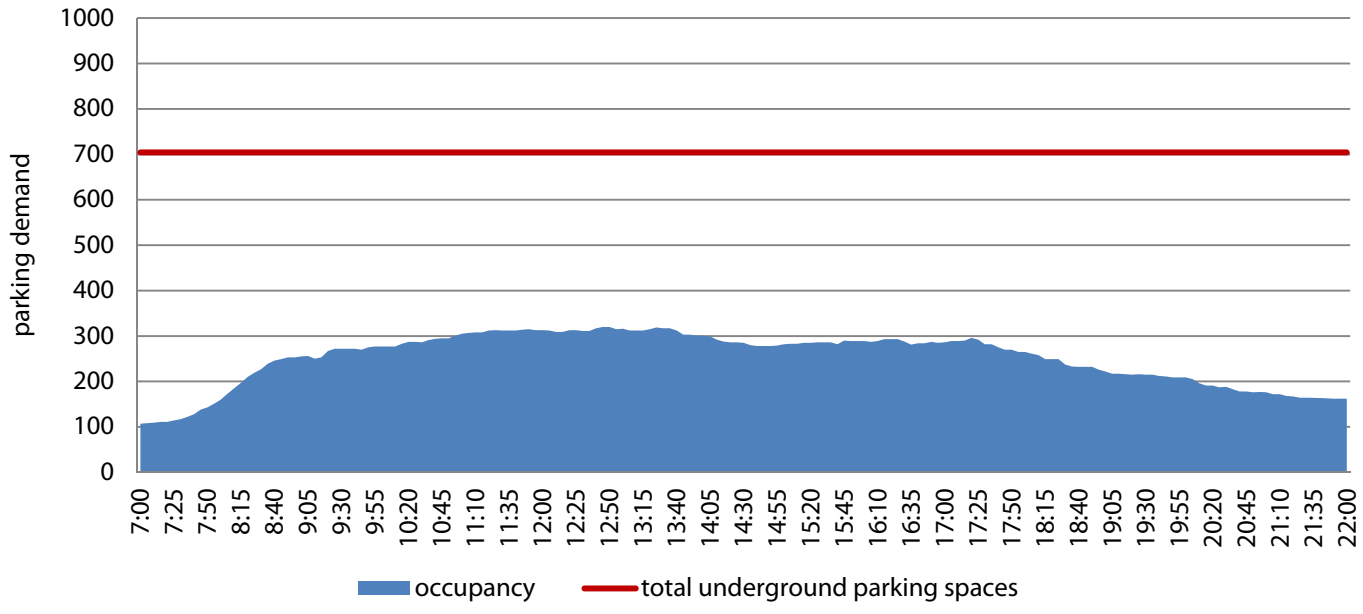
Parking duration is longer (28% parking over four hours) due to offices

Parking survey results:

The underground parking lot is busiest at 12.45pm when 320 cars are parked, reaching an occupancy of 45%. The lowest floor of parking remains virtually empty for the entire day. Turnover is very low at 0.9 cars/parking space during the survey hours between 7.00am and 10pm.

Indicator	value	unit
Underground supply	704	parking spaces
Average occupancy rate for all parking spaces	35.7	%
Turnover rate for all parking spaces in 14 hours	0.9	times
Maximum demand	320	cars
Peak parking time	12:45	PM

Parking occupancy:



Jinqiao parking (public off-street parking)

Site information:

- Address: under Guomao overpass, just north of Guomao metro station
- Official land use: Road. One section is also used for bus parking.

Jinqiao off-street parking is located underneath the third ring road and publicly accessible.

The northern section of the underground parking is empty and sometimes used for bus parking.

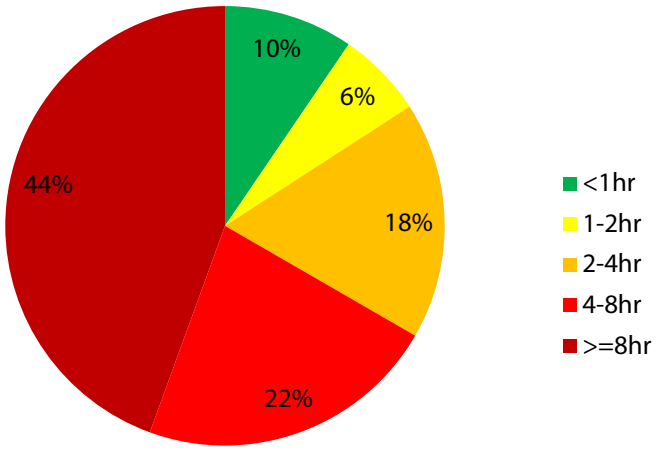
Across the street from Jinqiao off-street parking, on the right side of the picture, cars park illegally on the bike lane.

The pedestrian crossing at the entrance to Jinqiao off-street parking is blocked by vehicles unwilling to park inside the lot.

Parking price:

Time period	Parking price
Hourly	5 RMB/hour
Monthly	600 RMB/month

Parking duration:



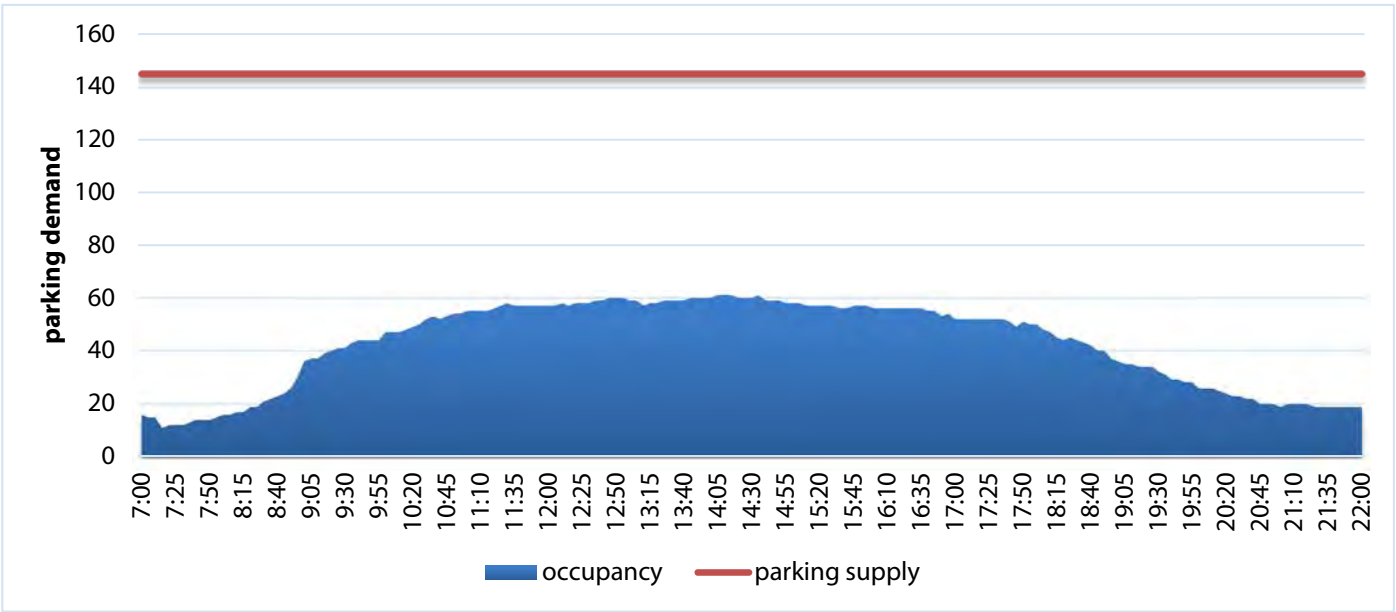
44% of drivers park over 8 hours. Only 16% parks under two hours.

Parking survey results:

Parking demand during office hours is fairly stable, indicating many employees park here throughout the day. The parking lot is busiest at 2.45pm when 61 cars are parked, reaching an occupancy of 42%. Turnover is very low at 0.45 cars/parking space during the survey hours between 7.00am and 10pm. Drivers currently parking on the bike lane right outside the Jinqiao parking lot, can easily find a vacant parking space here.

Indicator	value	unit
Supply	145	parking spaces
Average occupancy rate for all parking spaces	29.4	%
Turnover rate for all parking spaces in 14 hours	0.43	times
Maximum demand	61	cars
Peak parking time	2:35	PM

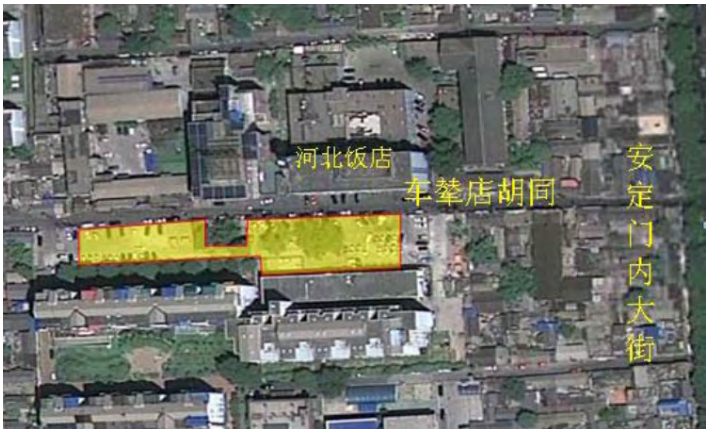
Parking occupancy:



3.3.3 Cheniandian Hutong mechanical parking

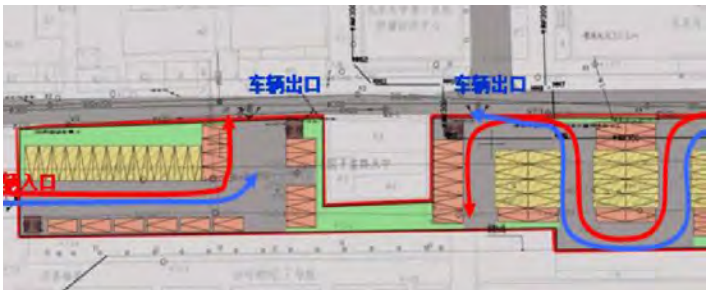
The mechanical parking lot in Cheniandian Hutong was initiated and financed by the Dongcheng district and opened in mid-2012. It was the first mechanical parking lot in the hutongs of Beijing and aimed at solving chaotic parking in the hutong's alleyways, in this area east of Houhai Lake. The underground parking has four storeys (3 floors underground, 1 floor on-ground) and consists of 193 parking spaces at two adjacent sites. It charges 300 RMB/month for the Hutong's residents and 800 RMB/month or 2 RMB/15min for outsiders. Operation is done by Dongfang Jielu parking managment, a state-owned company. Users need an RFID card to activate the machine that lifts cars in and out of the lots.

The Planning Bureau never approved the construction, because the parking lots are built on space designated for road use, but the Dongcheng district government pushed it through by classifying it as 'temporary parking spaces'. The Beijing Planning Society claims the costs were 22,000 RMB per parking space. The project team suspects that the actual costs are significantly higher and the opportunity costs of valuable downtown space is also not taken into account.



Aerial view of Cheniandian mechanical parking

Source: Beijing Urban Planning Society (2012), Dongcheng district Cheniandian parking building, in Beijing City Planning Formation magazine



Aerial view shows mechanical lifts with four parking spaces (in yellow), on-ground parking spaces (in light red) and directions for entrance (bright red) and exit (blue)

Source: Beijing Urban Planning Society (2012), Dongcheng district Cheniandian parking building, in Beijing City Planning Formation magazine

Each lift contains four parking spaces, of which one at ground floor

Many vacancies were identified in the mechanical parking lot, where the illegal parking outside proved to be full

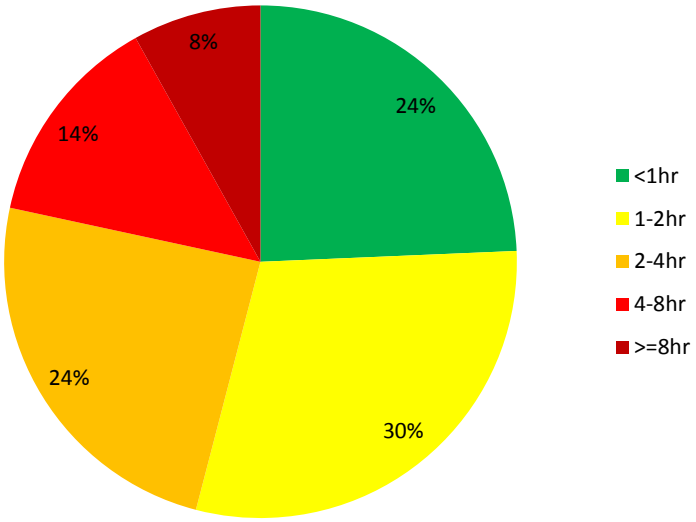
Survey results

Surveys were performed at the entire parking lot between 5.30am and 10pm. Turnover of parking spaces was very low, with only 119 movements during the survey period, resulting in a turnover of only 0.62 cars/space. Of all cars driving out and in, or in and out, of the parking lot, 22% parked over 4 hours. 54% parked under two hours.

Due to the low turnover, most parking lots were never seen fully lifted up. The parking guards claim not to be able to see the actual occupancy of each parking space and are unaware of which parking space is rented out. As a result the actual occupancy at the start and finish of the survey is unknown. It is known that multiple parking spaces very vacant on-ground at the start of the survey and remained so throughout the day and that the lifts that did go up throughout the day showed vacancies. Based on extrapolation of useful survey data the maximum occupancy is 53%.

On the other hand, parking demand right outside off-street parking lot remained high throughout the day. This parking is illegal but unenforced.

What the Cheniandian mechanical parking has done is attract more traffic and parking, rather than solve the problem of chaotic parking in the hutong.



Parking duration in Cheniandian hutong mechanical parking lot. 54% is parking under two hours, with 22% parking over 4 hours.

3.3.4 Liufang metro station area

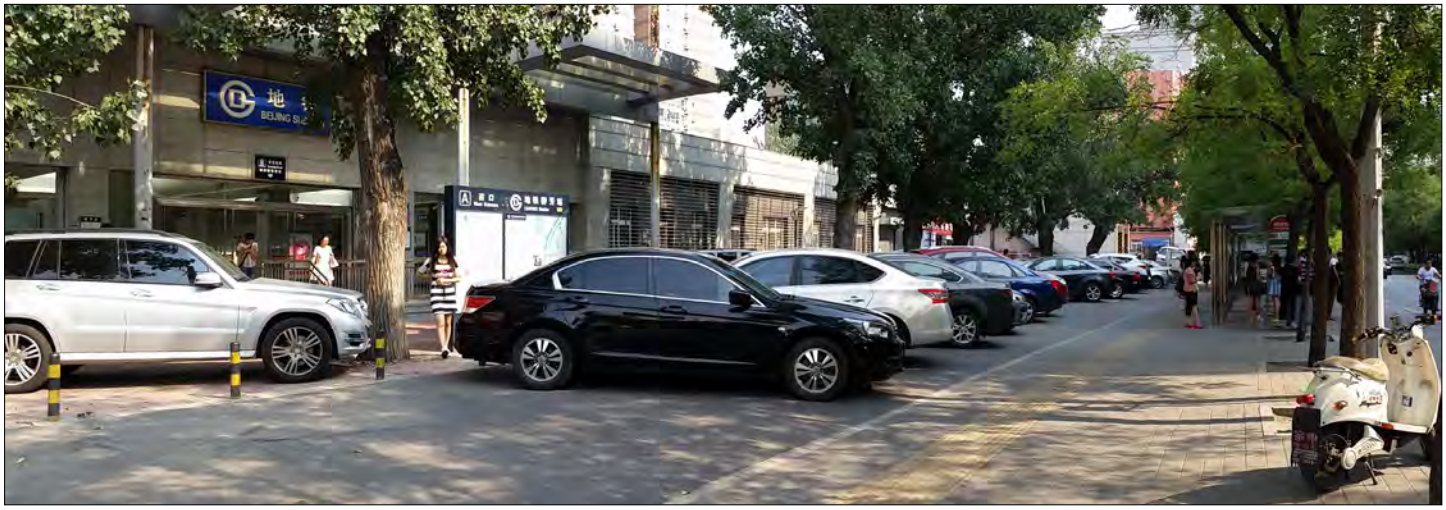
Parking facilities are provided on the western and eastern sides of Liufang metro station on metro line 13 in northern central Beijing.

On the western side 21 parking spaces are located on the setback and three car parking spaces are in use for bike parking. The operator of the P+R facility is Jinglianshunda, supervised by the Chaoyang district. Parking prices for P+R facilities, as set by the Development & Reform Committee, are not followed according to the parking guards. On the western side drivers are charged 2 RMB/15min (from 7am-9pm), 0.5 RMB/hour (from 9pm-7am) or 20-25 RMB/day. Staff from the metro company park for free.

On the eastern side 15 parking spaces are located on the sidewalk and setback and three car parking spaces are in use for bike parking. The operator is Gonglianshunda. Parking prices for P+R facilities, as set by the Development & Reform Committee are not followed, according to the parking guards. On the eastern side drivers are charged according to the official on-street parking prices for Beijing's central zone, which are 2.5 RMB/15min for the first hour and 3.75 RMB/15min for the following hours. Monthly prices can be negotiated with the parking guard.

Parking guards use locks to reserve parking spaces for drivers with monthly rents.

Parking at Liufang metro station entrances

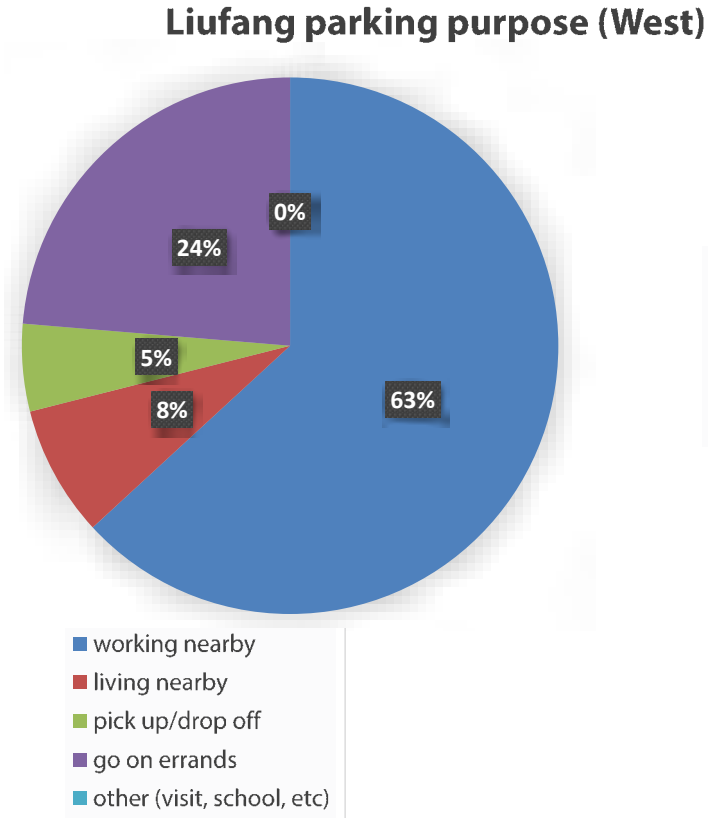


Parked cars block Liufang metro station entrance (west)

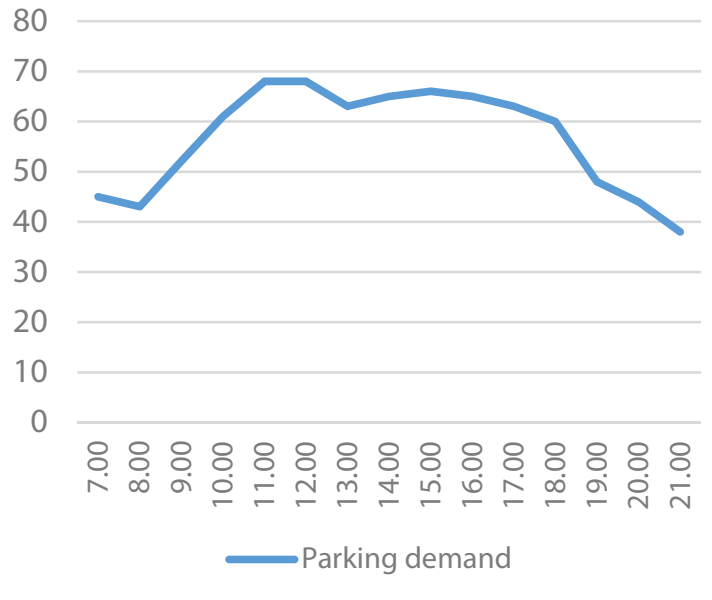
West entrance

Both on the western and eastern side cars park on the sidewalk and setback, preventing convenient entrance into the Liufang metro building. Spaces are demarcated illegally and charged for by parking guards at the site. Parking demand is highest from 11am-1pm.

On the western side several of the cars belong to staff working at the Liufang and Dongzhimen metro stations, according to the parking guards on duty at the time of the survey. A survey on parking purpose was conducted and found that 63% of drivers parking outside the metro station was working nearby, 8% was living in the vicinity and 24% went on errands.



Parking purpose at western side of Liufang station



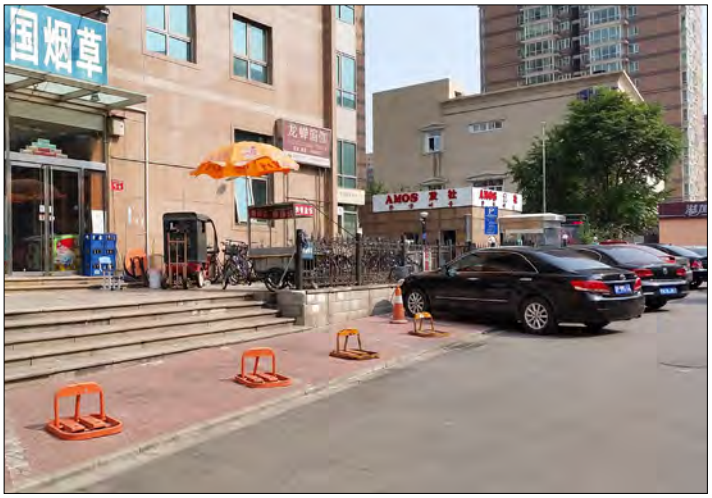
Parking demand at western side of Liufang station

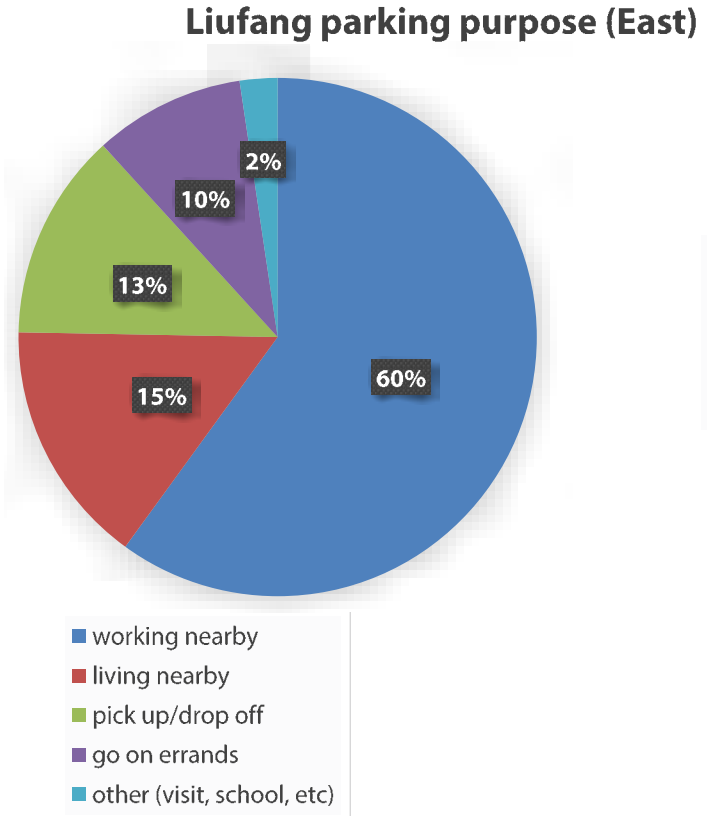
Parked cars block Liufang metro station entrance (east)

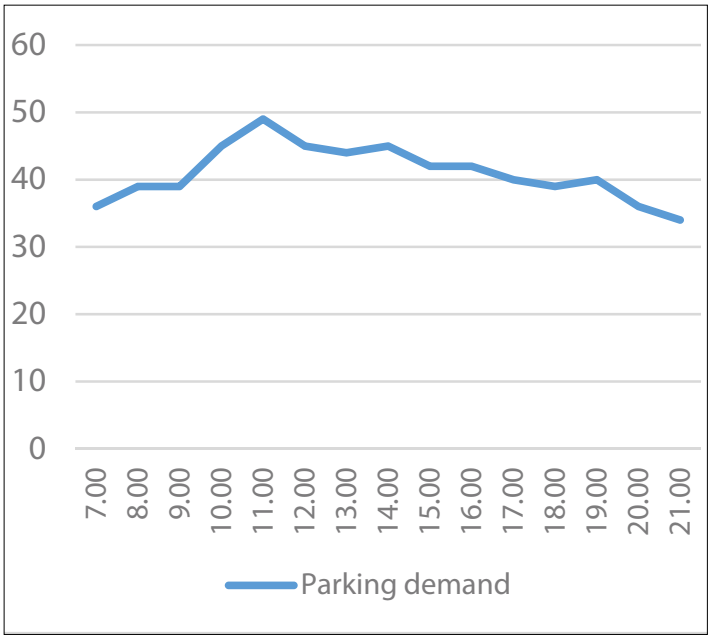
East entrance

On the eastern side most of the parking spaces are reserved for monthly parking by employees of companies located on the first three floors of the Xintiandi building, adjacent to the metro station, according to parking guards on duty at the time of the survey. Parking spot are reserved with the orange tools shown in the pictures below. Parking demand is highest from 11-12am.

A survey on parking purpose was conducted on the eastern side as well and found that 60% of drivers parking outside the metro station were working nearby, 15% was living in the vicinity, 13% parked temporarily for pick up and drop off and 10% went on errands.







Reserved parking for employees of adjacent offices (east)

Parking demand at eastern side of Liufang station

3.4 Survey results summary

In the on-street, off-street and setback parking surveys in three areas in Guang'anmen, three sites in Guomao and in Cheniandian and Liufuang, the following results were found:

- While on-street parking occupancies are high and illegal parking on streets, sidewalks and setbacks rampant, vast amounts of vacant parking spaces are found in adjacent or nearby off-street parking facilities. Parking on sidewalks and setbacks accounts for 67% of all parking demand in the Langqin area. In the Yuanwuqu area this is 19% and in Xinhe 53%. Average vacancy in the off-street parking lots were 81.3% in Langqin Guoji, 70.7% in Xinhe Jiayuan, 80% in Xingcheng Guoji, 64.3% Zhonghai Guangchang and 70.6% in Jinqiao. Each of these had large vacancies during peak on-street parking demand hours as well.
- The areas' parking supply is higher than the parking demand. The problem of parking in these areas is not a lack of parking spaces but a lack of parking management. Vacancies in off-street parking facilities can be utilized to host illegally parked cars on streets, sidewalks and setbacks. A better designed and enforced on-street parking system, with paid parking on all streets, can facilitate short-term parking and allows for car-free sidewalks and setbacks and bike lanes on most streets. Some streets had no parking fees imposed and others were cheaper, especially in the Langqin area.
- The parking price policy is not working properly, with parking prices that are negotiated with the parking attendants and discounted from the official price. This also discourages drivers to use vacant spaces in off-street parking. Moreover the parking revenue is not transparent, with no access to this information by the government.
- The parking zones are too large to effectively discourage drivers from driving to high-demand areas and streets within these zones.
- Traffic as well as cyclists and pedestrians are slowed down by illegally parked vehicles. Enforcement action against illegal parking is rarely taken.
- A large share of parked vehicles parks for more than three hours. In Langqin 46% of vehicles are parked over two hours. In Yuanwuqu this is 44% and in Xinhe 39%. The average parking duration in Langqin is 5.02 hours, in Yuanwuqu 4.14 hours and in Xinhe 2.51 hours. The turnover of parking spaces is also low at only 4.0 cars/parking space/day in Langqin and 3.6 in Yuanwuqu. Without time limits for on-street parking, these vehicles reduce the availability of vacant parking spaces and cause cruising for parking, adding to more traffic on the streets.
- The on-street parking systems lack modern technology, resulting in a lack of data on parking demand, occupancy, turnover and traffic. Parking revenue is not monitored. The current parking system cannot be integrated with future smart traffic systems.

4. Parking Problem Analysis

Based on the policies and surveys, this chapter analyses the parking problems in Beijing.

4.1 Parking strategies and policies

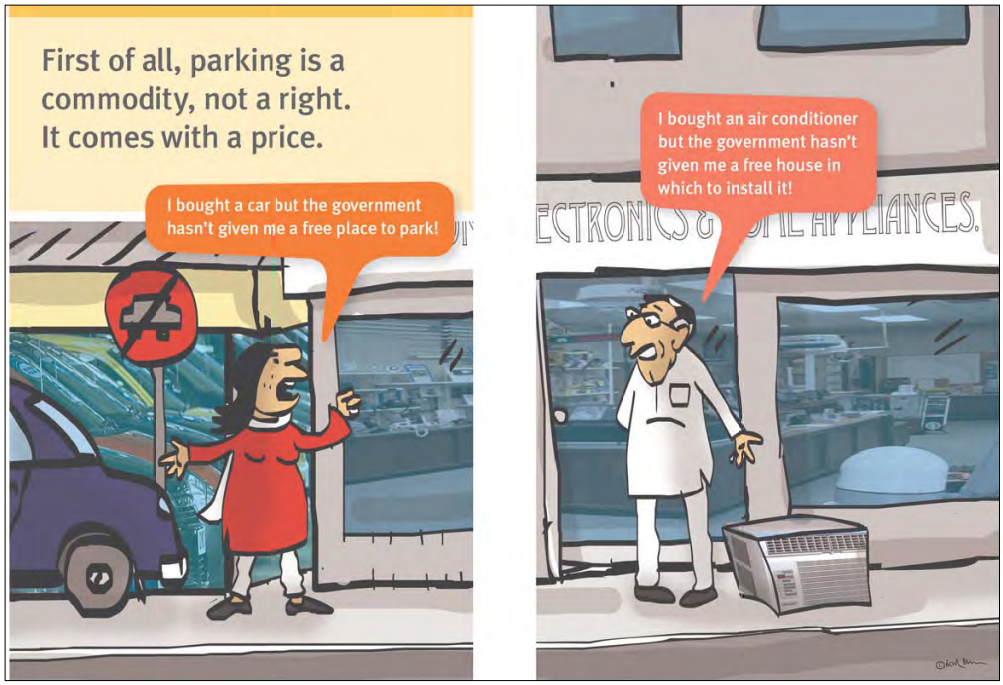
With fast growing car ownership, parking has quickly become a major problem for Beijing. Some of the parking policies are good, but actual implementation of these policies has not happened or is poorly executed. There is no public transport priority when buses are stuck in traffic jams caused by private car use. Some policies contradict each other: guiding car traffic away from central areas cannot be achieved when abundant off-street parking is supplied in central areas. High parking prices, with differentiations per area, are good on paper, but in reality drivers pay much less as they negotiate prices with the parking guards. A parking cap in the city center was never implemented, nor was the use of modern technology for on-street parking. Attracting private investment in off-street parking supply has proven unrealistic when drivers can park for free on streets because paid parking is lacking or illegal parking not enforced.

Other policies such as P+R facilities are costly with only limited effects. The Liufang P+R parking was heavily used by residents and employees living and working in the vicinity, but not by anyone who used the metro. P+R facilities require vast amounts of land in expensive areas (given its proximity to metro stations) that should rather be used for transit-oriented development (TOD). Furthermore, besides the investment costs for having these facilities built, the city government daily spends 6.89 RMB per P+R space to subsidize operational costs of P+R spaces, totaling to 25 million RMB in 2014.

Instead of using parking as a tool to restrict car use, especially in central areas, Beijing governments have rather sought to solve parking problems by increasing the supply of off-street parking. There are three major problems with this approach.

1. The government is not responsible for the provision of ample parking

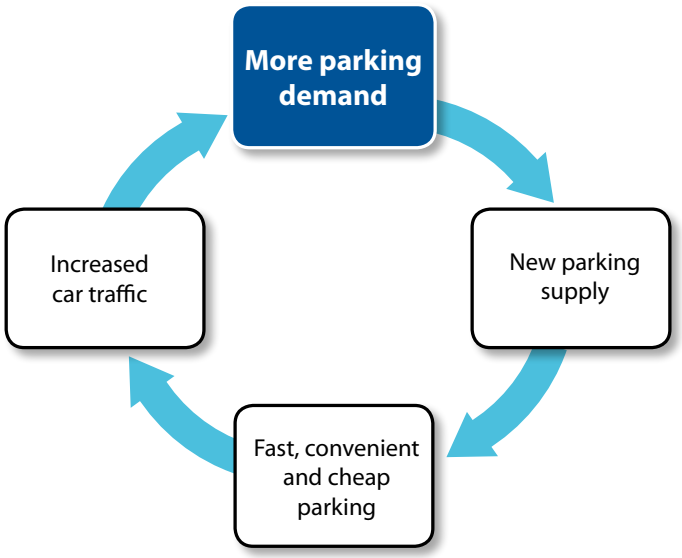
A parking space is a commodity, not a fundamental right. The government is not responsible for providing ample parking to residents. Instead, the government is responsible for well-organized traffic and streets, if possible with on-street parking, and the provision of transport systems, including public transport and walking and cycling infrastructure. It is also responsible for setting the right policies for off-street parking supply in which real estate developers and private investors play an important role. Finding a parking space is mainly the driver's own responsibility and the space is to be rented from the government (on-street) or building operator (private off-street) at a price that reflects its value and enforces the government's targets for traffic reduction.



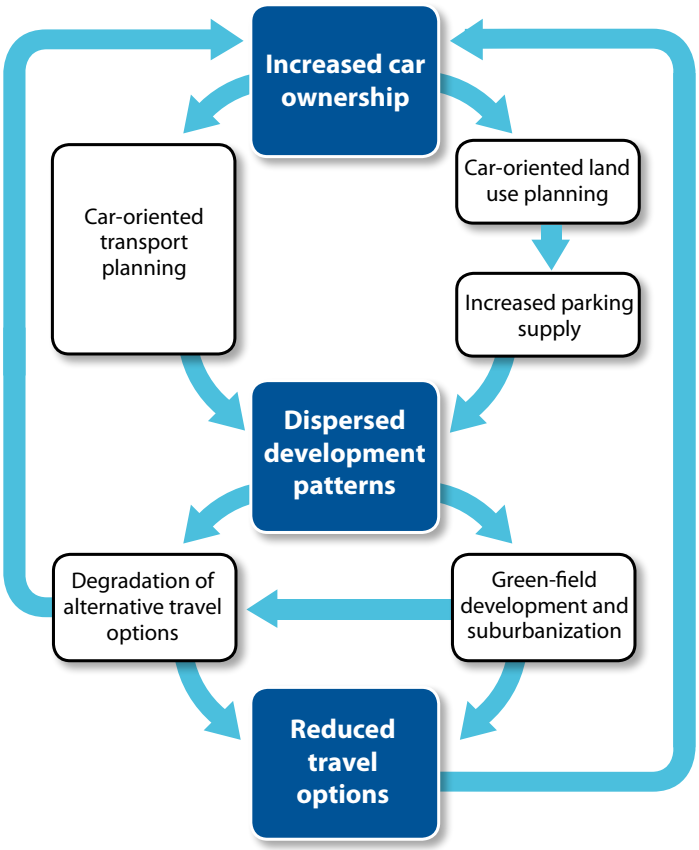
It is important to realize that a parking space is a commodity, not a fundamental right. An on-street parking space is on government land and essentially belongs to all people. The government can decide to allocate street space for on-street parking, but that needs to come at a price (rent) to its users. It is not the government's responsibility to provide everyone with a parking space.

2. More parking supply leads to more parking demand

The government for too long has not addressed on-street and illegal parking, allowed the construction of abundant parking in off-street buildings and even built off-street parking itself. This makes parking, and therefore driving a car, convenient and is only incentivizing increased car use, further exacerbating traffic congestion problems. Beijing needs to break out of this vicious circle.



Supplying more parking cannot solve parking demand



Solving perceived parking shortages on some streets with building more parking will inevitably lead to more traffic, more congestion, suburbanization and car dependency. Instead, a more restrictive approach to parking is needed where existing supply is used more efficiently and pricing controls demand for parking.

Building more off-street parking is not a solution; it may solve the problem for a short while, while at the cost of more traffic and resources (land & financial), but the parking problem will inevitably come back, only as a bigger problem. Moreover, building more parking and more and

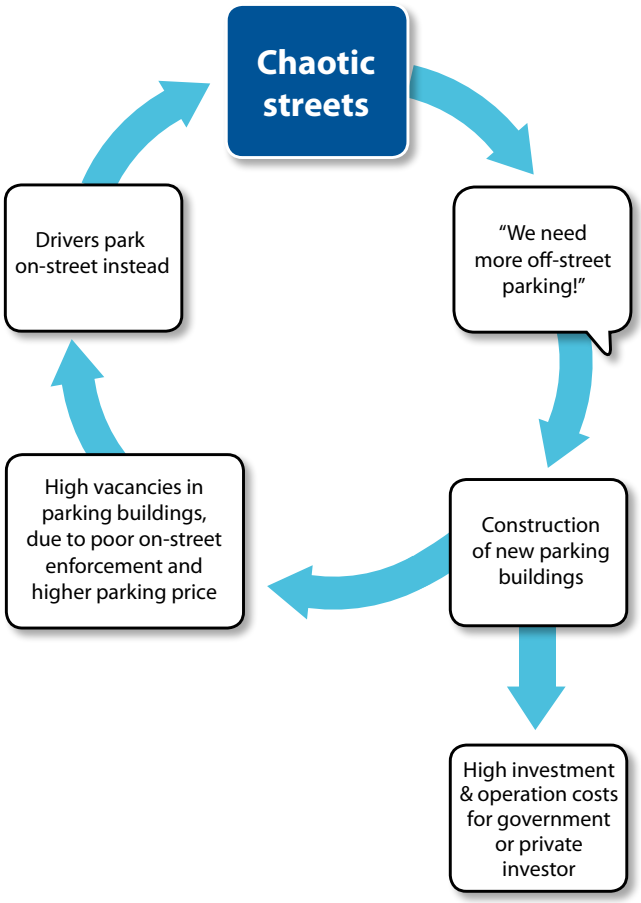
Off-street parking in residential area in Guang'anmen led to scattered urban development, degrading the quality of life

wider roads leads to dispersed development patterns and reduced travel options that lead to increased car ownership and car use.

In an effort to balance supply and demand for parking spaces, the government has only worked on the providing more supply, whereas reducing demand is the preferred solution. Reducing demand is done by setting high prices, enforce illegal parking and reduce, or at least cap, the number of off-street parking spaces.

3. Managing on-street and illegal parking are ignored

Surveys show chaotic streets with high parking occupancies and frequent illegal parking, while adjacent off-street parking lots show high vacancies. This is not surprising, since few streets have paid parking operation and illegal parking is not properly enforced, resulting in drivers parking on-street for free. Beijing's strategy of building more off-street parking is therefore ineffective and a waste of government's budgets, without organizing paid on-street parking, with formal prices, and enforcement of illegal parking first. On-street parking management is also expected to stimulate private investment in the provision of off-street parking, especially for all-day parking demand.



Paid on-street parking and increased parking enforcement is needed in Beijing before new off-street parking is necessary

4.2 On-street parking

As mentioned in the previous section, some streets have paid parking where others are free. This leads to high occupancies and low turnover in streets without a parking fee and low occupancies in streets with a parking fee. Also the parking zones are far too large, with the entire third ring road as the most expensive zone, which does not steer parking demand away from the most important areas within the third ring road. Drivers circle the blocks, looking for vacant parking space at low speeds and stop-and-go behavior, slowing down other traffic and adding to pollution, noise and danger to people.

Furthermore, on many of Beijing's streets the allocation of parking spaces is unclear. Parking spaces are illegally drawn by operators on streets, some on bike lanes and some not even drawn at all, and parking fees charged.

The use of primitive on-street parking systems result in large leakage of parking revenue into private pockets. CCTV did a recent research into parking revenues and found that contracts between city governments and city-wide parking operators jointly secure 300 million RMB annually for the right to operate on-street parking, but only pay 20-30 million RMB. Moreover, the current on-street parking system provides no service to drivers and no insights into parking demand, occupancies and turnover to the government, on which proper parking policies should be based.

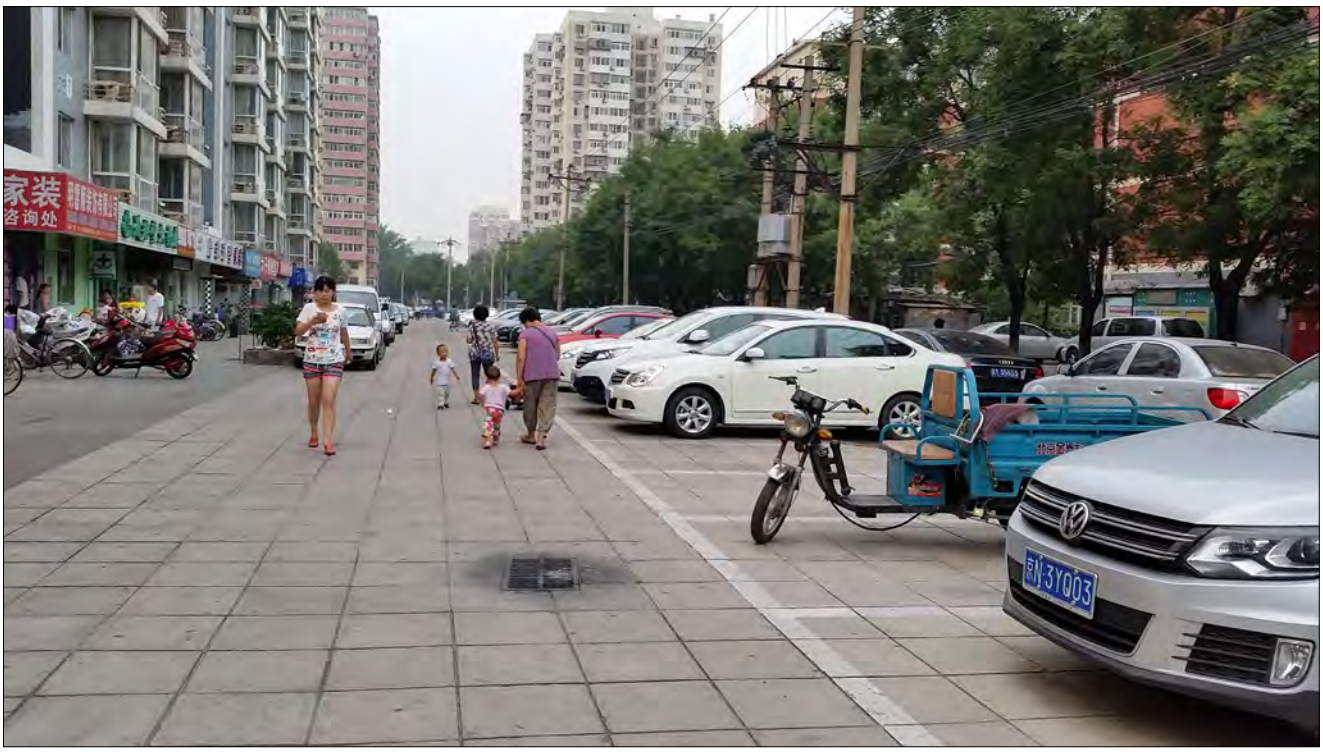
4.3 Parking enforcement

Illegal parking is abundant in Beijing due to poor enforcement. Illegal parking on setbacks and sidewalks cause problems for pedestrians who are forced to squeeze through parked cars, and businesses (shops & restaurants) who are less visible and access become more difficult. Bike lanes are often blocked by parked cars, leaving cyclists to share to street with mixed traffic. Given the large numbers of illegally parked cars without fines, it can be concluded that parking enforcement is poorly executed, which was confirmed by parking

Comparison of Beijing's vs. best practice on-street parking system

	Beijing on-street parking system	Best practice on-street parking system
Price	Price is negotiable with the guard and heavy discounts given for long-term (office & residential) parking. This leads to overcrowded streets and no disincentives to drive.	High enough to manage demand, resulting in short-term parking and sufficient on-street parking vacancy.
Zoning	No comprehensive parking zones implemented, so demand is not directed away from valuable areas. Many streets even have free parking.	Price is set based on occupancy, spreading demand among available spaces.
Payment options	Cash.	Cell-phone, pre-paid card, bank card, credit card, cash.
Operation	Guards having assigned the operation of a certain amount of parking spaces, resulting in high human resource costs and 'deals' between guards and drivers.	Efficient operation, integrated with data sharing and enforcement.
Enforcement	Traffic police hardly enforces, resulting in abundant illegal parking.	Strict enforcement (usually by operator) and high fines, resulting in compliance to parking regulations.
Government revenue	Near to nothing.	Substantial, financing other transportation systems.
Traffic Demand Management	Information on parking demand, occupancy, vacancy, turnover and revenue is unknown to the government	Because of the use of high-technology software and hardware, the government knows the parking demand, occupancy, vacancy, turnover and revenue and uses it for traffic demand management purposes and in communication with the public.
Setback parking	Frequent, making walking and building access difficult.	Not allowed and not practiced, creating pleasant environments where residents and businesses thrive.

Street in Guang'anmen area. Illegal, unpaid parking occurs on the bike lane, while paid parking 50 meters ahead is empty



Sidewalks and setbacks have turned into formalized parking lots and driveways.

On-street parking spaces used for recycling purposes

Paid on-street parking is not used, whereas free, illegal parking on sidewalk and setback prove popular. In fact, the on-street parking spaces, demarcated with red lines are drawn illegally by the parking operator and are not approved by the Traffic Police.

Illegal parking on bike lanes.

Parked cars at intersections make crossing the street a hassle for pedestrians.

guards.

Parking violations can be separated in two categories:

- Non-compliance to parking fee payment.
- Parking in a location where parking is not allowed, such as mixed traffic lanes, bike lanes, and sidewalks

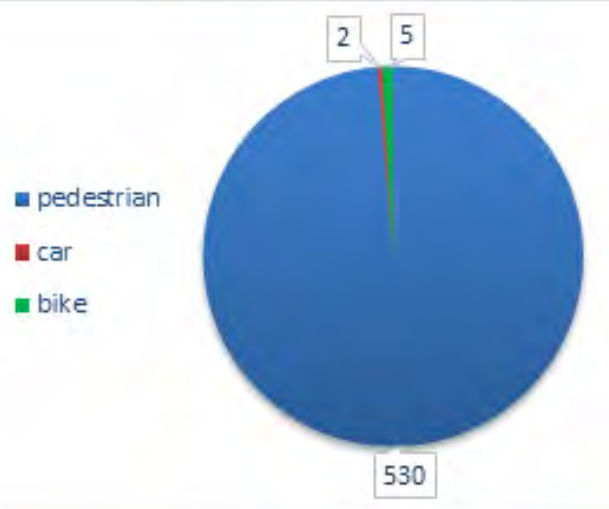
Enforcement of the former is in the hands of parking operators and is handled well, since there is a strong incentive for the operator to charge for parking. For the latter the Traffic Police (mixed traffic lanes and bike lanes) and Urban Management Office (sidewalks) are responsible. The Urban Management Office does not fine for illegal parking and the Traffic Police has no incentive, and therefore manpower, to enforce effectively. All fines from the Traffic Police are paid into the Municipal Finance Department bank accounts, of which the Traffic Police does not share any revenue.

Parking sign does not prevent illegal parking on street and sidewalk.

Cars drive and park on sidewalk.

Jinsong setback case study

A survey was undertaken at exit C of Jinsong metro station on Wednesday 20 August 2014 from 11.35-11.50am. Two vehicles blocked the entire setback where restaurants, a bank and shops are located. During the survey 530 pedestrians and 5 bicycles were observed walking or cycling on the setback, trying to squeeze past the two parked vehicles. The high number of people affected clearly shows that parking on setbacks is undesirable in this location.



Two cars parked on the setback block passage of 530 pedestrians and five cyclists

Empty off-street parking garage.

Empty off-street parking used for storage.

On-street parking is full, where real-time parking occupancy boards shows large vacancies in nearby off-street parking garages.

4.4 Off-street parking

When illegal parking is easy and on-street parking cheap, there is little incentive for drivers to park off-street. It also deters private investors from supplying off-street parking. The Beijing government even uses its own budgets to fund off-street parking garages and incentives developers with 5,000 RMB per parking space provided. Government funds should rather be used for construction alternatives to driving including

Public space in residential communities have turned into parking lots.

Public space in residential communities have turned into parking lots.

Parking supply in recently opened residential developments within the third ring road

Residential parking supply					
Name	**Name**	**Year of opening**	**Units**	**#parking spaces**	**#parking spaces/unit**
Naga上院	Naga Shangyuan	2007	99	248	2.51
国瑞紫金台	Guorui Zijintai	2013	323	772	2.39
玺源台	Xiyuan Tai	2013	719	1110	1.54
御金台	Yujin Tai	2008	180	270	1.50
世茂·工三	Shimao Gongsan	2011	504	726	1.44
屯三里	Tun Sanli	2011	828	1024	1.24
朱雀门	Zhuque Men	2013	776	942	1.21
远洋新干线	Yuanyang Xinganxian	2005	1121	1289	1.15
首开铂郡	Shoukai Bojun	2013	641	641	1.00
缘溪堂	Yuanxi Tang	2008	300	300	1.00
西单上国阙	Xidan Shangguoque	2010	82	82	1.00
铂晶豪庭	Bojin Haoting	2010	90	90	1.00
励骏华庭	Lijun Huating	2008	126	126	1.00
和平大道	Heping Dadao	2012	328	328	1.00
世茂宫园	Shimao Gongyuan	2011	202	198	0.98
西城晶华	Xicheng Jinghua	2008	834	810	0.97
世界城	Shijie Cheng	2008	719	538	0.75
地杰长安驿	Dijie Chang'an Duo	2013	968	721	0.74
前门前	Qianmen Qian	2009	426	314	0.74
保利蔷薇	Baoli Qiangwei	2006	713	500	0.70
中海紫御公馆	Zhonghai Ziyu Gongguan	2008	2200	1500	0.68
海赋国际	Haifu Guoji	2005	370	248	0.67
都城心屿	Ducheng Xinyu	2008	642	430	0.67
方庄六号	Fangzhuan Liuhao	2008	783	507	0.65
嘉里星源汇	Jiali Xinyuanhui	2009	317	203	0.64
圣世一品	Shengshi Yipin	2010	530	336	0.63
和平里de小镇	Hepingli Xiaozhen	2007	1300	800	0.62
远雄大观	Yuanxiong Daguan	2008	131	66	0.50
宇飞大厦	Yufei Dasha	2009	319	147	0.46
中雅阁	Zhongya Ge	2007	190	80	0.42
				Average:	0.99

Source: compiled from SouFun (December 2014), http://www.fang.com

Parking supply in recently opened office developments within the third ring road

Office parking supply					
Name	Name	Year of opening	Floor area (m2)	#parking spaces	#parking spaces/100m2
民生人寿大厦	Minsheng Renshou Dasha	2005	28,566	300	1.05
首科大厦	Shouke Dasha	2012	106,284	1,000	0.94
中汇广场	Zhonghui Plaza	2012	80,000	750	0.94
宝钢大厦	Baogang Dasha	2011	50,000	450	0.90
贵都国际中心	Guidu Guoji Center	2006	56,188	500	0.89
盈泰商务中心	Yinfeng Shangwu Center	2005	23,000	200	0.87
琨莎中心写字楼	Kunsha Center	2006	79,066	623	0.79
北京IFC	Beijing IFC	2010	162,398	1,223	0.75
中坤大厦	Zhongkun Dasha	2006	50,000	366	0.73
昌盛大厦	Changsheng Dasha	2012	61,500	450	0.73
丰融国际中心	Fengrong Guoji Center	2007	78,693	529	0.67
朗琴国际大厦	Langqin Guoji Dasha	2008	150,552	1,000	0.66
三里屯SOHO	Sanlitun SOHO	2008	315,680	2,000	0.63
银河SOHO	Yinhe SOHO	2012	329,080	2,000	0.61
凯晨世贸中心	Kaicheng Shimao Center	2006	194,000	1,050	0.54
丰汇时代写字楼	Fenghui Shidai	2008	89,000	480	0.54
国投广场	Guotou Plaza	2013	203,785	1,088	0.53
环球财讯中心	Huanqiu Caixun Center	2008	127,147	640	0.50
西单大悦城	Xidan Dayuecheng	2007	205,000	982	0.48
通用国际中心	Tongyong Guoji Center	2006	89,000	420	0.47
朝外SOHO	Chaowai SOHO	2007	150,000	700	0.47
中海广场	Zhonghai Plaza	2009	151,000	704	0.47
金贸中心	Jinmao Zhongxin	2013	200,000	855	0.43
侨福芳草地	Qiaofu Fangcaodi	2010	200,000	800	0.40
环球金融中心	Huanqiu Jinrong Center	2008	252,098	1,000	0.40
复星国际中心	Fuxing Guoji Center	2008	82,797	230	0.28
富力双子座	Fuli Shuangzi Zuo	2005	110,000	300	0.27
万豪国际写字楼	Wanhao Guoji	2012	130,000	300	0.23
北京银行大厦	Beijing Bank Dasha	2006	98,741	200	0.20
财富金融中心	Caifu Jinrong Center	2013	720,000	1,200	0.17
				Average:	0.58

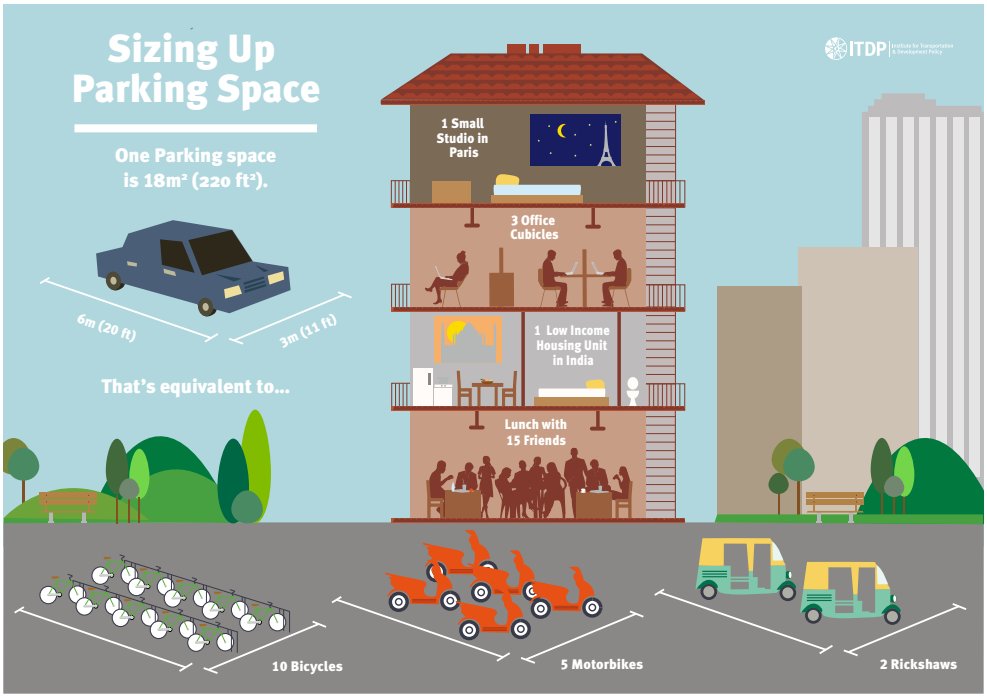
Source: compiled from SouFun (December 2014), http://www.fang.com

public transport, walking and cycling systems, as it also stipulates in its policies.

In the latest Five Year Plan, the approach of increasing off-street parking in residential areas is encouraging car ownership and will lead to higher car use and increased parking demand at the destination (most likely the city center). On the other hand, already developers build much more residential off-street parking than the standards prescribe as a minimum. All of the 30 residential buildings studied, which were built within the third ring road and under the current parking standard, built more than 0.3 parking spaces/unit, with an average of 0.99 parking spaces/unit. A change to the existing parking standard for new developments may therefore not have much of an effect to residential parking supply. For office parking supply the developments studied, also opened between 2005-2014, show an average of 0.58 parking spaces/100 m^2, where 0.65 is the minimum. Increases to parking standards lead to much more traffic in office-rich areas.

The plan of using public and green spaces for parking is detrimental to the livability of the city.

In residential communities, especially in older ones where no off-street parking was built with



On-street parking spaces, but especially off-street car parking spaces consume around 35m2 (including driveways and ramps) in precious urban areas. One car parking space uses the same space as a small studio apartment, three office desks, 15 restaurant seats or 10 bike parking spaces

the development, all public space has made way for on-ground parking. The places where children could once play, elderly could exercise and residents would meet and chat, have disappeared to make room for a few residents with a car.

4.5 Institutional challenges

It is hard for any government organization in Beijing to achieve positive parking reform, since roles and responsibilities are scattered among many organizations. Parking prices are set by the Development and Reform Commission, but they do this without data on traffic and parking, which are with the Communication Commission. Districts, who initiate paid on-street parking, need traffic police approval and cannot control the parking operator, since this responsibility is with the city-wide Communication Commission. Enforcement is done by the Traffic Police (for on-street) and the Urban Management Office but these have no capacity, incentive or interest in proper enforcement.

Parking operation and revenue

CCTV did surveys and found that the parking operation is often not carried out by the companies who won the right from the government, but they rather rent these parking spaces out to individual subcontractors and ask for a revenue target. A parking guard was interviewed in the Jianguomen area who said he works for 16 hours from 7am-11pm and has a revenue target of 20,000RMB per month from 25 parking spaces. This equals to 27RMB/parking space/day.

CCTV also reports that the Beijing government in 2011 published financial data on government revenue from parking concessions. In 2009 this was 33.7 million RMB and for 2010 21.1 million RMB. CCTV expects that the actual parking revenue from paying drivers is likely to be around 300 million RMB, so only a small share is given by the government.

Source: River City evening newspaper (December 2014), Beijing parking revenue: occu-pying the public road but who does the revenue go to?, http://www.jcwbw.com/gngjnews/201412/t20141209_327783.html

5. Parking Best Practices

5.1 London, UK

Source: *Europe's Parking U-turn: From Accommodation to Regulation* (Kodransky, K., Hermann, G., Institute for Transportation and Development Policy, 2010.)

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. Transport for London, the local government body responsible for most aspects of the transport system in Greater London, and directly supervised by the Mayor, is also giving the boroughs directions for parking policies. 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.

On-street parking

The borough of Westminster has eight different parking zones and four different fees for parking, ranging from £1.20 to £4.40 per hour. There are no unregulated areas within these zones. On-street residential parking spaces, indicated by signs painted on the street, are for shared-use between 10 a.m. and 4 p.m. for visitor use. Electric Vehicles and car sharing vehicles park for free. Four hour time limits are imposed for on-street parking. Annual review of parking prices are executed by the boroughs and prices are adjusted based on 85% occupancies and traffic conditions. Parking revenues go straight into a parking fund and a central finance team within the borough decides how to divide the funds to support transportation goals, which is a London-wide regulation. In the borough of Islington most parking payments occur by cell phone. Nearly 48% of revenue for short-stay parking comes from pay-by-mobile transactions.

Traffic enforcement

The Road Regulation Traffic Act of 1991 shifted the responsibility of traffic violation enforcement from the police to local borough councils. As a result, revenue from parking fines flow to boroughs' budgets. Most boroughs hire private companies for enforcement of illegal parking.

Off-street parking maximums

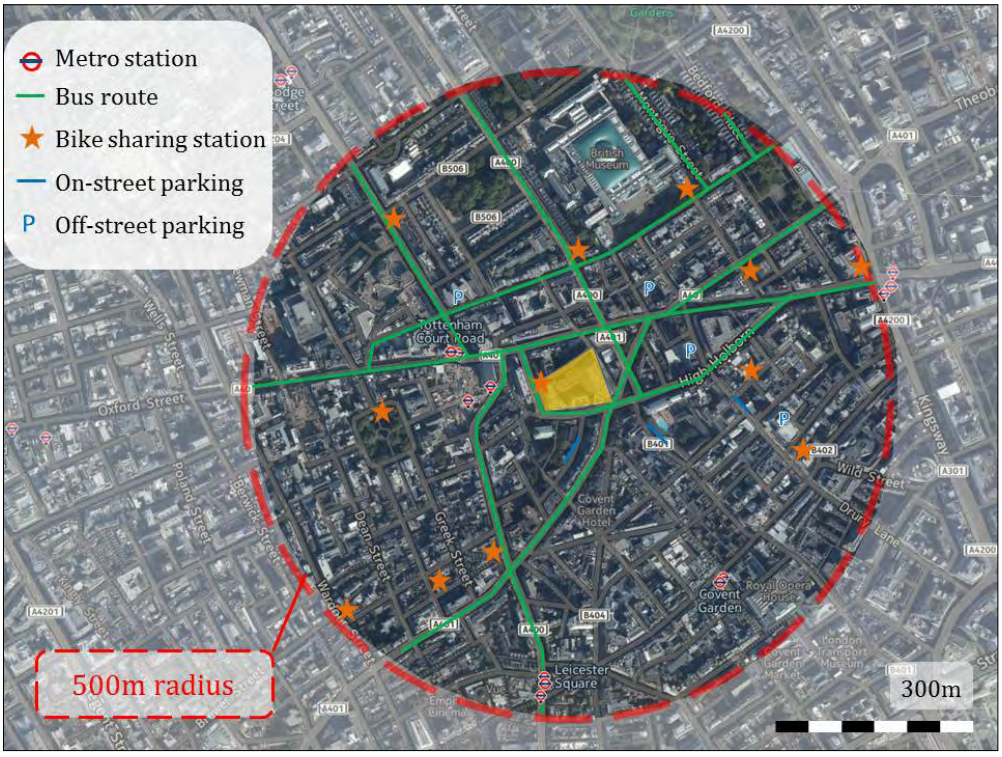
Following the new guidelines set out by the Greater London Authority, all of London's boroughs abolished minimum parking requirements and converted these into parking maximums from 2004. The aim is to have developers provide as little parking as they consider necessary. The city government invests in public transport to improve alternatives to driving.

London Central Saint Giles

The new Central Saint Giles development in central London is an example of successful high-density, mixed-use urban development with excellent transport access. This top-end development only has 10 car parking spaces.

Central Saint Giles is a 0.7 ha mixed-use development in central London, built at a cost of CNY 4.2 billion and completed in May 2010. The development consists of two buildings of up to 15 storeys in height, with office (37,625 m^2), residential, shopping and dining (2,276 m^2) uses at a FAR of 9.4. The development includes 109 residential units, of which 53 are affordable housing. The offices are used by a number of high-profile tenants including Google and NBCUniversal. The ground floor is centered around a courtyard, lined with shops and restaurants on almost the entire development. The buildings, as well as the public space can be entered from all sides, as the blocks are small (49m on average), and the development is open for all people to enter.

Only ten car parking spaces are provided, some for handicapped, and others at a cost of £100,000 each, due to the insistence of Camden borough council that the development should be largely car-free. Around the development there is a limited amount of metered on-street parking for short-term visitors, as well as 3 car parking garages, open to the public and charged at market-regulated prices. Although no car parking spaces are available in Central Saint Giles, there are 200 bike racks in the basement, providing dry and



secure bike parking. More bike racks can be found at street-level. To stimulate cycling to work, 12 showers with changing facilities and lockers are available. London's Barclays Cycle Hire scheme, that covers most of London, has a station at Central Saint Giles, and several more stations are in close proximity.

There are three metro stations (on three different lines) within 500 meters walking, with more metro stations close-by. The walk to Tottenham Court Road metro station, which is on both the red and black line, takes 2 minutes. The area is also covered by 17 bus routes, all with stops within a couple of minutes walking. The surrounding area has safe streets (with a speed-limit of 30 kms/hour) and compact intersections with continuous pedestrian and bike crossings.

Source: Galpin (2007), at Panaramio, http://www.panoramio.com/photo/3640383

Swiss Re building

The 30 St Mary Axe, widely known as the 'Gherkin' or 'Swiss Re' Building, is a 180m skyscraper in London's main financial district and opened in May 2004. The 41-floor building hosts 4,000 people, mostly employees of Swiss Re, a global insurance company. There is a net 46,000m² of office space and 1,400m² for retail on the first floor.

The building has no parking spaces for employees or visitors. It has 5 parking spaces for handicapped, 13 for deliveries, 52 for motorcycles and 118 for bicycles. There are two metro stations within 500m walking and two more within 700m, as well as one train station within 500m. Moreover there are 12 bus routes that pass the building. It has a bike sharing station right outside and the building is connected to London's bike lane network. The smaller footprint at ground-level allowed a public plaza in front of the building.

The building has become an iconic symbol of London. In February 2007 it was sold for CNY9.5 billion, making it Britain's most expensive office building.

5.2 San Francisco, USA

Sources: *SFpark Pilot Project Evaluation* (SFMTA, June 2014), and *U.S. Parking Policies: An Overview of Management Strategies* (Weinberger et al., February 2010).

On-street parking: San Francisco's SF*park*

San Francisco's SFpark is the largest, and by far the most sophisticated, on-street parking reform project in the United States. SFpark is the brand for the demonstration parking project by the San Francisco Municipal Transportation Agency (SFMTA), funded through the national Department of Transportation. In November 2008 SFMTA approved the legislation, in July 2010 installation of the meters began and in April 2011 the project started. It includes 6,000 metered on-street parking spaces (25% of total supply) and 12,250 spaces in SFMTA-administered garages (75% of total supply). With the project the SFMTA uses pricing to help redistribute the demand for parking. The goal is to encourage drivers to park in garages and lots, and to almost always have one space available on every metered block.

To achieve this, SFpark uses new technologies including smart meters, parking sensors, and a sophisticated data management tool. Some features of the system are:

- Demand-responsive pricing.

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

Guidelines used by SFMTA for changing parking prices

On-street		Off-street	
When average occupancy is:			
80–100%	hourly rate increases by $0.25	80–100%	hourly rate increases by $0.50
60–80%	hourly rate is not changed	60–80%	hourly rate is not changed
30–60%	hourly rate decreases by $0.25	<40%	hourly rate decreases by $0.50
<30%	hourly rate decreases by $0.50		

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

- Improved service to drivers: real-time information about where parking vacancy for on- and off-street parking direct drivers to available spots. Parking can be paid for with cash and credit card at the parking meters and cell phone remotely.
- Time limits for on-street parking. Time limits of 3-4 hours are used to prevent commuters from parking on-street.

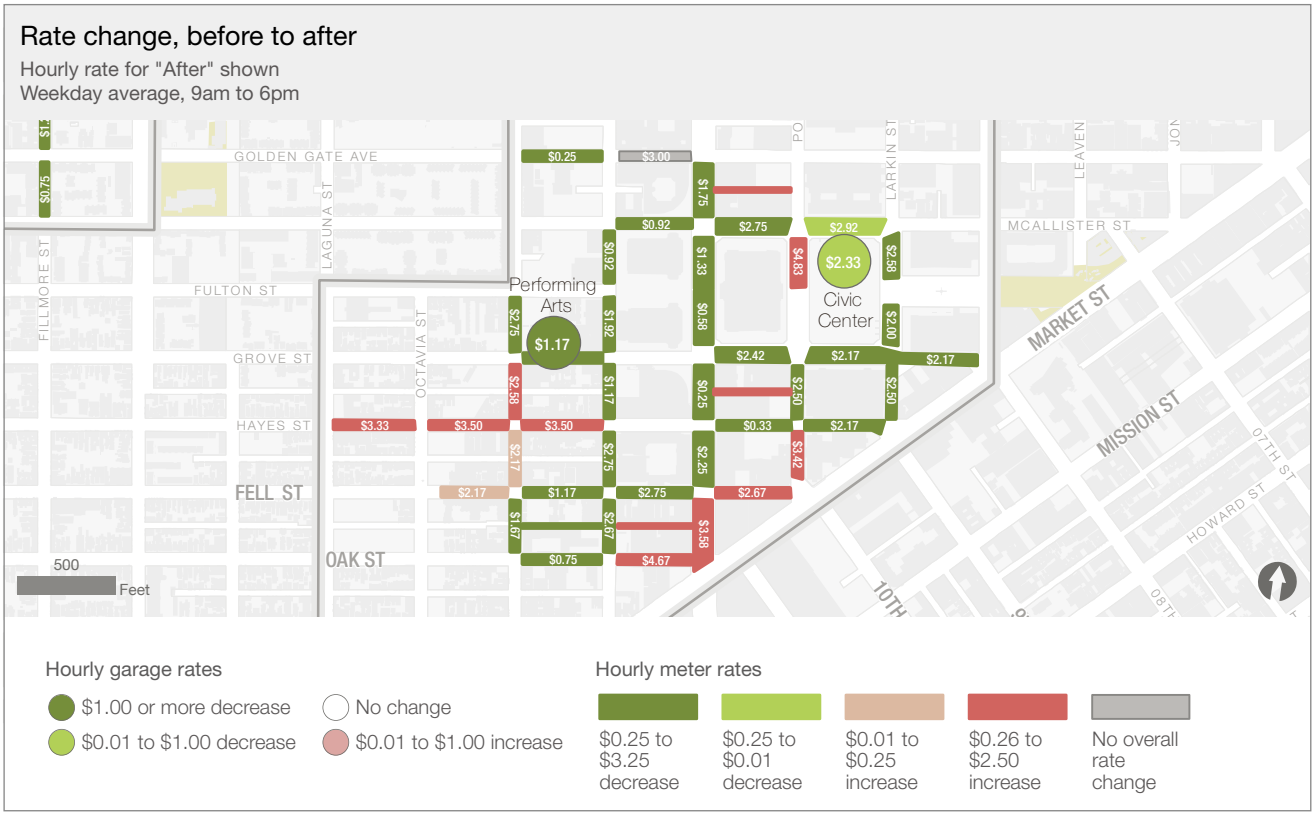
Results

Based on data between August 2011 and June 2013, results have included:

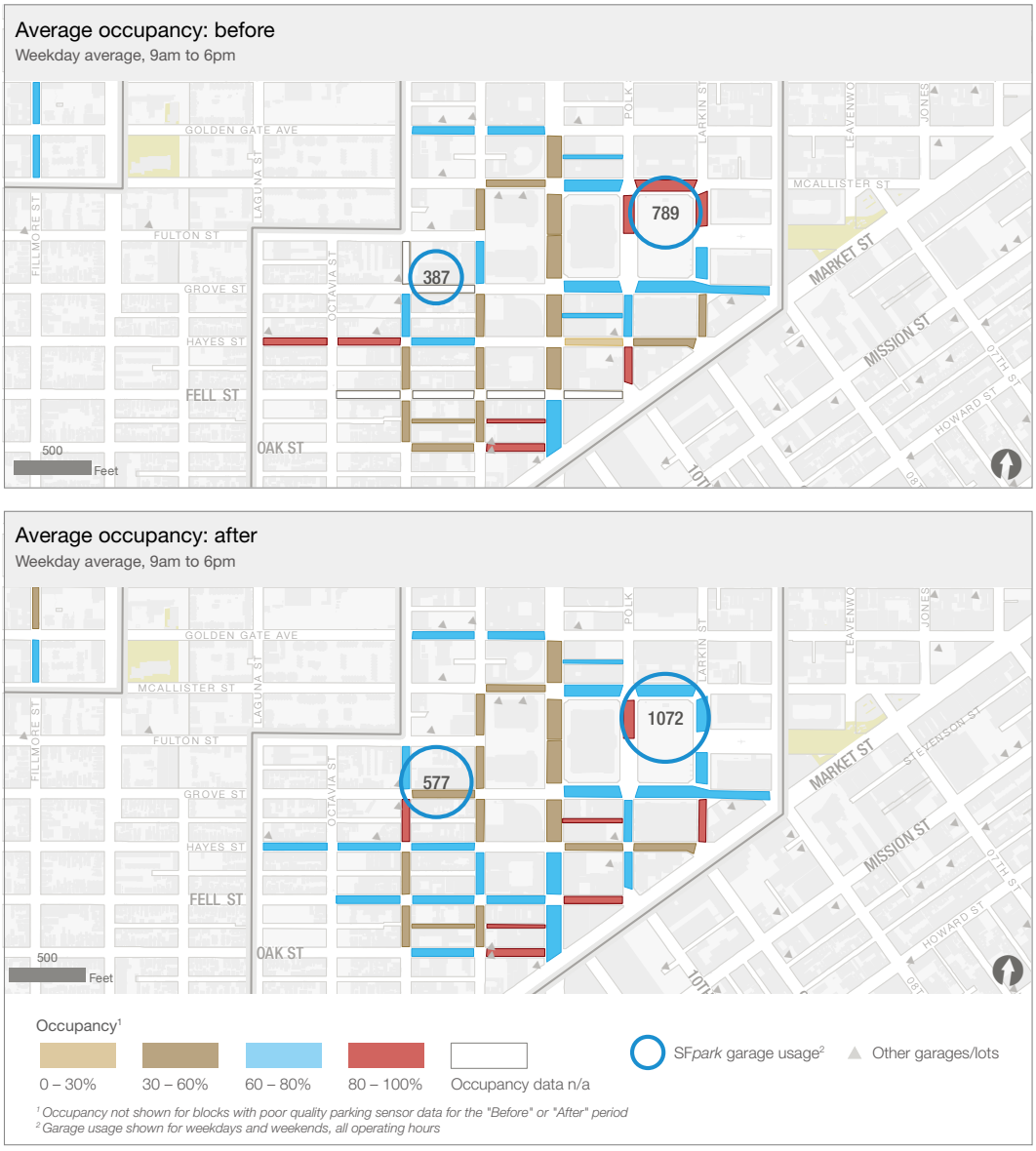
- On-street parking availability in pilot areas improved by 16%, and by 22% during peak periods, while parking availability in control areas went down by over 50% (where prices remained the same at $2,00/hour). In SFpark garages, utilization increased by 11% overall and by 14% during off-peak periods. Average daytime garage occupancy increased from 51 to 59%—a 14.5% increase. Even as occupancy increased, SFpark garages maintained parking availability1 at least 97% of the time. In other words, both on-street parking availability and off-street parking utilization improved when it mattered most to help reduce circling for on-street parking: during peak periods.
- Parking search time went down by 43% (13% down in control area) from 11.6 to 6.6 minutes.
- VKT in the pilot areas went down by 30% from 13.0 to 9.2km (6% down in control areas) and traffic volumes were drastically reduced.
- After SFpark, payment compliance increased by 21% on weekdays and by 12% on Saturdays.
- Due to the use of high-technology SFMTA collected real-time information on turnover, length of stay, failure to pay and other illegal parking allowing the city to continuously adjust prices and policies to improve the system and to more effectively deploy enforcement personnel.
- The highly transparent, rules-based, and data-driven approach to making changes to parking prices, which improved customer acceptance and service.

Source: SFpark Pilot Project Evaluation, SFMTA, June 2014

Based on occupancy rates of the on-street parking spaces the prices were adjusted. Some streets became more expensive, others became cheaper to achieve an occupancy of around 85%. Average prices increased in 4 and dropped in 3 areas.

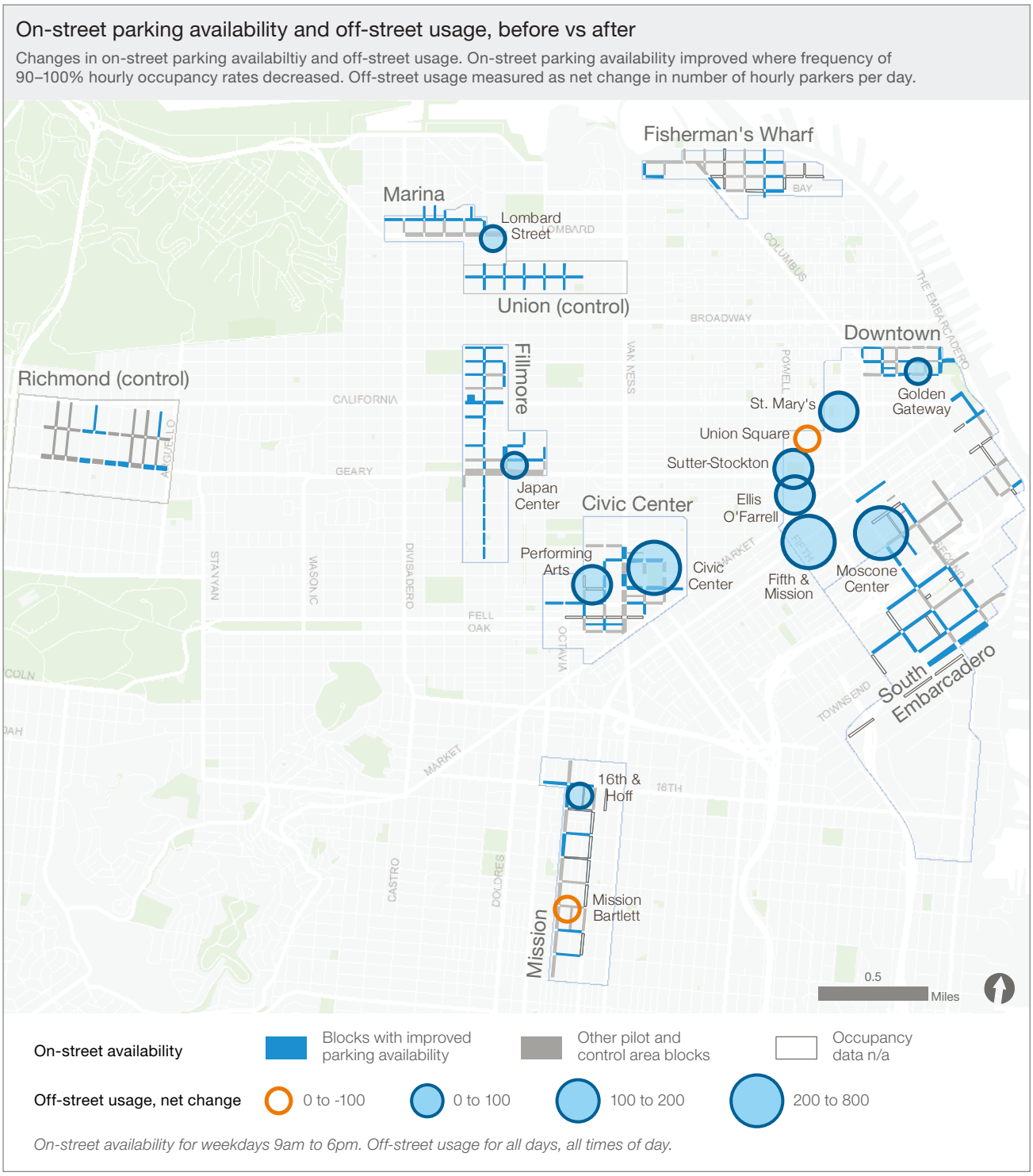


Example of price changes at the Civic Center area.



Parking space occupancies before (above) and after (below) on street around the Civic Center. On-street parking demand spread out more and off-street parking spaces saw higher occupancies.

Source: SFpark Pilot Project Evaluation, SFMTA, June 2014



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

Source: SFpark Pilot Project Evaluation, SFMTA, June 2014

Off-street parking

San Francisco has evolved over the last half century from a municipality that once required one parking space for every new dwelling to one of the most innovative examples of parking management in the United States. This has occurred through investment in transit, gradual replacement of off-street parking minimum requirements with maximums, parking unbundling, and proactive on-street parking management. A relatively small proportion of the city's residents — about 70

percent — own a car. High density development and a preponderance of buildings that pre-date off-street parking mandates has helped keep the number of autos per person low.

Due to its low residential population and high number of commuters, the city introduced many of its parking reforms downtown. Following the opening of the Bay Area Rapid Transit Authority (BART) rail line in 1973, the city authorized a parking cap of all downtown commuter parking spaces. Minimums do not apply to any use downtown, and a maximum of one space is permitted for every four downtown residential units. Similarly, parking may occupy no more than 7 percent of an office building's gross floor area — about one space for every 20 office workers.

San Francisco has proceeded to eliminate residential minimum parking requirements through the adoption of neighborhood plans for districts close to the downtown, from 1997. In 2005 the Rincon Hill Plan was the first to eliminate minimum parking requirements for all uses in a residential neighborhood. Most developers now build up to the maximum allowed number of spaces. The city's residential parking maximums range from 0.5 to one space per unit, depending on neighborhood factors such as access to transit and density; these were often converted from the existing minimum requirements.

San Francisco's Planning Department states that parking maximums have been achievable because they have been part of a larger package of policy and infrastructure and other changes for neighborhoods as prerequisite for development. Dedicated parking spaces for car sharing and covered bicycle parking are now common in larger residential developments.

5.3 Budapest, Hungary

Problem

Budapest rapidly motorized in the 1980s and 1990s, and with motorization came heavy congestion, related air pollution and parking problems. When Hungary, of which Budapest is the capital, became a formal member of the European Union in 2004, its cities had to comply to EU regulations and standards, including air pollution standards. To prevent having to pay the EU hefty fines, the Budapest government decided to tackle its traffic problems and shift its citizens to more sustainable modes of transport.

A warning sign for towing in case of illegal parking, to no effect. In the 1990s parked cars had invaded Budapest's streets, sidewalks and public spaces and congestion and pollution was rampant.

Source: Gyarmati (2011), Sustainable traffic in Budapest), https://www.itdp.org/wp-content/uploads/2011/06/197.-ITDP_Summit_Zoltan_Gyarmati_ITDP_Europe_-_02_Parking_1.pdf

Strategy

Managing parking was identified as a crucial and fairly easily achievable element of reducing car trips. The city government used a three-pronged strategy to attack the parking problems. First, it worked to centralize control of the entire

transportation system, including parking. Second, it set out to align the parking price with the price of alternative transportation (bus and metro) and align it with Budapest's goals for more public transportation and increase in walking and cycling shares. Moreover it wanted to see the price of parking reflected high-density areas and streets with low traffic capacity in central areas of the city. Third, the city decided to incorporate modern technology in its parking systems to better manage and enforce compliance with the new parking system.

Programs

The final decision was taken by the City Council to centralize Budapest's transportation system under the City Operation Committee, a group of policy makers that make key decisions about public transport, parking, and non-motorized transportation. The Budapesti Közlekedési Központ (Budapest Transport Center) was created to set out transport-related strategies and also manage transportation systems on a day-to-day basis. The role model for this concept was the Transport of London.

A new parking strategy with the following goals was created:

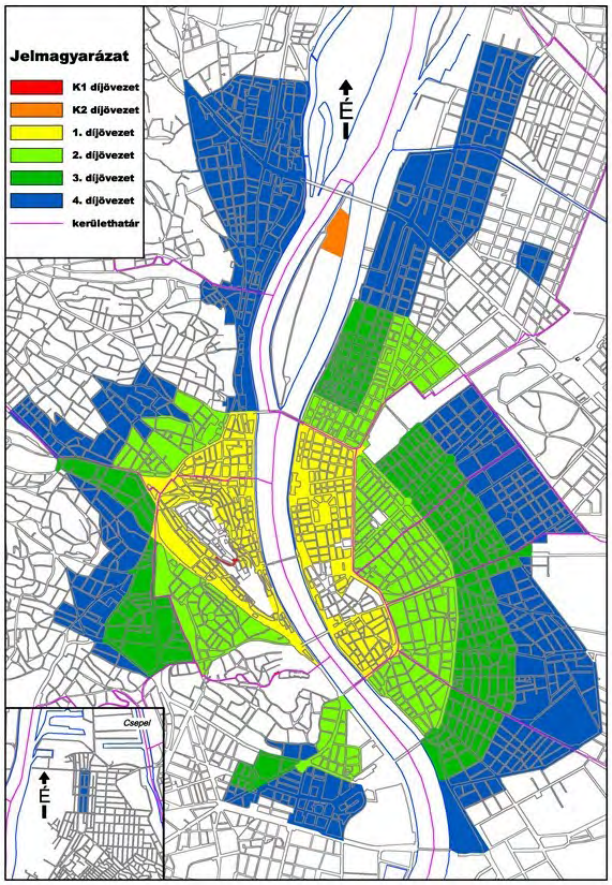
- Directing cars parking longer than 2-3 hours (mostly commuters) into off-street garages and parking lots away from the public realm.
- Achieve mode shift away from driving cars and into public transport. To strengthen the competitiveness of public transport against private transport, the costs of parking were raised to be at least as expensive as public transport. If public transport costs were raised, parking fees were too, in order to have make parking (and therefore driving) more expensive than using public transport.
- Secure operability of areas affected by parking reform. This meant providing sufficient parking spaces for residents, services, institutes and commercial units.
- Create a balance between the supply and demand for parking spaces.

On-street measures

As of 2014 the Budapest has established four parking zones with prices varying between zones based on density, transportation system capacity, and documented parking occupancy. Parking is more expensive than a public transport ticket in the two most central zones, and prices are also close the €1.20 (10RMB) public transport fare in the other two zones. The city has also implemented the highest-priced parking zones in the historic districts, in which a minimum amount of traffic is aimed for.

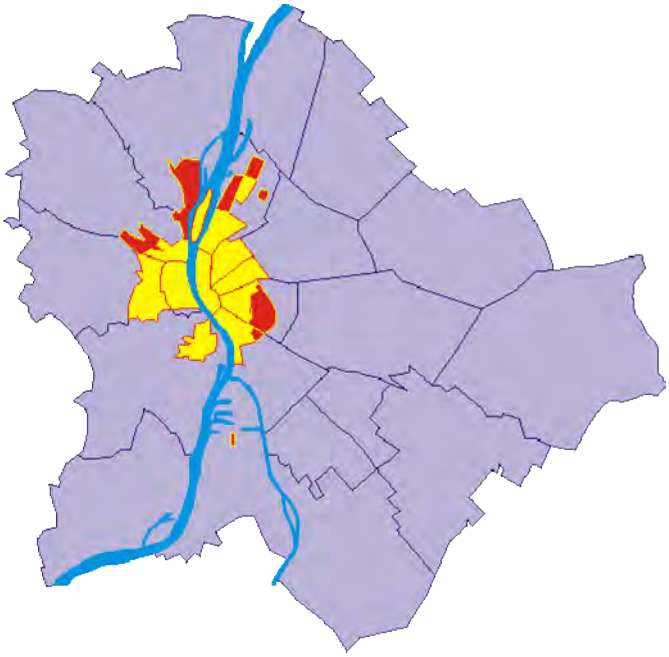
Budapest's hourly parking fees

Zone	Hourly parking fee	Parking vs. bus fee
1. Old city center (yellow)	15 RMB	1.50 x 1 bus ticket
2. City center (light green)	12 RMB	1.25 x 1 bus ticket
3. Intermediate zone (dark green)	10 RMB	1.00 x 1 bus ticket
4. Outer area (blue)	7 RMB	0.75 x 1 bus ticket



The paid on-street parking zones of Budapest with more expensive parking in areas closer to the city center.

Source: Gyarmati 2011



The city of Budapest. The yellow and red zones have paid on-street parking, where the grey areas have free on-street parking.
Source: Gyarmati 2011.

Higher fees are imposed in areas with either higher parking demand or limited parking supply, such as the historical city center. Zones in the outer parts of the city, where traffic congestion is no issue and sufficient parking supply available, parking fees are lower.

Budapest also used technology to make parking management and enforcement more effective and efficient. The city uses multi-space electronic meters, which allow a variety of payment methods, to collect parking fees in most paid parking areas. Cell phone payment systems can be used in most areas as well. Enforcement officers carry GPS-enabled devices that share data with the parking operator and city government.

The city government felt that private companies which implemented, operate and enforce the on-street parking system, were critical to the success Budapest has had with its on-street parking system. The contracts with some private companies will expire in several years after which the system is again in full ownership of the city government.

Off-street measures

To limit car ownership and traffic congestion, the city government realized that off-street parking spaces needed to be minimized, despite the minimum parking standards in place at that time. Initiated by non-governmental organizations (NGOs), dialogues were held between the city government, NGOs and real estate developers about how to minimize off-street parking spaces. Real estate developers also favored this approach as it reduced their building construction costs and leaves more space for sellable and rentable units. Moreover, investment in better public transport was seen by real estate developers to raise the value of their developments.

First, the government decided that a building permit is only granted when public transport to the new development is incorporated. In the building permit procedure, the Budapest Transport Center is a now an authority, similar to the fire department or the utility departments, who have power to deny developments (over a certain size) to be built without public transport provision.

Second, a regulation was put in place where a real estate developer could receive a 100% discount on the compulsory off-street parking supply, if the planned development is within 500 meters from a public transport station.

Third, if real estate developers wish to develop in areas for which the zoning regulations need to be changed, the government decided that the real estate need to co-finance the required public transport provision to this new development. In return, real estate developers receive discounts on the number of required off-street parking spaces.

Finally, minimum off-street parking requirements are now eliminated in Budapest. District governments, authorizing building permits, are allowed to give discounts of up to 100 % on off-street parking supply, on a case-by-case basis, supported by a study on alternative parking provision.

Results

A reduction of 15 % in vehicle kilometers traveled (VKT) was achieved. The parking occupancy in the inner-city zones dropped to around 70-80%, because of higher parking fees. New developments provide less parking and real estate developers focus on good public transportation and non-motorized transport access to their developments. Congestion and pollution dropped drastically.

Typical streets with well-regulated on-street parking in Budapest.

Source: ITDP-China, www.transportphoto.net

5.4 Shenzhen, China

In early 2014 Shenzhen's car ownership exceeded 2.75 million cars, with a monthly increase of 40,000, resulting in traffic congestion during peak hours. The city government launched a pilot projects for on-street parking reform by March 2014 to regulate and manage on-street parking in an effort to reduce parking demand and car travel for daily use and make better use of public resources. The project was implemented using the following phases:

Phase I: Planning & Design of on-street parking zones

Traffic surveys, parking supply and demand surveys provided insights into current parking practices in Based on the surveys four pilot areas were identified and include 1,673 on-street parking spaces. These areas had no parking fee at that time. Start of the operation of the system was set for 1 July 2014.

Phase II: Issuing new parking price policy and public hearing

Previous plans for parking price policies, developed in 2012 and 2013, were presented at public hearings and inputs used in revisions of the policy. The new parking prices, which only apply to the four pilot areas, were set as shown in the table below.

Parking prices (RMB per 30 minutes)

Time		Zone 1		Zone 2		Zone 3	
		First 30 mins	After first 30 mins	First 30 mins	After first 30 mins	First 30min	After first 30 mins
Weekday	Daytime (7:30-21:00)	5	10	3	6	2	4
Weekend		2	4	1.5	2.5	1	1.5
Night time (21:00-7:30)		Free					

Phase III: Project tendering & construction

Following the planning and design of the zones and system, the Shenzhen Road Traffic Management Center, under the Shenzhen Transport Center, tendered out the provision of technology. The parking technology consists of parking sensors, an on-board tag and a cell phone app. Tags can be bought at parking service centers as well as online. The on-street sensors automatically recognize a car with a tag installed, after which parking payment automatically starts. The other payment option is by cell phone app. PDAs for parking inspectors, as well as a data management center, which can communicate with all the equipment, were part of the technology provision.

Phase IV: Operation

For the operation of the new parking system, three phases were used:

- Step 1: During one month the government publicized the upcoming changes, explaining why the system is needed and how it works;
- Step 2: During one month the system was on trial. The operator was able to test and improve and drivers were given the chance to try out the system. Parking was not yet paid for during the trial stage;
- Step 3: Start of formal operation from 1 July 2014.

The inspection of parking payment compliance is done by the Shenzhen Road Traffic Management Center. When a parked car has not paid, the parking inspector records all necessary information using a handheld PDA, which prints a note that is put on the car's windshield and automatically sends the record of parking violation to the Traffic Police. The Traffic Police can subsequently act on surcharging, and car towing.

Official data from the first month of operation shows:

- 63,807 clients have registered in the system and 82% of this number used the cellphone app;
- The average daily occupancy rate is 42.31% and the turnover rate is 5.26;
- 80 inspectors are distributed among the four pilot areas;
- PDAs recorded 26,523 violations, including

9,221 for non-payment and 17,320 for parking in illegal places;
- The biggest complaint is the limited payment options. Especially drivers who do not park in the area frequently, found that the app and tag required too much hassle.

After the second month of operation the average occupancy increased to 49%, with average parking duration under 1 hour. A smaller number of violations was recorded, with 10,799 for non-payment and 7,112 for parking in illegal places.

Source: Southern Daily (2014), www.nfdaily.cn


Source: Shenzhen Evening News (2014), http://wb.sznews.com/html/2014-07/15/content_2941685.htm

Source: Shenzhen Channel (2014), http://www.s1979.com/shenzhen/201407/09124375309.shtml

The service kiosk offers customer service, including account registration, account information, topping up credit, invoice application and customer complaint service.

Off-street parking

The Shenzhen Urban Planning Standards and Guidelines (2014), defined by the Shenzhen Planning Land Resource Commission, commissions developers to provide off-street parking for new developments. Together with Shanghai, Shenzhen is the first Chinese city to adapt maximum, rather than minimum, parking standards.

For residential developments within 500 meters from metro stations, the residential parking provision cannot exceed 80% of the parking standard. For commercial land uses, the parking supply is based on land use, development intensity, transit accessibility and road capacity and categorized into three zones. In areas with good transit service, limited road capacity and high development density, commercial parking standards are allowed to be reduced further if a study proves less parking supply is needed.

5.5 Zhuhai, China

In 2012 Zhuhai (Guangdong province) implemented a new on-street parking system in the city center. A small number of 1,117 parking spaces on ten roads was implemented in two phases (3 roads by June 2012 and 7 roads by March 2013). A new parking price policy was introduced, shown in the table below.

Parking fees in Zhuhai's on-street parking system

Business roads (Red)		Regular roads (Blue)	
Peak hours	Off-peak hours	Peak hours	Off-peak hours
8:30-21:00	21:00-8:30	8:30-17:30	17:30-8:30
1st half hour: 2 yuan. After 1st half hour: 3 yuan	1st half hour: 2 yuan. Maximum price: 5 yuan/ time	Every half hour: 2 yuan	Every half hour: 2 yuan. Maximum price: 5 yuan/ time

Zhuhai uses parking meters for parking payment. Every parking space carries a number that is put in at the meter, followed by the desired parking time. Payment is done by bank card, either magnetic strip or chip card.

Parking fees are charged on street in red (higher fee) and blue (lower fee).

Source: Nandu.com (2013), http://epaper.oeeee.com/N/html/2013-05/24/content_1864314.htm

Parking space number and parking duration is selected at the on-street parking meter in Zhuhai. Payment is done by bank card.

Source: Zhuhai Urban Public Resources Operation Co. Ltd. (2012), Zhuhai city on-street parking meter system usage guidelines

Before implementation of the project, Zhuhai released a formal parking regulation, including a clear definition of a parking violation, consequences of parking violation and legal follow-up.

Parking sensors in the parking spaces communicate with the meters and send out a warning to the Traffic Police if parking time is expired for enforcement. A fine of 200 RMB applies.

Parking fine is stuck on a car's window for overstaying the paid parking time

Source: Zhuhai Urban construction group (2013), http://www.zhcjjt.com/?ty=lnews_view&newsid=155&kind=03

6. On-Street Parking Recommendations

The get better control, data and revenue from on-street parking in Beijing, new on-street parking systems and policies are highly needed. Recommendations for both are presented in this chapter.

A rendering is shown of Hongju Bei Jie in the Guang'anmen Langqin area, showing the benefits of the recommended on-street parking system. The street is currently stacked with illegally parked cars on the street and sidewalk. Walking is unpleasant and cycling has become dangerous with cars coming in and out of parking spaces. The restaurants and shops on the southern side (right in the picture) have become inaccessible.

The proposed on-street parking system includes perpendicular and parallel parking spaces on both sides of the street with parking meters visible in yellow. Vehicle encroachment on the sidewalk is physically prevented with the installation of bollard on the sidewalk's edge. To further enhance the attractiveness of the street for all users, bike lanes in both directions, a bike sharing station, a widened and continuous sidewalk, public seating and trees are included. To ensure slow traffic speeds and safe pedestrian crossing, the intersection with the small street heading south is raised.

6.1 Parking zones

The lack of coherent pricing of parking in Beijing, where some streets are priced and others are not and shown with the surveys in chapter 3, lead to drivers cruising around to find parking spaces without charge. It is recommended to develop on-street parking zones in which all streets where parking is allowed to be priced according the price of the zone in which they are located. The zone and its borders should be chosen in the most central and highest-demand areas where parking problems are worst, in order to lure drivers away from these valuable areas. Signs should indicate to drivers when entering an on-street parking zone or switching between one. Under supervision of a central city government, and with assistance from planning & design institutes, district governments need to carry out studies into parking demand, occupancy and turnover to identify which area require higher pricing than other areas.

Following what international best practice prescribes and European cities practice, it is recommended to implement paid on-street parking in areas where occupancies exceed 70% during peak demand hours (including illegal parking). The aim is to achieve 85-90% occupancy of on-street parking spaces during peak demand hours. At this occupancy rate most parking is used but some spaces are still available, reducing cruising to a minimum. Other factors such as existing traffic congestion and high-importance areas (business districts, historical and tourist areas, etc.) are also factors that should be taken into consideration when defining zones and their borders. It requires extensive, detailed studies into the parking occupancies for the entire city, but it is expected that Beijing needs to charge for parking in most of the area within the 5th ring roads and in some areas beyond that. Every district in Beijing would have at least a few areas where another one or two zones with a higher parking price. Parking zones are by no means static though. Many factors, which change over time, influence parking demand and zones and prices should change along to stay in line with the target occupancy rates. By expanding and adjusting the zones and prices according to parking demand, the parking problems of Beijing are gradually being solved.

6.2 Parking price

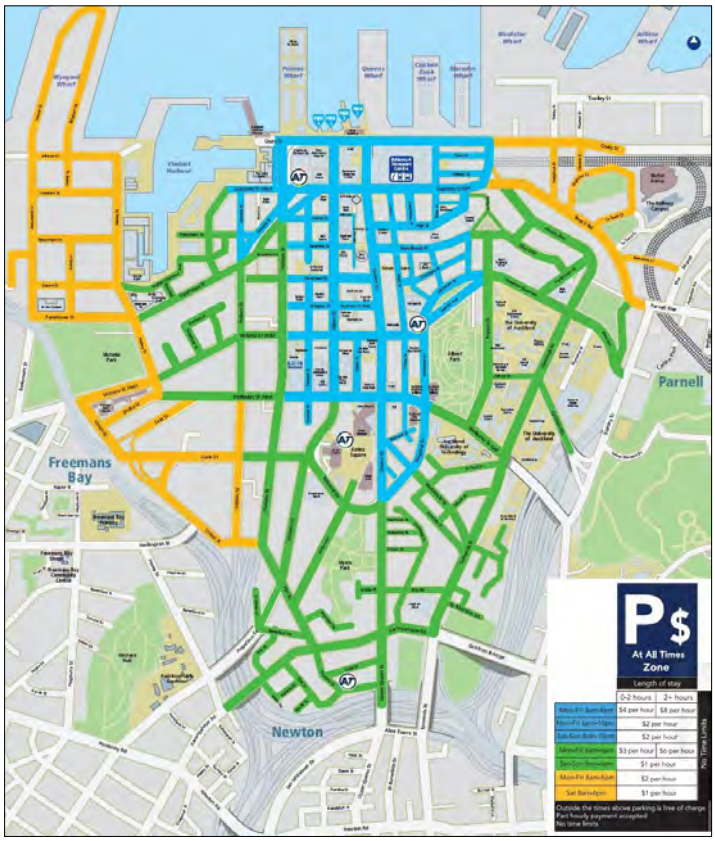
The parking prices set out by the Development & Reform Committee are mostly not followed. Illegal parking is poorly enforced, resulting in many drivers who park for free on streets, sidewalks and setbacks. Those who do pay can often make a deal with parking guards, especially for long term parking.

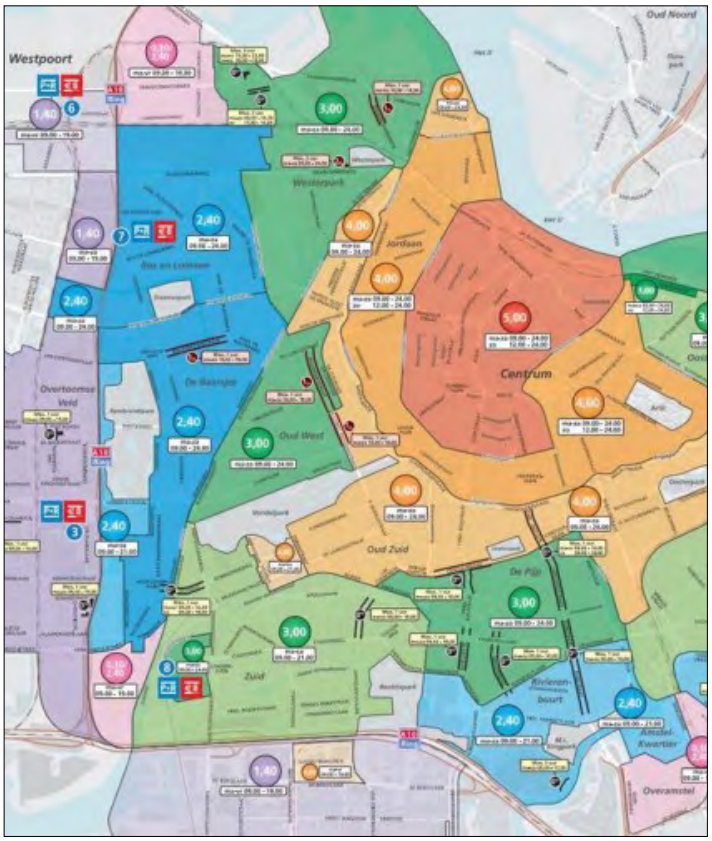
The price for on-street parking needs to be duration-based with no discounts given for

Signs indicate drivers they are entering the on-street parking zone in Budapest. The paid parking hours and three-hour time limit, as well as a restrictions to truck access over 3.5 tons are shown.

Source: ITDP-China, www.transportphoto.net, 2012

Source: Gyarmati (2011), Sustainable traffic in Budapest), https://www.itdp.org/wp-content/uploads/2011/06/197





Parking zones in Budapest (top), Amsterdam (above right) and Auckland (above left) show differentiated prices for on-street parking. Parking in closer proximity to the city center is more expensive.

Source: Google Blogspot, http://1.bp.blogspot.com/-q_yYtkLPF_k/UNO7jboKhSI/AAAAAAAAA3M/neXqOk-8GMFI/s1600/City-Parking-Zones-e1348033887825.jpg

Source: Gemeente Amsterdam (2014)

long-term parking. On-street parking should only be for short-term parking and high prices, combined with time limits, need to ensure this. A flat parking fee per parking event incentivizes drivers to park as long as possible to maximize the sunk costs for parking there. It also encourages long-term parking to occur on-street, where relocating this parking demand to off-street parking places is preferred. The surveys show there is a large share of long-term parking (>3 hours) on many streets. An hourly (or half-hourly) fee will encourage drivers to park only for as long as they need, resulting a higher turnover and higher vacancy of on-street parking spaces. More spaces will be available to short-term parkers who come for a quick purchase and leave immediately, so on-street parking spaces will see higher turnover and generate more customers for local businesses. A low price for curb parking may sound good for business, but it is not. Actual pricing of parking of the Development & Reform Committee's parking price will mostly affect commuters, who do not wish to pay hourly on-street parking fees. They will look for off-street parking spaces instead, giving back on-street spaces to short-term users, or use public transport, walk or cycle instead. Current hourly parking fees of 3.75RMB/15 minutes can be kept, although higher prices at high-demand, central locations may be needed. After implementation of the proposed on-street parking system, occupancies need to be analyzed and parking prices adjusted to the new demand.

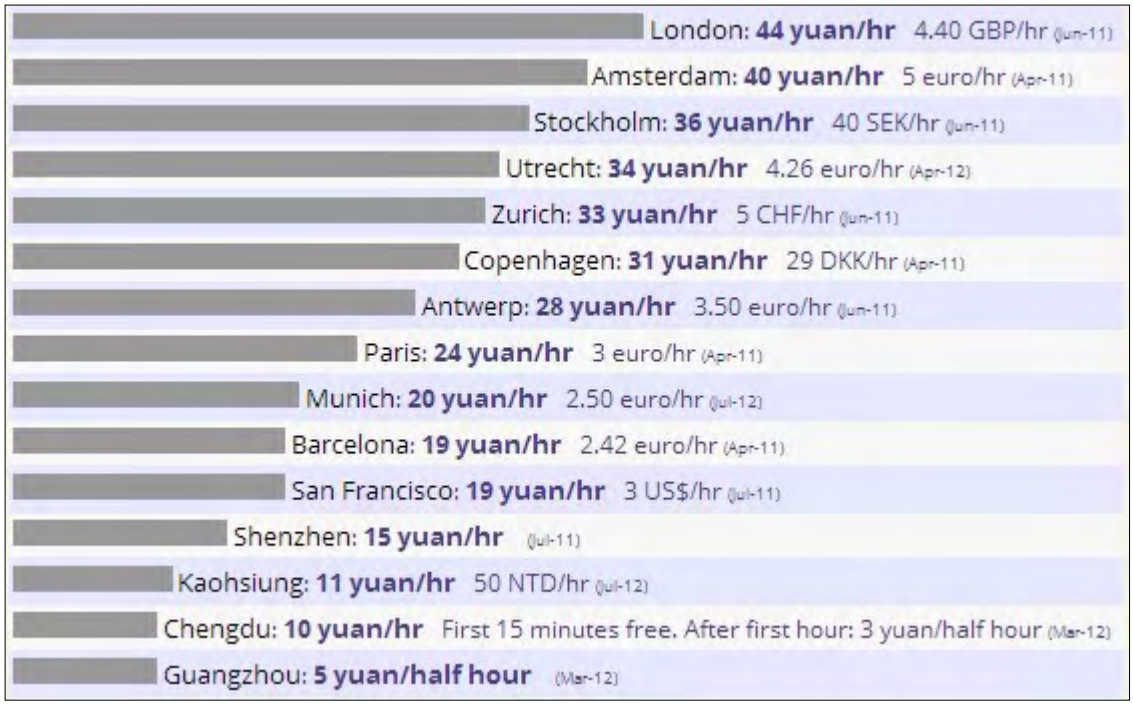
On-street parking fees for residential parking are recommended to be increased, since heavily discounted monthly parking fees incentivize car ownership, and therefore car use.

It is recommended to consider implementing incremental parking fees in future, when the system has matured. This entails raising the hourly parking fee incrementally for every consecutive hour parked. For instance, the first hour of parking costs 15RMB, the second 20RMB, the third 30RMB. This is an additional incentive for drivers to park off-street for long-term parking, freeing up curb-side space.

Finally, the Development & Reform Committee is not the best organization to take decisions on parking prices. Because parking prices are so closely related to transport, the Communications Commission should have a much stronger voice in the parking price.

6.3 Parking bans and time limits

When implementing the proposed on-street parking system, streets need to be redesigned to accommodate on-street parking spaces. On some streets no on-street parking should be designed for. Parking bans should be considered on streets with a clear traffic function (as already is the case

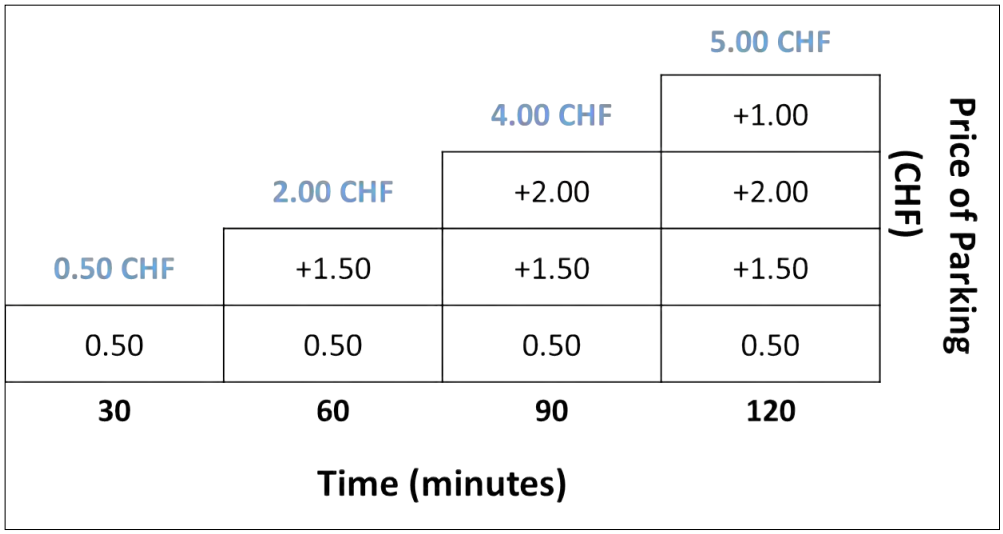


The chart above shows hourly parking fees for city centers in selected cities worldwide (in Chinese yuan/RMB).

No meters | Meters | Prices quadrupled

When London implemented paid on-street parking at Grosvenor Square in 1958, its problems of double parking disappeared, with drivers (especially employees) parking in nearby streets where ample spaces were available. When prices for parking were quadrupled, the street had solved its parking problems and vacant spaces became available.

Source: Transport Research Laboratory, UK

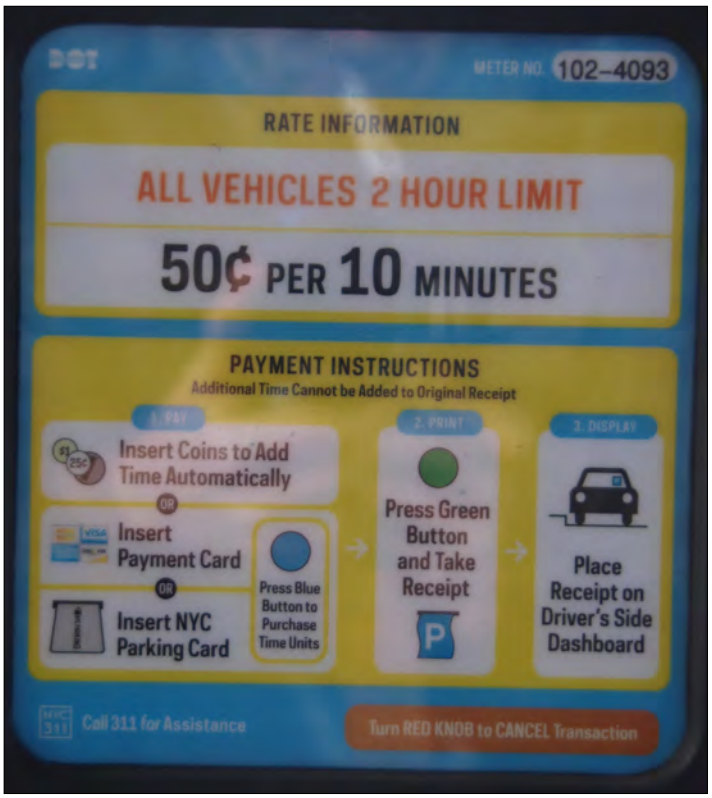


Zurich, Antwerp, Vienna, and Madrid have on-street pricing schemes that charge a marginal cost increase with successive time to capture the increased marginal burden of a car's presence. The graph shows Zurich's progressive charging scheme (1 CHF = 6.29RMB). It is recommended to consider implementing a similar pricing scheme if many drivers still park for longer than 2 hours after implementation of the on-street parking system.

Source: Gyarmati (2011), Sustainable traffic in Budapest), https://www.itdp.org/wp-content/uploads/2011/06/197

on ring roads), on streets with high pedestrian volumes such as shopping streets and on streets where traffic demand reaches road capacity or bike lane have priority. More street design recommendations are given in the section on parking design.

On-street parking spaces are meant for short-term parking and high turnover of parking spaces is needed to provide vacant spaces for those parking short-term and come for short shopping trips, business meetings, lunch, etc. Central zones of on-street parking system in European therefore often apply time limits of 30 minutes to maximum three hours. Hong Kong uses 2 hour This is also recommended for Beijing as an effective means to increase turnover and vacancy of on-street parking spaces. Time limits especially prevent commuters from parking on-street. In areas where plenty off-street parking spaces are vacant, time limits stimulate long-term parkers to park off-street.



Time limit of two hours displayed on an on-street parking meter in New York.

6.4 Parking technology

No technology is used for on-street parking in Beijing. The government, responsible for safe and effective streets, bike lanes and sidewalks, has no information on the parking behaviour of Beijing's drivers. Parking demand, occupancies, turnover and revenue are unknown. As shown earlier, parking has a major impact on the liveability of the city and the effectiveness of its roads and transport system. It is impossible to achieve successful transport demand management (TDM) without having basic data on parking behaviour. The implementation of a regulated on-street parking system gives the government the opportunity to obtain these data and have control over parking and traffic in the central areas of Beijing. With these data appropriate parking prices can be set and parking policies, regulations and restrictions explained, monitored and improved. Moreover high-technology makes revenues transparent and separates parking payment from parking inspection, leaving no possibilities for 'leakage' of parking revenue.

Furthermore the use of technology can create better service to drivers, who also 'get something in return' for paying a parking fee. Such benefits include multiple payment options, pay-per-minute rather than event, customer service and guidance to vacant parking spaces.

Such technology requires more investment up-front but over the long-term is more cost-effective from both the government and operator's point of view. More important, such a system provides exceptionally valuable information for the city government on parking and traffic that would not be obtained with manual payment at parking guards or traditional parking meters.

Modern on-street parking management is much more than installing parking meters on the streets. Parking management includes the following tasks:

- procuring, operating and maintaining parking payment machines and other hardware (e.g. cell phone payment)
- checking of parked cars and parking spaces and troubleshooting
- communicating clearly with drivers, including installing signs and supplementary information (traffic signs, road markings)
- enforcing parking regulations, including fining and fee collection
- analysing the parking data from operation (occupancies, turnover, revenue, etc.) and city-wide data to improve operations and ensure good service to drivers. This is also includes (real-time) sharing of this information

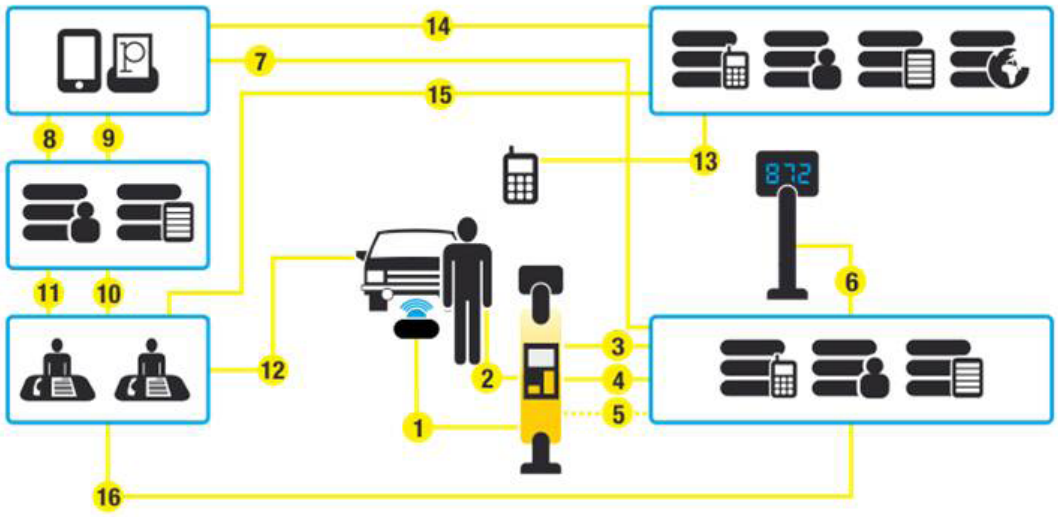
with the city government for planning and regulations
- procuring or developing, operating and maintaining the software systems
- providing customer service about parking regulations, prices, fines and other communication activities.

The system's ability to comply with the above is fundamentally influenced by the technical devices used. High tech solutions allow for better and real time monitoring and evaluation, and offer more user-friendly interfaces and payment options via a reliable IT system. The more automated a parking system is, the more efficient it is, allowing for a more correct fine tuning of parking zones and fees to steer drivers to the desired parking behaviour.

A properly implemented modern parking system ensures that:

- the machinery, tools, devices, equipment and information technology systems are mutually compatible and work together to create an interconnected, reliable system;
- customer service issues are monitored and recorded for daily review with data being set up allowing for easy querying, and backed-up to prevent data loss.
- parking operation is monitored and includes the following hardware: a dispatcher service, vehicles, IT infrastructure required for the enforcement and sanctioning of parking regulations (fining, wheel clamping and/or vehicle removal), for the collecting, handling and storing of monitoring data, and for the ensuring of the operational condition of monitoring devices.
- a control centre can control and monitor all components of the parking system (including financial data), to analyse data and act upon the results of analysis and to share data with relevant stakeholders (i.e. other municipal institutions).
- customer service handles issues without delay and provides reliable information to customers.
- hardware elements (specifically the parking machines) are regularly maintained and operate reliably, and the troubleshooting of

On-street parking systems that have become very successful and effective in other cities around the world make use of high-tech solutions and have integrated all elements of parking management. The graph above shows the recommended integrated parking system for Beijing.



1. Sensor - detecting the magnetic field of the car and sending the signal via RFID to the parking meter
2. Parking meter - communicating to data center via GPRS (3G/4G)
3. Financial data - sent by the parking meter to the data center via GPRS (3G/4G)
4. Technical (maintenance) date sent by the meter to the data center via GPRS (3G/4G)
5. Parking places occupancy data sent by the meter to the data center via GPRS (3G/4G)
6. Server sending real-time parking occupancy data to LED parking space occupancy signs via GPRS (3G/4G)
7. Communication between parking controllers' and technicians' PDAs and the data center via GPRS (3G/4G)
8. The controllers' PDA sending data of non-paying car drivers to front and back office server via GPRS (3G/4G)
9. The technicians' PDA sending and receiving via GPRS (3G/4G) the maintenance data to the front and back office server
10. The front and back office server sending the data of the non-paying car drivers to the front and back office employees
11. The front and back office server sending and receiving the maintenance data to the front and back office employees
12. Customer service between car driver and front office
13. Data communication via GPRS (3G/4G) and/or SMS and/or voice call for cell phone payment between the car drivers phone and the mobile payment server
14. Data communication via GPRS (3G/4G) between the cell phone payment server and the controllers PDA – for check on parking payment
15. Data communication between the mobile phone payment server and the front and back office server
16. Data communication between the front and back office employees and the data center via the internet

problems is done within an acceptable time frame.

The complex parking system is to be managed by a single entity, best done by a contracted operator which is responsible for the procuring, management and operation of all components in the system, from the hardware and software to the human resources and administrative aspects.

A modern parking system is based on an automatic data collection, information share, equipment surveillance and task distribution. Monitoring interface can display the status of front equipment and controllers, such as parking meter battery status, payment amount, alarms, locations, occupancy rate of the zones, etc. This reduces the need for large amounts of staff.

Main features of the technology

There are two mainly parts involved in the technology- hardware and software. The technology must be developed according to the requirement of the city as well as the rich experience of the parking operator, so that it provides a perfect combination of the technology and management.

Modern parking systems equipment are:

- Smart parking meters
- PDA for parking controllers
- Occupancy sensors
- LED occupancy boards
- On-board tag.

Smart parking meters

It is recommended to use smart parking meters, also known as pay-and-display machines, which serve multiple on-street parking spaces. Drivers need to able to find a parking meter within close proximity from the parking space (1 parking meter per 40 parking spaces is used). Drivers enter their license plate number on the smart parking meter's touch screen and then provide different payment options. Multiple payment options provide a better service to drivers and increases adherence to parking fee payment. It is recommended to include the following payment options:

- RFID card: this smart card can be integrated with the Beijing City Transport Card, that is already in use for payment on Beijing's metros, buses, taxis, P+R parking and numerous shops and services.
- Bank card (with NFC technology)
- Cash: although not a preferred option from an operational perspective (requires expensive and intensive manual labor and is prone to vandalism and theft) the cash option with bank notes only is recommended to increase acceptance of the system and compliance to the fee.
- Cell phone payment: the most convenient payment option is by cell phone. Payment can be done using text messages to phone numbers clearly indicated on the parking meters, or by using an app on smart phones. These apps can also provide additional information and services, e.g. real-time vacancy of parking spaces, both on- and off-street. Cell phone payment eliminates some of the problems associated with parking fee collection. Numerous companies offer cell phone payment systems for parking which charge customers a small service fee, thereby passing down any costs associated with the service to the customer, not the government or operator. Cell phone payment is also a good way to get buy-in for introducing paid parking because it makes parking so much easier for drivers, who don't need to look for coins or rush back to a meter when the paid parking time is running out.
- On-board tag: for fully automated parking payment, drivers can choose to register with the operator and have an on-board tag installed in their car. This tag registers location, time and movement and detects when, where and for how long drivers are parked. Payment is linked to accounts and payments are processed automatically. Overviews of payment can be reviewed online.

Formal receipts can be printed on the meter on request, but tickets of payment proof need not be placed underneath the windshield.

Solar-power, with batteries for incidental downtime, reduce energy use and do not require digging up the pavement for ordinary electricity supply with cables. This make installation much cheaper, faster and more flexible during operation.

The parking meters communicate with the main system through wireless GSM networks (GPRS/3G/4G), for which cables are not needed. Data on parking behavior are transmitted real-time and problems can be reported without the need for manual checks. The parking meter

automatically sends out errors such as jammed cash, a lack of paper for receipts or full cash boxes to the main system.

The system should monitor the operation of the meters, indicating malfunctions, forwarding financial, statistical and technical data in a scheduled regime to the central database for processing, storage and access. Operational parameters, such as parking fees and times, should be able to be modified remotely from the control center.

The parking meters can also be in constant communication with the parking occupancy sensors through RFID and transmit these data to the main system who can transmit the information to the real-time occupancy signs.

The smart parking meters should be clearly visible to users, operate continuously (24/7), function at very cold and hot temperatures, be vandalism-proof and operate in Chinese Mandarin and English.

The parking meters greatly help the government and operator in monitoring and management of the parking system. The two way information systems in these machines allow for real-time remote monitoring, by:

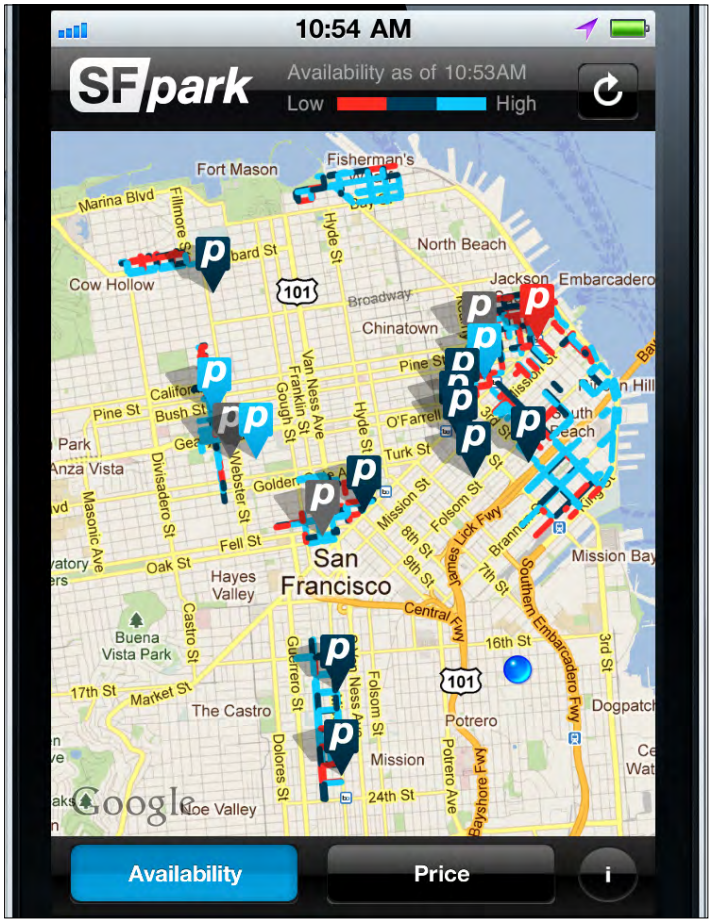
- sending information about the current working state and the technical condition of the machines directly from the machines; this is used to organize the technical staff, plan maintenance schedules, and troubleshoot problems.
- sending daily information about the revenue generated from operations as a system and per machine, as well as usage and turnover information; this information is used to prepare reports and accounts, as well as see changes in usage and determine if changes need to be made in the parking pricing, zones, or times of usage.

These smart parking meters are different from traditional parking meters. Traditional parking meters control somewhere between 1 and 4 specific parking spaces and accept coins or smart card payment. The meters then display the available parking time and measure the time passed since parking started. These meters do not provide any of the service to drivers or data to the government that the proposed smart parking meters do.

A solar powered parking meter in Nijmegen, the Netherlands. The number '6059' underneath the P sign represents the phone number for cell phone payment. After registering with the service online, drivers no longer need to use the parking meter and can pay through text messaging or with an app.

Parking meter in Budapest, Hungary

Mexico City parking meter



The app of SFpark, San Francisco's on-street parking system, shows real-time vacancy and prices of on- and off-street parking spaces. It helps directing drivers to available parking spaces and thereby reduces cruising.

PDAs for parking operation and enforcement

For parking operation and enforcement, it is recommended to equip parking guards with handheld PDAs. The PDAs have GPS, GPRS, license plate recognition software, camera and a separate mobile printer that is connected via bluetooth. The PDAs communicate directly with the central system.

With payment done at the meter or by cell phone by license plate number input, no paper proof of payment tickets are needed under the windscreen of the driver. To check for parking payment, inspectors rely on the use of handheld PDA devices (portable manual computers). Parking inspectors scan the license plate with the PDA and its license plate recognition software and are automatically told by the system whether the driver of the car has paid. If he has, the inspector moves on to the next parked car. If not, the PDA will print a fine that is to be put under the wind screen wiper of the car. The inspector is asked to take pictures of the car from different angles and input the brand and colour of the car. The fine is then printed automatically, with a time and location stamp, and the violation is registered in the central system.

Parking inspectors are assigned different routes on a frequent basis, making it impossible for them to have control over the same parking spaces all-year-round. Drivers are no longer to make deals with parking inspectors and are required to pay the official parking price.

The PDAs should have the following functions:

- automatic scanning of license plates with license plate recognition software;
- camera for photo-documentation of parking violations;
- logging violation data (location, time, vehicle license number, etc.);
- printing fines by automatically determining the charge and printing the ticket;
- transmitting data and content to the central database.

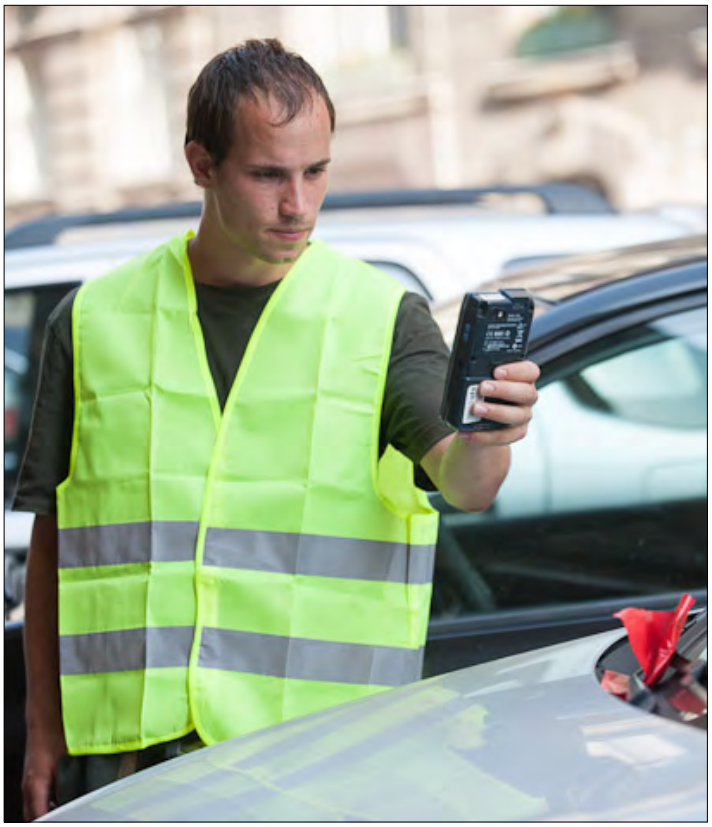
The PDA shortens the period required for verification and fining, has thorough documentation of violations and is transparent. PDAs can work in online or offline mode (the latter usually meaning that events are recorded only without GPRS/3G/4G communication). When in online mode, PDAs provide information on the

movement and inspection activities of wardens on a continuous basis (so that the movement may also be displayed on a map), thereby ensuring the continuous monitoring of wardens as well as the possibility for subsequent evaluations. PDAs can upload event data and photographs to the central data base on a continuous basis.

The data gathered through PDAs are connected with software to other parts of the parking system, for instance the surcharging department. Cars parked in illegal locations can also be documented by the parking inspectors and messages sent automatically by the system for immediate enforcement follow-up.

Parking inspector shows predefined route for the day.

PDAs used by parking inspectors in Budapest. The license plate is scanned using license plate recognition software. Connected with Bluetooth to a printed carried on the inspector's belt, fines are printed automatically in case of non-payment.



Parking inspector takes a picture of the fine put on the windshield.

Sensors and Electronic Parking Guidance Systems

It is recommended to install Electronic Parking Guidance Systems that show real-time vacancy of parking spaces. It directs drivers to nearby parking facilities and helps decreasing search time and cruising. Drivers spend a significant amount of their travel time searching for parking and this measure will reduce that drastically. Every on-street parking space includes an underground sensor that identifies whether a parking space is occupied, through radio magnetic fields, which eliminates issues with inundation due to rain. The sensors communicate wireless with the parking meters which communicate with the central system that controls the automatic updates of vacancies. It is recommended to include vacancies of off-street parking spaces as well (by cooperating with management companies of parking in public parking garages) in order to lure drivers away from on-street parking and make better use of available off-street parking.

Sensors in every parking spot detect whether a space is occupied or not. Through radio frequency it communicates with the parking meter and the central system to assist in parking operation and provide real-time data to the electronic parking guidance systems, website and app.

Source: Europe Parking Systems

Real-time parking vacancies in off-street parking buildings in Beijing and Barcelona. Vacancies in the on-street parking system can be integrated with these systems to reduce searching time for parking, thereby minimizing traffic.

Source: ITDP-China, www.transportphoto.net

Software system

To be able to have all hardware in continuous communication with each other and the central system, numerous intelligent software systems are needed for data storage, inquiry, analysis, surveillance and other operations. An integrated IT system is necessary to fulfil all tasks of parking management and operation.

Technical Operations Management subsystem:

- Automatic collection, analysis and reaction to technical alerts from the smart parking meters
- Automatic collection, analysis and reporting of financial data from the smart parking meters
- Automatic start and process control of wheel clamping or towing in case of parking in illegal locations (on-street, sidewalk, setback, etc.)
- Provide data and control of the parking occupancy LED boards
- Visual presentation of the status and activities of the smart parking meters (technical and financial data), inspectors, technicians, maintainers, collectors, wheel clampers, traffic signs, road paintings, occupancy boards, to ensure a fully transparent operation.

Account Management subsystem:

- Background subsystem for smart parking meters and cell phone payment
- Cash-free payment solutions
- User interface for drivers (via internet) to track their parking and change their settings
- Full functions for customers' balance inquiry, charging and other service

Mobile Payment application:

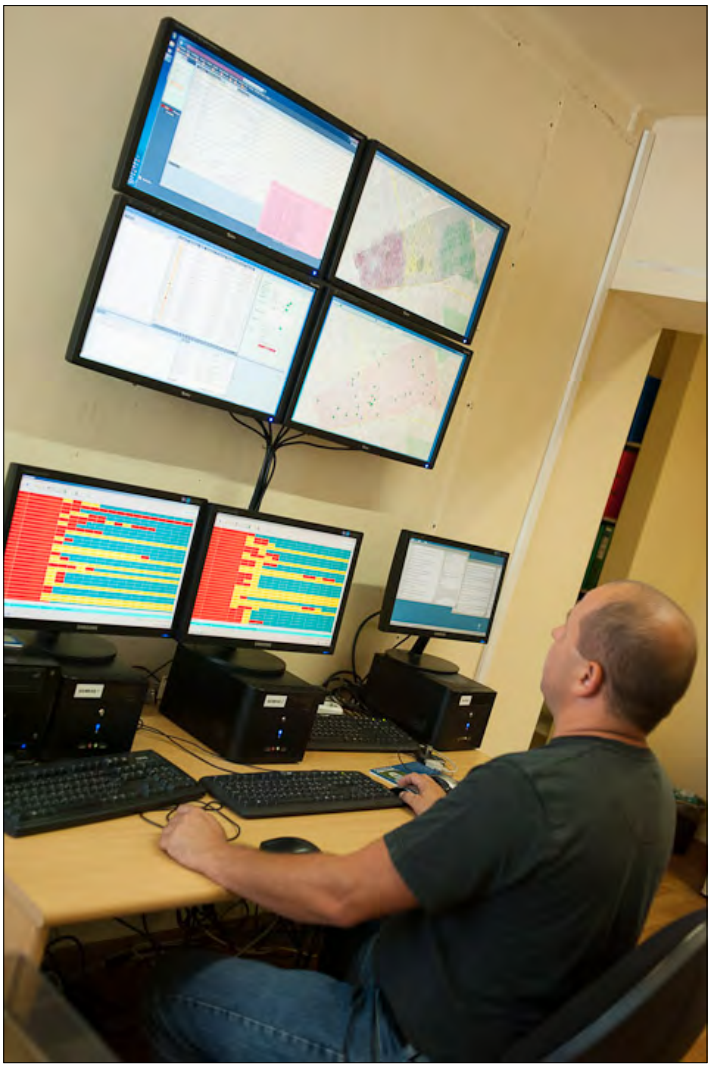
- Simple-to-use user interface
- Presenting free parking places near to the position of the driver on map (parking guidance)
- Extremely easy to start and stop parking
- Real-time showing of time and costs of ongoing parking
- Parking History and Change settings function

PDA subsystem for surcharge generation, technical operation, money collection and wheel clamping:

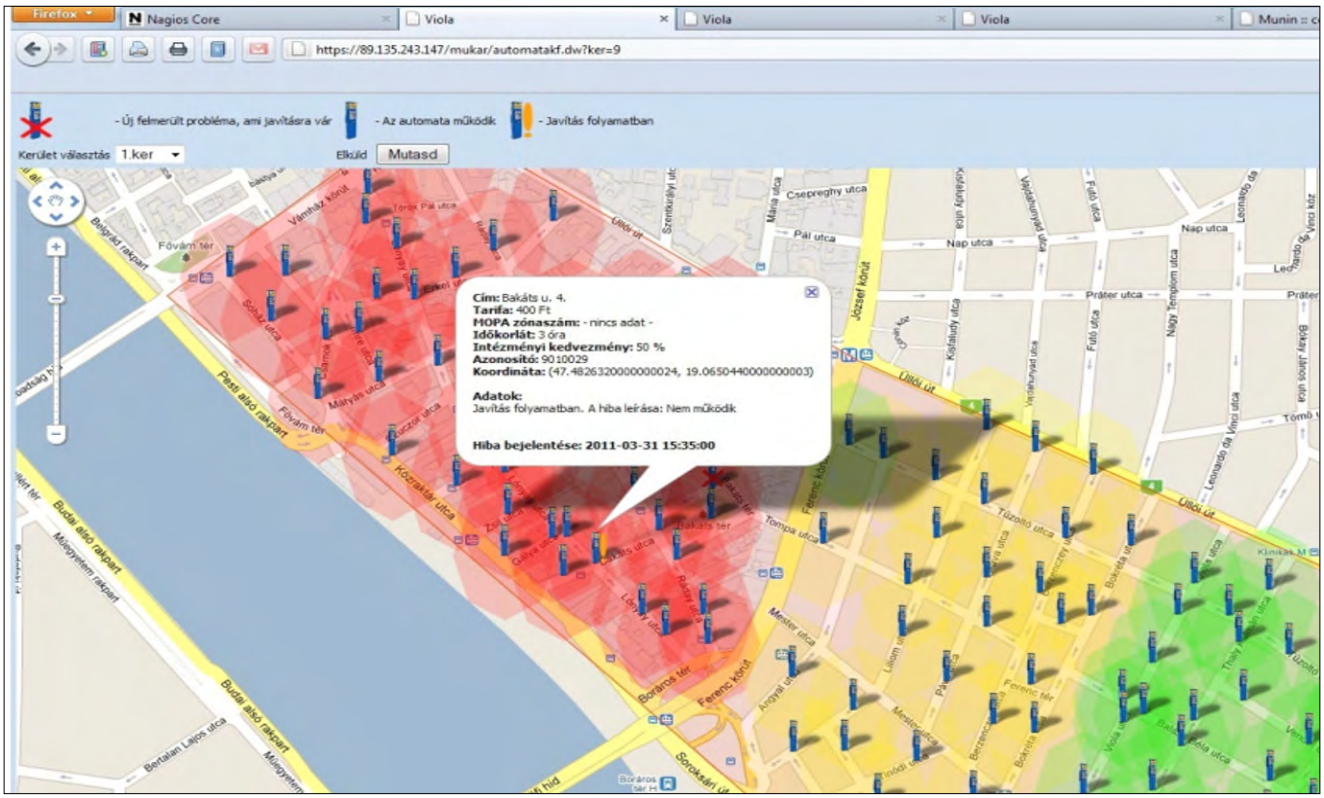
- Large scale of automatization of surcharge generation
- Minimizing human errors by strictly regulated processes
- 3G/4G communication via mobile internet
- Tracking the activities of the street staff

Dedicated subsystem for surcharge management:

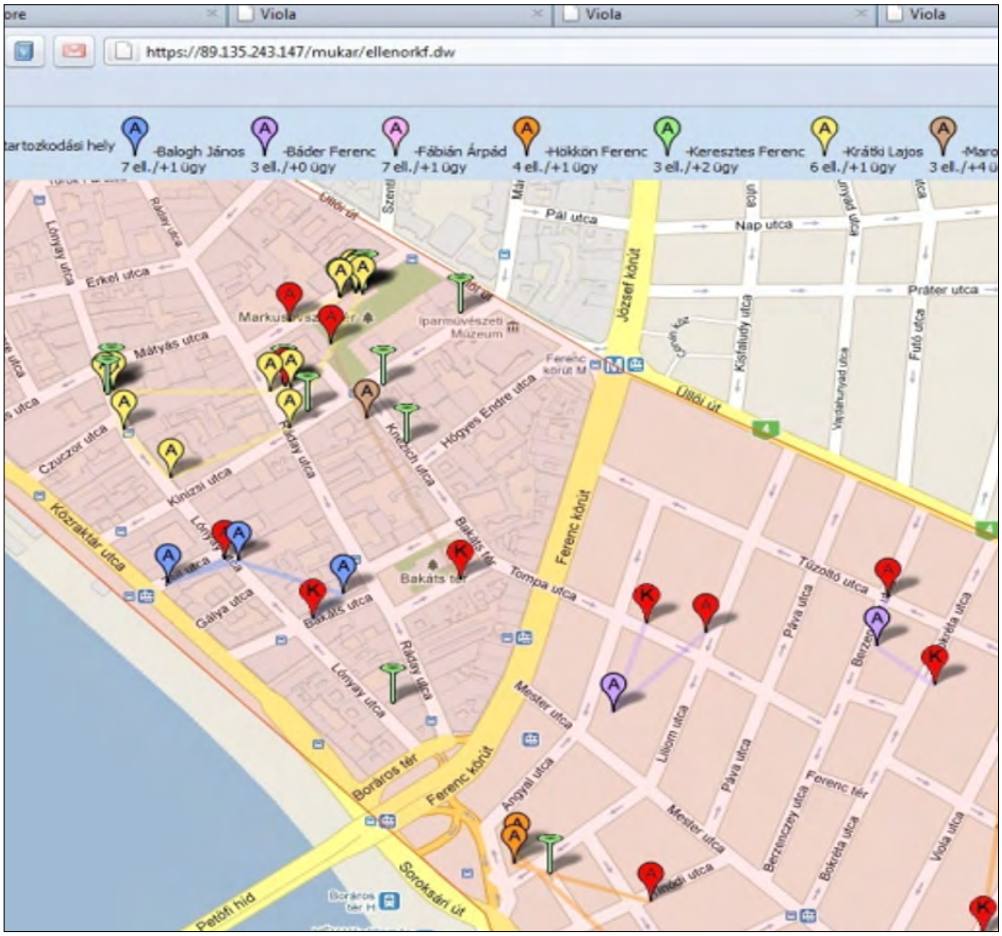
- Collecting the surcharges from the inspectors' PDA-s
- Full functionality for managing customers' complaints at the front- and back-office
- Automatized notice letter generation, complaint handling, user interface for customers for checking their surcharges.



Real-time data on the parking situation outside are visible to the parking operator and government which both have access to the data. Operations and troubleshooting are managed from here.



Real-time data on the status of smart parking meters. Notifications or bugs are reported by the meter automatically. Online, both the government and operator have insights into the operational data, such as the amount of cash money in the meter parking at any time.



Real-time data on the status and location of parking inspectors.

6.5 Parking enforcement

The surveys described in chapter 3 show how common illegal parking on Beijing's streets, sidewalk and setbacks has become without proper enforcement carried out. Enforcement of parking payment within the paid on-street parking system can best be done by the parking operator, using the technology described earlier. The parking operator can also best be put in charge of notifying drivers of parking in illegal locations. It is in the operator's best interest that drivers park in the paid on-street parking system, rather than illegally on streets and sidewalk.

Currently enforcement of illegal parking is sparsely done by a government organization cooperating with the Traffic Police. Despite not having the legal right to issue fines, they document the parking offence (include taken photo proof), share this with the Traffic Police and stick a notice on the car's window. This summons the driver to report to the Traffic Police and pay the fine there.

This protocol works well, but is currently done on a very small scale. The protocol can be followed by the parking operator as well. Traffic Police can be notified of illegal parking through the PDA, which also enables sending the location of the violation. The Traffic Police can then follow up on proper enforcement. Towing trucks can be used for immediate removal of illegally parked cars in locations causing danger to traffic and pedestrians. Wheel clamps can be used for illegal parking where no dangers to road safety are posed.

A car in Budapest (Hungary) is clamped for failing to pay the parking fee

Fines for parking sh ould at least recoup the costs of the towing or clamping plus administrative procedures and be high enough to ensure obedience to parking payment.

A scheme is needed where late payment (e.g.

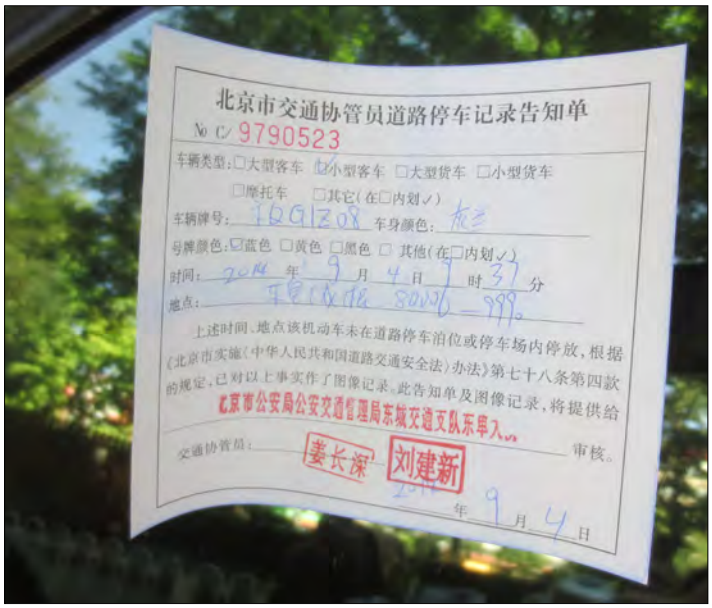
A truck is used by the Tianjin Traffic Police to tow an illegally parked car

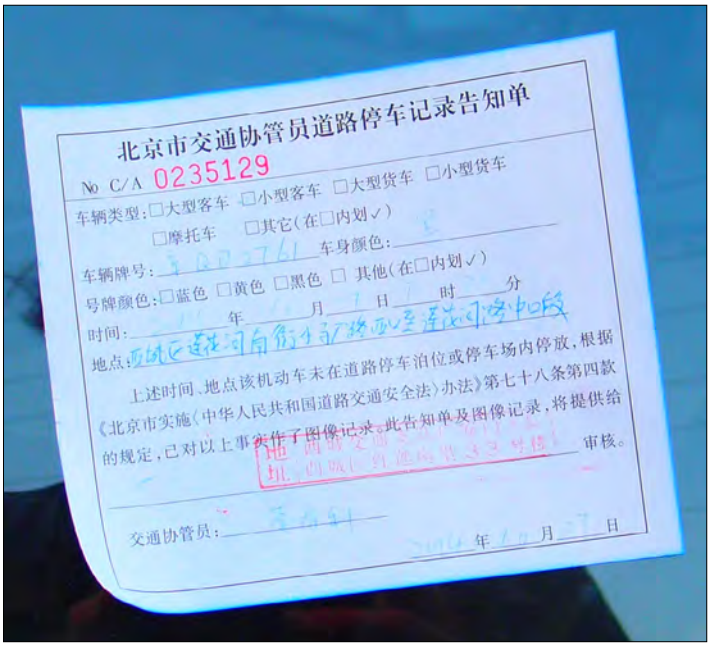
later than 20 days from receiving the fine) the fine doubles or triples. It is recommended to disallow issuing a new vehicle license when the driver fails to pay for parking fines. Another policy could be installed where parking violations result in a reduction of 'points' on the driver's license. When too many points are lost due to parking or other traffic violations, the driver's license is withdrawn.

The Traffic Police needs the financial means to invest in enforcement equipment and pay for personnel. Sharing in revenue from parking fines is preferred, locking in an incentive for the Traffic Police to enforce effectively. The responsibility of enforcement of illegal parking on sidewalks and setbacks should be with the Traffic Police.

Citizen enforcement

In 2005 Guangzhou implemented a successful approach to enforcement of illegal parking on walkways. Citizens could take a photo of the infringing vehicle, and submit it to the Traffic Police. The vehicle owner would be fined and the person submitting the photo received a cash reward of 20 RMB. The system was very successful, and subsequently generated complaints and even lawsuits from drivers who were illegally parking. It became controversial, and was unfortunately discontinued. Wuhan more recently tried a similar approach to parking enforcement.





Assistants to Beijing's Traffic Police stick notes on illegally parked cars, notifying the driver to pay a fine at the Traffic Police.

The proposed on-street parking system for the Guang'anmen Langqin area is shown in the graph above. It shows the proposed formal, paid on-street parking spaces and closely matches with the current locations of illegal parking, shown in the top graph. Enforcement of illegal parking for this area is therefore expected to be minimal.


Illegal parking
vehicles, peak demand time
50
25
12.5
0
.03
.06
.09
Kilometers
30
Chunshuguan Jie
17
Guang'anmen Nan Binhe Lu
10
2
5
5
Nan Binhe Lu
1
0
0
12
Guang'anmen Wai Nan Jie
15
61
21
Guang'anmen Nan Binhe Lu
1
0
Yaziqiao Bei Jie
13


Proposed on-street spaces
vehicles spaces
100
50
25
0
.03
.06
.09
Kilometers
46
Chunshuguan Jie
44
Guang'anmen Nan Binhe Lu
22
24
0
0
Nan Binhe Lu
0
22
73
0
Guang'anmen Wai Nan Jie
71
47
0
Guang'anmen Nan Binhe Lu
0
47
Yaziqiao Bei Jie
20

6.6 Parking design

When implementing the proposed on-street parking system, streets need to be redesigned to accommodate on-street parking spaces. The design of on-street parking spaces needs to be carefully integrated with traffic lanes, public transport-priority lanes, bike lanes and sidewalks.

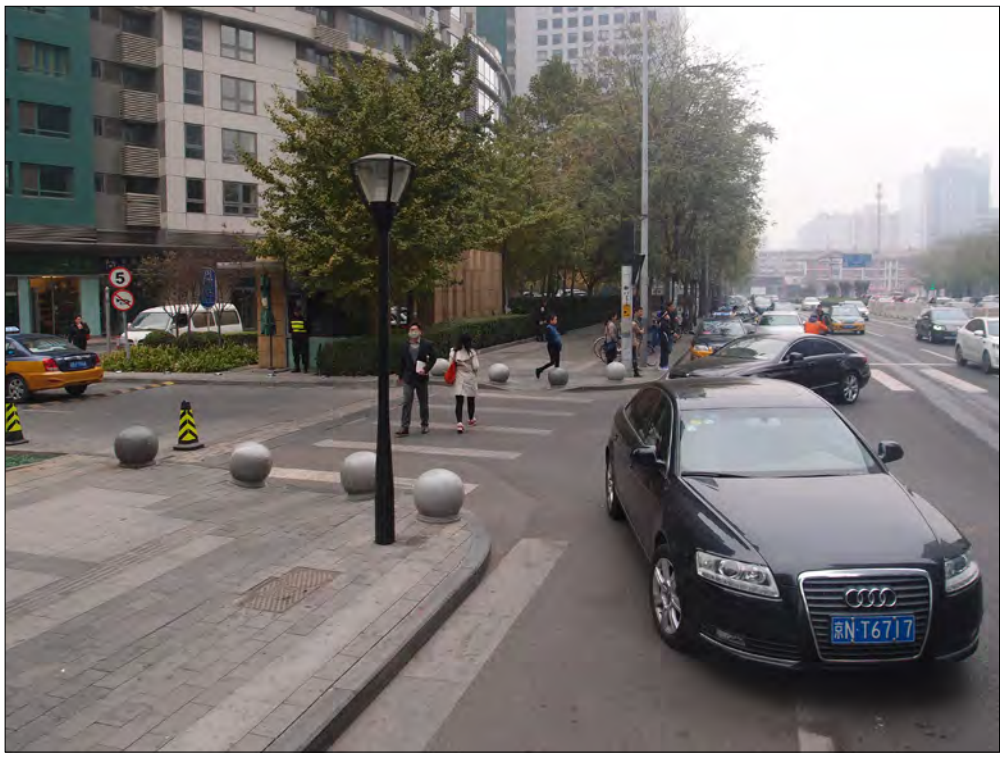
To make drivers stick to parking in dedicated parking spaces and to prevent parking on sidewalks and public spaces, the implementation of bollards, or other forms of physical separation, is needed. This also helps keep building entrances free from obstructions.

At intersections, crossings and bus stops on-street parking spaces ought to be removed and bulb-outs created. At driveways into parking buildings raised driveways should ensure continuous walkways and pedestrian priority.

In the design of the on-street parking system, space should be reserved for public space elements in-between parking spaces. Instead of having parking spaces along the entire length of the street, some spaces can be used for outdoor seating, bike sharing, restaurant seating or other high value uses. This will be beneficial to business, where shop owners could be allowed to use the space for their use, while creating a more lively street.

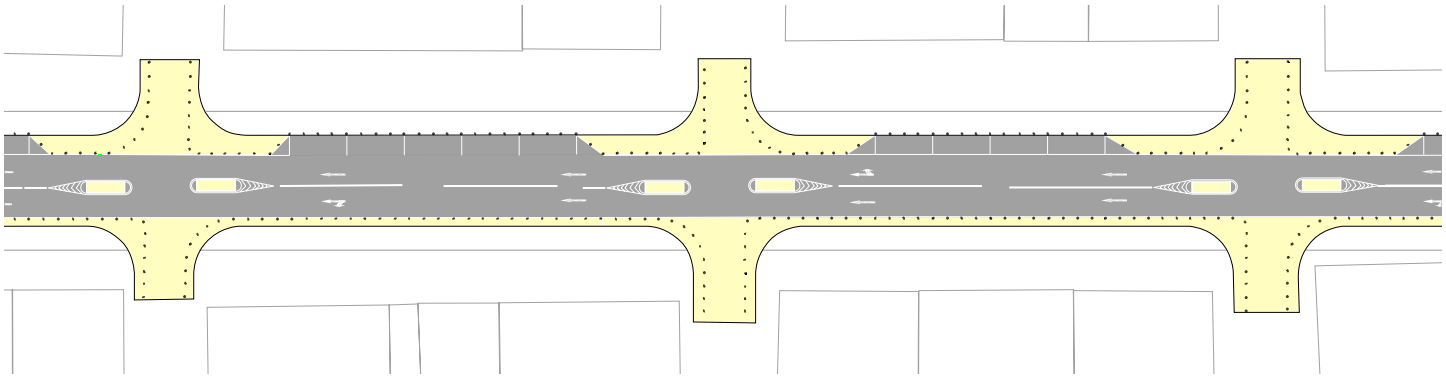
On-street parking examples from (top) Amsterdam, Lyon, Utrect, and Paris. Parking spaces are clearly demarcated and sidewalks and bike lanes are free from vehicles. Parking meters are clearly visible (including cell phone number for cell phone payment) and formal bike parking spaces are provided. Shops entrances are visible and accessible.

Bollards in Seoul keep sidewalks free from parked cars along the Cheonggyecheon greenway.



Existing driveway at the southeastern entrance of Xincheng Guoji prioritizes car traffic. Bollards are set too far apart leaving space for cars to park on the pedestrian crossing, blocking pedestrians. Illegal on-street parking is blocking the bike lane on Jintong donglu.

A raised, continuous walkway is proposed, where drivers need to slow down and give way to pedestrians. Bollards prevent illegal parking in the entrance and a curb is protecting the bike lane from illegal parking.



To prevent cars from parking at the pedestrian crossing and to shorten the pedestrian crossing, bulb-outs are designed for intersections.

Bulb-outs, outdoor seating, bike sharing stations and bike parking stands mix with on-street parking spaces in Copenhagen, Lyon and London.
Photos: ITDP-China, www.transportphoto.net

6.7 Business model

In Beijing, as in nearly all Chinese cities, parking operation and management is fully outsourced by the district governments. In an open bidding procedure the operator is selected that pays the highest fee to the district government in exchange for the right to operate paid on-street parking. Information on these deals for Beijing are unknown, but in Chinese cities these typically vary from 40-80RMB/parking space/month. The service level agreements between the government and private company are weak and require little to no technology. Data on parking demand, turnover and revenue are not provided to the government and parking fees, set at municipal level, are not respected.

Without experience in parking operation, let alone with high-technology, it is not recommended for Beijing's district governments to set up their own government-owned parking company, procure equipment and start operation. The governments are simply lacking the technical know-how and operational experience to implement and operate successful on-street parking systems and risk wasting government budgets with an inferior system. Instead, cooperation with private sector companies with operational experience is essential.

Currently parking revenue is not shared with the government. The best type of business model is where the government remains in control of parking revenue but cooperates with private operators for investment, technology provision and operational experience. The city government, or a city-owned company, should start a tender in which it describes the requirements for the on-street parking system and operation, according to the system proposed in this report. Private operators participate in a public bid after which the winner is announced based on the lowest fee requested from the government, but also on criteria such as quality of the system, operational experience, financial guarantees, etc. The private

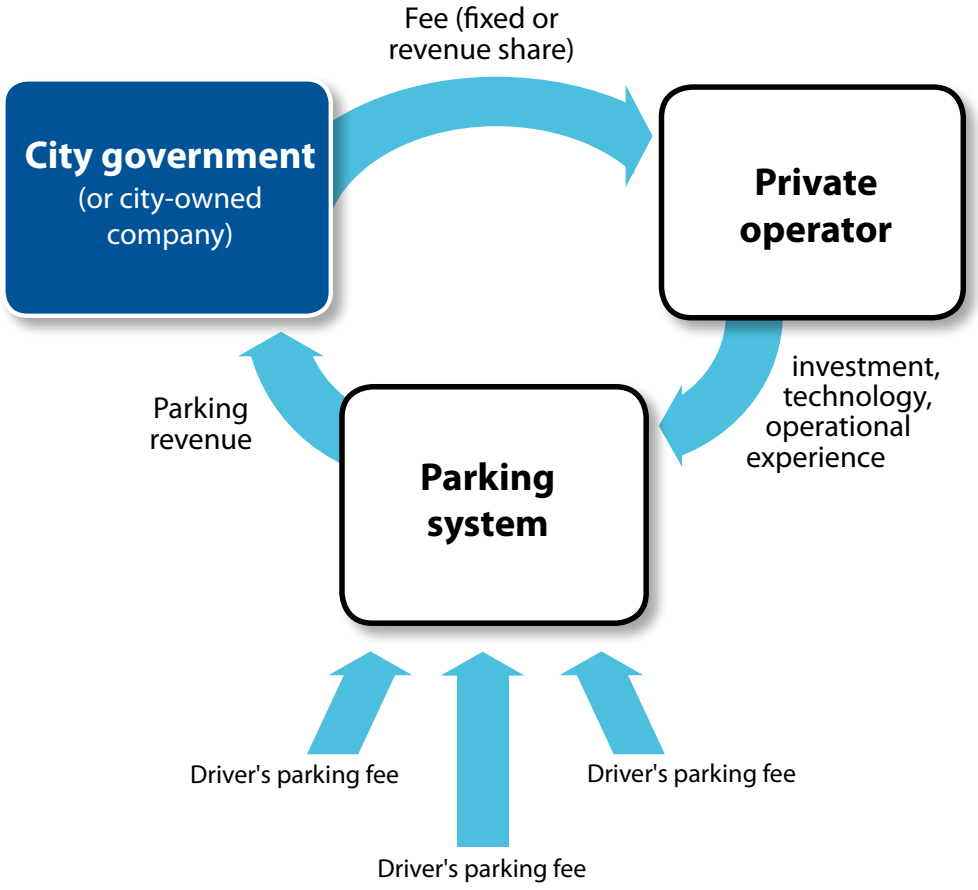
operator implements and operates the system for a 10-15 year period and all parking revenues are paid into bank accounts of the city government. From this revenue the private operator is paid based on fixed fee, proposed in the tender and acknowledged in the contract, or better, based on revenue share. With a revenue share the government reduces the risk of possible, lower than expected parking revenues.

Because all parking revenue is funneled through the city-owned accounts, plenty of revenue is left for improvements to public transport, walking and cycling improvements. At the end of the contract the ownership of the parking system is transferred to the city government, who can then decide to operate themselves or contract out a new tender for private operation.

Advantages for the government:

- An advanced parking equipment and software system at zero cost;
- It can tap from private experience in parking technology and operation;
- Parking data are obtained at no costs;
- Control over parking revenue and transparency to drivers;
- Much higher parking revenue that can be used for investment in transportation alternatives.

Crucial is to have a bid with terms of reference that include detailed system and operational requirements and a contract with service level agreements in as much detail as possible. Since this work needs to be done before the project starts, expert advice is required up front. The operator should be held accountable to the SLA, with fines for non-compliance and even termination of the contract if no solution exists.



Proposed parking business model

6.8 Costing & finance

Since no detailed study has yet been done in the actual number of on-street parking spaces, for the purposes of this analysis it is assumed that, based on the size of the Guang'anmen and similar on-street parking projects in Chinese cities, the system would comprise of 12,000 on-street parking spaces.

6.8.1 Direct investment costs

The direct investment cost items are described below. The investment costs exclude bollards and enforcement equipment (clamps, towing vehicles, etc.), but include Chinese VAT of 3%.

Smart parking meters

To minimize the maximum walking distance to a meter and prevent queues for parking payment and, a meter is preferred for every 30 parking spaces. With 12.000 parking places a total of 400 smart parking meters is needed. Costs include occupancy sensor signal receivers.

Occupancy sensors

All on-street parking spaces have occupancy sensors. Construction costs are included in the unit costs.

PDA and separate mobile printer

One parking inspector is expected to control 50 parking spaces. For 12,000 parking spaces, 410 parking inspectors are needed per work shift. Inspectors use a PDA for license plate scanning, communication with the control center and taking photo evidence of parking violations. The printers are needed for printing of fines. Technical maintenance can be done with 10 technicians per shift, for which PDAs are needed as well.

On-board tag

Costs for on-board tags for fully automated parking payment are included in the costs of the system. Tags are beneficial to drivers who park frequently in the paid parking zone, such as residents and employees working in the zone. Although the number of users is expected to be lower, a total of 12,000 tags are assumed.

Led occupancy boards

The occupancy boards need to be placed at strategic locations, depending on the street network. An estimated number of 120 pieces are expected to cover the planned parking zones.

Software systems

Several software systems are needed for different equipment and the system's control center. Software needs to be localized for Beijing's project and the interface has to be developed for integration with the systems in use by related stakeholders in Beijing (such as the Communication Commission for the sharing of parking data and the Traffic Police for enforcement) several departments existing system.

Parking space demarcation

All on-street parking spaces are demarcated and given an ID number.

Direct investment costs for 12,000 on-street parking space demonstration project in Guang'anmen

Direct investment costs	Units	Total costs (RMB)
Smart parking meters	400	16,000,000
Parking meters' installation	400	600,000
Occupancy sensor	12,000	18,000,000
PDA and separate mobile printer	410	2,870,000
On-board tags	12,000	9,600,000
Occupancy boards	120	9,600,000
Software	1	3,000,000
Parking space demarcation	12,000	720,000
5% unforeseen costs		2,963,500
TOTAL		**¥63,353,500**

6.8.2 Indirect investment costs

The parking company needs to set up an office, customer service center, work room for technicians, training facilities, parking inspectors' changing room and storage, PDA charging and inspector dispatching center. Assumed in the cost calculation is for these spaces to be rented with interior construction to be done. Office furniture, also including computers, printers and related office equipment (scanner, internet, etc.) are needed. Parking inspectors' work cloths, 20 cars, tool kits, and spare parts for the hardware equipment.

Indirect investment costs for 12,000 on-street parking space demonstration project in Guang'anmen

Indirect investment costs	Units	Total costs (RMB)
Kits for technical staff	20	60,000
Workroom	1	197,000
Cars	20	2,000,000
Furniture for employees	127	317,500
Computers and office equipment	127	444,500
Customer office establishment	2	677,000
Cell phones	611	244,400
Working clothes	523	261,500
PM fixture kit	1	100,000
5% unforeseen costs		215,095
TOTAL		**¥4,516,995**

Additionally, the management cost for the 6 month construction period is added. For the 1-month trial period, when the operator is operating at full costs but receives no income, investment costs are allocated as well.

Total investment costs for 12,000 on-street parking space demonstration project in Guang'anmen

Total investment costs	Total costs (RMB)
Direct investment costs	63,353,500
Indirect investment costs	4,516,995
Management costs during construction	1,200,000
1 month trial operation	4,100,739
5% unforeseen costs	3,658,562
TOTAL	**¥76,829,796**

6.8.3 Financing costs

A project length of 10 year is assumed. For a commercial bank loan 10.2 % interest is assumed, based on the Chinese interest base (6 %) and an additional 70 % margin (4.2 %). Total interest over 10 years equals to 46,019,833 RMB, making the total investment for the operator over a 10 year period: 122,849,629 RMB.

6.8.4 Operation costs

HR cost

From the start of operation, parking inspectors check 50 parking places, meaning 240 parking controllers are needed at any given time. With 24/7 operation, in the first year 800 day-time and 47 night-time parking inspectors are needed. From the second year, 480 parking controllers are needed for the day-time. From the third year we calculate with 156 inspectors in the day shift and 47 in the night shift, since operation has matured by then. For comparison, in European cities, with similar technology, a controller can check 200 parking spaces. Furthermore there is 1 head of the department and another 36 people assisting staff.

There should be two brick-and-mortar customers offices customers office in addition to online service. There will be 1 head of department, 27 staff and 10 security personnel operate 7 days a week. With modern technology, technical maintenance is very efficient and only 32 staff are needed, headed by the CTO. Three IT staff do IT maintenance. Three staff do PR and marketing, in cooperation with the government. Three full time lawyers take care of legal issues.

Due to automated software only 10 employees are needed at the financial department: one chief accountant, 4 financial administrators and 4 labor issue administrators, as well as the head of the department who is also CFO of the company. For HR 5 staff are needed. The company management consists of a CEO, COO, Head of Purchasing, Quality Control and Secretary/Head of Office.

The yearly labor cost of the parking company is 32,626,800 RMB in the first and second year and drops to 18,639,000,- RMB from the third year onwards, mostly due to a lower number of parking inspectors.

Maintenance cost of the technology

The maintenance cost for the hardware is containing all the necessary expenses to ensure 24/7 operation of the equipment. These costs include spare parts, the cost of charging the batteries (even with solar charging the batteries have to be charged once a month).

Maintenance cost (support) and license fee of software

For maintenance to the software system, a fairly high 10% of acquisition cost is assumed, since

the parking management system is complex, with many interrelated software.

Other operation cost

For PR and marketing, aimed at continuous, transparent customer service and feedback, an annual cost of 3,600,000 RMB is assumed. Including 5% unforeseen costs, the operation costs for the first year are 51,555,021 RMB, which increases by 3 % inflation annually. Operational costs drop from the third year due to savings in staff. Operation costs of the third year are 37,727,531 RMB (including 5 % unforeseen costs).

6.8.5 Parking revenue calculation

Some assumptions are made for the calculations of parking revenue, which are set out as following:

- Day time operational hours are assumed from 7.00am-9.00pm. Even though the daytime parking fee is higher, only 8 RMB/hour is assumed.
- Night time operational hours are assumed from 9.00pm-7.00am (0.5 RMB / half hour)
- Given inflation and growth of parking demand, parking fees will surely rise over the 10 year contract period. In the calculation the parking fee is kept stable though.
- Only 25% parking occupancy of drivers paying for parking is assumed. Although not every driver will pay and demand is not high during the entire day, revenues can be expected to be much higher. With the maturing of the system compliance to parking payment is increased by a very conservative 1% annual increase from the second year of operation.
- An average parking duration of two hours, based on the surveys, is used.

The revenue calculation is as follows: one parking space has 14 hours of parking operation in the daytime (7am-9pm), multiplied by 365 days, so 5,110 operational hours per year. If we take the first year's occupancy rate of drivers parking and paying of 25 %, then 1277.5 hours are sold. With 2 hours average parking duration per parking event, 639 parking actions at 16 RMB = 10,224 RMB is spent at each parking space. For 12,000 on-street parking spaces, this equals 122,688,000 RMB.

For night time we calculated with 2 parking events/parking space/night. So the income is calculated as follows: 12,000 parking places x 25% occupancy rate x 2.5,- RMB / parking action x 2 parking events/night x 365 days = 5,475,000,- RMB for all night time parking.

The parking revenue for the first year for both day and night time is 122,658,000 RMB. For subsequent years the assumed 25% occupancy rate is increased incrementally to 34% due to higher parking demand and higher payment compliance.

6.8.6 Profitability calculation

The revenue share between the government and private parking operator are assumed following these ratios, although these are negotiable before signing of the contract.

Revenue shares between government and private operator

Year	Government revenue share	Private parking operator share
1	30%	70%
2	30%	70%
3	30%	70%
4	40%	60%
5	40%	60%
6	40%	60%
7	40%	60%
8	40%	60%
9	50%	50%
10	50%	50%

The profitability calculation of the 10 year contract period is shown in the table below. The following conclusions can be drawn:

- Total revenue from the 12,000 parking places is 1,518,126,000 RMB;
- The Beijing government earns 39% (average of 10 years) of all revenue as a net profit, amounting to 601,611,540 RMB, as well as the local business taxes/VAT of the parking company and the parking company's employees' taxes (income tax, social security, etc.);
- The parking company will earn 61% (average of 10 years) of the revenue, amounting to 916,514,460 RMB. Operation cost are 434,300,830 RMB and investment cost (capital and interest) of 122,849,629 RMB leaves the parking company with a net profit of 226,486,642 RMB.

Profitability calculation (per year). Total revenue and profit for company and government shown at bottom

		1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Number of parking places		12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places	12,000 parking places
Yearly inflation (base: last year)		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Cumulated inflation (base: 1st year)		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
OP Rate		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
IMP Rate		100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Operation time											
Operation time DAYTIME	7:00 / 21:00	14 h	14 h	14 h	14 h	14 h	14 h	14 h	14 h	14 h	14 h
Occupancy (counting the occupancy rate of the cars parking AND paying the parking fee)		25.00%	26.00%	27.00%	28.00%	29.00%	30.00%	31.00%	32.00%	33.00%	34.00%
Operation time		5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year	5,110 hours/year
Occupancy		1,278 hours/year	1,329 hours/year	1,380 hours/year	1,431 hours/year	1,482 hours/year	1,533 hours/year	1,584 hours/year	1,635 hours/year	1,686 hours/year	1,737 hours/year
Average parking period (hour)	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h	2.0 h
Number of yearly parking action per places		639	664	690	715	741	767	792	818	843	869
Average income by 1 parking event (based on 8,- RMB / hour and every started hour equals one hour's fee)	¥ 16.00	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0	¥ 16.0
Income		**¥ 122,658,000**	**¥ 127,545,600**	**¥ 132,451,200**	**¥ 137,356,800**	**¥ 142,262,400**	**¥ 147,168,000**	**¥ 152,073,600**	**¥ 156,979,200**	**¥ 161,884,800**	**¥ 166,790,400**
Operation time NIGHTTIME	21:00 / 7:00	10.0 h	10.0 h	10.0 h	10.0 h	10.0 h	10.0 h	10.0 h	10.0 h	10.0 h	10.0 h
Occupancy	25%	25%	26%	27%	28%	29%	30%	31%	32%	33%	34%
Parking action / night	2	2	2	2	2	2	2	2	2	2	2
Average parking period (hour)	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h	5.0 h
Average income by 1 parking event (based on 0,5,- RMB / half hour)	¥2.50	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5	¥ 2.5
Income-night		**¥ 5,475,000**	**¥ 5,694,000**	**¥ 5,913,000**	**¥ 6,132,000**	**¥ 12,702,000**	**¥ 6,570,000**	**¥ 6,789,000**	**¥ 7,008,000**	**¥ 7,227,000**	**¥ 7,446,000**
% of revenue for parking company		**70%**	**70%**	**70%**	**60%**	**60%**	**60%**	**60%**	**60%**	**50%**	**50%**
% of revenue for government		**30%**	**30%**	**30%**	**40%**	**40%**	**40%**	**40%**	**40%**	**50%**	**50%**
Total income of parking company		**¥ 89,693,100**	**¥ 93,267,720**	**¥ 96,854,940**	**¥ 86,093,280**	**¥ 92,978,640**	**¥ 92,242,800**	**¥ 95,317,560**	**¥ 98,392,320**	**¥ 84,555,900**	**¥ 87,118,200**
Total cost		**¥ 55,181,738**	**¥ 56,197,400**	**¥ 38,240,591**	**¥ 38,717,537**	**¥ 39,341,276**	**¥ 39,976,355**	**¥ 40,630,486**	**¥ 41,304,242**	**¥ 41,998,210**	**¥ 42,712,997**
Amortization (Capital consumption allowance)			**¥ 12,946,840**	**¥ 12,946,840**	**¥ 12,946,840**	**¥ 12,946,840**	**¥ 16,183,550**	**¥ 3,236,710**	**¥ 3,236,710**	**¥ 3,236,710**	**¥ 3,236,710**
Business tax/VAT (to local government)	4.5%	¥1,597,837	¥1,648,190	¥840,134	¥861,596	¥889,665	¥918,243	¥947,679	¥977,998	¥1,009,227	¥1,041,392
EBIT		¥32,913,526	¥22,475,290	¥44,827,375	¥33,567,307	¥39,800,860	¥35,164,652	¥50,502,685	¥52,873,370	¥38,311,754	¥40,127,101
Interest		¥7,620,781	¥7,122,349	¥6,570,632	¥5,959,932	¥5,283,945	¥4,535,691	¥3,707,444	¥2,790,652	¥1,775,849	¥652,558
EBT		¥25,292,745	¥15,352,941	¥38,256,743	¥27,607,375	¥34,516,914	¥30,628,961	¥46,795,241	¥50,082,718	¥36,535,905	¥39,474,544
Income tax 25 % (to national government)	25%	¥6,323,186	¥3,838,235	¥9,564,186	¥6,901,844	¥8,629,229	¥7,657,240	¥11,698,810	¥12,520,680	¥9,133,976	¥9,868,636
Net income		¥18,969,559	¥11,514,706	¥28,692,557	¥20,705,531	¥25,887,686	¥22,971,721	¥35,096,431	¥37,562,039	¥27,401,928	¥29,605,908
Dividend base		**¥14,307,230**	**¥11,514,706**	**¥28,692,557**	**¥20,705,531**	**¥25,887,686**	**¥22,971,721**	**¥29,757,475**	**¥31,306,292**	**¥20,131,378**	**¥21,212,066**
Parking companies net profit		**¥14,307,230**	**¥11,514,706**	**¥28,692,557**	**¥20,705,531**	**¥25,887,686**	**¥22,971,721**	**¥29,757,475**	**¥31,306,292**	**¥20,131,378**	**¥21,212,066**
Government's net profit		**¥38,439,900**	**¥39,971,880**	**¥41,509,260**	**¥57,395,520**	**¥61,985,760**	**¥61,495,200**	**¥63,545,040**	**¥65,594,880**	**¥84,555,900**	**¥87,118,200**
CASH FLOW											
Net income		¥18,969,559	¥11,514,706	¥28,692,557	¥20,705,531	¥25,887,686	¥22,971,721	¥35,096,431	¥37,562,039	¥27,401,928	¥29,605,908
Interest +		¥7,620,781	¥7,122,349	¥6,570,632	¥5,959,932	¥5,283,945	¥4,535,691	¥3,707,444	¥2,790,652	¥1,775,849	¥652,558
Income tax +		¥6,323,186	¥3,838,235	¥9,564,186	¥6,901,844	¥8,629,229	¥7,657,240	¥11,698,810	¥12,520,680	¥9,133,976	¥9,868,636
EBIT		**¥32,913,526**	**¥22,475,290**	**¥44,827,375**	**¥33,567,307**	**¥39,800,860**	**¥35,164,652**	**¥50,502,685**	**¥52,873,370**	**¥38,311,754**	**¥40,127,101**
Consumption +		¥0	¥12,946,840	¥12,946,840	¥12,946,840	¥12,946,840	¥16,183,550	¥3,236,710	¥3,236,710	¥3,236,710	¥3,236,710
EBIDTA		**¥32,913,526**	**¥35,422,130**	**¥57,774,215**	**¥46,514,147**	**¥52,747,700**	**¥51,348,202**	**¥53,739,395**	**¥56,110,080**	**¥41,548,464**	**¥43,363,811**
Debt service - Interest		¥7,620,781	¥7,122,349	¥6,570,632	¥5,959,932	¥5,283,945	¥4,535,691	¥3,707,444	¥2,790,652	¥1,775,849	¥652,558
Debt service - Capital		¥4,662,328	¥5,160,760	¥5,712,477	¥6,323,177	¥6,999,164	¥7,747,418	¥8,575,665	¥9,492,457	¥10,507,260	¥11,630,552
Income tax		¥6,323,186	¥3,838,235	¥9,564,186	¥6,901,844	¥8,629,229	¥7,657,240	¥11,698,810	¥12,520,680	¥9,133,976	¥9,868,636
NET CF		**¥14,307,230**	**¥19,300,786**	**¥35,926,920**	**¥27,329,194**	**¥31,835,362**	**¥31,407,853**	**¥29,757,475**	**¥31,306,292**	**¥20,131,378**	**¥21,212,066**

Revenue and profit over 10 year period		
Revenue day time	¥	1,447,170,000
Revenue night time	¥	70,956,000
Total revenue	¥	1,518,126,000
Revenue for government (avg. 61%)	¥	601,611,540
Revenue for parking company (avg. 39%)	¥	916,514,460
Operation costs parking company	¥	434,300,830
Net profit parking company	¥	226,486,642
Net profit local government*	¥	601,611,540

** Total local government profit from the project consists of profit from parking revenue (601.6 million RMB), business tax/VAT (10.7 million RMB) and taxes on the company's employees (such as income tax, social insurance, etc.)*

7. Off-Street Parking Recommendations

7.1 Abolish parking minimums for new developments

Beijing currently uses parking minimums for new developments. Parking minimums, especially for residential land use, are not high, compared to other Chinese cities, but are likely to rise in the forthcoming updates to the parking standard.

Minimums require developers to build more parking than would often be needed. This was proven with the surveys at residential, commercial and office parking garages, as presented in chapter 3. at By doing so, they build costly parking that sits empty and encourages residents to drive. Minimum parking regulations impose major societal costs and undermine efforts to create balanced, sustainable transportation systems. Minimum parking regulations create a cycle that encourages car transportation, and, in turn, influences public authorities to require more parking.

This analysis is strengthened by a New York study which found that accessory parking at home is more likely to generate auto commutes than other factors including household income, auto ownership or a host of other things usually associated with the decision to drive (ITDP, 2010).

Minimum parking regulations reduce density, increase distances between destinations, reduce land values and increases traffic congestion, air pollution, and construction costs, as well as discouraging walking, bicycling and public transport.

Minimum parking requirements are especially damaging to central business districts (CBDs).

Many developers worldwide acknowledge this and negotiate with the government to build less parking than required to prevent having to pass the cost of expensive parking on to buyers and tenants.

Construction of underground parking spaces in China costs approximately 3,000 RMB/m2 (Cutian City Newspaper, 2014). With an underground parking spaces requiring 30-40m2, the total costs per space are 90,000-120,000 RMB per parking space and operational costs are approximately 240RMB per month (Guangzhou Price Bureau Cost Survey Team, 2013).

7.2 Implement parking maximums

It is recommended for Beijing to change parking minimums into parking maximums. Minimum parking standards 'lock in' driving into the urban fabric whereas parking maximums are a powerful tool to control the number of parking spaces and put a hold on dramatic vehicle growth. It lets developers decide the appropriate number of parking spaces reasonably needed, within maximums defined by the government, and reduces land and costs associated with excessive parking supply. These maximums are based on road capacity, public transport access and livability factors like air quality. Developers are in favor of these regulations, as it lowers unnecessary costs to their development, thereby increasing their likeliness of selling apartments and increasing their profitability.

Cities that have successfully solved parking problems and have successful urban development have taken a restrictive approach to parking supply and implemented parking maximums. Buildings do not necessarily need parking, but rather good access. This access can be provided with high-quality public transport and NMT facilities, which have much less or no negative impact on traffic and air quality. For instance, the highest-value office and commercial building in London has no parking places at all, only some for handicapped, motorbikes and bicycles. Three metro stations are located within 500 meter from the building and three more within 1 kilometer. This shows parking often does not add value but extra costs to a building. London implemented a parking maximums for offices at 1 parking space per 1,000-1,500m2 of office space. Many cities, including Japanese, also exempt small buildings (under 1,500m2) from mandatory parking construction. Other European capitals like Paris (France) and Budapest (Hungary) have lower (down to zero) maximums for developers, when the development is close to public transport. In return the developers need to co-finance public transportation to the development (which also benefits the developer since it raises its value).

In China, Shenzhen is the first to implement maximum standards for parking supply in new developments. The Shenzhen Urban Planning Standards and Guidelines (2014), defined by the

Shenzhen Planning Land Resource Commission, allow developers to provide a maximum of 80% of the normal supply for residential developments within 500 meters from metro stations. For commercial land uses, the parking supply is based on land use, development intensity, transit accessibility and road capacity and categorized into three zones. In areas with good transit service, limited road capacity and high development density, commercial parking standards are allowed to be reduced further, if a study proves less parking supply is needed.

In Shanghai developments within 300 meters from rail transit station are allowed to decrease residential parking standards by a maximum of 20%, following the Shanghai Regulatory Plan Technical Guidelines (2011) by the Shanghai Planning and Land Resource Bureau.

7.3 Implement a parking cap

A parking cap is a strategic land use and transportation demand management regulation that Beijing can use to influence both on-street and off-street parking supply within a city or designated zone. Also known as a lid or freeze, a parking cap strategy seals the total available and future projected parking space at a selected level. It can also be incrementally adjusted to reach long-term modal shift goals. By capping the total number of parking spaces, the city and district governments have more control over the growth of car use and can decrease congestion, decrease pollution and stimulate the use of NMT and public transport.

Some cities went so far as to freeze the parking supply at existing levels in downtown districts, recognizing the need for a limited number of parking spaces to satisfy essential car trips. Beyond a certain threshold, the supply of parking no longer fosters a healthy and desirable area. This policy approach was successful in reaching desired, long-term city environmental and mobility goals in selected cities such as Portland, New York, Boston and Zurich.

New York City set a parking cap in 1982 for the Manhattan Core, encompassing the Central Business District (CBD) below 96th Street, as a way to control the supply of public off-street parking. Meanwhile, accessory parking—that is in addition to the floor area already permitted for development—was deemed optional and an amount only up to a maximum value would be allowed. Many parcels of land previously occupied by parking facilities have been replaced by more premium uses. As a result, the total off-street parking supply in the Manhattan CBD decreased from approximately 127,000 public parking spaces in 1978 to 102,000 spaces in 2010.

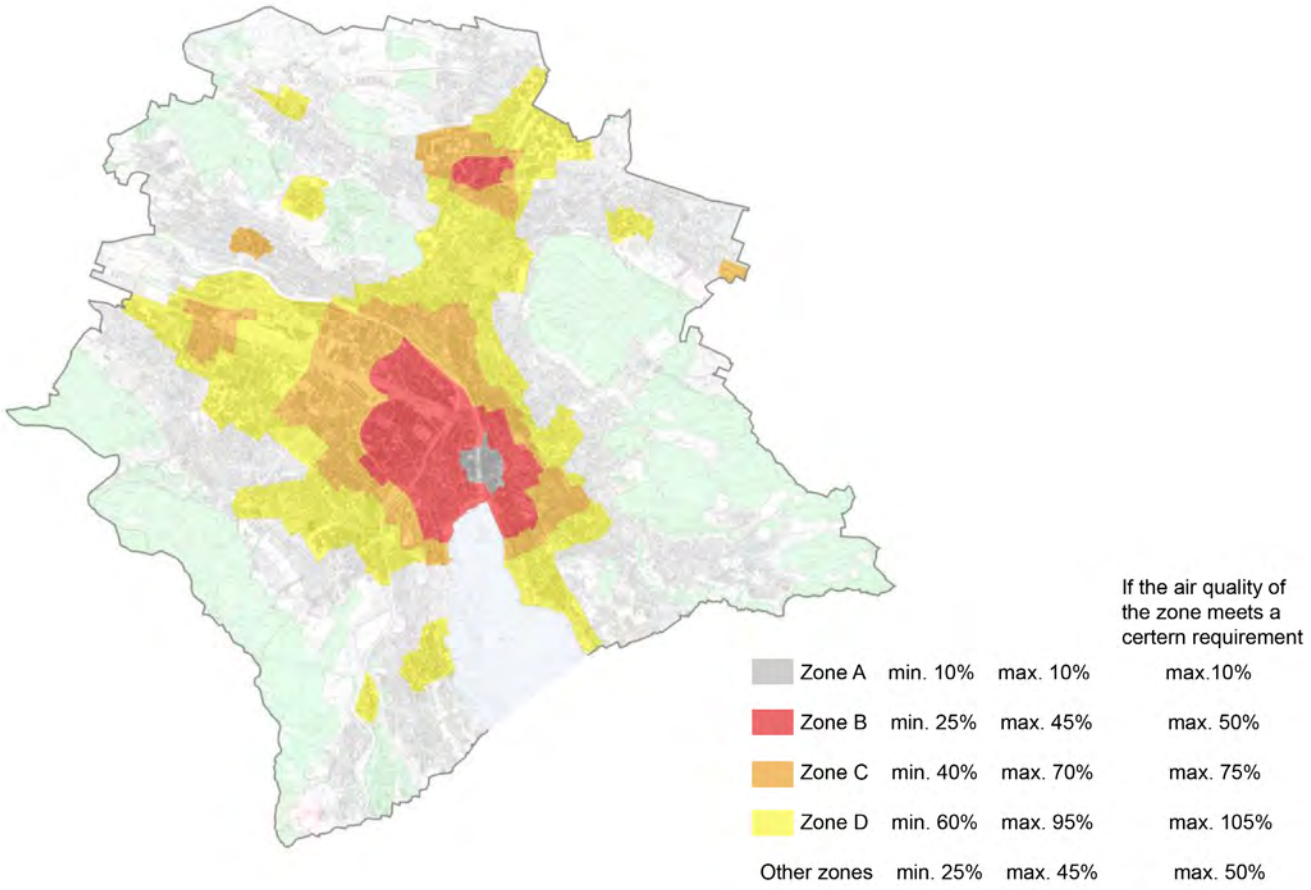
Boston instituted a freeze in 1976 to reduce car congestion and encourage public transit use. The freeze is administered by the Air Pollution Control Commission (APCC), which issues permits to build parking based on existing supply and a reserve set aside in a parking freeze bank. The bank exists in the event that a parking facility is converted to another use. Future developers can still tap into the bank and build parking as of right if the ceiling for the district has not been reached. The freeze extended to East Boston in 1989 and South Boston in 1993. Parking is controlled by both land use regulation and the State Implementation Plan, which are meant to monitor how the state complies with federal air quality standards. On-street parking spaces are exempt from the freeze. While the off-street parking cap succeeded in reducing congestion into the city, the cheap curbside parking spaces encouraged cruising within the downtown—especially due to the higher price of parking in off-street facilities. Over time, the finite number of off-street spaces either increases in value or remains underutilized if the on-street situation is not managed well. It encourages sharing of parking spaces for different demand groups, such as commuters versus shoppers and residents, since no new supply can be expected and thus leads to greater efficiency of use.

Zurich (Switzerland), Hamburg (Germany) and Copenhagen (Denmark) 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, bikeways or public-transport only corridors.

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

Various parking cap approaches by New York, Boston and Zurich

City	Year Cap Introduced	Number of Spaces	Type of Space Impacted
New York Manhattan Core	1982	Unknown	Public off-street parking
Downtown Boston			
South Boston			
East Boston	1976		
1989			
1993	35,556		
30,389			
4,062	Commercial Parking		
Divided further into 3 subzones			
Limits Commercial & Employee Parking at Logan Airport			
Zurich City Center	1996	Set to 1990 supply level	Public On- and Off-Street
Parking Cap with a Reduction Goal			



Zurich's maximum allowable off-street parking supply depends on the building's proximity to high-quality public transport. Maximums can be lowered if air pollution targets would be violated.

Source: Stadt Zurich, Tiefbauamt (2011)

additional pollution without violating ambient air quality norms. The city has long been investing in public transit while decreasing private car access and every development within the city is 300 meters away from a transit stop. For all land uses exempt from the parking cap, such as private residential developments, a mobility plan can be submitted to the Mobility Management department. For example, landlords can include a transit pass as part of an apartment lease and build bike parking to avoid fulfilling the parking requirements. These policies have helped making Zurich one of the most livable cities in Europe.

Formulating a parking cap

The general idea of a parking cap is to influence individual travel behavior in a way that favors non-driving modes, which must be done in conjunction with improvements to transit infrastructure as well as biking and walking facilities. An individual will contemplate travel preferences based on factors such as cost, time, comfort, safety and attractiveness.

Any strategy that is intended to affect trip choice needs to be targeted at changing individual traveling preferences. Establishing a parking cap is important to limit car traffic but not to the point where the area economy suffers from a decrease in access to destinations. The proposed approach for establishing a parking cap is based on mode split goals, which can be set in two ways:

- Freeze Approach: This method, implemented in Zurich, Hamburg and Copenhagen and described earlier, freezes the existing parking supply and no longer allows additional parking supply, unless other on-street or off-street parking spaces are to be cancelled. A gradual reduction in the number of parking spaces can be used to lower car trips over time. This approach is useful for built-up areas and areas that need to be protected from more increasing car travel.
- Modal split approach: This method uses the desired modal split for an area and uses traffic models, based on surveys of existing traffic. It entails setting an ambitious target aimed at a modal split favored to public transport and NMT, rather than car traffic. Too high a car modal split value generates higher congestion, makes the environment less livable and requires more land for a parking, low-value land use. Too low a car modal split value may hamper the area from functioning and threatens its competitiveness, especially in areas where few high quality alternatives are available. Using traffic models, the desired modal split is then translated into car trips and parking supply for different buildings. This can be used to formulate the parking maximums for new buildings. This approach can be used for both existing and new development areas.

In both approaches access to alternative traffic modes such as public transport, walking and biking are needed to accommodate modal shift away from cars.

In Beijing, parking supply caps were already stipulated in the Beijing Transportation Development Program 2004-2020, written by the Communication Commission in 2005. The city government, in cooperation with the districts, needs to freeze the parking supply in congested, central areas and define modal split targets for each of Beijing's areas, based on factors such as road capacity, desired vehicle volumes and speeds, public transport access, accepted levels of pollution, density and number of jobs. Especially for central areas that are to be protected and where congestion is currently problematic, modal splits favoring public transport and NMT are needed. Beijing's OD traffic model can be used to compare existing and desired modal split and to calculate parking caps and maximums for each area. Existing parking supply can then be reviewed and spaces removed, starting with setbacks, on-street and publicly operated off-street buildings. Parking maximums for new developments are then to be set for each area as well. Detailed studies for each area are needed.

7.4 Private, residential parking

This type of parking constitutes of parking garages or on-ground parking lots on the residential development's premises. If Beijing's latest policy in stimulating parking supply in residential areas is proceeded, this will lead to increased car ownership and car use, putting even more pressure on the city's road system. As the surveys in chapter 3 show, additional off-street parking will only sit empty if on-street parking is not managed

Selected residential parking standards

City	Min. residential parking standard (parking spaces)	Note
Budapest	1.0/unit	but 0.5 within 500m of PT
Hong Kong	0.057-1.275/unit	high variety, depending on PT availability and apartment size
Strasbourg	0.5/unit	within 500m from PT
Stockholm	0.14/room	assumed: 3 rooms
Shanghai	0.3-0.8/unit	0.3 if <100m2; 0.5 if 100-150m2; 0.8 if >100m2
Tokyo	0.28/100m2	
Hamburg	0.2/unit	
Barcelona	0.17/unit	1.0 per 2-6 units, depending on area
London	0	maximums: 1.0/unit (2 bed rooms)
Paris	0	maximum: 1.0/unit
San Francisco	0	maximum: 0.25/unit
New York (Manhattan, below 60th st.)	0	maximum: 0.20/unit

Many cities worldwide have implemented a parking maximum for residential parking in their standards for new residential developments, where others have low minimums and discounts for proximity to public transport.

Source: ITDP China (2014), http://globalparking.net

appropriately. Especially when developments are in close proximity, say 500 meters, of metro stations, parking maximums should apply to promote the use of metro. Parking maximums are needed to control the number of parking spaces to ensure the operability of the area.

For older residential areas, such as hutongs, where no off-street parking was built, a restrictive approach to parking supply is needed. The surveys at Cheniandian hutong show that few residents use the parking lot, despite a very low parking price. Enforcement of illegal parking within the hutongs would increase occupancy in the parking lot. But providing parking solutions for residents living in hutongs is not recommended. More off-street parking requires land and is expensive. Constructing mechanical parking costs 50,000-100,000 RMB per parking space and operational costs are 2,400RMB per year. Moreover, providing more supply is only a short-term solution. Within several years new off-street parking may be needed again.

Instead, no off-street parking should be built in these areas and existing parking vacancy in the surroundings better used with parking sharing.

A proof-of-parking policy, successfully used in Japanese cities, can be considered for older areas as well. Before a new license plate is issued, residents who buy a car then first need to prove having a parking space, by showing proof of ownership of a parking space or a long-term rental contract of a parking space. This puts the problem of finding parking with the car owner rather than the government. Implementing a very limited number of residential permits for yearly parking could be considered, but this can only serve a small number of residents and only in areas where parking vacancies during day and night exist. It should be priced such that it reflects the value of the land, rather than being a favor to drivers.

It also advised against to install electrical retractable bollards on public streets that only allow residents to enter. Especially during day time, when residents are at work, this parking supply would sit empty.

7.5 Private, commercial parking

Abundant supply of parking at offices and shopping centers induces more car trips. When an employee has plenty of parking spaces available

Selected commercial parking standards

City	Min. commercial parking standard (parking spaces)	Note
Shanghai	0.6/100m2	
Stockholm	0.4-0.6/100m2	
Tokyo	0.3/100m2	
Singapore	0.2/100m2	
Seoul	0.1/100m2	
Strasbourg	0	0.5/100m2 if parking demand cannot be found in vicinity
Amsterdam	0	maximum: 1.0/250m2
San Francisco	0	maximum 7% of total floor space
London	0	maximum: 1.0/1,000-1,500m2
Hong Kong	0	

Commercial parking standards are low or capped with maximums in international cities

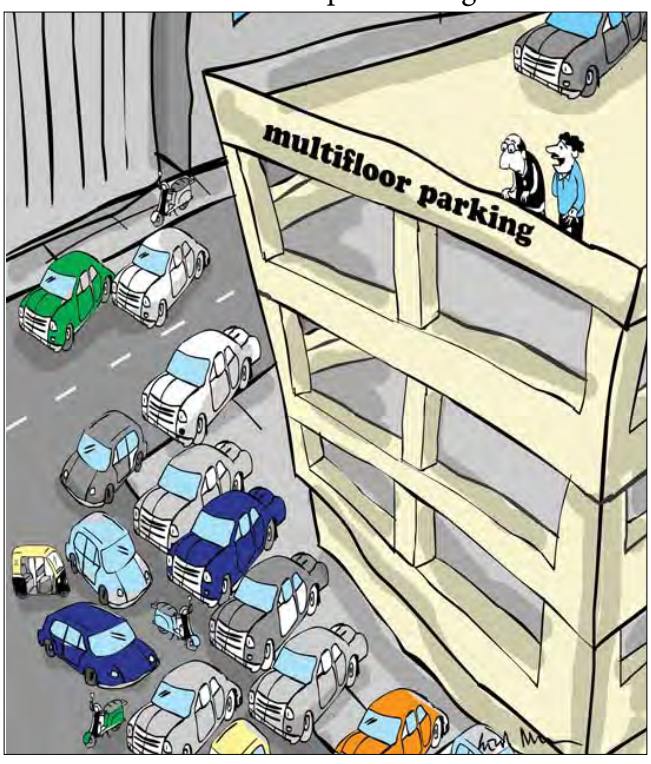
Source: ITDP China (2014), http://globalparking.net

at his office, or a person has ample parking spaces to choose from at a shopping center, the chances this person drives to work or shops will increase. Parking supply therefore induces traffic and puts a burden on road capacity. Moreover, existing parking lots often have large vacancies, as proven in chapter 3. The Beijing governments needs to limit car use by imposing parking maximums for new commercial developments. The sharing of parking spaces among different land uses and buildings in the vicinity, as described in the next section, also helps making better use of existing parking facilities.

7.6 Public off-street parking

Publicly accessible off-street parking places can be parking garages, parking buildings or on-ground parking lots that are not part of the public road. Development of new off-street parking buildings in Beijing will serve little purpose if the on-street parking is not taken on first. The surveys presented earlier show that publicly accessible off-street parking lots have fairly low occupancies, whereas occupancies on some streets are very high. Poor on-street enforcement and free on-street parking make off-street parking lots unviable, for drivers and investors.

When implementing the recommended on-street parking system, especially when combined with slightly cheaper prices for off-street parking and time limits for on-street parking, many drivers will shift to off-street parking. It is not recommended for the government to develop more off-street parking with public funds. Rather, it should focus on making more existing off-street parking open to the public. Private investors will see opportunities in off-street parking supply with an effective on-street parking system implemented. The government does need to control private off-street parking lots. Through 'zoning' the location and size of off-street parking lots needs to be controlled to prevent negative traffic



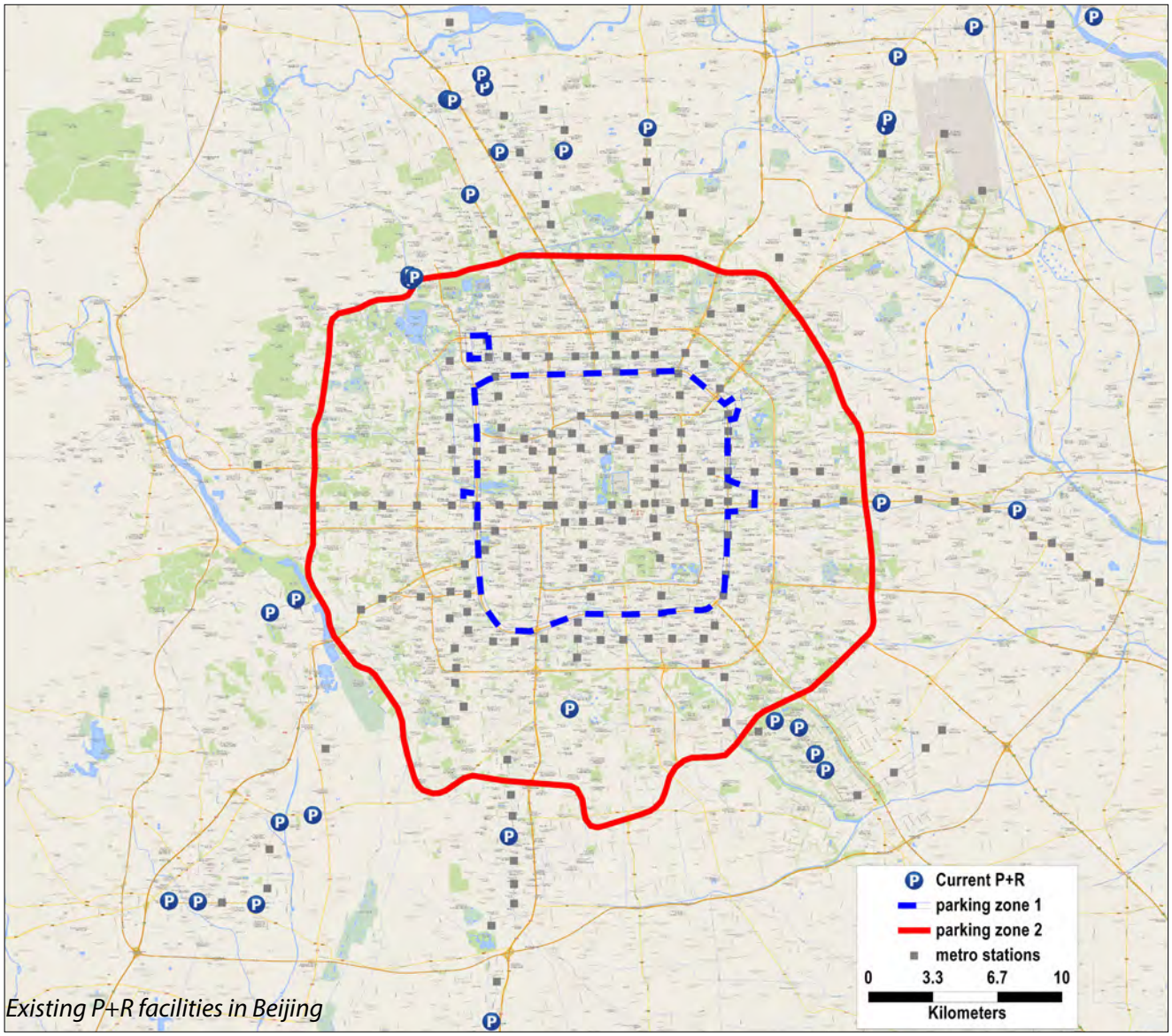
On-street parking must be tackled before private investment in off-street parking supply can become viable

and air pollution impacts and prevent too much land being taken up by parking. Parking prices in these off-street facilities should be decided by the market and not controlled by the government, also for monthly and yearly rental. Off-street parking prices should be aimed at being lower than on-street parking prices to lure long-term parking to off-street parking garages. Private parking operators are likely to develop pricing schemes tailored at different parking needs and ensuring high occupancy. This will result in higher parking rates in the city center than in suburban areas and monthly parking rates that reflect the actual value of the parking space.

7.7 P+R facilities

According to the Beijing Communication Commission by October 2013, 37 P+R parking lots were in operation. Based on these data and

Metro station	Line	District
天通苑北站	5	Changping
通州北苑站	Batong	Tongzhou
传媒大学站	Batong	Chaoyang
安河桥北站	4	Haidian
长阳站	Fangshan	Fangshan
篱笆房站	Fangshan	Fangshan
大学城站	Fangshan	Fangshan
南关站	Fangshan	Fangshan
苏庄站	Fangshan	Fangshan
西二旗站	Changping	Haidian
朱辛庄站	Changping	Changping
生命科学园站	Changping	Changping
新宫站	4	Fengtai
天宫院站	4	Daxing
枣园站	4	Daxing
文化园站	Yizhuang	Daxing
万源街站	Yizhuang	Daxing
荣昌东街站	Yizhuang	Daxing
荣京东街站	Yizhuang	Daxing
张郭庄站	14	Fengtai
园博园站	14	Fengtai
霍营站	8	Changping
龙泽站	13	Changping
花梨坎站	15	Shunyi
后沙峪站	15	Shunyi
南法信站	15	Shunyi
俸伯站	15	Shunyi



Existing P+R facilities in Beijing

the latest on Baidu Maps, 27 P+R parking lots were identified (shown right and below).

Metro lines connect suburbs with the rest of the city with high-capacity and high-quality public transport. The often central locations of metro station see large flows of daily passengers and metro station areas are areas for prime economic urban development. The metro station area therefore is not suitable for very low-value, space-consuming P+R facilities. Not only are big opportunities for more suitable land development lost, existing land uses are negatively affected by the depleting effect land used for on-ground P+R parking facilities. Further growth of P+R facilities is discouraged and redevelopment of existing P+R facilities is recommended.

7.8 Parking sharing

Shared parking is when variations in activity patterns between different parking users can be accommodated by sharing of parking spaces at different times of the day, week, month and on special occasions.

In Beijing, parking standard regulations dictate the creation of parking space based on individual land uses. This leads to underutilization of space that takes away the possibility to develop

City	Office	# parking spaces	Day Park	Night, Weekend and Public Holiday Parking	Register
Beijing	Municipal Government	110	7:30-18:30 8 RMB/hr (same price as surrounding area)	150 RMB/month	Only for monthly parking
Xiamen	City Admin. Service Center	963	8:00-18:00 Free	Fee charged	N/A

City	# offices providing shared parking	# residential developments providing shared parking	# Shared parking spaces	Year started
Hangzhou	135	256	9,200	2008
Hefei	Total: 114		9,505	2009
Xi'an	52	N/A	N/A	2013

Parking sharing practices in selected cities.

more active uses and compact design for the development.

Shared parking works like a 'food court' where restaurants share tables for guests. Individual new developments in Beijing all build parking for their own site, but they would be better off developing shared parking for several sites within close proximity of each other. Parking demand at each site varies throughout the day: residential areas have higher parking demand at night than during office hours, whereas offices have higher demand during office hours than at night.

By pooling the development of parking spaces and making these open for public access, many parking spaces, land and costs can be saved. Parking sharing helps balancing parking supply and demand and reduces the need for new off-street parking spaces.

Weekday peaks	Evening peaks	Weekend peaks
Offices	Shopping malls	Shopping malls
Banks	Restaurants	Parks & tourist sights
Schools	Cinemas	Cinemas

Different land uses have different peak parking demand hours

Shared parking can be advantageous for developers, businesses and governments. It can alleviate traffic congestion, allow for increased density near transit and promote compact development.

The main benefits of pursuing a shared parking strategy include:

- Efficient and optimized use of existing parking infrastructure
- Burden on developers to build more parking relieved
- Support for transit-oriented development.

Shared parking can reduce parking requirements by 20-40%, creating positive economic, social and environmental benefits. For Beijing to reap the full benefits of such a program, parking needs to be publicly accessible with no private, reserved spaces. Parking sharing can be achieved for both existing off-street parking, as well as for to be supplied parking in new developments.

7.8.1 Parking sharing for existing parking

For existing parking supply, districts should conduct studies studying existing parking supply and demand at varying times of the day. With residential parking being a big problem, identifying nearby offices with large vacancies at night, would eliminate the need for expensive, new off-street parking buildings. The government can also act as an intermediary in helping the private sector identify how the spaces can be shared. For instance, Stockholm Parkering in Stockholm, Sweden is a parking authority that helps developers find available parking spaces in

the surrounding district. The parking lot owner can significantly increase its parking revenue by charging drivers for parking spaces that would otherwise be unused. Parking fees, and penalties, are needed though to encourage users to not overstay parking hours and ensure vacancy during office hours. Also an agreement can be signed between the parking lot owner and user, as is applied in some cases in Beijing and Shanghai.

7.8.2 Parking sharing for new parking supply

For new developments the Planning Commission should forbid operators to sell or rent individual parking spaces to single users and parking sharing should be made a requirement for operators of off-street parking. Monthly and yearly rental can still be sold to users, but a fixed parking space should be banned to ensure maximum occupancy of all parking spaces and ensure efficient use of land. Other stimuli could be higher allowable floor area ratios (FARs) for a higher percentage of shared parking.

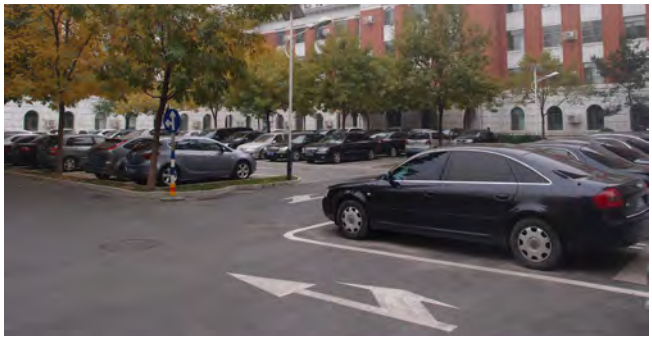
7.8.3 Chinese parking sharing examples

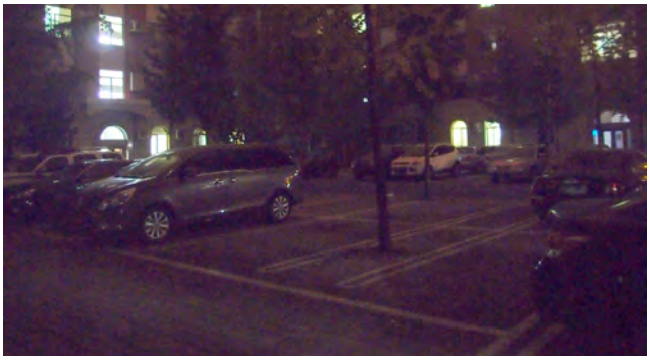
Over 14 Chinese cities have a policy to encourage and guide parking sharing or have implemented parking sharing, including Beijing, Shanghai, Guangzhou, Xiamen, Hangzhou, Hefei, Xi'an, Jinan, Zhengzhou, Nanjing and Quanzhou.

In 2011 the Beijing government announced the a notification of parking sharing to encourage and guide institutions in opening their parking lots to the public after working hours. By 2011, 61 parking lots were sharing 8,946 spaces in 6 central districts. Most of these shared parking lots are open to residents in the surroundings between 6pm and 8am. In late 2013 the Beijing government approved another policy on parking sharing where more details of the mechanism were explained and where charging parking fees were allowed as long as these follow the Parking Price policy and after registration with the Industrial & Commercial Bureau.

An example of parking sharing in Beijing is the Shifu Dalou on the corner of Huaibaishu Jie and Changchun Jie in Xicheng district. This building used to host the former city government headquarters and now hosts multiple state-owned enterprises and government-affiliated organizations. It has over 300 on-ground parking spaces which are mostly used during office hours by drivers who have a sticker on the car's windshield, indicating payment of a monthly parking fee. After office hours at 6.30pm the parking lot opens up for visitors; especially residents in nearby areas use the parking lot at night. During our time of visit in late October 2014 at 9.00pm, many residents had parked inside the premises but even more spaces were vacant.

When visitors come parking at night, the parking guards ask visitors when entering when they will leave. They are asked to leave before 7am if they park inside. If drivers wish to park longer, guards only allow them to park on the setback outside the gate. The parking price is 150RMB/month for visitors who join the parking sharing scheme.





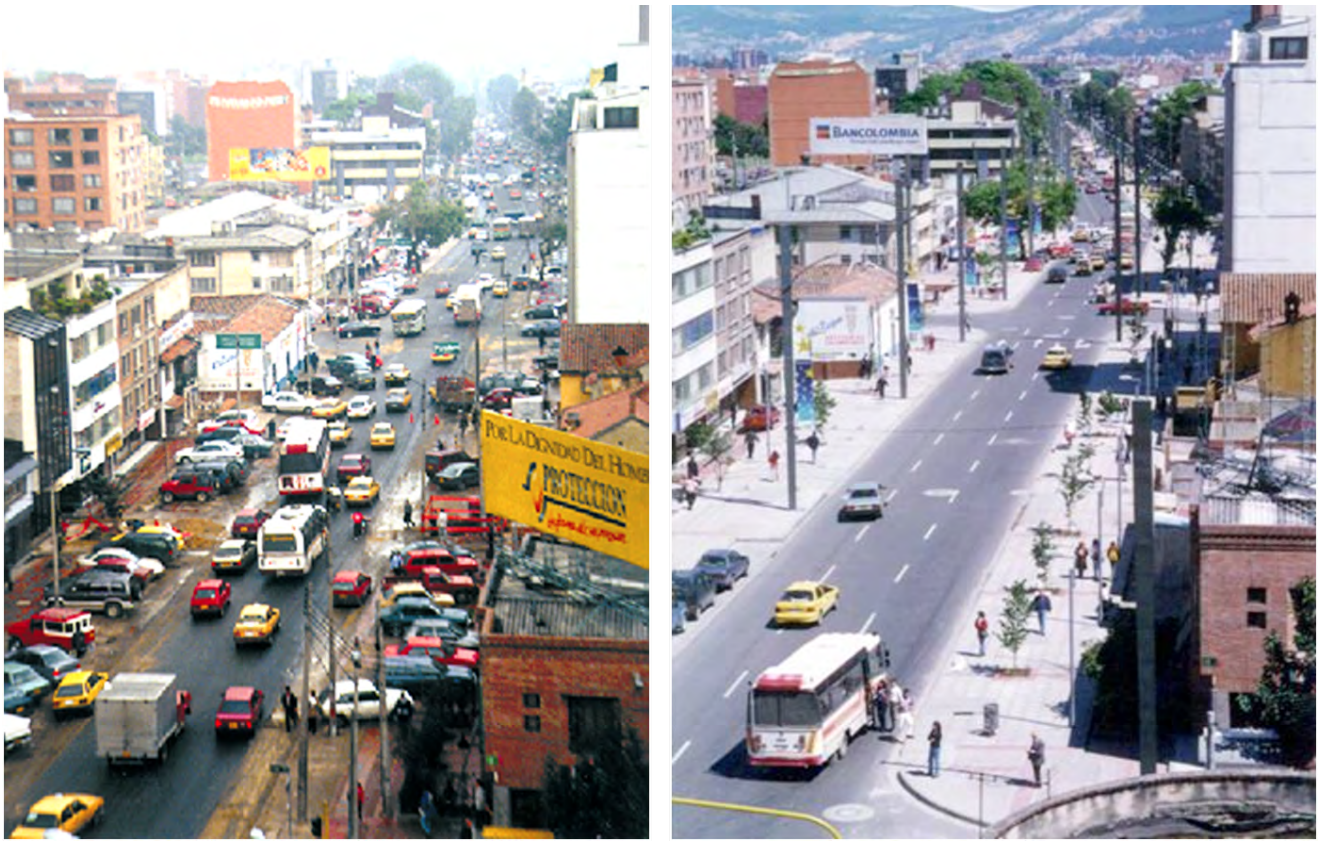
Shifu Dalou building: parking for employees during the day (above) and for residents at night (below)

7.9 Banning setback parking

Beijing has abundant parking occurring on setbacks, the space between the building front (privately owned) and sidewalk (publicly owned). Few practices are as destructive of the urban environment and livability as setback parking.

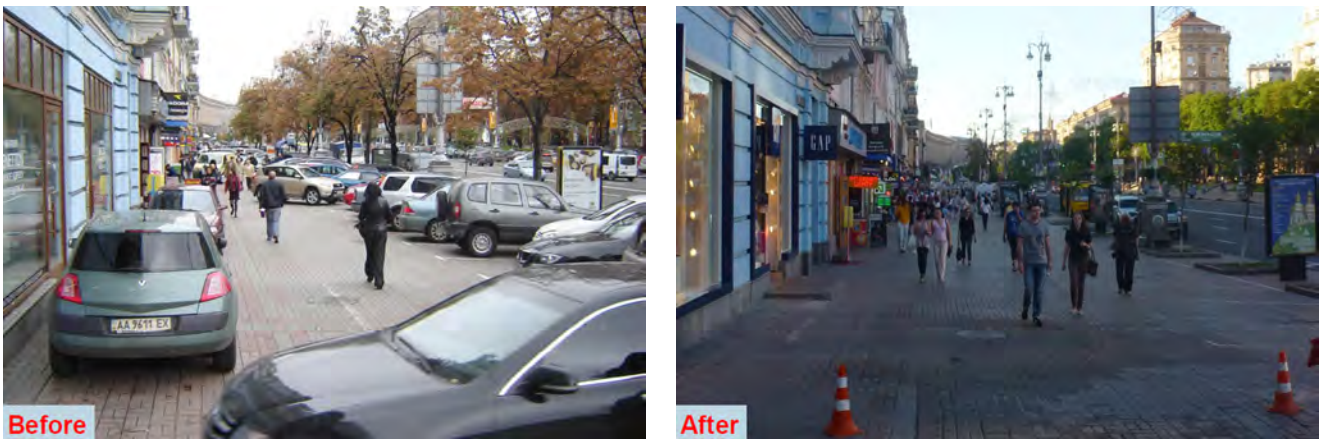
Use of the setback for parking requires incursion of the sidewalk for access to those spaces, damaging the pedestrian environment. On smaller setbacks cars do not even fit on the setback and spill over onto the sidewalk, leaving little to no space for walking. Moreover it leads to poor building access and backwards urban design.

To preserve urban fabric and promote a pedestrian oriented streetscape, setback parking is recommended to be prohibited and parking to be eliminated or moved to areas behind buildings, ideally combined with physical barriers such as bollards to assist with enforcement.



Bogota (Colombia) managed to clear many of its setbacks from parked cars, starting with the term of Enrique Penalosa as mayor in the late 1990s.

Source: ITDP



Setback parking in Kiev (Ukraine) was removed and now creates a much more attractive shopping environment where shops thrive.

8. General Parking Recommendations

8.1 Communications

Parking is becoming an increasing annoyance to Beijing's residents and media have recently been investigating parking revenues and which organizations pocket these. Now is the time for the government to act and implement policies and systems that provide long-term, sustainable solutions to parking, with positive effects to traffic and pollution.

Of crucial importance is explaining what the parking reform entails, how it works and what the benefits for the people are. Important is to demonstrate how the proposed on-street parking system organizes the streets, provides parking spaces for those who need it, improves walkability, livability and road safety, reduces congestion, reduces air and noise pollution and increases appeal and business from tourists and locals. The proposed technology enables the government to be transparent about parking revenues.

Residents may not like paid parking, at price levels according to the standard, but it needs to be explained that that is the only way to steer drivers' behavior and make on-street parking spaces available to them. It is made easy to pay with different payment modes and the revenue is open about parking revenues and how they are used to develop public transport and NMT improvements. Through open communication it can be explained to Beijing's residents that this parking reform benefits them and is best for the city.

8.2 Residential permits

It is not recommended to provide residential permits for those living within the on-street parking zone. If it is decided to provide residential permits, for instance for old residential areas

Parking meter in Brisbane states that "Money collected from this parking meter is being used to build and maintain footpaths across Brisbane". Clear communication on parking revenue increases drivers' acceptance of paid parking.

Source: Karl Fjellstrom. www.transportphoto.net

Ring-fencing of parking profits for public transport investment and clear communication to citizens are crucial in support for parking reform.

where no off-street parking exists, then a capped number of permits needs to be found (based on available spaces) for which residents need to apply. The government should set strict criteria such as maximum 1 permit per family, no outstanding fines, yearly renewal and a fee.

8.3 Institutional changes

Parking responsibilities are scattered among different government divisions. The implementation of a parking reform commission, composed of stakeholders from all of Beijing's organizations involved in parking and supervised by the Mayor, is recommended. High-level officials from the Communication Commission, Planning Commission, Traffic Police, Beijing Municipal Development and Reform Commission, Urban Management Office, Construction Commission and Industrial&Commercial Bureau need to be hired part-time to work with the Mayor on comprehensive on-street and off-street parking reform and part-time with each of their bureaus to implement the policies set forth under the new commission. This department can also assist district governments with parking expertise and assistance in implementation on district level. Having Mayor's approval is crucial in being able to align all agencies in formulating holistic, comprehensive parking policies and create the environment for successful demonstration implementation and scale-up.

8.4 Ring-fencing

Rather than depositing parking profits into a general fund it is strongly recommended to ringfence parking profits to finance alternative sustainable transport projects like public transport, NMT, bike sharing and public space improvements. Buy-in from drivers and local stakeholders can be earned with this type of initiative because drivers can see where their parking fee goes and that it is spent on transportation improvements and local stakeholders see improvements come to their neighborhoods. 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. 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.

8.5 Levies

Providing off-street parking spaces at destinations, like offices and shopping centers, influences mode choice. If more parking spaces are provided, more people are incentivized to drive there rather than take public transport, walk or cycle. Besides restricting off-street parking supply with maximum parking standards, the government can also decide to levy fees for each off-street parking space provided to employees or shoppers. In the United Kingdom 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.

9. Proposed Implementation Schedule

To implement parking reform in Beijing, starting with a demonstration project is recommended. Guang'anmen, which already has plans for on-street parking reform, can be a good area to start. Parking problems are wide-spread and of different nature, and solutions to the current problems in Guang'anmen can serve as examples for other areas in Beijing. In the implementation schedule Guang'anmen district is used, but other districts can be chosen as well for demonstration implementation.

The following steps for on-street parking reform are recommended.

Phase 1: Surveys and preliminary planning & design of demonstration parking project (2-3 months)

Detailed parking studies need to be conducted in the Guang'anmen area. Surveys include:

- Existing on-street parking demand, occupancies, turnover, supply and illegal parking;
- Existing and planned off-street parking demand, occupancies, turnover and supply
- Traffic surveys into average speed during peak hours to identify areas where a more restrictive parking should be followed;
- Identification of no or low-parking supply areas, based on existing pedestrian volumes, historical and tourist value, business centers, etc.

Based on these surveys, preliminary zones and designs for each streets can be made. Improvements to walking, cycling and public transport can be incorporated when redesigning road cross sections.

Phase 2: Public tender (2 months)

Starting partly simultaneously with conducting the survey, the government needs to establish detailed requirements, both technical and service, of the on-street parking system it envisions, following the recommendations outlined in this report.

Selection of the private parking company should be done under a public procurement tender. The winning bid is the most cost-effective offer that meets those requirements. Other factors that should be taken into consideration include financial stability and viability of the private operator, relevant experience, references and equity requirements for investment. This can be included in the tender as pre-qualification criteria or it can be formally evaluated in the tender process.

Phase 3: Contracting (1 month)

The contract is the main mechanism the government has to control the level of service of the operator and determine the fundamental parameters of operations. There are two main components of the contract: the obligations and the rights of the operator. The obligations establish performance standards to the system and service the government requests. The rights establish the payment or revenue that the operator receives in return. Furthermore, the rights and obligations of the government are to be defined.

Phase 4: Construction (4 months)

During the construction phase the main activities are installation of parking hardware (parking signs, parking meters, occupancy sensors, occupancy boards, etc.), road construction, installation and debugging of the communication network, establishment of the central management office and staff recruitment and training. Projects with a smaller number of parking spaces can be constructed sooner, down to two months.

Phase 5: Operation

Before formal operation, a one month trial operation is recommended to let drivers get familiar with using the system and let the operator fix teething problems, both technically and operationally.

Full-fledged operation can start after the one month trial, if the operator meets the level of service set out in the service level agreement.

The implementation schedule, including on-street demonstration reform, institutional changes, off-street reform and financial reform, is shown in the following graphic.

Implementation schedule of Beijing parking reform

Implementation schedule	15-Feb	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16
On-street parking demonstration:																	
Surveys, preliminary planning&design	■	■	■	■													
Public tender				■	■												
Contracting						■											
Construction							■	■	■	■							
Trial operation											■						
Full operation												■	■	■	■	■	■
Transparent communication and service to users												■	■	■	■	■	■
Review parking prices based on traffic and parking data												■	■	■	■	■	■
Conduct surveys, planning&design in other areas			■	■	■	■	■	■	■	■	■	■					
Institutional:																	
Improve Traffic Police's capacity							■	■	■	■	■						
Formation of parking reform commission			■	■	■												
Off-street parking policy refor:																	
Preparation of parking cap in Guang'anmen								■	■	■	■	■	■				
Allow reduced parking supply around metro stations	■	■															
Prepare parking cap and maximums in selected areas																	
Financial:																	
Prepare legislations for parking fines and surcharging			■	■	■	■	■	■									
Implementation of sustainable transportation fund									■	■	■	■					