

# The role of on-street urban parking schemes for power two wheels in sustainable mobility

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## Abstract

In order to improve the provided level of urban mobility, transportation planners are trying to implement measures and their associated infrastructures which are placed along the urban environment. The main objective of these measures is to force daily trips, mainly for work and entertainment purposes, to alternative modes of transport which do not aggravate the environmental conditions so much and, in general, can lead to a more efficient operation of the urban transport system of a city. Local authorities have already understood the importance of this fact and are trying to ensure, in a more organised way, the attractiveness of this alternative choice along the trip chain (from the origin point to destination point). The Municipality of Thessaloniki, Greece, has quite recently constructed a number of parking sites for Power Two Wheels (PTW) in the city centre, in order to support the use of alternative, less polluted means of transport as motorbikes and mopeds. The research presented in the framework of this paper has attempted to determine the advantages and disadvantages of this PTW parking scheme related to its operation. The methodology followed includes on site observations in twenty five (25) organized parking sites for PTW all over the city centre and at the same time includes the assessment of demand and supply in each site. The results of a stated preference survey are also presented, investigating the responses and expectations of motorcyclists as far as parking facilities are concerned in the central area of Thessaloniki.

*Keywords: parking policy, power two wheels, sustainable mobility.*



## 1 Sustainable development and mobility

Undoubtedly, the rapid economic development that was initiated after the Second World War, in the middle of the 20th century, changed dramatically the human activities and in parallel increased its impacts at the broader habitat environment on which they are embedded.

This unforeseen fact led to a number of serious, complex and difficult to solve problems in social, economic and mainly in environmental level, even threatening the future existence of the human kind as well as the planet Earth itself.

A lot of theories have been elaborated through the decades aiming to overcome the above mentioned threats. The approach that seems to enduringly gain more and more supporters worldwide is that of Sustainable Development [1].

Although there is not any common accepted definition about the Sustainable Development, it could be considered that if any measure, action or policy in general, satisfies many – or in a theoretical manner all – of the sub-categories of the Table 1 below, then the goal of sustainable planning has been achieved [2].

Table 1: The three categories regarding sustainability issues.

ECONOMIC	SOCIAL	ENVIRONMENTAL
Affordability	Equity	Pollution Prevention
Resource Efficiency	Human Health	Climate Protection
Cost Internalization	Education	Biodiversity
Trade & Business Activity	Community	Precautionary Action
Employment	Quality of Life	Avoidance of Irreversibility
Productivity	Public Participation	Habitat Preservation

Source: [2].

Since the sustainability straightforward interrelates with the development, a special consideration should be paid to a key element of the development which pertains to be the transport sector. If all the components that comprise the development are sustainable, then the sustainable development is achieved.

According to a definition which originates from the European Union Council of Ministers of Transport, a sustainable transportation system is one that [3]:

- a) Allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations.
- b) Is affordable, operates fairly and efficiently, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development.
- c) Limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable



substitutes, while minimizing the impact on the use of land and the generation of noise.

The objective of this paper is to examine the potential contribution of a PTW parking management scheme to the sustainable mobility. More specifically, the research presented in the framework of this paper concerns the existing situation in the central area of the city of Thessaloniki, Greece and attempts to determine the advantages and disadvantages related to the operation of this PTW parking scheme. The research methodology included on-site observations in twenty five (25) organized parking sites for PTW all over the city center and at the same time included the assessment of demand and supply in each site. The results of a stated preference survey are also presented within the same paper. These results refer to the responses and expectations of drivers of PTW as far as parking is concerned in the central area of Thessaloniki. Issues like road safety, aesthetics and user information in the central area of the city, as far as PTW are concerned, are also addressed.

## 2 The role of parking management in sustainability

Parking management includes a variety of strategies that encourage more efficient use of existing parking facilities, improve the quality of service provided to parking facility users and improve parking facility design. Parking management addresses a wide range of transportation problems, and supports a variety of transportation, land use development, economic as well as environmental objectives [4].

Nowadays, there is an essential need for alternative use of parking lots, aiming to serve the PTW users, instead of car users. PTW driving has been proved to be one of the most desirable ways of mobility especially in cities with highly congested networks, since it outmatches all the other modes, in terms of travel time and parking finding.

The promotion of the use of two-wheel cycles in central areas imposes the need for an acceptable level of safety, security and accessibility as far this specific transport mode is concerned. In terms of accessibility, parking facilities play a crucial role. Although this issue is of significant importance for the development of a sustainable mobility plan in urban areas, planners and engineers usually put a lot of effort towards the development of on-street car parking policy and secondarily deal with parking policy for PTW. It must be mentioned at this point that the implementation of on-street PTW parking charges proved to be an effective strategy in increasing usage of off-street parking lots and public transport use in Taipei [5]. The choice to use PTW for particular trip, as important information for policy makers, was investigated in the framework of a study undertaken for the UK Department of Transport and as a result, models were developed [6]. The Municipality of Thessaloniki, Greece has quite recently implemented a number of parking sites for PTW in the city center. This practice has been adopted by many modern cities all around the world due to the increase of the use of PTW in city centres. This trend has to do with the advantages of PTW over private car in congested areas.



### 3 Analysis of PTW parking scheme at the centre of the city of Thessaloniki

In the framework of the Aristotle's University of Thessaloniki research activities, a study was carried out in the year 2007 concerning the examination of parking conditions for PTW in the central area of the city of Thessaloniki, Greece [7]. Thessaloniki's centre is the heart of the whole city. It is a major marketplace and the place where a great diversification of services resides; notably commercial, manufacturing and small industry. It is also a residential district as well as a tourist attraction area due to its many historical and cultural monuments. It must be mentioned at this point that the city of Thessaloniki faces daily traffic and associated environmental problems, especially in its central area, almost for all the hours during the day.

The methodology followed includes on site observations in twenty five (25) organized parking sites for PTW all over the city centre of Thessaloniki (see Figure 1). These sites include a total number of 548 parking lots which are provided to the drivers free of charge. It must be noticed at this point that there isn't any master plan concerning the location and parking capacity of these sites.

Surveys and observations carried out in the framework of this specific research referring to both parking demand and supply calculations. For the purposes of the research, measurements covered not only the area of the designated parking sites but their impact area as well. It must be mentioned at this point that, for the purposes of the specific research, the impact area of each parking site is defined as the area of a 40m buffer zone around each site. Measurements were taken during the period January – February 2007 and they were divided in three (3) discrete time periods as following: 08:30-10:30, 10:30-23:30 and 12:30-14:30. The specific time periods correspond to the traffic peak periods in the city centre, which are mainly affected by the working hours of the shops and offices.

Data analysis showed that only a part of the demand is actually served by the 25 sites, as it was expected to a great extent. More specifically, the 548 parking lots of the 25 sites are only capable to serve 51% of total demand in the areas where the specific parking sites had been constructed. Demand exceeds supply not only in the case where the 25 sites are considered as a whole, but also in the case where each individual site is considered.

Provided that 93% of the PTW were observed to park on sidewalks, it is made clear that the construction of exclusive parking sites for PTW are of a great benefit to pedestrians' safety and comfort, quality of life and environmental conditions in general. What is really interesting is the fact that occupancy of the 25 parking sites lies in the area of 55% to 61% of their capacity. In other words, drivers prefer not to park their PTW in the areas provided for this specific purpose. There are quite a lot of reasons to explain this behaviour, as following:

- Inappropriate location of the parking sites in the city centre (in terms of the land use in the near area of the PTW parking sites). Drivers have as their first option to park their PTW as close as they can to their final destination (e.g., commercial streets, recreational areas).



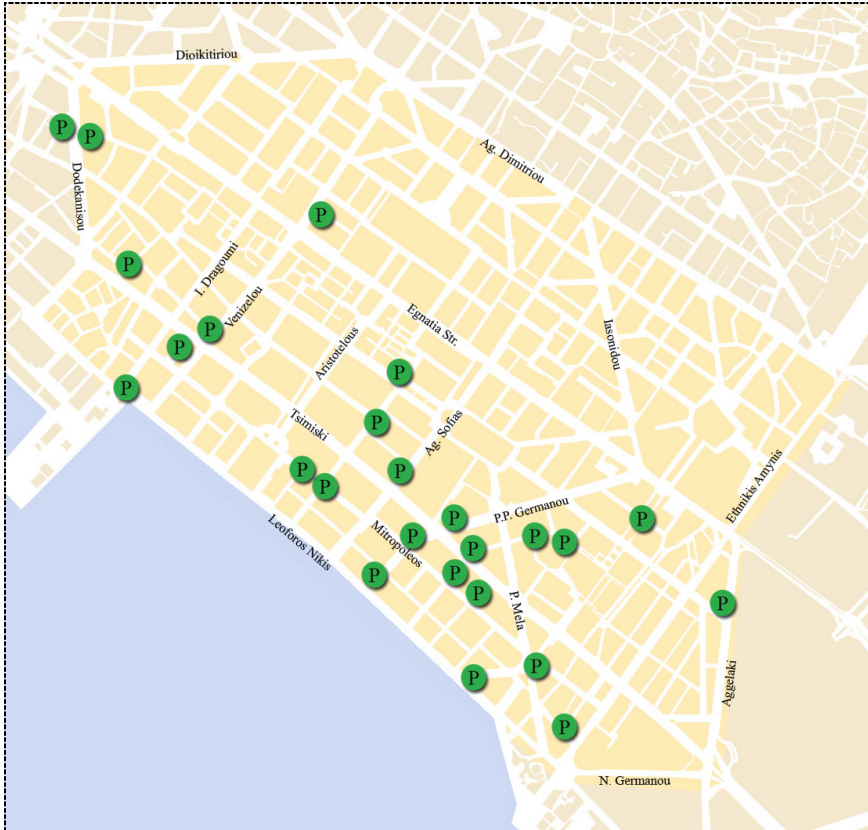


Figure 1: Location of parking sites in the Thessaloniki city centre.

- Presence of containers dedicated to garbage collection within the area of the PTW parking sites (this fact leads to loss of valuable space for PTW).
- Illegal car parking which often constraints entrance and exit of PTW to the parking site.
- Insufficient signing for the drivers of the PTW (quite often certain parking sites cannot be easily detected by the drivers in the central network of the city).
- Absence of the appropriate PTW parking equipment (e.g., equipment to serve safety and security purposes).
- Lack of provision of adequate information for the users concerning the location and characteristics of the parking sites in the city centre.
- Lack of parking sites promotion and advertisement.

The characteristics of the 25 parking sites together with the results of the demand and supply measurement are presented in Table 2.

The variation of demand and supply for the 25 parking sites together with the designed capacity is presented in Figure 1.

Table 2: Characteristics of the parking sites and demand-supply data.

location	capacity (lots 2x1m)	formally parked PTW	adjacent yet informally parked PTW	total demand for PTW lots	fulness ratio (formally parked / capacity)	of total demand informally parked PTW	of total demand formally parked PTW	lots needed to cover total demand	shape	dimensions (m)	area (m <sup>2</sup> )
AGIAS SOFIAS 17	18	17	36	53	0,94	0,68	0,32	35	R	18.5 X 2.2	40,7
ERMOU (OTE)	22	19	66	85	0,86	0,78	0,22	63	R	22 X 2.2	48,4
PALAMA - TSIMISKI	13	11	10	21	0,85	0,47	0,53	8	R	15 X 1.8	27
FILIKIS ETAIRIAS	7	6	8	14	0,81	0,59	0,41	7	R	11 X 1.3	14,3
P.P. GERMANOU	20	16	35	51	0,78	0,69	0,31	31	R	20 X 2.2	44
DODEKANISOU - VALAORITOU	13	9	51	60	0,72	0,85	0,15	47	R	13 X 1.9	24,7
KOMNINON - MITROPOLEOS	42	30	39	69	0,71	0,57	0,43	27	2T	0.5(17 X 7) + 0.5(18 X 7)	122,5
MITR. IOSIF - TSIMISKI	16	10	28	38	0,65	0,73	0,27	22	R	16 X 2	32
DODEKANISOU - OAEF	19	12	34	46	0,63	0,74	0,26	27	R	19.5 X 2.2	42,9
GOUNARI - I. MICHAÏL	24	15	18	33	0,63	0,54	0,46	9	2R	2 X (14 X 1.8)	50,4
K. NTIL - MITROPOLEOS	60	37	36	74	0,62	0,49	0,51	14	2T	0.5(12 X 7) + 0.5(12 X 7)	84
KOUSKOURA 7	16	10	25	35	0,60	0,72	0,28	19	R	16 X 2.2	35,2
ROGOTI - TSIMISKI	13	8	20	28	0,59	0,72	0,28	15	R	15 X 1.8	27
K. NTIL - V. IRAKLIÏOU	50	28	40	68	0,55	0,59	0,41	18	NB	N/A	100 (est.)
PALAMA 21	10	5	10	15	0,50	0,67	0,33	5	R	9.8 X 2.5	24,5
CHR. SMYRNIS - TSIMISKI	12	6	27	33	0,50	0,82	0,18	21	R	15 X 1.7	25,5
VENIZELOU - IOUSTINIANOÏ	14	7	52	59	0,50	0,88	0,12	45	2R	(7.4 X 1.8) + (0.8 X 1.8)	31
MITROPOLEOS (FANARTOTON)	36	17	67	84	0,48	0,79	0,21	48	R	22.5 X 3.2	72
BENIZELOU	26	9	28	36	0,33	0,76	0,24	10	R	13.4 X 4.2	56,3
I.DRAGOÏMI	15	5	42	47	0,33	0,89	0,11	32	R	15 X 2.2	33
STR. KALARI	16	4	28	33	0,27	0,87	0,13	17	R	11 X 3	33
LOUÏ (NAVARINO)	16	4	8	12	0,25	0,66	0,34	-4	2R	(5.8 X 2.1) + (10.5 X 3.2)	45,8
AGGELAKI	22	5	32	38	0,24	0,86	0,14	16	P	11 X 4.5	49,5
VOGATSIKOU	38	9	26	35	0,24	0,74	0,26	-3	R	43 X 1.8	77,4
KATOÏNI	10	2	14	16	0,20	0,87	0,13	6	R	12 X 1.8	21,6
total	548	301	779	1080	0,55	0,72	0,28	532			1062,7

R = Rectangle  
 2T = Two separate Triangles  
 2R = Two separate Rectangles  
 P = Parallelogram  
 NB = No Boundaries

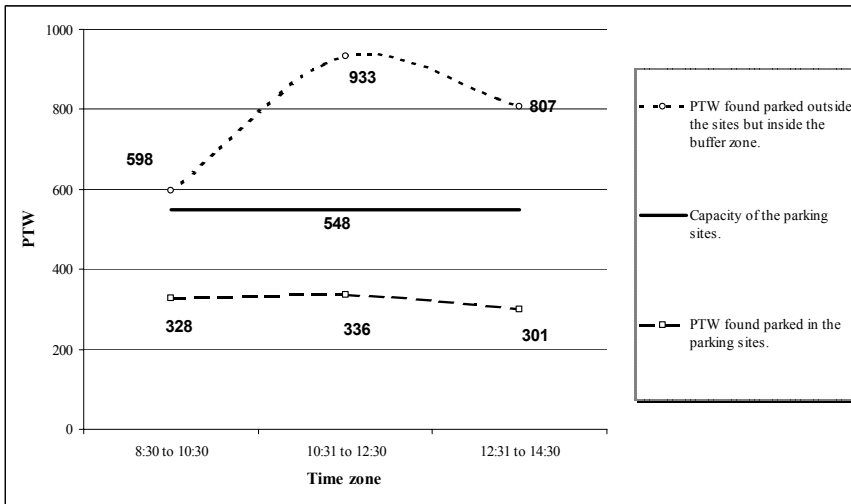


Figure 2: Demand, supply and capacity in 25 parking sites in the city centre.

Indicative photographs of parking sites in the central area of Thessaloniki are presented in Figure 2.

In addition to the measurements presented above, a Stated Preference (SP) survey took place in the framework of the same research [7]. The SP survey was considered necessary in order to investigate the behaviour of the PTW drivers as far as their mobility characteristics are concerned. A questionnaire was designed to serve the purposes of the SP survey which was carried out during the period February – March 2007. A total number of 60 questionnaires was collected and analysed. It must be mentioned at this point that respondents include drivers who park either in the parking sites (1/3 of participants) or outside the parking sites (2/3 of participants). Hereinafter, some of the most interesting findings of the SP survey are presented.



Figure 3: PTW parking sites at Vogatsikou Str. (left) and P.Mela Str (right).

The majority of respondents belong to the 25-54 years old age group (90%). The use of 50cc to 125cc PTW in the city centre is noticeable (52%). The fact that 67% of participants stated that they also own a private car along with their PTW shows that even those who can afford to have both vehicles, they prefer to use the one they think it is the most convenient for them taking into account the traffic and parking conditions in the city centre. A percentage of 76% of total PTW trips made by the respondents are of business purpose (from home to work and vice versa). This is considered as important information that needs to be taken into account when transport demand policy is designed for the city centre by the respective authorities. A percentage of 85% of the drivers use their PTW for 5 to 7 days a week, mainly during morning period.

A percentage of 82% of the drivers are willing to legally park their vehicles and use the designated parking sites. For the rest drivers, main reasons for the non-compliant behaviour include inconvenient parking sites, absence of available parking lots and finally, unsafe and insecure parking environment. It must be mentioned at this point that the provided level of safety and security conditions in the parking sites is considered as sufficient by only 36% of the respondents (this percentage actually highlights the need to pay much more attention to these two factors in order to attract more PTW drivers).

The evaluation of the measure about the construction of parking sites for PTW in the city centre shows that it is highly appreciated by the drivers (95%). However a considerable percentage of 77% of the drivers stated that they would like to have access to some sort of printed information regarding the location of

the parking sites. This pre-trip information would promote and encourage the use of PTW in the city centre. In order to show the importance and need for this kind of information it must be mentioned at this point that only 8% of the respondents knew that there are more than 20 parking sites located in the city centre. At the same time, 37% of the respondents thought that the number of the parking sites in the city centre is less than 5. The installation of an integrated direction signing system in the city road network was considered as a necessary step by the vast majority of the respondents (90%). As far as the necessary safety and security equipment of the parking sites is concerned, respondents stated that they would need the following provisions: ground anchor and other respective equipment (72%), covered parking (65%), CCTV systems (53%). When the issue of charges was raised, only a percentage of 28% is willing to pay 0.7 euros/hour provided that the parking sites will be fully equipped as previously described.

#### **4 The contribution of PTW parking installations on meeting the sustainability goal**

Without any doubt, in order to meet the aim of sustainable development and sustainability in general, a combination of various, multidimensional parameters should be satisfied. These parameters must be accomplished into the broader activities of each person separately and that is the reason why it is very difficult to elaborate a common framework of the criteria that should be met in order to reach the goal of sustainability.

However, a classification of the potential criteria that should be satisfied was presented in Table 1, on the first section of this paper. This classification is proved to be effective enough for the investigation of the contribution of transportation measures and initiatives into the goal of sustainability [8]. It is clear that the improvement of the network operation could affect a series of the subcategories presented in Table 1.

First, at the economic level it is sure that the most sufficient operation of the urban transport network, which can be achieved by the usage of friendly modes such as the PTW, can lead to the improvement of affordability and productivity levels in the study area. Moreover, a reliable transport network attracts additional trade and business activities and can improve the efficient reallocation and distribution of the available resources.

Taken into account the outcomes of the presented research, it can be easily concluded that as far as the economic level is concerned, the goal of the sustainable development could be achieved under certain circumstances since the fragmentary installation of parking sites for PTW isn't by itself a panacea. It presupposes additional supportive measures such as pre and on trip information, initiatives related to the safety and security issues and effective signing along the network and nearby the parking sites.

On the other hand, no additional analysis is needed to conclude that measures such as the coordinate operation of parking sites for PTW indeed satisfy most of the subcategories of the social level. Quality of life, human health and equity are some of the most representative examples. Of course, issues related to education





and public participation are not satisfied and probably that gives answers to the question of the unsatisfied level of operation and service of the PTW parking sites, that was derived for the Thessaloniki case study presented above.

Finally, the environmental level is another key category that totally seems to satisfy the require criteria for sustainability, in the case of installation of PTW parking sites at a central area. Pollution prevention, climate protection and avoidance of irreversibility are some of the subcategories that are being satisfied, given the fact that the transportation sector – on which the share of private vehicles is too high – is one of the major contributor in the pollution of the environment nowadays.

## 5 Discussion

The coordinated provision of parking sites for PTW is expected to improve the equilibrium between the modes (modal split) in an urban area in favour of environment friendly modes. In general, PTW have advantages when comparing with the private cars in terms of the available space needed for parking and of course in terms of the polluted emissions, a factor that seems to become more and more important through the last decades.

Since the demand for PTW has been increased, the need for effective installation and operation of the respective parking infrastructures has increased proportionally. The absence of an integrated parking policy for the PTW modes leads to non-compliant behavior, such as parking on the sidewalks, at plazas and pedestrian streets and decreasing the rate of mobility and accessibility of an area or city.

The need for a better, coordinated way of parking for PTW modes relates also with the safety and security matters, since it decreases the incidents of stealing or vandalism. Additionally, it has been proved that the installation of PTW parking sites near the bus and metro station or terminals can increase the usage of friendlier to transfer modes [9].

It is sure that the installation of PTW parking sites along the urban streets decreases the available parking lots for private cars, so it is a measure that acts against the usage of private vehicles. Taking into consideration the severe traffic and environmental problems that have been observed in the city of Thessaloniki, the support of such initiatives is essential.

However, as the analysis has shown, the construction and operation of such sites cannot achieve the goal of the sustainable development by itself. Additional supportive measures embedded in a broader parking policy must be followed in order to change the travel pattern and the travel behavior of the traveler in order to materialize a trip with a more efficient and less polluted – in other words in a more sustainable – way.

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