


Article

# Effect of Residential Parking Policy Derogations on Sustainability of Streets: The Case of Gaziantep, Türkiye

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**Abstract:** Rapid urbanization causes severe parking problems in developing cities. Parking policies cannot be strictly applied in some cases because of varying claims by developers. The variables such as household density, car ownership, and availability of public transport, and the new challenges such as sustainability, climate change, and sustainable mobility still remain insignificant in parking policies. The appropriate parking policies are immediately needed; however, the question is “which policy is appropriate for which city?” In this study, the evolution of residential parking policies is analyzed through the policy analysis process and parking survey methods. In conclusion, maintaining the status quo and not monitoring the applied policy results during the peak period of urbanization caused an irreversible spillover problem. In particular, some exemptions, such as the derogation payment and lack of public district parking lots, increased the pressure on the on-street parking capacity and sustainability of streets. A case study parking survey in a large-city center shows that parking demand is exceeding the capacity by 166% for average daily occupancy on weekdays and 111% on weekends in 2022, compared to 61% in 2015. Five policy alternatives are developed and the “zone parking policy” is concluded to be the most appropriate one for districts while the “mobility level of zones” needs more action at the city level.

**Keywords:** transportation; parking demand; residential parking policy; sustainable mobility; parking occupancy



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## 1. Introduction

Parking policy is a major aspect of modern city planning. Parking policies can be classified into three main types: (1) conventional policies, which predict the parking demand to determine the supply; (2) market-based policies, which command and control the parking demand; (3) parking management policies, which manage the demand. A fourth type has recently appeared, called (4) sustainable parking management, which manages parking demand while also considering the effects of climate change. Conventional parking policies provide free on-street parking and minimum off-street parking spaces. Minimum parking policies require a compulsory number of off-street car parking spaces for new developments, where the parking demand is predicted according to the intended use. It has been assumed that if new developments provide the minimum required parking for their own facilities, the parking supply will exceed the demand, and spillover can be accommodated by on-street parking in the vicinity [1]. Depending on their growth, cities can shift among these parking policies. In European cities, Mingardo et al. [2] observed that conventional parking policies were prevalent in the 1960–1980s as welfare and car ownership increased. In the 1990s, these cities shifted to market-based policies, and parking management policies have been dominant since the 2000s [2]. Sustainable parking management involves integrating parking management with sustainable urban mobility plans (SUMP). This improved policy type frees up valuable public space to make cities more attractive; supports the local economy; reduces vehicular traffic; improves congestion, road safety, and air pollution; and reduces emissions to mitigate the effects of climate change [3].

Many developed cities in Europe [2], Melbourne in Australia [4], and New York in the USA [5] have shifted among these parking policy types to adapt to and mitigate growing parking demand. One solution adopted by many European cities was to reduce the parking requirements in residential areas to influence the levels of car ownership and car usage [6], which replaces the conventional policy with parking management [7]. City planning is also driven by new challenges such as climate change and managing a transition toward sustainable mobility [8]. Reclaiming urban spaces for people and creating a high-quality environment are important parts of the sustainable mobility agenda, and setting residential and low-emission zones are measures that have been well documented to improve the quality of life [9]. The shift in parking policy of European cities has improved accessibility and mobility, the quality of life, the local economy, and municipal revenue [2]. The excess parking areas in public spaces and on sidewalks in European cities offended citizens, which caused their governments to shift their parking policies. In Europe, on-street parking is generally controlled by municipal or district policy, and off-street parking is controlled through zoning and building regulations. The shift in parking policies had impressive results: revitalized and thriving town centers, significant reductions in private car trips, reduced air pollution, and a general improvement in the quality of life [6]. Litman [10] evaluated several parking strategies such as capacity control, tariff, taxation, design, and information technologies and concluded that cost-effective parking management policies could reduce the required parking by 20–40% compared with conventional planning policies, which provides many economic, social, and environmental benefits.

The minimum required parking for new developments, on- and off-street facilities, and the central business districts (CBDs) is an important tool for parking management. In some countries, laws and legislation use conventional minimum/maximum requirements to set parking policies in cities and do not consider variables such as household density, car ownership, availability of public transport, and the urban population growth rate or new challenges such as climate change and sustainable mobility. In the European Union (EU), parking policies are generally left to local governments. Most European cities set the minimum required parking for residential areas. For example, Amsterdam, Swedish cities, and the Madrid CBD require one parking space per residential unit. Barcelona requires 0.16–0.5 spaces per residential unit depending on the unit area. Copenhagen requires 1 space per 100 m<sup>2</sup> and Hamburg requires 0.2 spaces per residential unit in the CBD and 0.8 spaces per residential unit outside of it [6]. Some studies have evaluated the removal of the minimum required parking. In Greater London, the removal of minimum parking policies reduced residential parking to 40% below the previously required rate [11]. Similarly, the authors of [12] studied a district of Los Angeles and found that removing the minimum required parking reduced the residential parking supply to around 50% of the previously required rate. Other studies focused on the impact of the minimum required parking on car ownership. In central and outer London, the authors of [13] showed that reducing the number of residential parking spaces did not limit the increase in car ownership in areas 10 km away from the city center because of a lack of public transport services for daily life. Meanwhile, residents tended to drive to destinations with relatively good public transport if the parking requirements were generous [14]. Manville and Shoup [15] criticized the conventional policy of meeting the parking demand and offering free parking as being inefficient, increasing car dependency, causing a parking oversupply, leading to sparsely populated and unattractive urban and residential areas, and destroying street life. For Australian cities, pressure on on-street residential parking is mostly caused by new higher-density housing with insufficient off-street parking spaces [16]. Asian cities might be expected to have off-street parking policies similar to those of many older areas in western cities. However, most of these cities have parking policies that are surprisingly conventional and promote automobile dependence and still involve minimum parking requirements [17]. A study in China analyzed a unique phenomenon called the developer-led supply pattern and two suggestions are made for parking policy for district and neighborhood bases. It is concluded that a rationale for an effective parking policy is to

differentiate districts by their land development density, which is lacking in current practice in China. Such differentiation in policy and regulation should be considered as leverage that may help densely developed districts to promote the use of public transport [18]. As a developing country, the parking policy of Türkiye has many unique characteristics that are significantly different from developed cities in North America and Europe. It could be classified with Asian cities but has different features from all these regions.

Previous studies have mostly focused on analyzing the results of parking policies implemented by a city or district through surveys, questionnaires, and/or statistics [7,16,19,20]. In contrast, the present study used the policy analysis process, which allows parking policies to be evaluated both before and after the implementation. This is a well-known methodology in the social sciences and can provide an overall assessment of parking policies. It is a useful tool for evaluating existing parking policies or developing new ones. As a case study, the policy analysis process is applied to evaluate the parking policies of residential areas in a large-scale city in Türkiye. The results can be used to define the chronological phases and development of residential parking policies and help to provide an adequate proposal for the next amendments or proposals. The methodology used in this study can be applied to all cities to not only evaluate existing parking policies but also identify key aspects of new proposals and develop an overall theory on parking policy.

## 2. Materials and Methods

### 2.1. Policy Analysis Process

Public policy is defined as the relationships and interaction with the environment of any public institution [21,22], or anything the government prefers to do or not to do [23]. Therefore, to solve a social problem, the management (i.e., the government) can either apply positive measures or maintain the status quo [24], both of which will have an effect. Public policies are activities carried out by governments to satisfy social needs [25]. The policy analysis process involves identifying potential policies to address a problem and then comparing their effects to choose the one that is the most effective, efficient, and feasible. This ensures a systematic approach to choosing the best policy for a given situation [26].

Anderson [27] and Dye [23] have identified seven models for the policy analysis process, which are Institutionalism; Systems Theory; Pluralism; Elitism; Process Method; Rationalism; Incrementalism. The policy analysis process model is considered the most appropriate for analyzing residential parking policies because it determines which of various policies achieve a given set of goals in light of the relations between the policies and goals. This approach has been used to develop suitable policies for several different public issues, including health [28], education [29], scholarships [25], and the environment [30].

Even after a policy is implemented, there may be some doubt whether the problem is resolved appropriately or the selected policy is being implemented properly. These concerns require that policies and programs be monitored during implementation to ensure that there are no inadvertent alterations, to measure the impact, to determine whether the intended impact is occurring, and to decide whether they should be continued, modified, or terminated [31].

### 2.2. Parking Survey Case Study

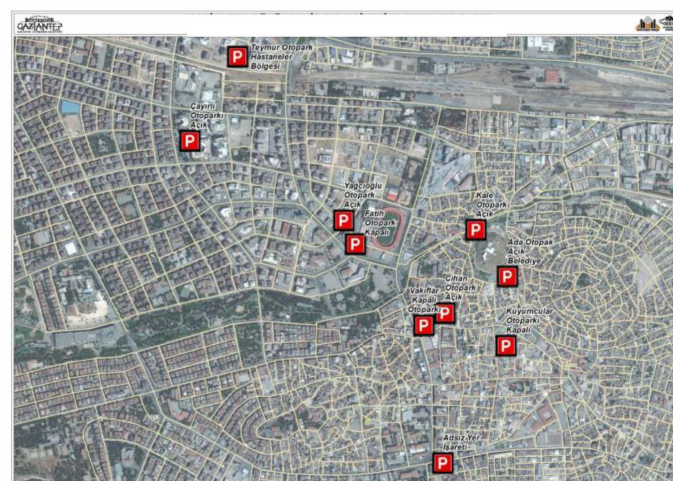
The case study is performed for Gaziantep, a large-scale city in Türkiye, with 2.5 M inhabitants in 2022. Gaziantep is among the oldest continually inhabited cities in the world and its residents hope to preserve that legacy. Located in the south region of Türkiye, bordering Syria, Gaziantep serves as Türkiye's gateway city to the Middle East and is an important industrial center on the historical Silk Road [32] (Figure 1a). The city's economic structure is fairly well-balanced with modern and traditional industries, with a successful industry export income of USD 10.5 billion in 2022. Since 2015, the city has been a member of the UNESCO Creative Cities Network with an emerging tourism sector. Gaziantep has attracted investment in restaurants and other tourist destinations centered around a historic

castle. Fast city growth puts tremendous pressure on land markets, housing markets, and public services infrastructure [32] such as on-street parking facilities (Figure 1b).



**Figure 1.** (a) Gaziantep's position in the world and Türkiye [33]. (b) Sketch of Gaziantep City including main arterials [34].

In 2016, the Transportation Master Plan for Gaziantep included a parking study in the city base with 6 open and 4 multistory off-street parking lots (Figure 2). The parking lots are in the old city center and near 3 Hospitals. The total capacity of these parking lots is 2606 and all of them are located in the business centers, rarely including residential apartments. The daily average occupancy of the off-street parking lots was 53% in 2015. Similarly, the daily average occupancy on 27 on-street parking facilities in the old city center and CBD area of the city in 2015 was 52.2% [35]. The average parking duration was 37 min.



**Figure 2.** Off-street parking lots' study in the 2015 Transportation Master Plan for Gaziantep [35].

This study is different from the previous parking study for on-street parking areas in the central CBD with mixed land-use planning. The chosen area is constructed under the minimum requirements of the 1993 Parking Regulations in the act, i.e., 0.25 parking areas per dwelling. The observed district consists of residential buildings, office buildings, shops, cafes, and restaurants. The derogations stated in the parking regulations were paid to the municipalities. However, only one district parking lot was constructed within the area. This CBD area was observed in order to understand the effect of the derogations for the minimum requirements, lack of district parking lots, and spillover problems. The daily average occupancy for this area was 61% in 2015.

When conducting a parking survey the area should be carried out within 200 m walking distance of the site. This includes all available public areas where you could legally park a vehicle within a 200 m walk from the CBD area. This area is not a circle with a 200 m radius but a 200 m walking distance as measured along all roads up to a point 200 m from the site. The survey included a weekday and weekend day within the described area [36].

The parking statistics are calculated by the in-out parking survey data [37] collected from the electronic payment system of the municipality. The electronic data from the system include data on plate numbers and in-out parking times for each parking car. The data are consolidated first for 15 min time intervals and then 1 h intervals for the whole time of payment systems between 08:00 and 18:00. The accumulation and occupancy of the chosen on-street facility are computed [37,38]. Accumulation can be found as the initial count plus the number of vehicles that entered the on-street parking facility until that time minus the number of vehicles that just exited for that particular time interval. Parking load is obtained by simply multiplying the number of vehicles occupying the parking bay at each time interval by the time interval. The parking index, also called occupancy or efficiency, is the ratio of the number of bays occupied in time duration to the total space available and shows how effectively the parking space is utilized [39]. The following are the parking statistics for parking analysis [37].

$$\text{Accumulation} = (\text{Initial number of parking vehicles}) + (\text{Number of vehicles parked during the time interval}) - (\text{Number of vehicles exit during the time interval}) \quad (1)$$

$$\text{Parking Load} = \text{Accumulation} * \text{Time Interval} \quad (2)$$

$$\text{Parking Index (Occupancy)} = \frac{\text{Parking Load}}{\text{Parking Capacity}} * 100 \quad (3)$$

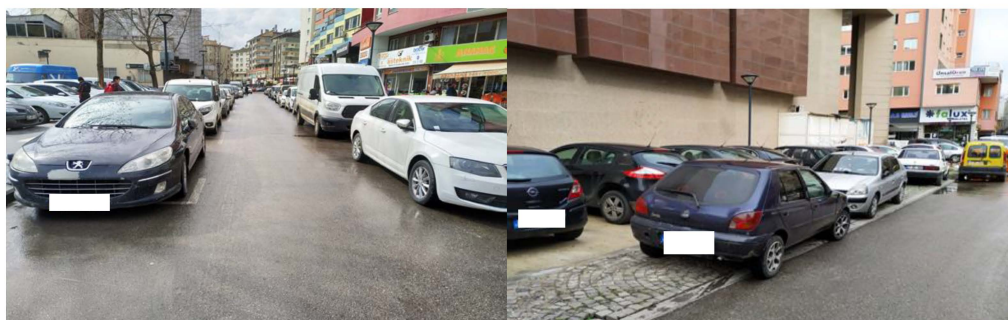
### 3. Results

#### 3.1. Residential Parking Policies in Türkiye

Turkish city planning is generally based on the concept of mixed land use, where a zone can include different facilities such as housing, shopping, the CBD, and public spaces. Because of increasing car ownership, policymakers and city planners are being challenged to find solutions to the increasing demand for parking. Vehicles are parking everywhere in cities, even in the middle of the street, on pedestrian crossings, and on sidewalks. Thus, spillover parking is a very common problem (Figure 3). On- and off-street parking is planned according to the classical approach of ensuring the minimum required parking. In residential areas where parking demand is for longer periods, streets are generally used as parking areas. Nighttime parking near residential areas has generally been replaced by facilities for non-residential activities during the daytime. Car use in daily life depends on the activities of households. Some studies on Turkish cities have shown that automobiles are used for 1–2 h and are parked for the rest of the day. At 22:00, almost 90% of cars are parked in residential areas, while this rate goes down to 40% at 9:00 a.m. On average, an automobile is parked for 13 h and 25 min near housing [40].

The parking regulations are set by the central government and are published in the Turkish Republic Official Gazette [41–47]. They are implemented by local municipalities, but they do not utilize transportation master plans (TMPs) or parking studies. New residential developments are evaluated in terms of city planning, and the pressure of on-street parking in multi-facility zones on the traffic flow is not considered. Derogation is implied for such residential developments; if there is not enough space for the minimum required parking, developers can pay the municipality for an allocation in district parking lots (i.e., multistorey parking garages or open parking areas constructed by municipalities within a district). Developers generally prefer to pay for the allocation to reduce housing costs. Unfortunately, municipalities tend to use these funds for other needs. As a result, neither the minimum required parking nor district parking lots are constructed in residential areas

and the off-street supply becomes less than the minimum requirements in reality; this affects the whole transport network of the city.



**Figure 3.** On-street parking in the CBD and spillover problem.

Turkish parking policies were first established in 1976 [48]. The policy issued in 1993 was valid for 25 years, after which a minor amendment was issued in 2006 to include the effect of the urban population. In 2018, a radical policy was published, and municipalities were given 4 months for implementation. This was postponed throughout 2020, and it finally came into force in March 2021 after several important amendments. The most striking aspect of the 2018 policy [46] was that it included definitions for park-and-ride facilities and TMPs for the first time. In addition, it stated that TMPs should be referenced when developments are being planned. The policy does not mention increased car ownership but stipulates that each dwelling must receive one parking space. The 2021 amendment [47] accounts for the effects of income level and indirect zoning by categorizing dwellings according to the area. The most important point of the 2021 policy is that dwellings can have another parking area in the same zone if the minimum required parking cannot be satisfied within the parcel boundary. In addition, municipalities have a deadline of 3 years to build district garages. Table 1 presents a chronology of the parking policies in Türkiye.

**Table 1.** Chronology of residential parking policies in Türkiye (developed by the author).

Official Gazette Date	Residential Parking Policies Minimum Requirement for Residential Areas	Enacted Date
27 July 1966	2–6% of the planning area depending on high-, medium-, or low-density residential areas and the urban population	27 July 1966 (on the publication date)
10 January 1968	No requirements	11 January 1968 (on the publication date)
7 May 1976	0.25 per dwelling	7 May 1976 (on the publication date)
26 April 1984	Average of 0.16 per dwelling according to the urban population and flat area	26 April 1984 (on the publication date)
1 July 1993	0.25 per dwelling	1 October 1993 (3 months later)
22 April 2006	0.33 per dwelling	22 April 2006 (on the publication date)
22 February 2018	1 per dwelling	1 June 2018 (postponed)
7 September 2018	1 per dwelling	15 September 2018 (postponed)
7 November 2018	1 per dwelling	30 June 2019 (postponed)
31 May 2019	1 per dwelling	31 December 2019 (postponed)
31 December 2019	1 per dwelling	3 March 2020 (postponed)
24 March 2020	1 per dwelling	30 June 2020 (postponed)
25 March 2021	0.33 per dwelling < 80 m <sup>2</sup>	25 March 2021 (on the publication date)
	0.50 per dwelling (x); 80 m <sup>2</sup> < x < 120 m <sup>2</sup>	
	1 per dwelling (x); 120 m <sup>2</sup> < x < 180 m <sup>2</sup>	
	2 per dwelling > 180 m <sup>2</sup>	

Turkish parking policies have been constantly revised and postponed. This is primarily because the urban infrastructure and existing development plans do not comply with

prepared parking policies. A wide range of zoning amendments was required for the implementation of the 2018 parking policy. Then, the government amended the policy instead of the zones. The 2021 policy seems more realistic and may address existing problems that developed during the peak urbanization period. Construction of parking lots in city centers and residential areas is another challenge because these environments have no available parcels of land left.

### 3.2. Peak Period of Urbanization

The demand for residential parking has been affected by the rapid increases in urbanization and car ownership. Table 2 presents the population, number of cars, car ownership rate, and urbanization rate of Türkiye in the past several decades [49]. Urbanization has increased by 7–15% per decade and reached 93% in 2020. From 1980 to 2020, the urban share of the total population increased by 209%. Parking policies have been set to address the issues caused by this rapid urbanization.

**Table 2.** Urbanization and car ownership rates between 1927 and 2020 (%) (produced from the data of the TurkStat, 2020).

Year	Total Population	Urban Population %	Rural Population %	Change in Urbanization %	Car Ownership per 1000 Persons	Change in Car Ownership %
1927	13,648,270	24.2	75.8	-	No data	-
1940	17,820,950	24.4	75.6	0.2	No data	-
1950	20,947,188	25	75	0.6	No data	-
1960	27,754,820	31.9	68.1	6.9	No data	-
1970	35,605,176	38.5	61.5	6.6	4	-
1980	44,736,957	43.9	56.1	5.4	17	325
1990	56,473,035	59	41	15.1	29	71
2000	67,803,927	64.9	35.1	5.9	65	124
2010	73,722,988	76.3	23.7	11.4	102	57
2020	83,614,362	93	7	16.7	154	51
Total Change for 1980–2020	87%			209%		806%

In 2020, Türkiye had 12.9 million cars, compared to 742,000 cars in 1980. The number of cars per 1000 persons was 17 in 1980 and reached 154 in 2020, which is an enormous increase of 806%. The peak increase in car ownership was 325% from 1970 to 1980 (Table 2).

In 2017, the average car ownership in EU countries was 512 cars per 1000 persons, as opposed to 149 cars per 1000 persons in Türkiye [50]. Thus, the car ownership rate can be expected to continue to increase.

Table 3 gives the age of the housing stock built in cities during this urbanization period. About 95% of the housing stock was built after the 1990s (<30 years), for which the minimum required parking was set by the 1993 parking policy.

**Table 3.** Age of housing stock in Türkiye (%) (produced from the data of the TurkStat, 2019).

Years	0–5	6–10	11–15	16–20	21–30	31–40	41–50	50+
%	50.09	14.20	9.20	9.50	12	3.50	0.70	0.10

The number of cars per dwelling can be roughly calculated according to the household size. Table 4 compares the minimum required parking per dwelling with the average car ownership according to household size. Between 1980 and 2000, the minimum required parking was greater than the average car ownership per dwelling. Between 2000 and 2020, the minimum required parking was less than the average car ownership per dwelling. The increase in car ownership per 1000 persons was 282% for 1980–2000 and 186% for 2000–2020. Thus, car ownership increased rapidly until 2000 and then slowed down. The number of cars per family size increased by 50% in 1980–2000, 30% in 2000–2010, and 25% in 2010–2020. These results cannot strongly support the conclusion that the minimum

required parking affects car ownership. However, the increase in the vehicle purchase tax in 2002, which reached 200% for some cars, should also be considered. Notably, the parking policies maintained the status quo for a 20-year period and did not take any proactive measures. In particular, the derogation payment increased the pressure on the on-street parking capacity.

**Table 4.** Minimum parking space required per dwelling and car ownership according to household size in residential areas (developed by the author of this paper).

Years	Legislation Enacted	Household Size (Family Members)	Car Ownership per 1000 Persons	Average Car Ownership per Dwelling (Number of Cars according to Household Size)	Increase in Number of Cars according to Household Size (Dwelling)	Minimum Requirements per Dwelling
1960	27 July 1966 10 January 1968	-	-	-	-	-
1970	10 January 1968 7 May 1976	-	4	-	-	0.25
1980	26 April 1984	5.32	17	0.09	-	0.16
1990	01 July 1993	4.97	29	0.14	50%	0.25
2000	22 April 2006	4.5	65	0.29	50%	0.33
2010	22 April 2006	3.9	102	0.40	30%	0.33
2020	22 April 2006	3.3	151	0.50	25%	0.33
2021	25 March 2021		154	0.51		<80 m <sup>2</sup> : 0.33 80–120 m <sup>2</sup> : 0.50 120–180 m <sup>2</sup> : 1 >180 m <sup>2</sup> : 2

### 3.3. Establishing the Evaluation Criteria for Parking Policies

Some basic criteria are listed below for formulating a successful residential parking policy. Public policymaking depends on collecting the necessary information about a problem, determining the needs, considering different alternatives, and creating an effective strategy related to them [51]. Policymaking efforts may not always result in legislation. In some cases, governments may opt to keep the status quo.

- **Legislations:** SUMP, TMP, and parking master plans are not compulsory in Türkiye and are only prepared by some cities that have mayors with a vision. Thus, most cities do not have such plans even when their population is more than 1 million persons. These plans should be considered when setting criteria for parking policies.
- **Costs and benefits:** Fuel consumption should be considered to account for the effects of emissions and air quality. The time saved with the appropriate parking policy should also be included.
- **Effectiveness:** Improvements to accessibility and mobility, reduction in spillover, and amount of time saved should be considered.
- **Sustainability:** Environmental, social, and economic sustainability should be considered. The general geographical structure and climate characteristics of the city such as the air quality and noise should be accounted for. Livability criteria such as the number of accidents, emissions, and traffic congestion should be considered. Low-emission regions and parking needs should be determined. Incentives for electric vehicles should be identified.
- **Socioeconomic constraints:** The urban population growth rate is a factor; the population may be rising too fast in one city or actually decreasing in another. Population density is another factor; in areas with high population density, parking areas should be constructed according to policy specifications. Car ownership has not been determined for each city, district, or zone according to low-, middle-, and high-income groups or socioeconomic data. The level of income for a district must be integrated into policies.

### 3.4. Identifying the Alternative Policies

The proposals for parking policy alternatives are identified with the established evaluation criteria above in Section 3.3. Some of these options have been previously proposed in parking policies (e.g., Regulation 1966) but were not implemented. Some are inspired by the best practices in the EU or other countries. More alternatives can be added but here only five different policy alternatives are considered.

- Policy 1: Keep the status quo or business as usual (BaU).
- Policy 2: Zone parking based on SUMP, TMP, and parking plans.
- Policy 3: Calculate the minimum/maximum required parking for each dwelling according to the mobility level of a zone (e.g., the car ownership rate, public transport service level, and urbanization rate). The required parking spaces would be implemented strictly for new developments without derogation.
- Policy 4: If the required parking space cannot be created within the boundaries of the same parcel of land, a housing development must produce a certificate indicating that another parking space is available in the same zone or district. This parking space could be an on-street parking space provided by the municipality. This certificate would be bounded to the residence and be used during its buy and sell procedures.
- Policy 5: Car ownership can be limited considering land use for each zone and according to existing facilities. For example, one car per dwelling may be permitted in the old city area.

Policy 2 can be implemented by districts while Policy 3 requires more actions at the city level. Thus, decision-makers can determine if a city has a large enough budget to improve the mobility level of a zone or if the required parking should be tailored to the needs of residential buildings. Policy 4 was partially implemented by the 2021 policy. Policy 5 is ambitious, and it would probably be rejected by the public.

### 3.5. Implementation of Parking Policies and Case Study Results

The implementation phase is defined as the transformation of policy goals and objectives determined at the beginning of the process into action [52]. Public officials play a very important role in policy implementation by defending it to the public and securing their support. This can be done by raising awareness of problems and explaining how the policy addresses them. On-street parking applications are not adopted by the citizens in Türkiye. Therefore, the different parking fees are very limited depending on variables such as price policies, peak hours, or CBD areas. The local municipality implements the on-street parking facilities and mayors refrain from penalizing vehicles parked incorrectly or removing them from the road to avoid the reaction of the citizens while performing on-street parking applications. There is no parking permit application for the residents residing in Türkiye but the parking spaces of disabled residents are reserved and marked.

Here, a case study is done for a large-scale city in Türkiye for a better understanding of the effects of parking policies and for the implementation and monitoring. The case study area in Figure 4 consists of residential buildings and office buildings together as a mixed-plan CBD area. The apartments have an average of 20 dwellings per building and at least five obligatory parking areas according to the 1993 legislation. The on-street parking data are collected from the municipalities' electronic payment system in minutes and then consolidated into hours. The payment system is active between 08:00 and 18:00 by the decision of the municipal council. Parking fee policies are not included in the study. However, at the time of the work, the fee for 10 h of parking for the whole day, between 08:00 and 18:00, is approximately USD 3.3. The chosen area is the main CBD area with six zones where the availability of parking is most difficult. The in-out parking survey consists of 215 bays on weekdays and 194 bays on the weekend and has a lot of commercial activities (Figure 4). There were 57 and 52 parking (existing) cars, respectively, on the street in the morning when the on-street parking started and at 08:00 in the morning when payment time started. This shows an occupancy rate of 26%. For the weekday, the

occupancy is 60% at 8:00–09:00 a.m. and reaches a maximum of 248% at 15:00, the peak hour for the commercial zone. It can be assumed that the rate of 60% shows the effect of both the residents of the region and those who come to their workplaces at that hour. For the weekend, the occupancy is 34.5% at 8:00 a.m. and reaches a maximum of 162% at 15:00, the peak hour for the commercial zone. The on-street parking facilities start to exceed their capacity at 09:00 a.m. on weekdays and 11:00 a.m. on weekends. The occupancy exceeds the capacity because the cars are parking in double lanes or the small vehicles are using less area and more than plotted vehicles are using the bays (Figure 5). The average daily occupancy is 166% for weekdays and 111% for weekends (Table 5).



Figure 4. Parking survey area including available on-street facilities within 200 m [53].

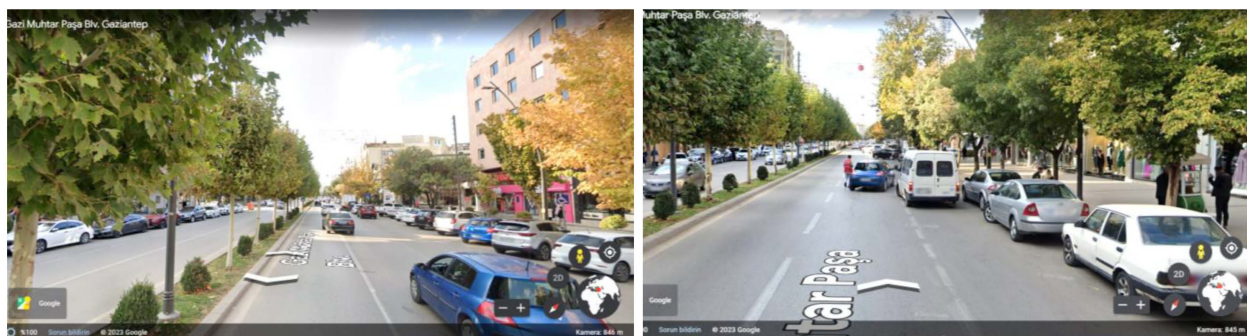


Figure 5. On-street parking in the survey area [53].

The daily average occupancy was 61% in 2015 and reached 166% in 2022. This result exposes that the sustainability of streets is failed in Gaziantep due to the implemented parking policies. It is interesting that the 111% weekend occupancy is less than the weekday which could be explained that the region includes many official buildings.

An apartment building in the survey area could have shops, cafes, and restaurants underneath the flats. If an apartment building is constructed without the minimum required parking (i.e., by using derogation) and a restaurant is opened on the ground floor, then the residents and restaurant clients will want to park in the same building. Thus, the assumption that new developments will provide the minimum required parking for their own facilities and that supply will be greater than demand could not hold in the case study area. Accordingly, spillover must be accommodated by on-street parking, which increases the pressure on the on-street parking capacity. The case study area directly faces this problem, and on-street facilities suffer from the spillover parking demand during the whole day and lose the sustainability of mobility facilities.

**Table 5.** Parking statistics for in-out parking survey in Gaziantep, Türkiye.

Weekday Parking Survey					Weekday Parking Survey				
Parking Survey Date:		14 December 2022, Tuesday			Parking Survey Date:		17 December 2022, Saturday		
Parking Lot Capacity:		215			Parking Lot Capacity:		194		
Existing # of Parking:		57			Existing # of Parking:		52		
Time Interval	In	Out	Accumulation	Occupancy (%)	Time Interval	In	Out	Accumulation	Occupancy (%)
08:00–09:00	116	42	131	60.93	08:00–09:00	23	8	67	34.54
09:00–10:00	243	150	224	104.19	09:00–10:00	91	56	102	52.58
10:00–11:00	318	243	299	139.07	10:00–11:00	151	103	150	77.32
11:00–12:00	324	288	335	155.81	11:00–12:00	199	150	199	102.58
12:00–13:00	274	224	385	179.07	12:00–13:00	217	152	264	136.08
13:00–14:00	299	264	420	195.35	13:00–14:00	230	185	309	159.28
14:00–15:00	341	276	485	225.58	14:00–15:00	183	185	307	158.25
15:00–16:00	309	259	535	248.84	15:00–16:00	168	159	316	162.89
16:00–17:00	262	337	460	213.95	16:00–17:00	180	214	282	145.36
17:00–18:00	102	277	285	132.56	17:00–18:00	120	244	158	81.44
Daily Average Occupancy (%)				166	Daily Average Occupancy (%)				111

In Türkiye, past policies have seen important changes in the required parking space of apartment buildings with 20 flats. The 1993 policy required parking space for 5 vehicles, while the 2006 and 2021 policies required space for 7 and >20 vehicles, respectively. These changes directly increase the cost of the flats, so developers did not want to obey the policy and lobbied decision-makers. Consequently, the minimum required parking was not strictly implemented. Instead, the parking policy implementation prioritized construction areas and the housing cost, which left cities facing an irreversible parking problem.

Streets have reached their capacity limit, cannot serve sustainable mobility, and residential areas are struggling with a lack of parking. During the urbanization period, the minimum required parking was not obeyed or enforced strictly. Developers believed that providing the minimum required parking would increase housing prices and pay derogation. Meanwhile, municipalities did not construct district garages as expected and used the derogation funds for other needs. This created an unsuccessful parking demand management. Because of the derogation, residential zones have less than the required 0.25–0.33 parking spaces per dwelling in reality. The main deficiency of parking policies in Turkish cities appears to be due to developers paying for a derogation to avoid providing parking spaces in parcels with limited areas and a lack of district parking lots. This increased the pressure on the on-street parking capacity.

#### 4. Discussion

The parking problem has disturbed citizens in various ways by reducing the livability of cities; increasing traffic accidents, spillover, and air pollution; and violating the rights of pedestrians. Vehicles parked on roads due to insufficient parking spaces delay the arrival of emergency vehicles such as firetrucks and ambulances to the scenes of incidents. Non-target groups of the objectives of parking policies have suffered tremendously from the problems caused by insufficient parking, but these losses have not been brought to the awareness of policymakers.

The residential parking policy derogation is unique to Türkiye. During the past decades, developed countries implemented conventional, market-based, and parking management strategies and nowadays shifted to sustainable parking management strategies but Türkiye could not follow this order. It can be seen from the amendments of the parking policies in Türkiye during the rapid urbanization period that the public policymakers could not find a solution to the parking problem but could create a fund for the municipalities by derogation payments. Unfortunately, this fund did not use for district parking lots and did not help to solve the parking problem. This relationship becomes evident with the results of the parking survey case study. The exemptions or implications that do not obey the residential parking policies increase the pressure on the on-street parking, increase

the spillover problem, and threaten the sustainability of the streets for mixed-use CBD areas. This result supports the Australian cities' study which resulted as "pressure on on-street residential parking is mostly caused by new higher-density housing with insufficient off-street parking spaces".

Paying the derogations and having parking bays less than minimum requirements in the residential areas could be thought of as parallel to the EU sustainable parking management policies. Nevertheless, minimizing the minimum requirements without establishing a sufficient level of public transportation will not decrease car usage and will force people to use cars. Thus, insufficient minimum requirements in residential areas will cause pressure on on-street parking facilities. Additionally, only derogation payments and having fewer parking bays will not support sustainable parking management policies. Current parking policies should be continuously evaluated to develop proactive measures. Sustainable parking management strategies for residential areas should be considered as a whole integrated strategy including the following key aspects.

- The population growth rate of cities and car ownership rates in low-, middle-, and high-income groups should be identified to zone cities in line with SUMP, TMP, parking master plans, and land-use plans as well as to create region-specific policies.
- The maximum/minimum required parking should be tailored according to local conditions such as car ownership, housing density, and public transport network availability.
- Livability criteria such as the number of accidents, emissions, and traffic congestion should be evaluated.
- The identified variables should be incorporated into new proposals to have more flexible, accurate, and localized parking requirements.
- Public transportation should be improved in all cities and zones, especially residential areas that cannot provide the minimum/maximum required parking.

It is thought that the problems of old city centers and built-up zones will also find solutions if the suggestions determined here are taken into consideration while making new amendments. In addition to the empirical evidence from the residential parking-based spatial analysis in the case study, more studies in commercial and official areas will contribute to a more comprehensive understanding of the parking mechanisms. Further case studies in cities of different scales will enrich the understanding of the relationships between planning, policies, and parking for a sustainable city and the role of market power in a rapidly urbanizing country. The framework implemented here can be applied in all developed or developing cities and will help to identify the shortcomings of existing policies and create appropriate proposals.

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