The Impact of Ridesharing Services in Athens

Athens, May 2024

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Executive Summary

The scope of this study is **the socioeconomic and market analysis for the full deployment of real-time, fee-based ridesharing services in Athens**. Within the context of the study, possible, generated opportunities of the city's economic and social development, deriving from ridesharing services, are explored and discussed. The objective of this study is the assessment of ridesharing impacts in the Athens economy and society. Additionally, the emergence of ridesharing service in Greek islands is explored.

Supporting research work involves a thorough analysis of the status-quo in mobility and transport, in the Athens metropolitan area, a review of ridesharing attributes and practices and a **stated preference (SP) survey**, which targets at capturing traveler preferences with respect to the introduction of ridesharing services in the city. Based on the SP survey, a multinomial choice (MNL) model is developed, and an analysis of the transportation market is undertaken, using the MNL choice model and a market sampling approach. SP survey outcomes reveal that Athens travelers seem to understand what ridesharing is and its difference from traditional, substitute transport services. Furthermore, travelers state that they would use such services, if available in Athens.

As **Greece is gradually recovering** from almost a decade long economic turmoil, traffic conditions in Athens seem to be restoring to their pre-crisis status. At the same time the city's public transport system is challenged and the taxi market remains strongly regulated. Greece has an outdated urban mobility regulatory framework that strips the Greek public from potential solutions for its mobility and limits earning opportunities for drivers. Such an environment tends to create preferential conditions for private vehicles. The **socioeconomic and impact analysis** target year 2030, and consider two scenarios; a fully licensed (Scenario A (full)) and a light licensed scenario (Scenario B (light)) for fairly regulating ridesharing services in Athens. The Scenario A (full) assumes ridesharing services undertaken by companies hiring private vehicles with drivers, while the Scenario B (light) considers licensed, self-employed individuals offering these services. For both scenarios, only on-line reservation (e-hailing) is allowed.

Using SP survey and **market analysis outcomes**, ridesharing impacts in the economy and personal mobility are assessed for the Athens metropolitan area. Market analysis results show that ridesharing services could attract from 647K to 772K daily travelers by year 2030, including shifting, latent and seasonal demand. Travelers will mostly shift from private cars (4.3%-5.3%) and to a much lesser extent by public transport (2.2%-2.7%) and taxis (0.7%-8%). Interestingly, while being a substitute mode for ridesharing, taxis do not seem to be significantly affected, a fact attributed to the already high demand for taxi usage over the previous years, reaching its limits.

Also, **impact analysis outcomes** shows that ridesharing services can possibly yield an additional net 17.4K to 36K equivalent full and part-time jobs respectively, in the Athens metropolitan area the year 2030. Furthermore, the change in vehicle trips is expected to be marginal, as reduction in private vehicle trips is counterbalanced by produced trips due to travelers shifting to ridesharing from public transportation. Savings in parking space (equivalent to 4.2%-5.3% of the Athens downtown area) are also identified. Savings with respect to travel time range from 5.1% to 6.5% by introducing ridesharing services whereas the light licensed scenario yields user cost savings up to 7.4% over existing conditions.

The **socioeconomic analysis** for the full deployment of ridesharing services in Athens, is performed for a time horizon of 7 years (2024-2030). For each alternative ridesharing scenario, the investment and operational costs of ridesharing drivers as well as monetarized socio-economic benefits (travel time benefits, vehicle operating costs savings, externalities and so on) are estimated, and, appropriate economic performance indicators (NPV and IRR) are derived. The analysis shows that the introduction of both ridesharing scenarios has a positive impact to social welfare exhibiting a favorable IRR value up to 21% and an NPV up to 238M€ proving the ridesharing services feasibility in Athens over time.

The study concludes that the introduction of **ridesharing services in Athens**, in a fairly regulated manner, can contribute to social welfare to a good extent. On the other hand, ridesharing is expected to affect substitute modes only slightly. Findings of this study could be useful for further discussion on the development of ridesharing services in Athens and other cities in Greece.

Alongside Athens, the Greek islands are also witnessing a need for ridesharing services to improve the local road transport service, particularly in light of a significant 20% increase in tourist arrivals compared to the previous year, 2022. The transportation needs vary widely across the islands, yet a common challenge emerges: local road transport services struggle to meet transportation demand due to high seasonality. While traditional taxis, public buses and rental cars have long been the mainstay of public use transportation within these islands, the need for more flexible, efficient, and cost-effective travel options is increasingly apparent. The availability of taxis is critically low, with Ionian islands and South Aegean islands, including the islands of Rhodes and Mykonos, dropping to only 12 taxi available per day and per 10,000 travelers during July to September. Crete exhibits the lowest ratio of available taxis per travelers compared to other islands and is also lower than the national average. This low availability, coupled with the stringent taxi market regulations and the inadequate frequency and coverage of public buses, leads to a reduced quality of public transport services. **The introduction of ridesharing services in the Greek Islands is a matter of vital upgrading of tourists convenience, supporting** sustainable tourism and economic growth.

1 Introduction

1.1 Overview

Information and Communication Technologies (ICT) are inevitably changing urban mobility in the modern era. **Innovative transportation services** based on new technologies have been introduced in cities worldwide, aiming at improving urban trips, enhancing mobility and optimizing the use of transportation infrastructures.

Real-time **ridesharing** has been among those ideas which expand the concept of ridesharing, by utilizing web technologies for exploiting unused transport capacity, at a low cost. While ridesharing has been an established concept for years (in the forms of carpooling or vanpooling), technology has transformed it into a formal transportation service, which successfully competes with and/or complements traditional transportation modes.

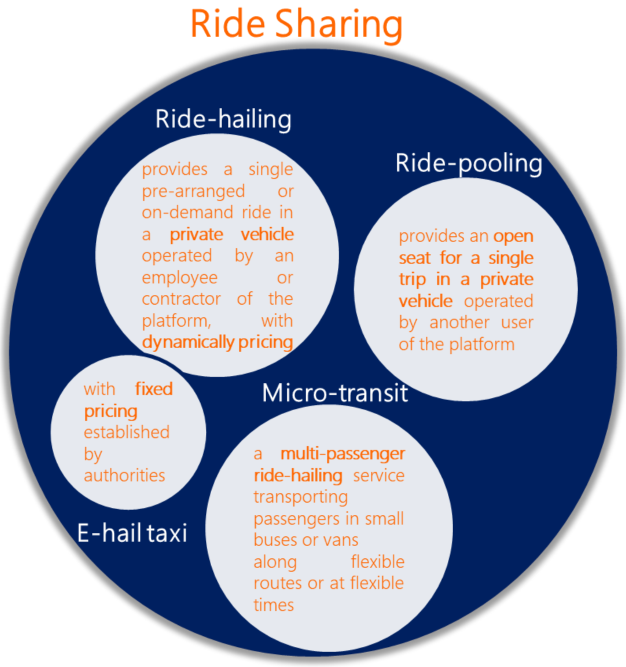
Real time, fee-based ridesharing services have been expanding worldwide, taking advantage of this new world of technological innovation. While there exist several legal, institutional and social barriers and opposition towards that expansion, travelers in urban areas seem to be attracted to real-time ridesharing, for reasons such as low cost, accessibility and convenience of service. Furthermore, ridesharing services create new jobs in an industry requesting innovation, quality, monitoring and constant evaluation.

As such, impacts of real-time, fee-based ridesharing are worth investigating to capture its potential in different **socioeconomic** settings around the globe. Athens is such a case of city struggling to recover from an extended period of economic recession and degradation both in mobility and transport services. Therefore, it is of special interest to analyze possible gains from the introduction of innovative services, under socioeconomic conditions hardly encountered in other parts of the developed world.

1.2 Scope and Objectives

The scope of this study is to analyze and evaluate **the socioeconomic and market status and prospects for the deployment of real-time, fee-based ridesharing services in Athens, Greece**. The study aims at identifying opportunities that ridesharing can generate in the economy and society of the capital of Greece, with focus on one hand on employment and on the other hand on the improvement of the mobility of individuals.

In the following figure, the main forms of ridesharing services are presented briefly, as considered in the current research.



In this context, the study focuses on that **specific form of ridesharing**, in which travelers hire private cars with drivers for a fee, using mobile phone applications or web-based services (often referred to as real-time ridesharing).

Study objectives include an impact analysis of the potential of new jobs that can be created, and the overall added value, which can be generated for the employment landscape in Athens and other areas in Greece. Furthermore, the mobility service improvement in Athens is examined for the city's travelers (cheaper and faster trips, new habits, etc.). Using appropriate analysis tools, impacts on employment and mobility are assessed, with emphasis to the shift from other modes (private car) to ridesharing, as well as to the generation of new trips because of ridesharing services (latent demand).

The study's **methodological approach** is summarized as follows: Initially, a thorough investigation of the current mobility status in Athens is undertaken, using available mobility and transportation data. Next, ridesharing potentials for the city of Athens are identified using appropriate tools, including a stated-preference survey, a mode choice model and a quantitative analysis of the Athens transportation market. For that purpose, different scenarios of introducing ridesharing in Athens, in a fairly regulated manner are considered.

Based on **survey and market analysis outcomes**, socio-economic impacts of ridesharing introduction in Athens are quantified and assessed. The results of this stepwise methodology lead to a properly substantiated synthesis of the socio-economic ridesharing costs and benefits and to the estimation of the economic performance of ridesharing services in Athens.

1.3 Structure of the Report

This Report is **structured** as follows:

- The second chapter presents the **status-quo** on mobility and transportation in the Athens metropolitan area, and identifies opportunities rising for establishing ridesharing services in the city.
- The **potential of ridesharing** in Athens is discussed in detail in the third chapter.
- Anticipated **economic and employment impacts** resulting from ridesharing services are analyzed in the fourth chapter.
- The sixth chapter presents the **socio-economic analysis** for the introduction and operation of ridesharing services in Athens within a time horizon 2024-2030.
- **Conclusions and recommendations** are summarized in the seventh chapter.

1.4 Study Team Members

This report is the final deliverable of a study prepared by the following team of experts:

- George Yannis, Professor, NTUA School of Civil Engineering.
- Eleni Vlahogianni, Professor, NTUA School of Civil Engineering.
- Panagiotis Papantoniou, Assistant Professor, University of West Attica.
- Virginia Petraki, Associate Researcher, NTUA School of Civil Engineering.

The team was supported by data collection personnel (interviewers), who carried out the study's survey.

2 Current Mobility Services in Athens

This chapter presents current transportation and mobility conditions and services in the Athens metropolitan area, as well as identifies opportunities for introducing ridesharing services in Athens.

2.1 The Athens Metropolitan Area

Athens is the capital and largest city of Greece, and among the most important economic centers in Southeastern Europe. The city hosts significant commercial, financial, and industrial activities, and its port (Piraeus) is the largest passenger port in Europe and the second largest in the world.

Athens has a Mediterranean climate, which is characterized by seasonal changes between prolonged hot and dry summers and mild to cool winters with moderate rainfall. The **Athens metropolitan area** covers approximately 640 km^2 and has a population of approximately 3.8 million inhabitants (ELSTAT, 2022).

The **city of Athens** (Municipality of Athens) has a population of about 645,000 inhabitants within its administrative limits (ELSTAT, 2022), and a land area of 38.96 km2. Residencies correspond to a 35% of the metropolitan area's total land uses, while 7% of that land corresponds to industrial activities, 6% to administration, 5 % to recreation and 26% to commerce and other activities (Ministry of Environment, Energy and Climate Change, 2014).

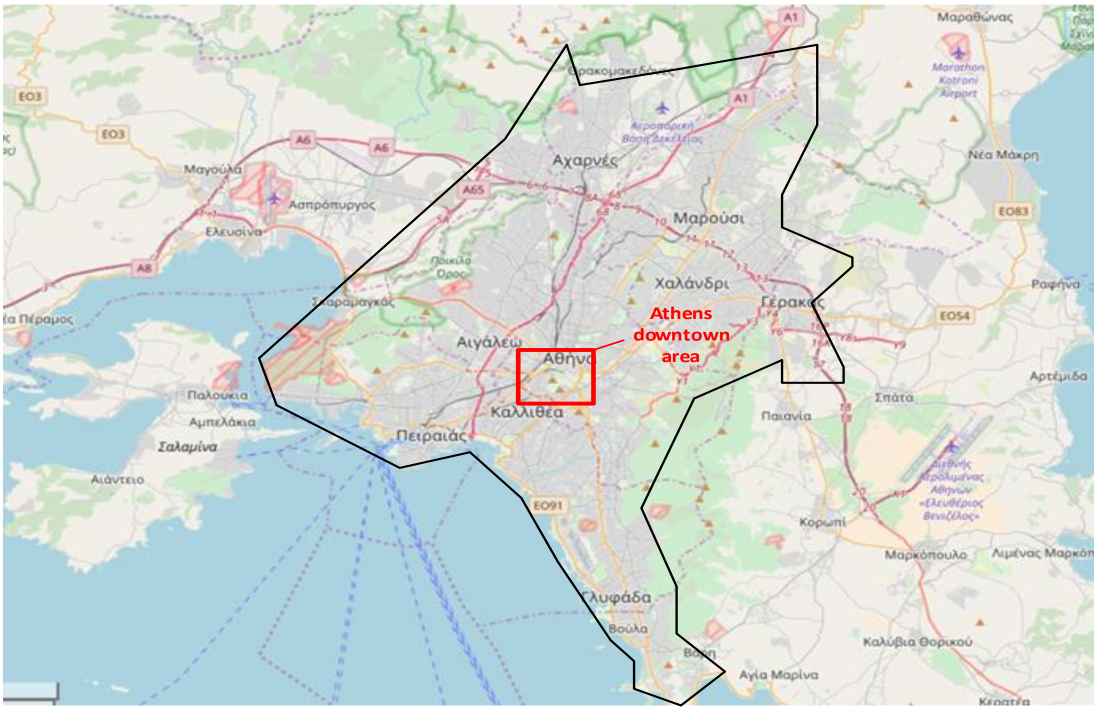


Figure 2. 1 The Athens metropolitan area and suburbs (Source: Open Street-maps, project team analysis)

Athens is the 6th most populous capital and the 9th most populous metropolis of the EU. The City of Athens has a population density of approximately 16,500 inhabitants / km2 and ranks among the most densely populated cities in Europe.

2.2 Population

According to the national census of 2021, the Athens metropolitan area had a population of 3.814.064 inhabitants, which corresponds to about 37% of the country's population.

The **average population density** of the metropolitan area was 1,302 inhabitants/ km^2 for the 2021 year. Assuming the same population growth as in period between 2011 and 2021 (-0.04%/year), the Athens metropolitan area population for 2024 is estimated to be 3,809,711 inhabitants, as presented in the next figure (Hellenic Statistical Authority, 2021).

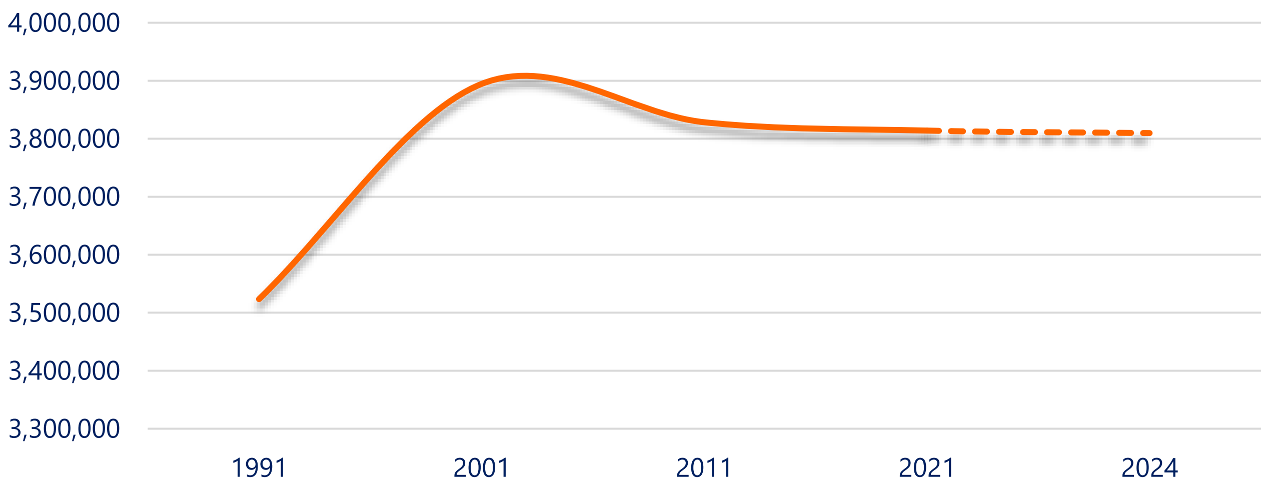


Figure 2. 2 Population evolution for the Athens Metropolitan Area, 1991-2024 (Source: Hellenic Statistical Authority, 2023)

Apart from its population, which is expected to remain relatively constant in the years to come, the city experienced a remarkable surge in tourism in 2023, welcoming over 14 million visitors, a significant increase from the pre-COVID annual average of 10 million.

2.3 Vehicle Ownership

About 50% of households in the Athens metropolitan area own a single passenger car, while almost 25% of them have more than one passenger cars (Hellenic Statistical Authority, 2021).

Figure 2.2 illustrates vehicle fleet evolution in Athens for different vehicle types in the last decade, based on new vehicle registrations; data are obtained by the Hellenic Statistical Authority (2023). Between 2004 and 2011 an increase in vehicle ownership by about 4% per year was observed, while in the period between 2011-2014 the total number of vehicles in the Athens metropolitan area remained relatively stable, a result of the country's underperforming economy at that time. However in the period after 2014, an annual increase between 1% and 2.5% on the vehicle fleet is noted. This alone may be considered as an indicator of some improvement in the city's economy.

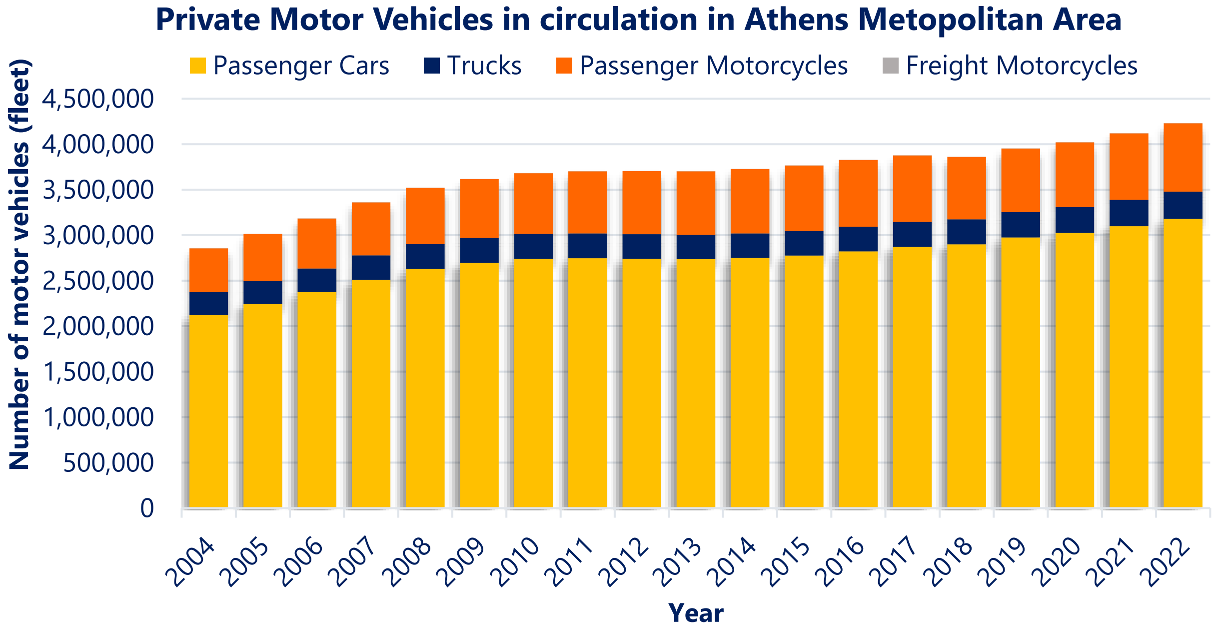


Figure 2. 3 Private vehicle fleet evolution per transport mode in Athens Metropolitan Area, 2004-2022 (Source: Hellenic Statistical Authority, 2023)

Vehicle ownership in Greece is expected to rise again in the forthcoming years, albeit at a relatively low rate.

2.4 Road Network

Athens is surrounded by mountains in the north, east and west, and by the Saronikos bay coastline in the south. The entire metropolitan area is therefore **rather constrained** with respect to available urban space. The evolution of the Athens Road network has largely followed the gradual expansion of the city since the mid-20th century.

Figure 2.4 presents the core **roadway corridors of Athens**: the Athens – Thessaloniki motorway (PATHE) and the Kifisias / Messogion – V. Sofias – Syggrou corridor undertake most of the traffic between the City of Athens, northern suburbs and the port of Piraeus, while the Attica tollway is used for bypassing the city center, for accessing the Athens Airport and for accommodating traffic between the western and eastern parts of the Athens metropolitan area.

Traffic to and from southern suburbs and the coastline is served by the Poseidonos and Voulagmenis corridors. It is noted that only the PATHE and Attica tollway are freeways, while the rest of the corridors are a mix of urban freeways and arterials with signalized intersections. There are some additional arterials with signalized intersections and interchanges around the city, mostly offering access to and from the city center.

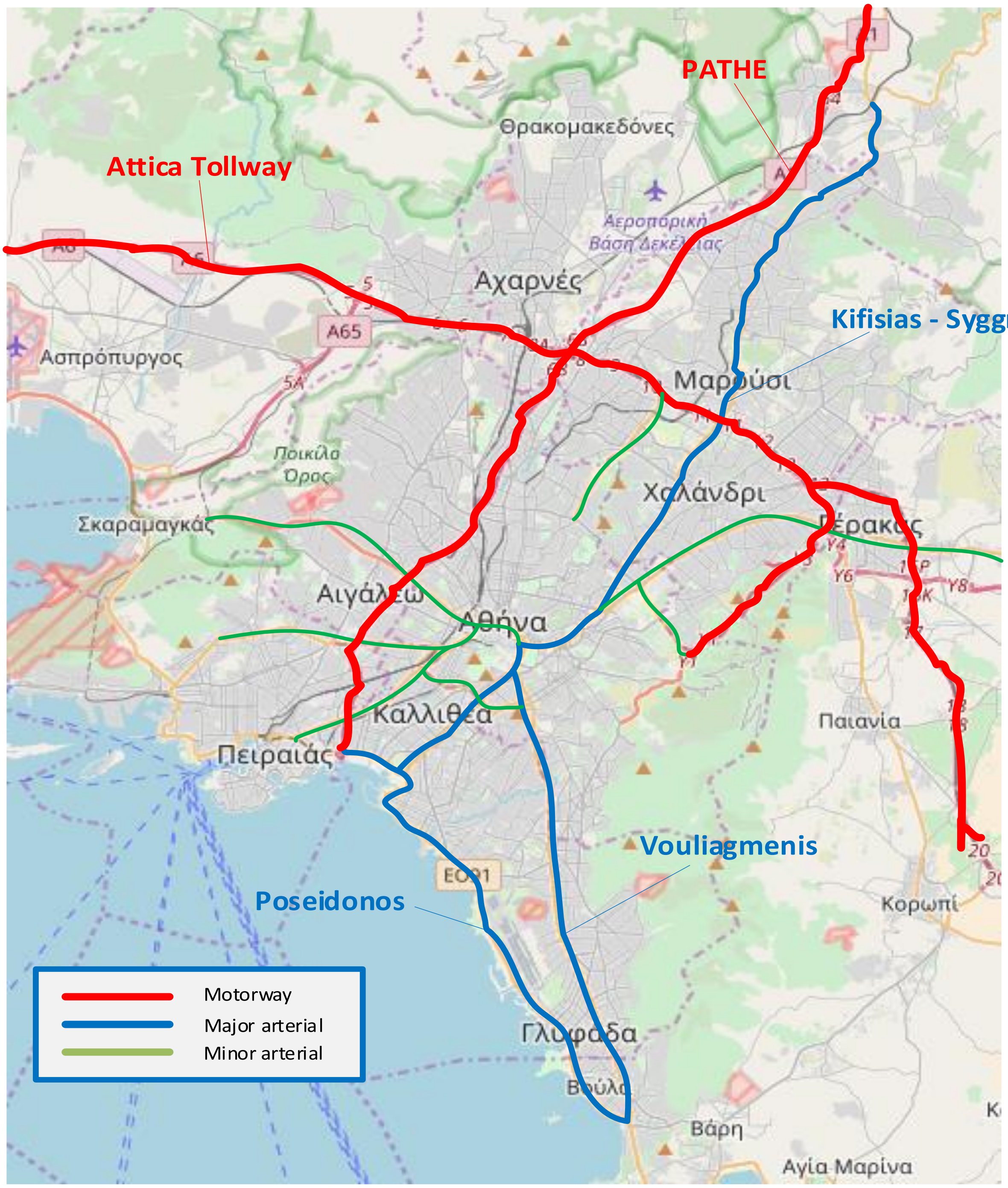


Figure 2. 4 Major road corridors of the Athens Metropolitan Area (Source: Open Street Maps, project team analysis

The **total length of roads in the Athens metropolitan area is about 16,000 km**, among which 2,800 km correspond to the city's major road network. The city's main road network consists of 4200 at-grade intersections (approximately 1100 are signalized) and about 100 interchanges. Only 11% of the city's road network has upgraded geometric and operational characteristics (roads with two lanes per direction and central median); 76% of major roads have a single lane per direction, and the rest of them has at least two lanes per direction (with or without a median). Furthermore, 5% of the roads have a carriageway width of under 7 m, 33% a width of 7 to 10 m, 36% a width of 10-15 m and the remaining 26% a width of over 15 m (Frantzeskakis and Yannis, 2000).

The road network of Athens consists of a limited number of urban motorways, while on the other hand, most major traffic corridors are signalized arterials.

2.5 Road Traffic and Parking

Traffic conditions in Athens are like other European metropolitan areas, with (often severe) congestion in major corridors (even freeways), during morning and afternoon peaks. According to recent data from the Athens Traffic Control Center, after a downward trend in the past years, traffic has started to grow in the Athens road network since 2017 (Athens Traffic Control Center, 2019).

About **3,600,000 trips** were expected to be undertaken by private cars in the greater Athens area on a typical day in 2017 (Voskoglou – Maris and Associates, 2015). Average travel speeds with private cars during peaks are estimated at about 20-25 km/h, while during off-peaks these may increase up to 50 km/h, depending on flow conditions in the city's urban freeways.

Furthermore, as Athens is a summer destination for **tourists** and a vivid city with daily long recreational activities, traffic congestion may occur in non-typical peak (morning or afternoon) periods, during weekends and so on (Frantzeskakis and Yannis, 2000).

Both **curbside and off-street parking** space is limited, particularly in the Athens downtown area, the port of Piraeus and in commercial areas of the metropolitan area and suburbs. Cruising for parking space and illegal (on-street) parking are commonly encountered and have a negative impact in the city's traffic and public transport operations, pedestrian and bicycle movements.

Curbside **parking control and management** is implemented in some areas of Athens, while fees for off-street parking vary considerably, depending upon the location. For instance, entrance fees to a parking facility in the Athens downtown area may vary from 10€ - 15€, plus another 1-2 € per parking hour. On the other hand, parking facility usage costs in the Athens suburbs may range from 5-7€ (Athens Urban Transport Organization, 2020).

2.6 Public Transportation

The Athens public transport system consists of three metro lines, two tram lines, a sub-urban rail line and about 250 bus and trolley bus lines. The system's spatial coverage is adequate, with bus lines offering access to all parts of the Athens metropolitan area.

Public transport services are offered 19h daily (5:00 to 24:00), while there are some bus lines operating between 24:00 and 5:00). During the weekends, Athens metro lines 2 and 3 extend their service, up to 2:30. Figure 2.5 illustrates the Athens public transport system.

Fixed route modes: The Athens metro network includes three lines of a total length of 85.3 km and 67 stations; an additional extension of 3 km and 3 stations is under construction. A fourth line of a total length of 25 km is planned and construction in part of it (12 km) will commence in this year. The system operates over 100 6-car trains with minimum 3-min headways during peaks and produces over 50 million vehicle km daily. Over 810,000 passengers use the Athens metro daily (2019) (Athens Urban Transport Organization, 2020).

Apart from the metro system, **two tram lines** connect the center of Athens with the coastline; a further expansion of the tram network to the port of Piraeus operates by the end of 2021. The Athens tram network has a length of about 30 km and 59 stops. The system is operated by 34 vehicles at headways between 10 and 15 min and carries 31,000 daily passengers (2022) (Athens Urban Transport Organization, 2023).

Bus Network: Last but not least, the city has an extensive network of bus and electric bus (trolley bus) lines, with a total length of 6,000 km, over 8,200 stops and a nominal a fleet of 2400 vehicles (2000+ thermal buses and more than 350 trolley buses). More than 30% of buses use natural gas as fuel (CNG buses), while another 30% are Euro IV diesel buses (Athens Urban Transport Organization, 2020). Large part of the fleet is aged and obsolete, as it has long passed its service life. Bus lines typically operate at frequencies of 5 to 30 min and carry almost 1,000,000 passengers daily (2021).

New Technologies: Automatic vehicle location (AVL) systems, automatic passenger counting (APC) systems and an automated (smart) fare collection system (based on magnetic cards) are installed in the Athens public transport system, offering advanced passenger information services, as well as improved fleet management and operations (Athens Urban Transport Organization, 2020).

Trip characteristics: The average amount of time travelers spent commuting on a typical weekday is 71 min, while trip duration exceeds 2 hours every day for almost 16% of riders. The average amount of time that travelers wait at bus stops or stations is 18 min, while 34% of travelers wait for over 20 minutes. The average distance traveled by public transport is 6.8 km, while 13% of passengers' travel for over 12 km using public transport (Athens Urban Transport Organization, 2020).

The Athens public transport system has a very good spatial coverage, but its performance has degraded in the past decade, because of budget cuts. Efforts are made for recovering, albeit at a slow pace.

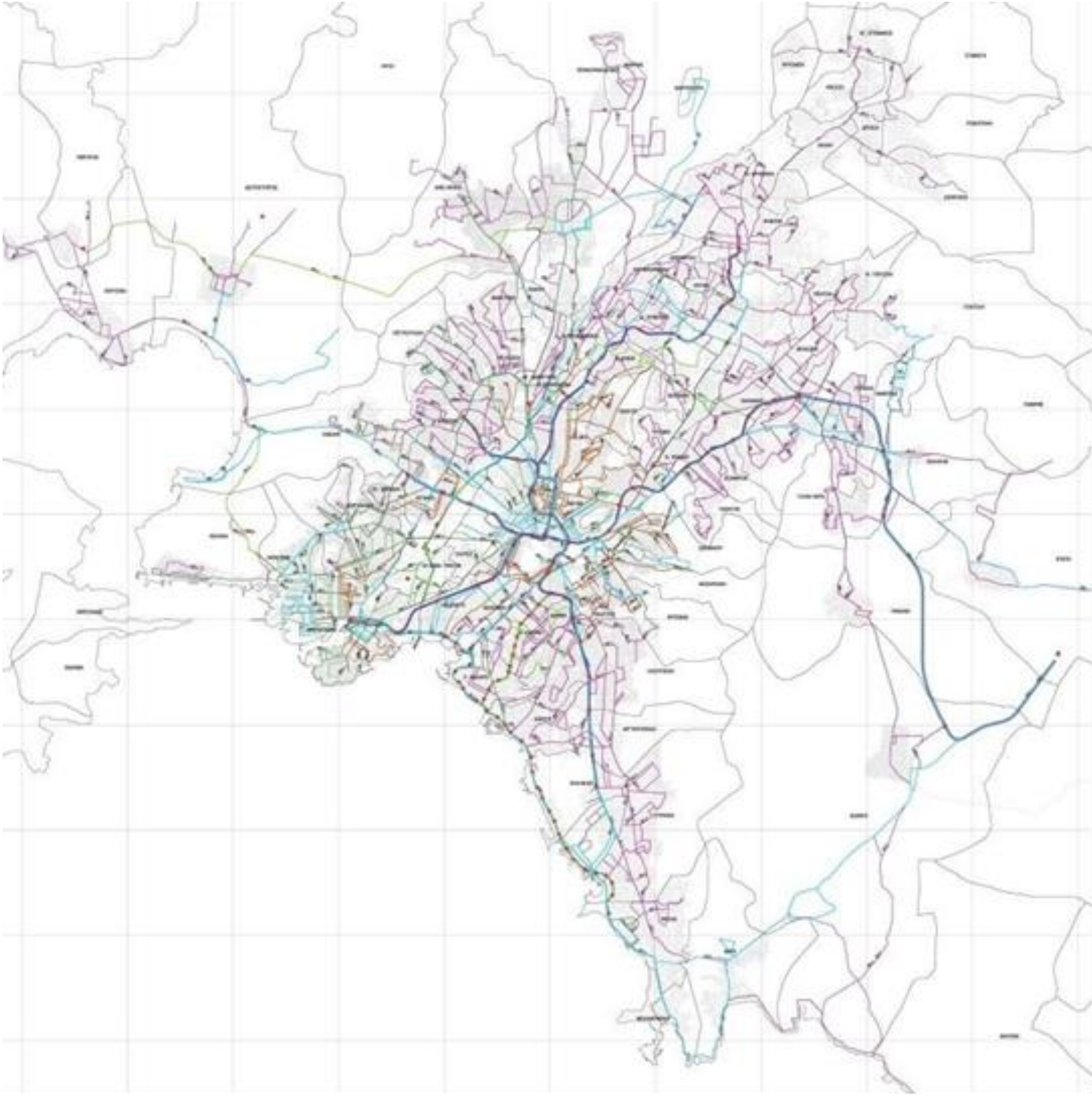


Figure 2. 5 The Athens public transport network (source: NTUA analysis)

2.7 Taxi Market

There are about 13,600 taxis currently operating in Athens (Region of Attica, 2023). The taxi market is heavily regulated as there is a cap on the number taxis, and tariffs are set by the Greek government (European Commission, 2016a). Taxi activity is regulated by national legislation (Law 4070/2012) with respect to operations, licensing, and requirements for vehicles, drivers and owners.

Licensing and permits: Taxi owners are either individuals or joint ventures. Taxi drivers may own a vehicle or act as employees to taxi owners. A license is issued for vehicles, while taxi drivers need to have a special driving permit. A tender based license acquisition procedure for vehicles is conducted at the regional level every two years; each region decides upon its license cap. While obtaining a taxi permit in Greece does not require special training or exams, there are some qualitative requirements set for taxi drivers, such as an adequate knowledge of the Greek language, having attended compulsory education, and being healthy to drive a taxi. A taxi driver permit is renewed every 5 years (Law 4070/2012).

Operations: Taxis may be hailed in the street, booked by phone or on-line platforms. In the recent years, taxi users in Greece seem to have largely adopted the use of mobile applications, such as UberTAXI, Freenow, Taxiplon, SATA-IQ, for booking taxi services.

Taxi Fares: The criteria for setting tariffs are determined by government bylaws. Different, km-based and traffic delay–waiting time tariffs are set, depending on the time of the day (day, night) and the area of service. There are minimum charges per route and additional charges may apply (for luggage transportation, phone booking etc). Fares may be freely negotiated between taxi drivers and passengers, in cases of pre-hiring. Also, fixed fares have been introduced to and from the Athens Eleftherios Venizelos Airport.

Taxi Specifications: Law 4070/2012 sets specific technical and equipment specifications for taxis: vehicles should have 5 seats (including the driver), air-conditioning and specific engine types and they must be equipped with a taximeter and the taxi sign on the roof. Depending upon a vehicle's engine size, allowed taxi age is between 15-18 years for Athens and 20-24 years for other cities of Greece.

The taxi market is heavily regulated with respect to licensing and tariffs. On-line services and applications for taxi booking have been popular over the recent years, compared to curbside hailing or radio-taxi booking.

2.8 Other Providers

Since 2012, travel agencies and car rental companies can offer services of hired cars with drivers, following prior reservation of a minimum of six hours. Laws 4070/2012, 4093/2012 and 4688/2020 set specific details with respect to introducing such services, as well as technical requirements for vehicles used (for example, engine sizes of at least 1500cc).

According to **a critique by OECD**, current legislation prevents competition and hinders free selection of transportation services. For example, as taxis do not have any time constraints in service provision, they enjoy a clear advantage over hired cars with drivers (International Transport Forum, 2015). Also, minimum requirements for hired cars with drivers are not compatible with freedom in choice of business assets, a fact that prevents suppliers from offering other services or even entering the transportation market (International Transport Forum, 2015).

The local legislative framework is currently prohibitive with respect to offering ridesharing services. Specifically, according to **Law 4530/2018** (Article 12, p.1), natural or legal persons that provide online or phone intermediation services for transport services with public use vehicles ought to have a permit for engaging in the relevant market (market for taxi or ridesharing services) if they (a) allow for price differentiation including via discounts or other commission subsidies; or (b) influence critical aspects of the transportation service by providing for certain requirements in addition to the ones already provided by law.

Therefore, the existing legal framework (Law 4530/2018) treats ridesharing platforms as transportation service providers (and not ICT service providers), and sets **strong barriers** in their operations, with special focus on tariff subsidization by platforms. In this context, Law 4530/20180 practically mandates that ridesharing platforms operate in the context and under the provision of laws for taxis and hired cars with drivers, and therefore strongly hinders their operations.

It is worth mentioning that **Uber ridesharing services** were launched for the first time in Greece on December 2014. However, not all services offered by Uber's mobile application were provided in the Greek market (European Commission, 2016b). Ridesharing service provision by Uber was postponed in 2018, because of the provisions of Law 4530/2018. Currently, only **UberTAXI** is available in Athens, Thessaloniki, Santorini and Corfu; UberTAXI connects passengers with professional taxi drivers, in the same way as other mobile applications operating in Greece. Fares for a trip arranged by UberTAXI are those determined by the national legislation for taxis.

To date, legislation and especially Law 4530/2018 provisions set strong barriers in the introduction of ridesharing services. Ridesharing platforms are treated as transport service providers and are practically subject to the provisions of legislation on taxis and hired cars with drivers. As such, ridesharing services are practically banned in Greece. Furthermore, there are no official incentives, subsidies or other forms of promotion for ridesharing.

2.9 Travel Demand Trends

Based on Athens Urban Transport Organization (OASA) travel demand model for the Athens metropolitan area the **typical daily linked person-trips in 2019** (origin destination pairs) were estimated at about 6 million. Given the fact that the population of Athens has been and is expected to remain relatively stable in the years to come, person-trips are anticipated to grow, following estimated trends of the country's GDP until 2030, as given by the Economic Research Service's International Macroeconomic Data Set of U.S.

For years 2020 and 2021, COVID impacts and related social distancing measures on daily trips evolution is presented in the following figure. 2022 daily trips are more or less those of 2019, indicating a return to some sort of normality in societal and economic conditions. **Daily person-trips in the Athens** metropolitan area are estimated at approximately 6.4 million in 2024. By 2030, this figure is expected to grow to about 7.1 million daily travelers.

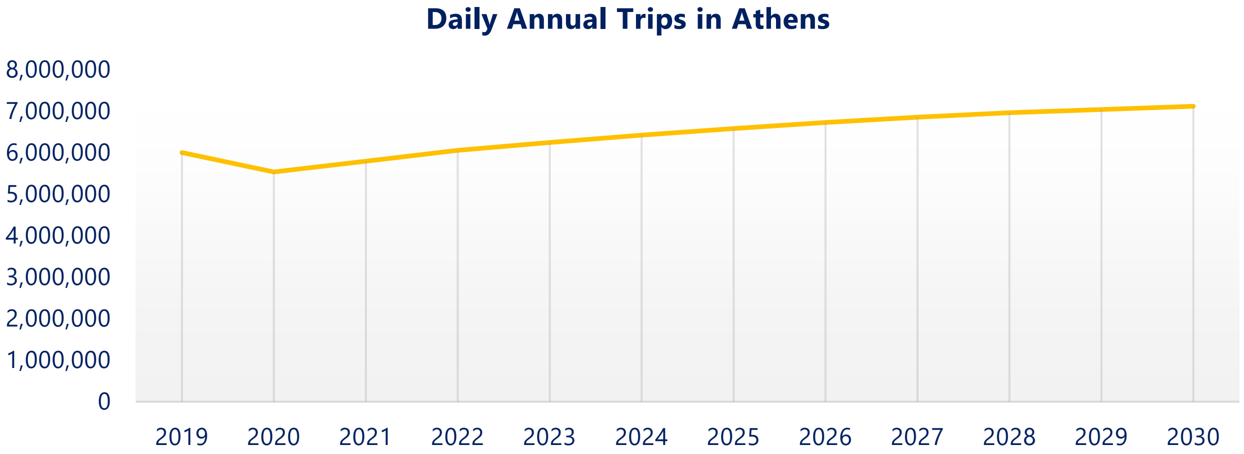


Figure 2. 6 Travel demand estimates (daily linked person-trips) for the Athens metropolitan area (Source: Athens Urban Transport Organization, 2019; project team analysis)

It is worth noting that **presented trip** estimates refer to a typical day and generated demand for transport, attributed to exogenous factors and especially tourism cannot be adequately captured. Indeed, in the last two years, tourism in Athens has exhibited a sharp increase of 25% (YoY% 2022/2023); this figure is expected to grow further in the future. In this context, seasonal demand estimates attributed to tourism will be treated separately, in the subsequent sections of this study.

2.10 Mobility Environment and Prospects in Athens

The urban transport market of the Athens metropolitan area already comprises several players competing or collaborating, in a still not fully stable socio-economic environment.

Indeed, the economic recession has had a severe impact to the city's mobility. Since 2010, fuel taxation, fiscal policies on private car ownership and usage, increased maintenance costs and degrading purchasing power had a considerable impact in private vehicle and usage. **Vehicle ownership** remained rather stable since 2010 and congestion levels were degrading up until the end 2015 (Athens Traffic Control Center, 2021). Indeed, for the period between 2009 and 2013, traffic volumes in major Athens arteries degraded by 9%-15% and travel times were lowered by 20% on average (Athens Urban Transport Organization, 2015).

In the period between 2016 and 2019, and before the COVID-19 pandemic outbreak, data on traffic volumes indicate an increase in passenger vehicle usage, coupled with a 10% average annual increase in new vehicle registrations.

Quality of **public transport** services also degraded in the same period. Lower ridership and increased fare evasion, coupled with an extensive cutback in government subsidies had a considerable impact to the revenues of the Athens public transport system. Unavoidable cutbacks in expenses led to reduced performance in terms of operating frequencies, vehicle and personnel availability and had a significant impact in the level of services offered to travelers. Furthermore, fare evasion expanded rapidly, with a large share of travelers (unofficially estimated at over 30%) using public transport without purchasing fares.

Since the beginning of the economic crisis in late 2009, ridership in the Athens public transport system has decreased by more than 20% (2019), not considering the COVID-19 period.

The **taxi market** was severely affected by poor economic conditions in the last decade. According to a recent study by the NTUA, in the years of the economic recession, the stated working time of most taxi drivers per day increased from 10h to 15 h per day, while their daily revenues were on average reduced by 50% (Spyropoulou, 2014).

Before the beginning of the recession, **over 75% of taxis had at least 10 rides per day**, while during the recession, 80% of taxis had at the most 14 rides per day. In addition, average daily distance travelled by taxis has decreased by 50% while the percentage of vacant km tripled with respect to total distance travelled (Spyropoulou, 2014).

On the other hand, **operational expenditures and taxation** of taxis services (previously under a preferential flat tax system) increased, while regulated tariffs were kept in the same levels. Finally, while barriers to entry the taxi market practically remained intact (because of a cap to the maximum number of licenses), costs of obtaining a taxi license in the secondary market decreased by about 40% (Spyropoulou, 2014).

Most recent (pre-COVID) data based on a stated-preference survey undertaken in the middle of 2018 (Milioti et al. 2021), indicated that over **70% of taxi drivers used to work at least 11 hours per day**, and 78.5% of them would undertake 10-24 daily trips. Also, over 40% of taxi drivers believed that demand for taxi had grown compared to the past two years. Finally, over 50% of taxi drivers used e-hailing application for picking up customers, with curbside taxi-service provision accounting for over 75% of drivers. This is clearly an indication that e-hailing platforms are gaining ground in the Greek taxi industry.

While no hard evidence is readily available, the taxi market seemed to partially recover in the pre-COVID period, a fact attributed to reasons such as the increase in tourist flows in Athens, the introduction of ICT taxi hailing platforms and the reduction in the taxi fleet in previous years.

A **ridesharing service** is expected to operate in a market struggling to revive, following a decade of demand and supply degradation. The economy exhibits a relatively weak growth, which is however expected to speed up in the forthcoming years. On the other hand, exogenous factors (such as boosting tourist flows) and even the people's perception of returning to socio-economic normality do have an additional, positive impact in mobility.

Possible **competitors** (private vehicles) of ridesharing services keep a stronghold, as a private vehicle is still considered an asset and a sign of wealth for local households. Fuel prices have slightly retreated despite heavy taxation and maintenance costs (particularly labor related) have adopted to current conditions. Furthermore, as no effective barriers to private vehicle usage are implemented (for example congestion pricing) in the Athens metropolitan area and illegal parking is frequently tolerated, vehicle traffic is expected to retain its role in the city's mobility, in the coming years.

As for the taxi market, the Athens metropolitan area has a ratio of more than **3.5 taxis per 1000 inhabitants**, while the corresponding ratios for London, Madrid and Paris are 2.4 taxis per 1000 inhabitants, 2.3 taxis per 1000 inhabitants and 1.1 taxis per 1000 inhabitants respectively (EMTA, 2013, 2017). While there is a cap on the maximum number of taxi licenses in the Athens metropolitan area, taxi supply is still high compared to other European countries.

Services of **hired cars with drivers** have mostly focused on tourists and were promoted by the local tourist industry. Legislation strictly regulates these services and hinders their expansion as a competitive transportation service.

In such an environment, ridesharing is expected to **fill gaps in transportation** services and potentially create some additional (latent) demand for transport.

- **First**, ridesharing offers comparable travel time transportation services to substitute modes at a lower cost, which makes it attractive to travelers, otherwise unwilling to use door-to-door transportation modes or even make some trips.
- **Second**, night-time trips not accommodated by public transport are a market where ridesharing could have a good share, especially in a city with a vivid night-life, such as Athens.
- **Third**, ridesharing is expected to benefit from boosting tourist flows in the forthcoming years. The global nature (same platform worldwide), on-line hailing, cashless payment, better cost and driver control and convenience, are some advantages which could make ridesharing attractive for Athens visitors.
- **Fourth**, given adverse parking conditions in the Athens metropolitan area, ridesharing could be an acceptable alternative for private vehicle users. These are only some indicative cases where ridesharing could offer comparative advantages over other modes in the city of Athens.

2.11 Summary

Socio-economic conditions of the past years have had a strong impact on the mobility conditions and services in the Athens metropolitan area. Indeed, there is an estimated reduction of trips from almost 8M in 2008 to 6M in 2019. According to forecasted growth of the Greek economy for the future years, and taking into account the COVID-19 impact for 2020-2021, daily trips could be increased to 7.1 M by 2030.

While vehicular traffic seems to recover slightly, alternative transportation services (particularly public transport) are still underperforming. On the other hand, taxi services are strongly regulated with respect to tariffs, operations and license caps. As such, the taxi market can hardly attract new travelers, since neither alternative pricing nor new services can be easily implemented.

Since there are limited disincentives for private vehicle usage in the Athens metropolitan area, a vicious circle of transportation is formed; low performance of public transport services and increased taxi-type costs leads to re-expanding the use of private vehicles, which in turn cause congestion and hinders operations of alternative modes.

Overall, current mobility services in the Athens metropolitan area tend to create preferential conditions for private vehicles. In this context, innovative mobility services could act as an efficient, alternative solution to dominating private vehicles, possibly combined with improving performance of the city's public transportation system.

National Technical University of Athens

3 The Potential of Ridesharing Services

This chapter investigates the potential of introducing ridesharing services in Athens. An overview of trends on mobility services and ridesharing is offered, attempting to set the framework for understanding the aspects of ridesharing and its applicability in the Athens metropolitan area. Results on a survey for ridesharing services undertaken in the Athens area are presented and discussed. Finally, a market analysis is undertaken using tools developed as part of this study.

3.1 Innovative Mobility Services

The emergence of novel mobility services, driven by the rapid advancements in information and communication technologies and the expanding sharing economy market, has created an unprecedented reality in the field of urban transportation.

A **wide range of mobility services are available to consumers**, including ride-sharing/e-hailing, car-sharing, on-demand transit and trip planning. These provide flexible, convenient and affordable transportation options creating a shift towards on-demand shared mobility and a less car-centric multimodal system. Data analysis and market trends indicate that more users are expected to use new mobility services combined with transit/private vehicles instead of solely the latter (CAR, 2016).

As the sector of **on-demand mobility** services has grown rapidly in the recent years, several types of transportation services have emerged and keep developing worldwide. Car-sharing services, such as Zipcar and car2go are experiencing major success by offering their own fleets of cars to be shared among users. BlaBlaCar and BlancRide connect drivers who have spare seats with interested travelers, to offset transportation costs, mostly focusing on long distance commuting trips.

Via Transportation and Chariot offer on-demand shared shuttles for $5 a trip, while Bridj offers point-to-point bus service in the Boston area. Companies like TransLoc and RideCell are developing technological solutions to optimize and automate the integration of flexible on-demand services into regular fixed route schedules operated by transit agencies (Bouton, n.d.)

Real-time ridesharing, also often referenced to as e-hailing/ride-hailing/ride-sourcing, is one of those new, major market segments in the transport sector. The term essentially refers to services that use smartphone apps to connect community drivers with passengers. There are several transportation network companies (TNC) worldwide that have adopted platform-based business models, acting as intermediaries between drivers and customers (Nicoll and Armstrong, 2016). Among the most popular service providers are Uber (worldwide), Lyft (US), Didi (China), Ola (India), Haxi (Europe), and Gett (Europe), EcoRIDES (USA) and Easy Taxi (developing countries).

Besides regular ride-hailing services, TNCs offer services that allow travelers to **share rides and split the cost** of a ridesourcing/TNC-enabled ride with someone traveling a similar route. Such ride-splitting services include UberPool, Lyft Line, GrabHitch, Ola Share, and Didi Express Pool.

Ride-sharing provides have also launched services, such as UberCOMMUTE, Uber's Destinations feature, Lyft Driver Destination and Lyft Carpool, where drivers input their destinations and accept rides from **users traveling on the same route** (PWC, 2016). Such services focus on exploiting vehicle capacity to its maximum extent while offering lower cost trips and thus contribute into reducing vehicle-km produced by private vehicles.

Worldwide revenues for the segment of mobility services provided over the Internet were estimated at $1,281 billion in 2023. Under an estimated annual growth rate of almost 5%, online payment mobility services will comprise a market of more than $1,572 billion in 2028 (Statista, n.d.(a)). Currently, the countries generating the highest revenues in the field are the US, China, the UK, Germany and France.

3.1.1 Global Trends

Ridesharing is one of the main drivers of the mobility sector growth with worldwide revenues amounting to $109 billion (2023), expected to exceed $200 billion by 2028, under an estimated annual growth rate of 6.83% (Statista,n.d.(b)). Similarly, the number of users is expected to reach 1.6 billion by 2028, a figure almost double than the one reported in 2022 (Statista, n.d.(b)).

This growth in the ridesharing market has been largely driven by **the ability to fill gaps** in transportation-related needs not met by other modes, as well as the lack of a well-defined regulatory framework (CAR, 2016). Particularly in cities where the taxi market is not as developed, TNCs have experienced continuous growth (CAR, 2016).

Overall, the market share of ridesharing is projected to steadily increase in the years to come, mainly due to the comparative price advantage of TNCs versus conventional taxis in almost all markets (PWC, 2016).

3.1.2 Case Studies in Europe

In Europe, ridesharing is expected to see a significant growth as well, with revenues up to US$19.3 billion in 2024 (Statista, n.d.(c)). The annual growth rate for the market is estimated at 3.6 % between 2024 and 2028, with a projected volume of US$22.3 billion in 2028 (Statista, n.d.).

Currently, **19.8% of Europeans actively use ridesharing services**, a number expected to reach 22.2 % in 2028. Uber operates in 96 European cities, while Blablacar operates in 16 EU countries, recently launching services in Eastern European countries, including Czech Republic and Slovakia (PWC, 2016).

Estonia was the first European country to legalize and regulate Uber, along with a local, popular service called Taxify in 2016. On-line ridesharing services are regulated with respect to fare transparence and safety (ERR, 2017, Uber under the hood, 2016). In parallel, the country promotes the right of taxis on street hailing exclusivity to encourage far competition (Uber under the hood, 2016).

In **France**, Uber has experienced significant success because of limited taxi supply, convenience of service and the surge of unemployment since 2008 (Landier et al, 2016). However, the country's regulatory framework and taxi industry opposition have hindered further development of ridesharing (Landier et al, 2016, Dillet, 2017).

On the other hand, in **Spain**, ridesharing providers (Uber and Cabify), encountered opposition by professional taxi drivers, forcing the companies to offer only licensed driver services (Lomas N., 2017). In other European countries, such as Demark and Hungary, governments have been recently establishing legal obstacles against real-time ridesharing services, such as Uber (Reuters Staff, 2017).

The United Kingdom is one of the largest ridesharing markets, as the government has made the collaborative economy 'a priority', aiming to 'make the UK a global center for the sharing economy (PWC, 2016). Indeed, revenue in the ridesharing segment amounts to US$1.6 billion, a number expected to double by 2022 (Butler and Topham, 2017). However, Uber has recently lost its license in London, after being banned by local government body Transport for London due to "a lack of corporate responsibility" in relation to reporting serious criminal offences, obtaining medical certificates and driver background checks (Statista, n.d.(e)). Conversely, corporate ridesharing has not faced such problems and is quite successful in the UK, with major corporate ridesharing companies like Liftshare and Faxi leading the way (Frost and Sullivan Consulting, 2016).

Finally, in Croatia, Uber is available in cities along the Adriatic coast. While until 2017, the Croatian government proclaimed that Uber services were not legal in the country (Pavlic, 2016), recent legislation promotes the use of mobile applications as fare metering devices, allows e-hailing, alleviates government control on tariffs and removes the cap on driving service licenses (Pavlic, 2017).

Despite a fluid regulatory environment, the users penetration of ridesharing services in Europe is projected to grow from 19.8% in 2024 to 22.2% by 2028.. Despite successful operation of ridesharing companies, a significant proportion of prospective users remain relatively unaware of the concept or the actual differences between ridesharing, hailing and carsharing services (Frost and Sullivan Consulting, 2016).

3.1.3 Opportunities

Based on modern urban structures and existing transportation system deficiencies, several distinct opportunities arise for ridesharing service providers.

First and foremost, ridesharing exhibits a **major potential in dense urban areas** and along commuting corridors, particularly when parking supply is limited, and public transit coverage is insufficient (Deloitte, 2015; Franck et al, 2015). Similarly, inner-ring suburbs in 10 to 15 miles from the urban center have a high percentage of commuters with similar trip patterns, ending in downtown areas or suburban office parks (Deloitte, 2015).

Further, ridesharing is predominantly used for social trips performed during the evening and night. In fact, during those times more people chose ridesharing services over driving.

A dedicated survey by APTA (APTA, 2016) found that services like Uber and Lyft were **most frequently used in the evening**, while peak demand was observed between 10 P.M and 4 A.M. on the weekends, when public transit services are least available. Thus, cities with student populations and/or nightlife facilities present an advantageous setting for ridesharing.

What is more, ridesharing has the potential to solve the **"first/last mile problem"**, i.e. the lack of connectivity between transit stations to passenger's origins or final destinations (Landier et al, 2016).

Particularly in less dense areas, long-distance trips between residences and workplaces intensify the "first/last mile problem" (Uber and AFI, 2017). **Ridesharing may complement public transport services** instead of solely substituting for them (Landier et al, 2016).

To that end, a cooperative agreement was reached between Uber and the Metropolitan Atlanta Rapid Transit Authority (MARTA), where MARTA offered users access to the Uber app to facilitate travel to their final destination (Nicoll E. and Armstrong S., 2016). A similar collaboration was reached between the service provider and Dallas Area Rapid Transit (DART) to alleviate mobility issues (Nicoll E. and Armstrong S., 2016).

Multimodal transportation initiatives present a unique opportunity for mobility service providers to expand their market share, build partnerships and collaborate with governments and public transport agencies. This is particularly true when public transport exhibits a sizeable share of total trips but cannot entirely meet mobility needs, or high travel costs call for effective intermodal transportation services (Uber and AFI, 2017).

The demand for such multimodal trips in urban areas is projected to rise by 20% each year for the next five years, finally stabilizing around 12%. A notable market opportunity for this business model arises in the case of dense European cities, where public transport is widely used and can provide excellent connectivity in combination with ridesharing (CAR, 2016).

Unemployment has been a main driver for the growth of the sharing economy, providing an alternative for those unable to find regular work (Rizk, 2017). This finding is also consistent in the case of ridesharing services, as inability to find permanent employment is pushing more and more people into registering as driver-partners for ridesharing operators (Landier et al, 2016).

In **Egypt**, where Uber reported more than one million active riders just two years after its operations, formerly unemployed young people constitute the main proportion of drivers (Rizk, 2017).

3.1.4 Risks and Barriers

Despite the unprecedented success and rapid growth, TNCs face significant **obstacles,** as competition among them becomes more intense, markets become saturated, and regulatory frameworks become more explicit (CAR, 2016).

Indeed, as has been the case in many cities, ridesharing providers also often face challenges from **local taxi associations**, worker unions and lawmakers complaining about unfair competition and alleging that ridesharing providers fail to comply with the standards required for established taxi firms.

In terms of increasing market size, **lack of awareness** among potential users remains a notable problem for ridesharing providers (Frost and Sullivan Consulting, 2016). Collectively, the requirement for drivers to hold professional licenses may be discerned as the most challenging issue, causing suspension or even complete discontinuation of operations (PWC, 2016).

Similarly, the **lack of clarity** regarding the definition of ridesharing activity creates problems for operators in terms of revenue taxation and legal status (PWC, 2016). Running the risk of being forced out of a market as "illegal dispatcher services" (Reuters Staff, 2017), ridesharing providers must therefore thoroughly consider the enterprise model selected in each case. Evidently, one of the critical factors for the success of ridesharing companies is the existence of a supporting regulatory framework.

In general, **support for ridesharing greatly varies among EU countries**. Some European countries have engaged in discussions to address the effects caused by platform-based mobility services to regular transportation service providers (Dillet R., 2017). The results of these talks are expected to largely affect the future of ridesharing applications in the European market.

Despite the various obstacles encountered by operators, **the growth of ridesharing services is considered certain based on current evidence** (Statista, n.d. (2016a,b,c,d); Frost and Sullivan Consulting, 2016). The extent of this growth, however, largely depends on government and legislative support for a sharing economy.

The EU Commission published a 'guidance notice' on how EU countries should regulate ride-hailing. It recommends the **removal of unjustified country rules** – from Return to Garage, Minimum Waiting Times, and license caps to map-reading tests, excessive vehicle requirements, and smartphone use bans. It also urges governments to ensure ride-hailing complementarity with transit/active mobility (especially in suburban areas) and to support PHV electrification.

3.2 Attitude of Sector Professionals

Ridesharing is obviously **a major competitor of official taxi services**, which, as mentioned earlier, operate under a strict regulatory framework. As such, taxi professionals are expected to strongly oppose any introduction of ridesharing services, even in the case this is regulated. A recently published survey on taxi driver attitudes in Athens (Milioti *et al.* 2021) revealed that sector professionals strongly disagree towards embracing elements encountered in ridesharing services, such as multiple hiring (taxi-sharing) and dynamic pricing. In the same survey it was found that taxi-drivers are not willing to give away privileges such as higher night tariffs, even if this meant increased revenues. Nevertheless, a good share of survey participants (over 30%) used taxi-hailing applications for picking up costumers.

Taxi professionals are fragmented into **different groups**, related to their professional status (license owners versus drivers), the way of doing business (curbside, taxi plazas, hailing etc.) and so on. Practically, the taxi market consists of numerous small-sized businesses, without either a common understanding of the market and its potentials, or the same rules and culture of service provision. Past efforts on creating large taxi companies and uniting forces of taxi professionals have failed, mostly because of their culture and disbelief in the potential and credibility of such initiatives.

Overall, the taxi sector consists of conservative professionals, not aligned with modern business practices. To their defense however, this is the case for taxi drivers in other European countries as well. Most of these professionals are unwilling to change their business model, especially in a post-COVID19 era with good market potentials and an increased demand for service. In the same context, since the taxi market is protected by a strict regulatory framework (which was built with the consent of professionals), it is highly probably that taxi professionals will strongly resist any directly competing service.

3.3 Introducing Ridesharing in Athens – a Survey

Real-time ridesharing is probably not well-known as a potential option for traveling around Athens. The city is overwhelmed by private vehicles, even in an era of economic recession, public transport offers relatively low-cost services and adequate accessibility, and there is extensive supply of taxi services around the city.

In this context, if an innovative transportation service is to be formally introduced in the city, it is necessary to identify **traveler understanding and stated acceptance** of such a service. A personal interview, questionnaire-based survey was undertaken, aiming at collecting information on the level of understanding and preferring ridership services over other travel options in the Athens Metropolitan area.

3.3.1 The Survey

The questionnaire survey included questions on **travel characteristics** of respondents, **satisfaction of respondents with current mobility services**, **knowledge level** of ridesharing services**, stated preference on alternative mode choice** sets and **demographics.**

The first section of the questionnaire focuses on recording the **respondent's travel profile**. This includes information on trip purpose, public transport usage, vehicle ownership, main travel mode used for accessing workplace or other activities, travel time and cost for accessing workplace and attributes considered important for mode choice (Cost, Travel time, Reliability, Comfort, Safety, Flexibility, Availability).

The second section of the questionnaire investigates **traveler satisfaction** on current mobility and transportation conditions in Athens. Respondents are asked to state their typical daily trip experience with respect to daily travel time and cost, public transport accessibility, access to taxi services, parking conditions, traffic safety and security, alternative travel options, as well as their overall satisfaction with their prevailing travel mode.

Knowledge related questions with respect to ridesharing are included in the third section, aiming at understanding whether respondents have a good idea of what ridesharing is about.

The fourth section is a choice set (**stated preference**) experiment, which targets at identifying and understanding prevailing parameters affecting traditional mode choice selection versus ridesharing. Finally, the fifth section collected information on demographics of respondents (gender, age, income, level of education and so on).

About 440 questionnaires were collected in total; subsequent quality, completeness and reasonability checks were undertaken, leading to a total of **395 valid questionnaires**, which could be used for further statistical and econometric analyses. A stratified random sampling technique was followed for data collection, reflecting current demographic characteristics of Athens inhabitants (gender, age, geographic distribution).

Pilot interviews were undertaken beforehand at the Katehaki metro station for assessing the quality of the survey process and questionnaires. The survey was performed in mid-September 2017, in **four suitably selected Athens metro stations** located in the center and suburbs of the Athens Metropolitan area (Syntagma, Elliniko, Peristeri and Panormou) and **four suitably selected major commercial areas** in Syntagma, Nea Smyrni, Glyfada and Chalandri. (Figure 3.1).

Figure 3. 1 Survey Process

3.3.2 Descriptive Statistics

A preliminary part of the analysis focuses on interpreting collected data using descriptive statistics. In this context, demographic data on gender, age, education and income are presented in Table 3.1 and Figure 3.2 respectively.

Table 3. 1 Distribution of participants per age group and gender

Age group	Female		Male		Total	
18 - 30	88	42%	80	44%	168	43%
31 – 55	74	35%	97	53%	171	43%
55 +	23	11%	34	19%	57	14%
Total	**212**	**100%**	**183**	**100%**	**395**	**100%**

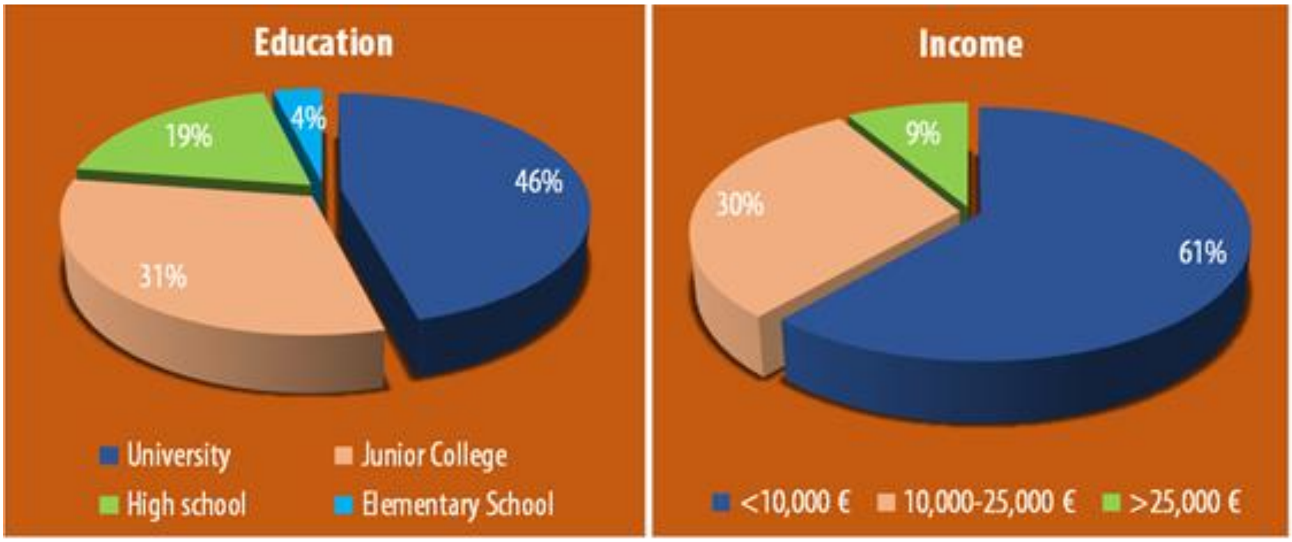


Figure 3. 2 Education/ Income Distribution of Respondents

Results presented above confirm that the sample follows **a properly balance stratification** with respect to gender, age, education and income. Furthermore, stratification is in general compatible with gender and age proportions found in the city's population of travelers.

In the next table indicative questions of the questionnaire are presented aiming to give a first picture with respect to ridesharing in general and to the current knowledge on UBER

Table 3. 2 Selected Questions

	Questions	Yes	No	Maybe	I don't know
Q1	Are you aware of ridesharing services	37%	50%	13%	-
Q2	Would you mind sharing a ride in a private car with people you may not know?	46%	24%	30%	-
Q3	Have you heard of UBER	59%	30%	11%	-
Q4	Have you ever used UBER in the past	12%	76%	12%	-
Q5	Do you think that Uber differs from taxi	38%	15%	21%	26%
Q6	Do you think that Uber differs from taxi	44%	6%	28%	22%

Based on the above, about **46% of respondents would not prefer to share a ride** with other unknown fellow passengers in a private car. This could be related to the negative impression caused in the past by crowded taxis performing multiple hiring in the Athens metropolitan area; this practice is currently neither allowed nor preferred in general by taxi driver.

Furthermore, **half of the respondents seem to be aware of ridesharing services**, at least to some extent; this is rather encouraging given the fact that currently, ridesharing services are neither widely advertised, nor officially recognized by authorities as a competitive transport mode.

Questions 3 and 4 presented above, offer information on stated knowledge on ridesharing and UBER in particular. Results indicate that while almost 50% / 60% of respondents have heard of ridesharing / UBER, only **12% of them have used some ridesharing service in Greece** and another 12% have used ridesharing services abroad. Figures 3.3a and 3.3b present statements on ridesharing potential in Athens:

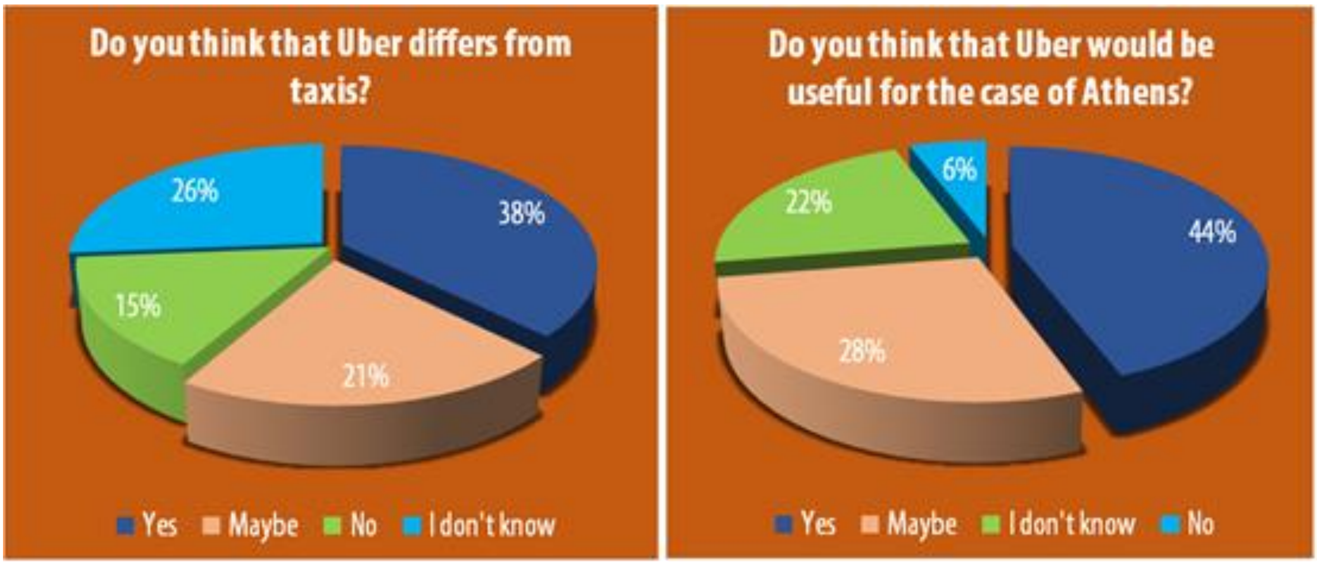


Figure 3. 3 **(a)** Ridesharing versus taxi distinction, **(b)** Potential of ridesharing services in Athens

Figure 3.3a indicates that many respondents are either **unsure or unaware of the differences between taxis and a real-time ridesharing service**; this may be attributed to the fact that ridesharing and taxi services in Greece share some common attributes such as electronic service booking and door-to-door services. On the other hand, core ridesharing services (those that involve use of private vehicles) have not been widely deployed in Athens.

An interesting remark drawn from Figure 3.7b is that **most participants (44%) think that ridesharing services would be useful for the case of Athens** indicating that people are willing to try ridesharing services. In a similar context, Figure 3.8 presents stated opinions in future ridesharing use.

Finally, Figure 3.4 presents **respondents' satisfaction** with respect to various aspects of their **personal transportation and mobility conditions**.

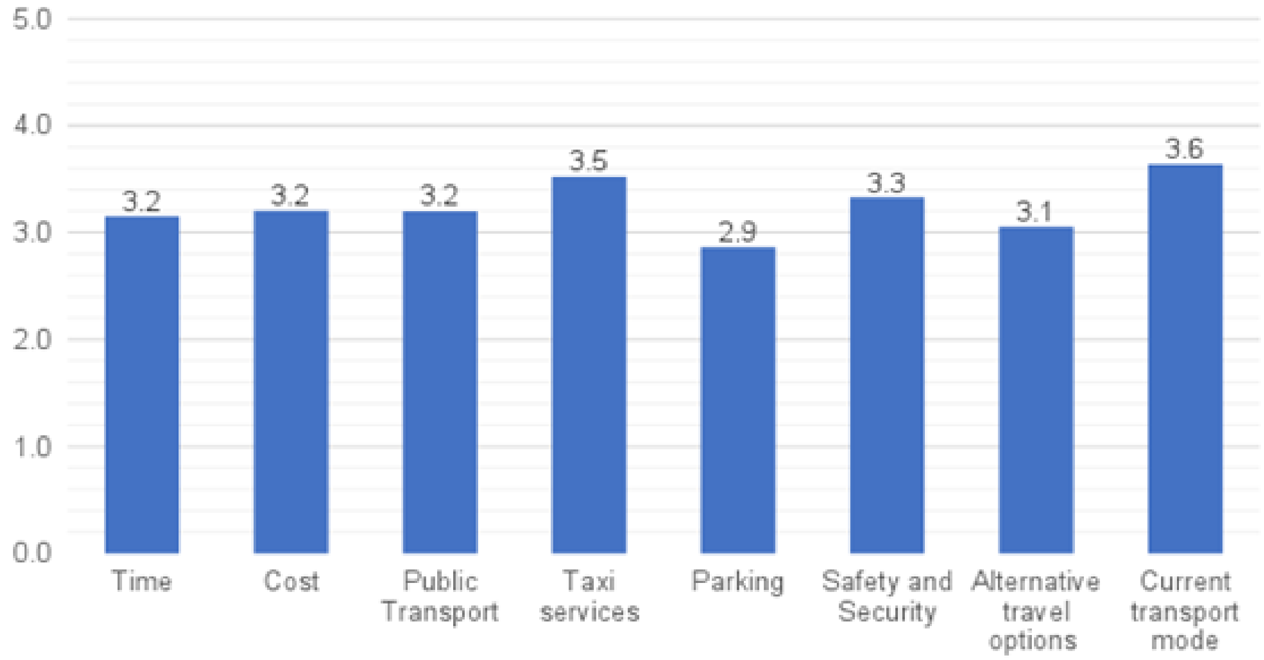


Figure 3. 4 Average satisfaction of respondents with respect to personal mobility and transportation aspects

(1: Worse – 5: Best)

Figure 3.4 results indicate that **respondents are moderately satisfied with respect to travel time and costs.** Given that travelers tend to select modes and routes that minimize their generalized cost, it seems that mobility options are not that satisfactory for respondents. Public transport accessibility satisfaction is adequate, while parking availability obtains the lowest rating among all aspects.

Satisfaction on safety and security is higher compared to other aspects, while respondents are moderately satisfied by alternative travel options. Finally, satisfaction of respondents with respect to their preferred mode of travel is relatively high. This is an indication that many respondents might not be willing to shift to another mode, given current conditions in the Athens transport system.

3.3.3 Mode Choice Model

As part of the survey, a stated-preference experiment is designed and implemented; its aim is to provide quantitative insights on **modal split if ridesharing services are introduced in the Athens** metropolitan area. Four alternative modes are considered (private car, public transport, taxi and ridesharing) and three attributes (travel time, cost and comfort) are selected for representing choice preferences.

The final, stated choice design for **four alternatives with three attributes** is based on an optimal orthogonal choice design (OOC) prepared for the purposes of this project. It is decided to set time, cost and comfort attributes as generic, since (a) stated experiments set a general level of these attributes and (b) respondents do not have a clear perception of time, cost and comfort for the case of ridesharing services.

Based on the above, the multinomial logistic regression (MNL) specification is shown in Table 3.3; private vehicle is the base mode for the model and therefore obtains a zero-constant term:

Table 3. 3 Mode choice model specification (MNL)

	Private Car	Taxi	Public Transport	Ridesharing
Constant*	-	-0.8909 (10.7575)	-0.2393 (-2.7255)	-0.2771 (-5.1799)
Cost*	-0.1230 (-11.0546)			
Time*	-0.0064 (-4.5143)			
Comfort*	0.4580 (10.5940)			

*Values significant at 99% are presented – t-statistics reported in parentheses

All signs of the MNL specification are as expected, time and cost coefficients have negative values, meaning that an increase in costs or travel time lowers the utility of a mode. Comfort coefficient on the other hand has a positive, statistically significant value; this implies that travelers consider comfort to be important in mode selection.

Assuming all attributes equal, **taxis exhibit the lowest utility among modes** (most negative constant term). This implies that there are other, unobservable factors negatively affecting taxi selection. In the same context, the constant term value for ridesharing is slightly more negative, compared to public transport. Possible selection of ridesharing over public transport is again negatively influenced by some additional, uncaptured factors. However, for both ridesharing and public transport, these factors remain significantly smaller compared to taxis.

3.3.4 Market Sampling

The developed mode choice model is discrete in nature; this means that model outcomes reflect average preferences of individuals for specific trips. A **simulation based, market sampling approach** is implemented to make aggregated inferences on market changes, following the introduction of ridesharing services; this is shown in Figure 3.5:

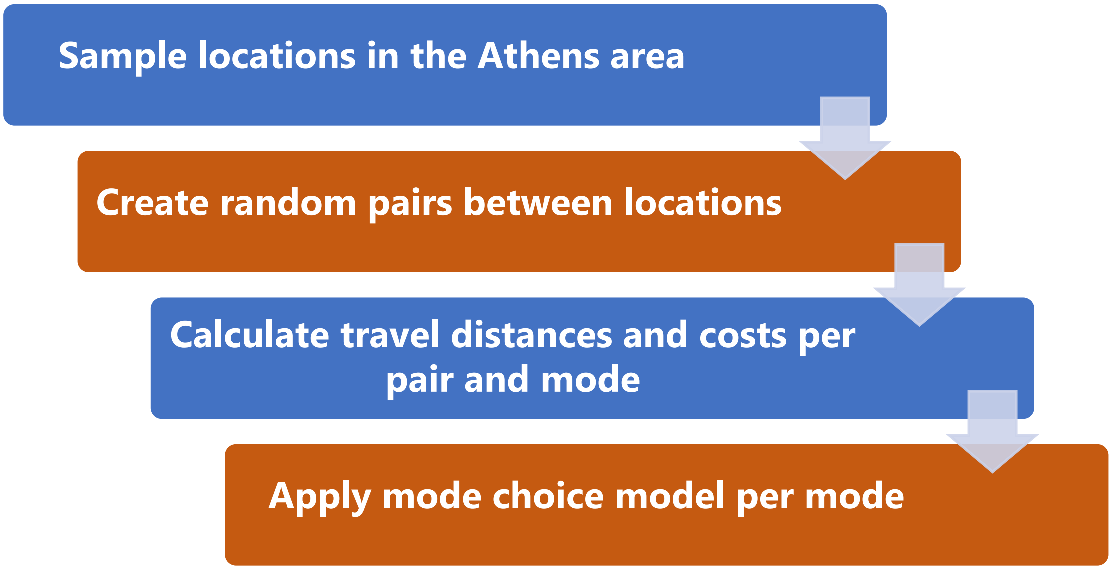


Figure 3. 5 Simulation based market sampling approach

A **set of over 2,000 locations in the Athens** metropolitan area are sampled using population density criteria for different municipalities (Figure 3.11). Then, about 4,000 pairs of various distances between them, are created between these locations, using a random number generator. For each pair, travel distances and times are calculated for private cars and public transport, using Google™ services. In the absence of exact data, travel times for taxis and ridesharing services are assumed to have an additional service (waiting) time over private vehicles (approximately 5 min for taxis and 8 min for ridesharing).

Costs are estimated per mode on a case to case basis (scenarios for ridesharing, described in section 3.3). The mode choice model is straightforwardly implemented for each pair and the probability of using a mode can be obtained. The average of probabilities for all pairs can then be used as an estimate of the market share for each mode.

A market sampling approach is used for making inferences on the Athens modal split under different scenarios, using discrete (individualized) mode choice models.

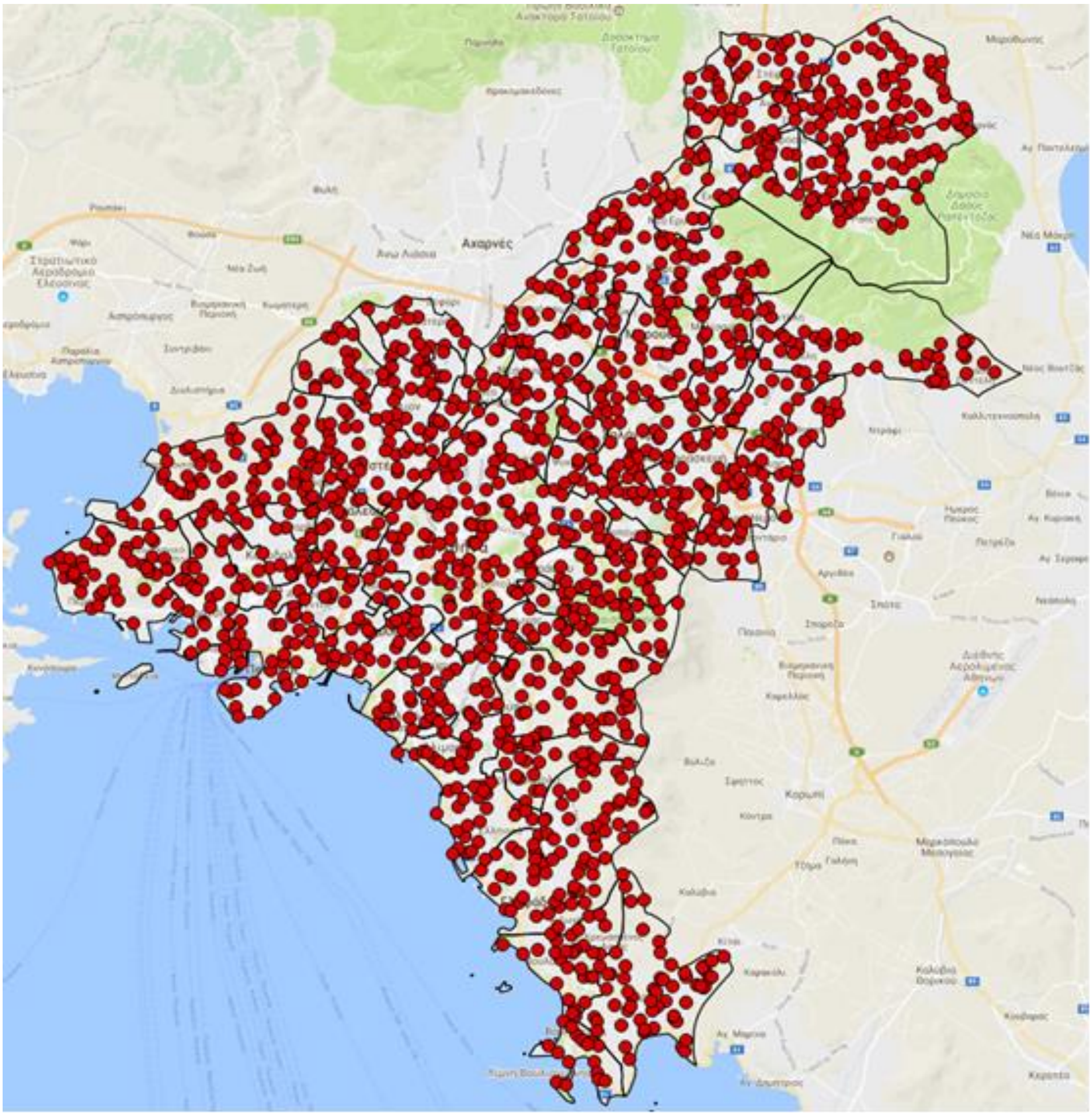


Figure 3. 6 Sampled locations in the Athens metropolitan area.

3.4 Market Analysis

3.4.1 Business Models

Given current conditions and prospects in the Athens transportation market, service provision and possible legislative regulations, a fairly regulated market could consider two alternative business models (from now on, scenarios A and B) for introducing ridesharing services. These are the following:

Scenario A (fully licensed service provision) assumes that ridesharing services are offered by car-rental companies and travel agencies, as a car-hiring service with professional drivers. Scenario A is based on OECD's recommendations according to their country assessment report for Greece (OECD, 2014), in which the following is stated: "We recommend abolishing the minimum duration of the service for car-rental-with-a-driver. By removing the artificial segmentation of the market, consumers will benefit from choosing freely from a wider range of services".

Scenario B (light licensed service provision) considers ridesharing services offered by properly licensed individuals in the form of small businesses; market entrance is allowed at a small fee, to any interested individual complying with pre-defined standards for vehicles and driver qualifications. Services are only booked on line and telephone reservation or street hailing are not possible. Scenario B follows the paradigm of Estonia and Lithuania; in these countries regulated real-time ridesharing offered by individuals is available, but street hailing is reserved for taxis only.

Assumed base user charges for the two scenarios are presented in Table 3.4; the light-licensed scenario is estimated to yield lower management and operational costs. Therefore, tariffs for the light-licensed scenario will be reduced compared to the fully licensed case. These involve a base fare and charges per km and min. It is noted that ridesharing fares have the option of dynamic adjustment in cases of excessive demand or supply. However, for the sake of the analysis, base fares are considered in the present case.

Table 3. 4 User charges (Tariffs) per scenario

User Charge Element	Scenario A (full)	Scenario B (light)
Base fare (minimum)	1.1 €	0.95 €
Charge/ km	0.6 €	0.5 €
Charge/ min	0.1 €	0.08 €

Costs for the remaining modes of the Athens transport system are as follows:

- Private vehicles: 0.38 € per km .
- Public transport: 0.5 € per trip
- Taxi: 1.8 € base fare plus 0.9 € per km and 11.8 €/hour charge in cases of delays

For **private vehicles**, "out-of-the-pocket" costs per trip are considered only and include fuel and parking costs. A mean distance-based cost per km of 0.17 € is calculated for an average consumption of 10 lt per 100 km (urban conditions), a representative gasoline price of 1.8 €/lt for the period of 2024-2030 and an additional 0.2 €/km for parking (assumption).

For **public transport**, the average fare is calculated based on 2022 data by the Athens Public Transport Organization; total annual revenues for the Athens public transport system were divided by total annual boardings for the same year, using official data from the Athens Public Transport Organization (Athens Public Transport Organization, 2022).

For **taxis,** time related charges in Athens are imposed in the case of delays only (in traffic lights, due to congestion and so on). To account for these charges, a randomly generated delay ranging between 0% and 15% is calculated over already determined travel times for taxi routes. The 11.8 €/h charge is imposed to this randomly generated delay, after being converted into a minute base rate of 0.197 €/min.

The **convenience attribute** in the case of public transport and ridesharing is set to 0 (lower convenience), while for taxis and private vehicles it is set to 1. For ridesharing in particular, an assumption on lower convenience (which is represented by the value of 0 in the convenience attribute) is set to reflect the country's mobile phone penetration, which is currently estimated to be at about 60% (Newzoo, 2017).

Ridesharing will be less costly compared to substitute modes (taxis), but limitations in smartphone usage by the Greek population is expected to reduce convenience in its usage.

Scenarios are assumed to be fully deployed in a mid-term horizon (target year 2030). This implies that by that time, travelers will have clear and concise (full) knowledge on provided services by all available travel options, including ridesharing, for both scenarios. These are compared to a "Business as Usual" (BAU) scenario, in which no ridesharing services are offered in Athens.

Finally, it is assumed that the mode choice model estimated for year 2017 will remain valid for year 2030; such an assumption is usually followed in relevant planning exercises.

The market share of ridesharing will be estimated for year 2030, considering two alternative business models (operational scenarios A and B) and assuming the mode choice model is valid for that year.

3.4.2 Market Shares

Using the **mode choice model** and **market projection method**, market shares per mode can be straightforwardly estimated for year 2017; these are shown in Table 3.5. It is noted that for the purposes of the analysis, these shares will be assumed to remain relatively constant up to year 2030.

Table 3. 5 Estimated Market Shares per scenario for years 2024-2030

Mode	BAU scenario	Scenario A (full)	Scenario B (light)
Private Vehicle	60.1%	55.9% (-4.3%)	54.8% (-5.3%)
Public Transport	32.6%	30.3% (-2.2%)	29.9% (-2.7%)
Taxi	7.3%	6.6% (-0.7%)	6.5% (-0.8%)
Ridesharing	N/A	7.2%	8.8%

*change over current conditions shown in parenthesis

Introduction of ridesharing is expected to have a positive impact towards reducing private car usage over the BAU scenario, while on the other hand it will slightly affect usage for public transport and taxis.

3.4.3 Demand for Ridesharing

Total demand for ridesharing in **person-trips is estimated for target year 2030**; this consists of the following parts:

- Demand attributed to shifting travelers from other modes, based on trip forecasts of previous years (base demand).
- Latent (induced) demand due to the full deployment of ridesharing services.
- Seasonal demand due to non-captured, recent increase in tourism flows in Athens.

3.4.3.1 Base Demand

As reported earlier, Table 3.5 figures (mode choice model outcomes) are assumed to remain valid for target year 2030. Using an estimate of 7.1M person-trips on a typical 2030 day (according to travel demand trends presented in section 2.9), Table 3.6 presents anticipated typical daily trips per mode for year 2030 and scenarios A and B.

Table 3. 6 Anticipated daily person-trips per mode for year 2030 with fully deployed ridesharing

	Daily Person-Trips	
Mode	**Scenario A (full)**	**Scenario B (light)**
Private Vehicle	3,976,203	3,897,960
Public Transport	2,155,259	2,126,806
Taxi	469,462	462,349
Ridesharing	512,141	625,950

3.4.3.2 Latent Demand

Latent (or induced) demand refers to **additional trips generated** because of endogenous changes in a transportation system (Litman, 2001). Introduction of ridesharing is such a case where mobility will be generated because of providing new, point-to-point transportation services (Deloitte, 2016).

For the case at hand, induced demand is estimated for a mid-term horizon, of year 2030. A change in travel time is used as a proxy for assessing the magnitude of those trips generated by ridesharing services. It is expected that generated trips will be mostly related to accessibility and travel time and not cost. Indeed, when cost is not a constraint for travelers, new trips will be created if convenience with respect to accessibility and travel time is improved.

Table 3.7 summarizes **estimated changes in average travel time** for scenarios A and B, compared to no-ridesharing conditions. These changes are derived using the mode choice model and market sampling approach presented in section 3.3.4, assuming that traffic conditions in Athens will not change significantly in next few years. For each random pair, travel time per mode is estimated for both no-ridesharing conditions and scenarios A and B, and weighted average travel time for all modes is calculated per case (current conditions and scenarios A and B). Using these average travel times, changes between current conditions and the two scenarios can be straightforwardly calculated.

Table 3. 7 Estimated average travel time changes because of ridesharing over BAU scenario

	Scenario A (full)	Scenario B (light)
Change in Travel Time (%)	-5.1%	-6.8%

Latent demand is estimated using **short-term price elasticities** with respect to time (Litman, 2001). A short-term price elasticity of -0.3; this value is followed by other studies for estimating induced impacts of ridesharing (Stefansdotter et al., 2015; Deloitte, 2016). Table 3.8 summarizes induced average daily demand (person-trips) for year 2030, for a previously estimated total daily demand of about 7.1M trips.

Table 3. 8 Induced daily person-trips due to ridesharing for year 2030

	Scenario A (full)	Scenario B (light)
Induced demand	114,302	126,150

Induced demand is expected to be generated by ridesharing services, as accessibility and travel times will be improved for point to point trips, without considering private car availability or access to taxi.

3.4.3.3 Seasonal Demand

Since 2014 Athens has exhibited a rapid increase in **tourist flows**, which are expected to grow further in the future years (Hatzidakis, 2015). These flows create additional seasonal trips which cannot be captured by forecasts based on figures from existing studies. Indeed, tourist activity in Athens maintained a consistent level from 2008 to 2013. However, a significant uptick occurred from 2014 to 2019, interrupted only by a decline in 2020 as a result of the COVID-19 pandemic. Subsequently, a resurgence in travel followed, with 2023 witnessing over 28 million arrivals and departures, marking a robust recovery in tourism.

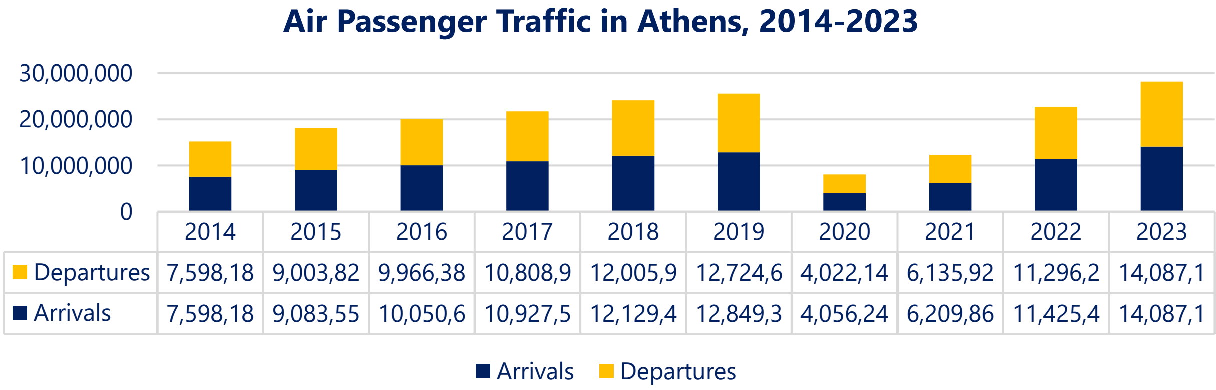


Figure 3. 7 Air Passenger Traffic in Athens, 2014-2023 (Source: Athens International Airport, 2023)

In detail, **annual stays of non-residents in hotels and similar establishments, campings and short stay accommodation establishments** for Athens in the period 2008-2013 were less than 4.5 million but exceeded 5.6 million stays in 2015 (ELSTAT, 2015). Visitor stays saw a consistent rise, peaking at 7 million in 2019 before the COVID-19 pandemic caused numbers to fall to 1.7 million. A recovery ensued in 2021, with stays climbing to 3.2 million, and this upward trajectory continued with stays reaching 7.1 million in 2022. Extrapolating from econometric forecasts correlated with the country's GDP projections up to the year 2030, it is estimated that annual non-resident nights spent in hotels will potentially escalate to 9.3 million.If a tourist performs on average 4 daily trips, additional, annual seasonal person-trips for 2030 could be estimated as 4 x 9.3M = 37M.

Since the **tourist season** has a duration of 150 days, this yields an average of 250,000 daily trips for that period. A modest ridesharing service share of 20% could therefore accommodate an additional **16,000 daily (seasonal) travellers**, not captured by forecasts based on existing studies.

This additional, seasonal demand can be further transformed to an equivalent annual average seasonal demand, which would be equal to 20% x 37,000,000 / 365= **20,274 daily person trips**.

3.4.4 Demand for Ridesharing

Table 3.9 summarizes typical daily demand estimates (person trips) for year 2030. According to Table 3.9, total demand for ridesharing range from 650K to 770K passengers for 2030, assuming a fair regulation, full deployment and perfect knowledge of ridesharing services by travelers. Based on these figures and assuming an occupancy of 1.7 travelers per ridesharing ride, Table 3.9 also presents total daily ridesharing (vehicle) trips. It is estimated that 355K to 430K ridesharing vehicle trips will be undertaken in a typical day.

Table 3. 9 Daily average demand for ridesharing (person-trips) per scenario (year 2030)

	Scenario A (full)	Scenario B (light)
Base Demand	512,141	625,950
Induced Demand	114,302	126,150
Annual Average Seasonal Demand	20,274	20,274
Total Daily Person Trips	646,717	772,373
Total Daily Vehicle Trips	380,422	454,337

3.5 The Emergence of Ridesharing in the Greek Islands

The Greek Islands, each with their own individual characteristics, are scattered across the Aegean and Ionian seas. With a total number of more than 6,000 islands, of which more than 100 are inhabited, the transportation needs are as diverse as the islands themselves. In many cases the level of service of local road transportation is challenged by large tourist inflows specifically during the summer period. While taxis, public buses and rental cars have long been the mainstay of public transportation within these islands, the need for more flexible, efficient, and cost-effective travel options is increasingly apparent. This chapter explores the need for ridesharing services the Greek Islands, advocating for their operation alongside traditional taxis to enhance the mobility of residents and tourists alike.

3.5.1 Socio-economic Characteristics

The **three principal clusters of Greek islands** are organized administratively into peripheries, encompassing the North Aegean, South Aegean, and Ionian Islands, alongside Crete. Islanders constitute a significant proportion of Greece's national population, with a substantive demographic concentration on the island of Crete. The decadal demographic trends observed in Table 3. 11 suggest a divergent evolution across the Greek islands. Notably, Dodekanisos and Kyklades clusters manifest a demographic expansion, which contrasts with the marginal decline evidenced in the North Aegean and Ionian islands.

Table 3. 10 Population in Greek islands (Source: Hellenic Statistical Authority, 2023)

NUTS2	NUTS3	NUTS3	Code	Population 2021	% of tot. Greek Population	YoY% 2011/2021
North Aegean	**EL411**	**Lesvos, Limnos**	**EL411**	100,423	1.0%	-3.2%
	EL412	**Samos, Ikaria**	**EL412**	42,828	0.4%	-0.1%
	EL413	**Chios**	**EL413**	51,692	0.5%	-1.9%
South Aegean	**EL421**	**Dodekanisos**	**EL421**	175,448	1.7%	8.6%
	EL422	**Kyklades**	**EL422**	152,372	1.5%	3.3%
Ionian Islands	**EL621**	**Zakynthos**	**EL621**	41,180	0.4%	1.0%
	EL622	**Kerkyra**	**EL622**	101,600	1.0%	-2.7%
	EL623	**Kefallinia, Ithaki**	**EL623**	38,926	0.4%	-0.3%

NUTS2	NUTS3	NUTS3	Code	Population 2021	% of tot. Greek Population	YoY% 2011/2021
	EL624	**Lefkada, Meganisi**	**EL624**	22,826	0.2%	-3.7%
Crete	**EL431**	**Irakleio**	**EL431**	305,017	2.9%	-0.2%
	EL432	**Lasithi**	**EL432**	77,819	0.7%	3.2%
	EL433	**Rethymno**	**EL433**	84,866	0.8%	-0.9%
	EL434	**Chania**	**EL434**	156,706	1.5%	0.1%

Alongside these demographic shifts, the **economic landscape** of each region is reflected in the evolution of Gross domestic product (GDP) per capita and in the unemployment rates.

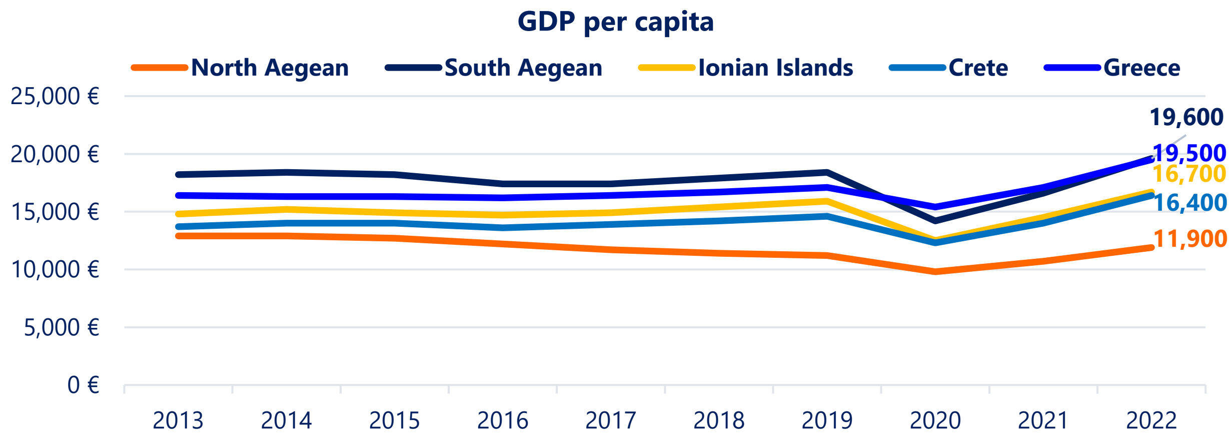


Figure 3. 8 GDP per capita for Greek islands (Source: Hellenic Statistical Authority, 2023)

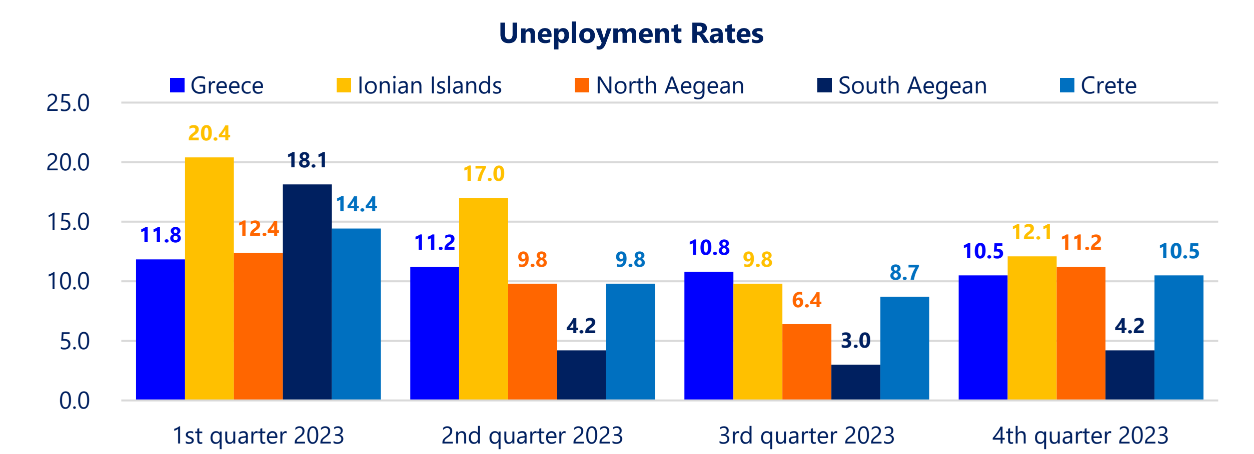


Figure 3. 9 Uneployment rates for Greek islands *(Source: Hellenic Statistical Authority, 2023)*

Greece's economic rebound is evident from the GDP per capita increase from €15,400 in 2020 to €19,500 in 2022, with regions like the South Aegean leading the growth at €19,600, likely due to its tourism industry. However, the North Aegean's modest rise to €11,900 suggests slower progress. The Ionian Islands also show recovery to €16,700, yet lag behind the South Aegean. Unemployment rates in the first quarter of the year present challenges, especially for the Ionian islands and South Aegean islands with rates peaking at 20.4% and 18.1% accordingly, well above the national average of 11.8%, pointing to economic difficulties outside tourism seasons. South Aegean's unemployment rate reflects the heaviest seasonal tourism-dependent economy among the rest Greek islands.

Ridesharing has the potential to create new employment opportunities that can adapt to the seasonal fluctuations of the Greek islands. During the high season, the additional jobs could support the increased demand for transportation in the tourist-heavy regions, particularly in the South Aegean and Ionian islands. Conversely, during the off-peak periods of Q1 and Q4, the focus could shift to regions like Attica and North Central Greece, which host winter destinations. By doing so, ridesharing could offer a more stable employment landscape year-round, helping to alleviate the stark seasonal unemployment spikes and drive a more balanced economic growth across the country.

The **Greek islands are a cornerstone of the Mediterranean's touristic appeal**, drawing millions of visitors annually, an inflow that substantially influences local economies, infrastructural and transport demands. The data presented in the following tables offer a depiction of the inflow of residents or non-residents across various Greek islands throughout 2023 by quarter.

Table 3. 11 Travelers flow in Greek island per quarter, 2023 (Sources: Hellenic Statistical Authority, 2023; Hellenic Civil Aviation Authority)

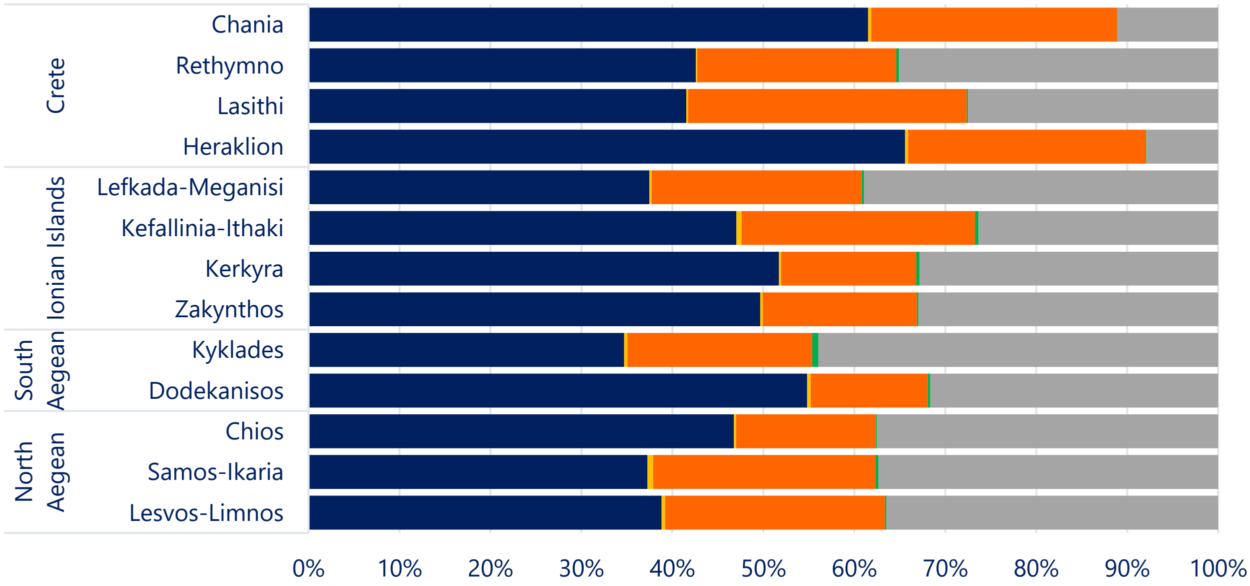
NUTS2	NUTS3	**Travelers Inflow by air and sea, 2023**				**Arrivals in hotels and similar establishments, 2023** (provisional)			
		Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
North Aegean	Lesvos, Limnos	18.9K	43.5K	104.7K	25.3K	23.7K	135.5K	336K	53.2K
	Samos, Ikaria	44.4K	132.3K	267.1K	57.3K				
	Chios	54.8K	82.2K	128.2K	66.0K				
South Aegean	Dodekanisos	239.4K	1,889.9K	3,105.5K	741.8K	138.9K	2,630.4K	4,378.6K	749.6K
	Kyklades	494.1K	2,565.1K	5,264.4K	901.6K				
Ionian Islands	Zakynthos	172.7K	790.1K	1,245.4K	342.4K	35.4K	1,001.5K	1,803.6K	215.4K
	Kerkyra	168.4K	662.6K	1,191.2K	247.3K				
	Kefallinia, Ithaki	111.4K	876.0K	1,715.4K	282.0K				
	Lefkada, Meganisi	17.5K	195.5K	422.4K	48.6K				

Greek islands, including the North Aegean, South Aegean, and Ionian islands, experience significant seasonal travelers inflows, with pronounced peaks in arrivals at hotels and similar establishments during the third quarter (July-September), aligning with the tourist high season. **The South Aegean, for instance, saw 4.4M arrivals in 2023's third quarter alone**, compared to the North Aegean and Ionian Islands with 0.3M and 1.8M, respectively. Within the Kyklades cluster, islands like Santorini and Mykonos each draw over a million arrivals via air and sea in the same period, while Rhodes from the Dodekanisos cluster sees numbers exceeding 3M. This surge leads to a substantial increase in demand for in-land transport, emphasizing the need for an efficient local road transportation system to service all the commuters especially during seasonal peaks.

3.5.2 The Road Transportation Landscape

Understanding the modal share of road transportation and public transport availability within the Greek islands is instrumental in evaluating the efficacy of current road transport system and identifying **opportunities for improvement**.

The following table presents the **size of the motorized fleet** in circulation in each examined cluster of islands and the distribution among modes, underscoring the differences in transportation preferences and needs among these regions.



	North Aegean			South Aegean		Ionian Islands				Crete			
	Lesvos-Limnos	Samos-Ikaria	Chios	Dodekanisos	Kyklades	Zakynthos	Kerkyra	Kefallinia-Ithaki	Lefkada-Meganisi	Heraklion	Lasithi	Rethymno	Chania
Private Passenger Cars	27,385	9,737	24,329	98,300	28,309	18,186	51,606	12,612	6,968	161,850	31,770	40,524	67,226
Public Use Passenger Cars	270	162	130	700	281	104	248	151	44	773	155	124	357
Trucks	17,056	6,399	8,009	23,058	16,594	6,210	14,850	6,883	4,290	64,606	23,453	20,841	29,553
Buses	109	74	68	506	551	61	364	105	46	120	107	289	61
Motorcycles	25,739	9,759	19,509	56,752	35,863	12,067	32,749	7,062	7,242	19,395	21,033	33,385	12,067

Private Passenger Cars · Public Use Passenger Cars · Trucks · Buses · Motorcycles

Figure 3. 10 Motorised fleet in circulation in Greek islands (Source: Hellenic Statistical Authority, 2023)

In most island clusters, **motorcycles and private cars represent comparable shares** of the road transportation modes. However, this trend does not hold in two Cretan cities, Heraklion and Chania, where the modal share is heavily dominated by private passenger cars. On the other hand, Kyklades islands demonstrate a significant propensity for motorcycle use.

The relatively lower numbers of buses and public use passenger cars like taxis underscore a gap in public transport options that could be bridged with targeted investments. Taxis, are constrained by the regulations that cap their quantity and govern their fares, which sometimes leads to a **supply-demand mismatch**. Buses offer an economical option but may lack the frequency and coverage to fully serve all areas, especially remote locations or during late hours. With the rise of tourism, especially during the peak summer months, demand often outstrips the offer of available taxis and buses, leading to long wait times and a shortfall in service during critical periods (Morfopos et al., 2023).

It is worth mentioning that Uber ridesharing services operate in **two Greek islands Santorini and Kerkyra (Corfu).** However, not all services offered by Uber's mobile application were provided in the Greek market (European Commission, 2016b). Currently, only UberTAXI is available which connects passengers with professional local taxi drivers. Fares for a trip arranged by UberTAXI are those determined by the national legislation for taxis. The figure below displays the taxi fleet currently in operation across the majority of Greek islands (Region of Crete, 2024(a) (b) (c) (d); Region of the North Aegean, 2023).

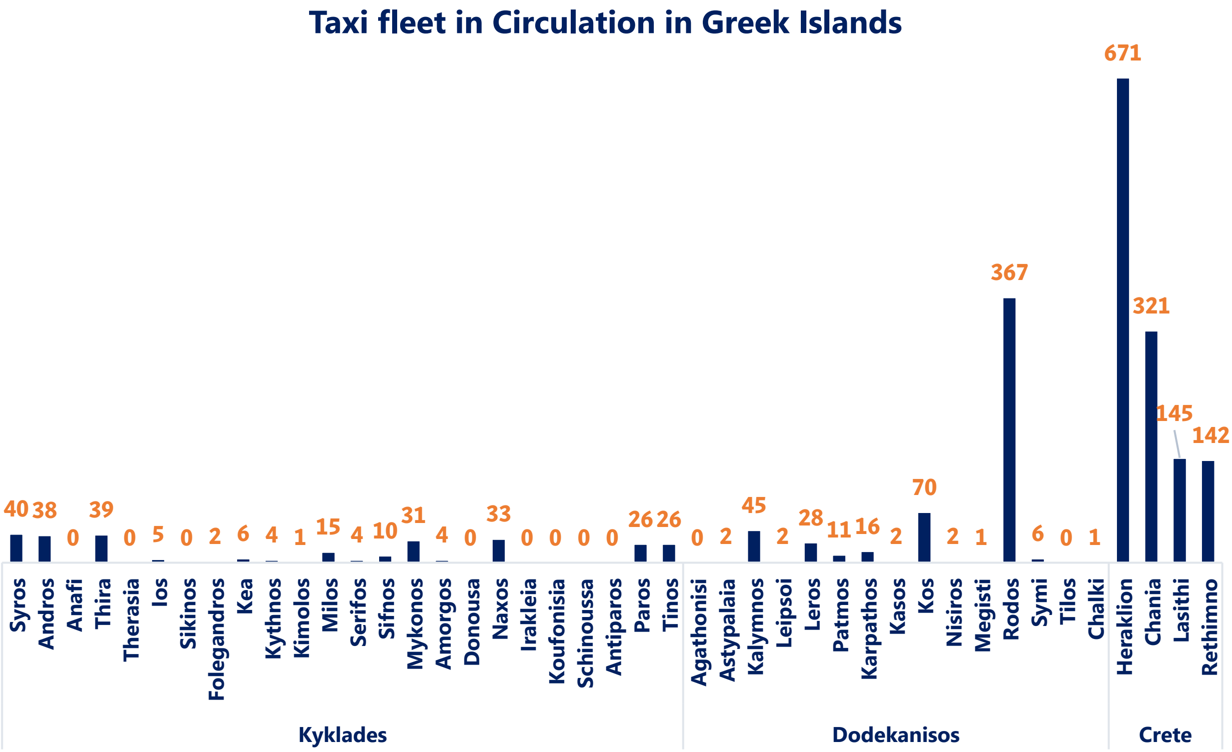


Figure 3. 11 Taxi fleet in circulation across Greek islands (Source: Hellenic Statistical Authority, 2023)

To better understand and respond to this seasonality in road transport demand, it is crucial to calculate the **daily number of travelers per quarter**. This calculation takes into account the nights spent in hotels and similar establishments in each region and quarter, as well as the population per region.

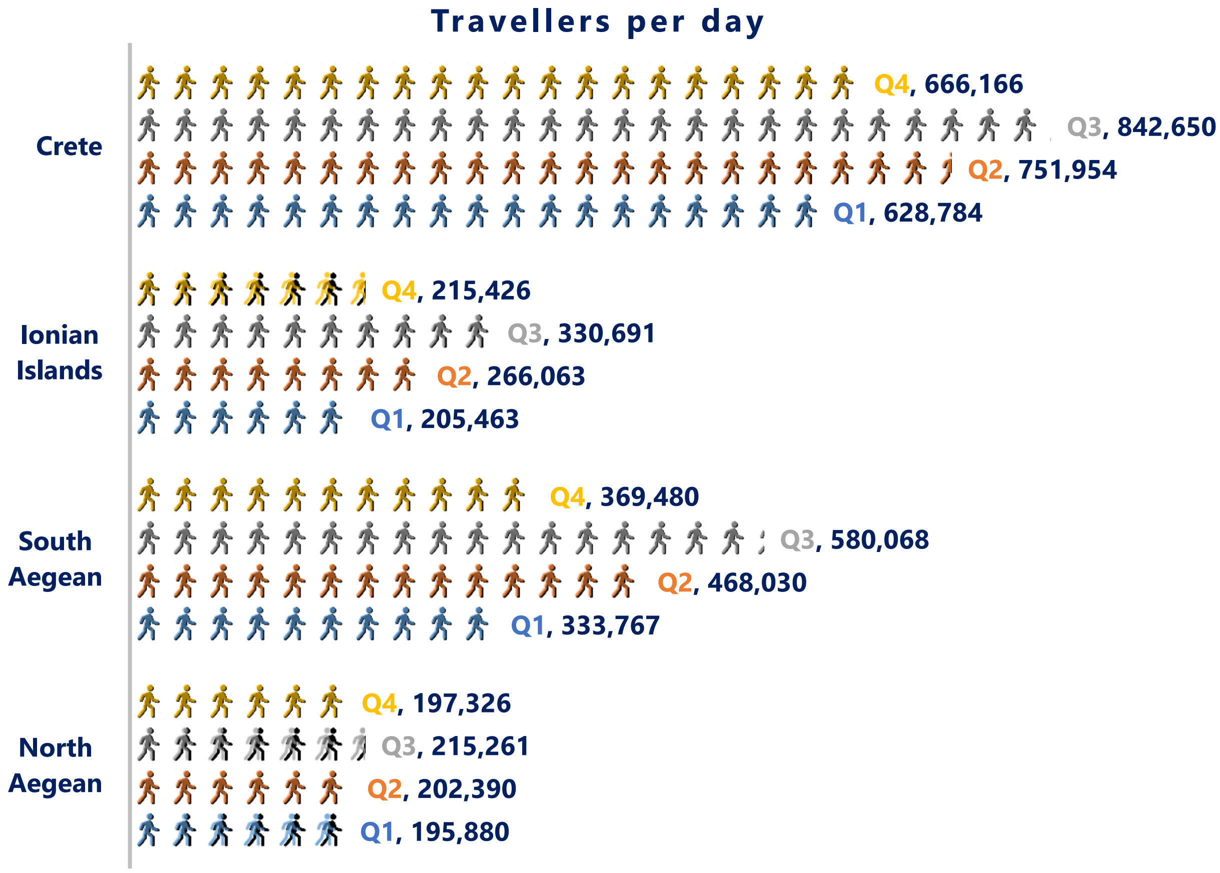


Figure 3. 12 Travelers per day in Greek island per quarter

The data in Figure 3.12 presents a clear picture of seasonality in travel patterns across various regions of Greece, with significant differences observed between quarters. During Q3 (July-September), which corresponds with the peak summer months, all regions experience their highest number of travelers. This is particularly pronounced in the **South Aegean and Crete**, where the daily travelers nearly double compared to Q1 (January-March) and significantly exceed those in Q4 (October-December). For instance, the South Aegean jumps from 333,767 daily travelers in Q1 to a staggering 580,068 in Q3, while Crete sees an increase from 628,784 to 842,650 in the same periods. The seasonal fluctuations in travel demand have important implications for regional planning and the provision of services, especially considering the wide variances in traveler numbers from the quieter Q1 and Q4 to the bustling Q3 period.

The ratio of taxis to travelers per day per region and quarter is estimated by adjusting the travelers figures to 80% of the total reported in Figure 3.12, reflecting the presumption that not all travelers necessitate transportation services.

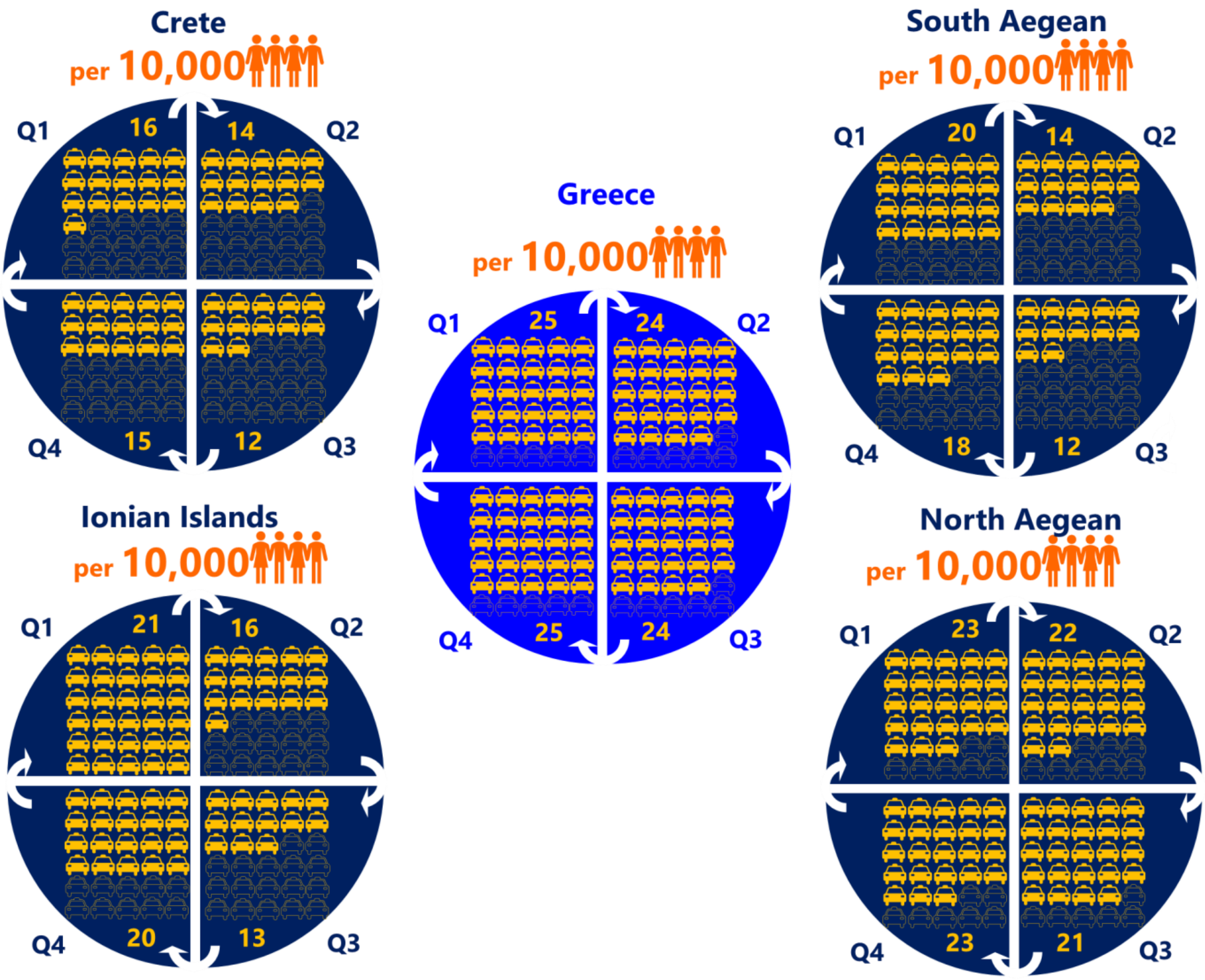


Figure 3. 13 Available taxis per day per 10,000 travelers across different greek islands and quarters

Figure 3.13 shows a **seasonal variability in taxi availability per day per 10,000 travelers** across the Greek islands. Notably, there is a pronounced low availability in the South Aegean islands, Ionian islands and Crete during the third quarter, with the available taxis per 10,000 travelers on a typical day decreasing to approximately 12 taxis. Comparatively, the national average sees a slight decline in the second and third quarter to 24 taxis, highlighting the pronounced seasonality in Greek islands, particularly within the South Aegean and Ionian regions. The North Aegean region, experience minor fluctuations, and maintains better availability, with its lowest offering at 21 taxis in the third quarter, significantly above the South Aegean's low. Crete exhibits the lowest daily ratio of available taxis per travelers compared to other islands and is also lower than the national average. This seasonality and low availability highlight a critical need for enhanced public use transportation solutions, such as ridesharing, to address the imbalance and ensure reliable mobility, particularly during peak tourist seasons.

3.5.3 The Case Studies

Three diverse islands are selected as case studies to illustrate variations in size, population, transportation infrastructure, and seasonality. Specifically, **Mykonos, Rhodes, and Crete**—with a focus on its city of Heraklion—are examined. These islands are some of the main tourism destinations in Greece.

Figure 3. 14 Case studies areas

Mykonos island is located in the South Aegean belonging to Cyclades cluster and spreads over an area of 105.5 square kilometers, with a coastline of 89 kilometers. Over the past 30 years Mykonos is worldwide recognized as one of the most cosmopolitan islands for summer vacations attracting tourists who travel from several areas worldwide. **Rhodes and Crete** are the ninth and fifth largest islands, accordingly, in the overall Mediterranean Sea. Heraklion, serving as Crete's administrative and cultural hub in the Eastern Mediterranean, highlights Crete's significant size and historical depth as Greece's largest island, extending over 8,336 square kilometers. Rhodes, positioned in the Southeast Aegean and part of the Dodecanese archipelago, covers an expanse of 1,408 square kilometers, bordered by a coastline of 220 kilometers.

Table 3. 12 Population density in case study regions (Sources: Hellenic Statistical Authority, 2023)

Cluster	Island/City	Population	Dif. % 2011/2021	Area (km^2)	Population Density
South Aegean	**Mykonos**	10,704	5.6%	106	101
South Aegean	**Rhodes**	125,113	8.3%	1,408	89
Crete	**Heraklion**	305,017	-0.2%	245	1,247

The South Aegean cluster comprises islands with diverse demographic and geographic characteristics that reflect their unique economic profiles and travel dynamics. Mykonos, with a population of 10,704, has experienced a 5.6% increase from 2011 to 2021, suggesting a growing community and resulting in a population density of 101 persons per square kilometer. **The inflow of tourists in Mykonos is exited 1.5 million** the year 2023 with the peak in the third quarter of the year, indicating a significant seasonality and underscoring the critical role of transportation in sustaining the island's economy. The island's economy is heavily reliant on tourism, particularly luxury and entertainment tourism, which creates a seasonal demand for short-distance travel that ridesharing could efficiently serve.

Rhodes, within the South Aegean cluster, has a population of 125,113, witnessing an 8.3% growth the last decade. Spanning 1,408 square kilometers, its lower population density of 89 suggests dispersed communities. The island's economy thrives on tourism, attracting over 3 million tourists in 2023, and is enriched by the presence of a university. The diverse mix of travelers (tourists, students and residents) and the widespread distribution of tourist sites underscore the necessity for a range of transportation options capable of navigating long distances and diverse landscapes, roles that ridesharing services could effectively fulfill.

Heraklion, in Crete, is markedly different with a significantly larger population of 305,017 that has slightly declined by 0.2% over the decade and it has a much higher population density of 1,247 per square kilometer. Heraklion's economy is multifaceted, with a balance of tourism, agriculture, and trade, reflecting a more constant year-round demand for transportation. The high population density and diverse economic activities present a ripe market for ridesharing, offering solutions for both regular travelers and tourist activities.

Access to the studied islands is provided through two main entry points: the airport and the port. However, once on the island, options for local transportation tend to be more restricted and less effective. **The public use transport market of Mykonos, Crete and Rhodes comprises several players competing or collaborating**, including:

- traditional taxis,
- public buses,
- private hire vehicle (PHV) with a driver,
- rental cars,
- and taxi boats (notably in Mykonos).

Local public bus services on Mykonos, Rhodes, and Heraklion offer extensive coverage but are plagued by infrequent trips and a lack of technological conveniences like real-time tracking. Mykonos has 15 routes and a fleet of 31 buses, Rhodes extends its network through 23 routes with 45 buses, and Heraklion operates 30 routes serviced by 60 buses, yet all face challenges in meeting peak season demand.

Regarding private transportation, Mykonos, Rhodes, and Heraklion offer car rental options, with **41, 60, and over 70 car rental companies** respectively, facilitating personalized travel. Both visitors and residents can access private transportation options, including renting private passenger cars or pre-booking a private hire vehicle (PHV) with a driver, following prior reservation of a minimum of six hours. This sector is notably robust and competitive among all examined islands.

Regarding **taxi services**, the situation is paradoxically constrained by both their availability and affordability. The table below delineates the taxi fleet size by region, alongside the daily availability of taxis per 10,000 travelers, unveiling notable variances across the islands under study. Mykonos exhibits the most pronounced seasonal fluctuation, with taxi daily availability decreasing from 28 taxis per 10,000 travelers in the first quarter to just 10 in the peak tourism season of the third quarter, underscoring a significant dependency on tourism. Rhodes displays a pattern akin to Mykonos, with taxi availability halving from the first to the third quarter. Conversely, Heraklion shows a gentler seasonal shift but a lower ratio of taxis per travelers, indicating a more stable service throughout the year.

The taxi sector in the examined areas is **further struggled** lacking modern systems for online bookings and tracking, which makes it less competitive and slower to respond to immediate needs. Consequently, this limited service utility results in an underperformance in meeting the dynamic transportation needs of the island's visitors. In this light, the integration of ridesharing services could offer a multifaceted solution.

Table 3. 13 Available taxis per day per 10,000 travelers in Mykonos, Rhodes and Heraklion, Crete

Island	Taxi Fleet	Available Taxis per day per 10,000 Travelers			
		Q1 2023	Q2 2023	Q3 2023	Q4 2023
Mykonos	31	28	14	10	22
Rhodes	367	29	20	16	26
Heraklion	671	22	19	17	21

In conclusion, despite variations in seasonal traveler influx, island size, and taxi fleet capacity across the Greek islands, there is a clear need to **improve the local road transport system**. Introducing ridesharing services could significantly contribute to overcoming economic and commuting challenges, offering a flexible and scalable solution to the transportation needs of these diverse island communities. Especially during the peak periods, ridesharing could meet the high road transport demand and improve accessibility by enabling both residents and visitors, including those with disabilities, to conveniently book their rides. It could offer a more cost-effective alternative to traditional taxis, which not only have higher per-kilometer costs but are also limited in number—a cap that often fails to meet the demand during tourist influxes.

Also, ridesharing has the potential to create **new employment opportunities** that can adapt to the seasonal fluctuations of the Greek islands. During the high season, the additional jobs could support the increased demand for transportation in the tourist-heavy regions, particularly in the South Aegean while during the off-peak periods (Q1 and Q4), the focus could shift to winter destinations of the country like Attica and North Central Greece.

By integrating ridesharing into the local transport ecosystem, the islands can ensure more equitable and efficient mobility solutions that adapt to the fluctuating needs of their economies and populations.

3.6 Summary

Ridesharing is among those services envisaged to contribute towards improving mobility conditions in urban areas. In this context, any ridesharing service would be added to the existing transportation players, in a recovering transportation market.

The survey on the state of mobility in Athens indicated that travelers are not satisfied by travel times and costs but exhibit a slightly higher satisfaction with taxi services. Contrarily, **parking access is the mobility aspect obtaining the lowest average satisfaction rate**. Also, travelers seem to have an idea of what ridesharing and Uber are all about and state that ridesharing services differ from taxis. Furthermore, survey participants state that they would use ridesharing in the future.

A mode-choice model was developed, and modal split was estimated for different scenarios of implementing ridesharing in the Athens area (full and light scenarios), following a market sampling approach. Results indicate that the introduction of ridesharing could reduce **private vehicle usage by 4.3%-5.3%**, while slightly affecting public transport ridership and taxi usage.

It is estimated that for year 2030, ridesharing could attract between **646,717and 772,373 daily travelers** on a typical day, including existing traveler mode shift, latent demand for ridesharing and additional seasonal demand attributed to tourist flows.

Beyond Athens, the **Greek islands** also demonstrate a need to enhance local road transportation services, primarily due to the significant seasonality in transport demand observed particularly during the second and third quarters of the year. Ridesharing services have the potential to enhance road transport service quality and cater to seasonal demand fluctuations, while also generating additional employment opportunities.

4 Impact Analysis

4.1 Economic Impact

This section offers a comprehensive analysis of employment and other economic impacts attributed to the introduction of ridesharing services in the Athens metropolitan area. Various aspects related to user costs, employment, tourism and the environment are discussed, based on available quantitative data and qualitative facts.

4.1.1 Employment

Several studies have reported impacts of ridesharing services to employment in the U.S.A. (Berger et al, 2017; Hall and Krueger, 2015), the Nordic countries (Stefansdoter, n.d.), France (Landier et al, 2016) and Egypt (Rizk, 2017). Indeed, a new service is expected to create new work opportunities if there is an adequate market to support it. Furthermore, barriers to entering the transportation market obviously have in impact to new job creation.

For the case of Athens, Table 4.1 summarizes the daily ridesharing vehicle trips per scenario for year 2030.

Table 4. 1 Anticipated ridesharing daily (vehicle) trips per scenario (year 2030)

	Scenario A (full)	Scenario B (light)
Vehicle Trips	380,422	454,337

Assuming an average of 20 and 12 daily rides for each driver for Scenario A and B respectively, Table 4.2 presents the number of **new, full-time equivalent job positions** which could be ideally created because of ridesharing.

Table 4. 2 Estimated full-time equivalent jobs created because of ridesharing services

	Scenario A (full)	Scenario B (light)
Full time equivalent jobs	380,422/20=19,021	454,337/12=37,861

Overall, ridesharing could generate between **19K and 38K full and part time equivalent jobs** in 2030, depending upon the licensing scenario considered.

On the other hand, reduction of **taxi usage** is expected to be low and partially compensated by the overall growth of the transport market by 2030. Indeed, in 2030 taxis were estimated to accommodate 7.3% of total person-trips (455,661 trips), while in 2030, about 6.5%-6.6% of total trips will be undertaken by taxis (469,462– 462,349 trips). This implies that reduction in taxi usage will not exceed 50,000 daily passengers for Scenario A and 57,000 daily passengers for Scenario B. Considering that a typical Athens taxi undertakes 20 rides per shift and an average of 1.5 travelers per ride (Spyropoulou, 2014), these figures correspond to **1,660 (Scenario A) - 1,897 (Scenario B) daily full time shifts** removed from the taxi industry.

However, these shifts are expected to **correspond to employees (and not taxi owners)**, who will eventually turn into ridesharing service providers. Furthermore, it should be noted that due to the cap in the number of Athens taxis, the taxi market cannot practically support the creation of new jobs. In this context, a net 19,021-1,660=**17,361** to 37,861-1,897=**35,965** equivalent full-time jobs are expected to be created by 2030.

Introduction of ridesharing services could possibly yield an additional net 17.4K to 36K equivalent full-time and part-time jobs respectively in the Athens metropolitan area by 2030. These jobs would be mostly created by travelers shifting from private cars to ridesharing.

It is noted that part of created jobs will be **seasonal**, especially those expected to accommodate transportation needs of tourists visiting Athens between May and September. Indeed, assuming 37M trips attributed to tourists (as indicated in paragraph 3.4.3.3), these correspond to about 247,000 daily rides during the tourist period (for a tourist period of 150 days and an occupancy of 1.7 travelers per ride) and 7,264 equivalent seasonal full-time jobs generated by tourists only. The city's growing tourist market could support the creation of equivalent full-time seasonal jobs in ridesharing services, during tourist peak periods.

4.1.2 Transportation System

The introduction of a new road transportation service will have an impact to the city's transportation system. Ridesharing has the advantage of higher occupancy over private cars and taxis (Stefansdotter et al., 2015), but may also attract travelers from (high occupancy) public transport.

In this context, as reported in section 3.4.2, an estimated 4.3%-5.3% of private vehicle users and another 0.7%-0.8% of taxi users will shift from private vehicles to ridesharing. Given that in Athens, private **vehicle occupancy** is estimated to 1.2 (IBI & NAMA, 2009) and taxi occupancy is on average 1.5 (Spyropoulou, 2014), a higher occupancy of ridesharing (assumed equal to 1.7) could yield some benefits with respect to produced vehicle trips. On the other hand, passengers shifting from public transport, as well as latent demand attributed to ridesharing are expected to create some additional vehicle trips. Table 4.3 presents vehicle trip estimates with and without ridesharing services for year 2030.

Table 4. 3 Daily Vehicle Trip Estimates for private cars, taxis and ridesharing (year 2030)*

	BAU Scenario	Scenario A (full)	Scenario B (light)

Private Car	3,562,460	3,313,503	3,248,300
Taxi	346,169	312,975	308,233
Ridesharing		380,422	454,337
Total	**3,908,629**	**4,006,899**	**4,010,870**
Difference	**-**	**98,270**	**102,241**
% Difference	**-**	**2.5%**	**2.6%**

*Vehicle trips per mode= Person trips per mode/ Vehicle occupancy per type

According to Table 4.3, a **minor increase of 2.5% to 2.6%** in vehicle trips is expected because of ridesharing; this is mostly attributed to latent demand and to a lesser extent to travelers shifting from public transport to ridesharing.

4.1.3 Urban Space

While there seems to be no reduction in vehicle trips because of ridesharing, there are still some environmental benefits attributed to ridesharing services. First, **demand for parking space** is reduced and urban space is made available for other uses. Considering that a curbside parking space requires on average 20 m^2 and a daily parking turnover rate of 3 vehicles per parking space (Rizomiliotis, 2009), total freed space for each ridesharing scenario is presented in Table 4.4 for year 2030:

Table 4. 4 Free urban space due to ridesharing (year 2030)

	Scenario A (full)	Scenario B (light)
Reduction in private veh-trips	248,957	314,160
Gain in urban space	248,957 x 20/ 3 = 1,659,715 m^2= **1.7 km^2**	314,160 x 20/ 3 = 2,094,402 m^2 = **2.1 km^2**

Savings in urban space are expected to be about 4.2-5.3% of the Athens downtown area (39.8 km^2) for year 2030. Roughly, saved space for year 2030 corresponds to two-way bikeways (2 m wide) of a total length of 900 km – 1130 km or bus lanes of a total length of 480 km – 600 km.

Second, **cruising vehicles seeking parking space will be reduced**; this can be roughly translated into carbon footprint savings attributed to the introduction of ridesharing. However, due to the absence of reliable data, no estimates on these savings are possible.

4.2 Personal Mobility Impact

This section discusses anticipated impacts of ridesharing in a person's mobility preferences; data from the survey and the mode-choice model are developed for that purpose.

4.2.1 Traveler Satisfaction

Data collected from the personal interview survey are used to capture anticipated mobility impacts for travelers. In this context, importance of trip attributes is captured; this is presented in Table 4.5.

Table 4. 5 Stated importance of attributes

Attribute	Not important	Somewhat Important	Important	Very Important	Extremely important
Cost	3.2%	3.8%	22.8%	30.6%	39.5%
Travel time	5.1%	1.6%	14.4%	37.0%	42.0%
Reliability	5.6%	4.3%	17.0%	34.9%	38.2%
Comfort	10.6%	4.5%	31.6%	20.0%	33.2%
Safety	3.3%	2.0%	14.4%	39.5%	40.8%
Flexibility	7.1%	2.8%	23.5%	21.0%	45.6%
Availability	3.0%	2.3%	12.2%	43.8%	38.7%

According to Table 4.5, **flexibility is the most important factor**, identified by respondents, followed by travel time, safety and cost. Clearly, real-time ridesharing, which is based on web-based applications, is suited towards offering flexible services and low travel times. Interestingly, comfort is of lesser importance to respondents.

Flexibility is important in the case of "last-mile" transportation, which often carried out by private cars. Ridesharing is ideal for a case, where flexibility is required in options for accessing or egressing from public transport.

4.2.2 Travel Time and Cost Savings

The market sampling exercise described in section 3.3.4 yielded average, system-wide travel times and costs for the BAU and ridesharing scenarios, which correspond to the consumer surplus attributed to the introduction of ridesharing services.

Related figures for travel time and travel cost are presented in Tables 4.6 and 4.7.

Table 4. 6 Average travel times for existing conditions and ridesharing scenarios.

	BAU Scenario	Scenario A (full)	Scenario B (light)
Average Travel Time (min)	38.15	36.20	35.54
% Savings	-	-5.10%	-6.84%

Table 4. 7 Average costs for existing conditions and ridesharing scenarios.

	BAU Scenario	*Scenario A (full)*	*Scenario B (light)*
Average Travel Cost (€)	2.82	2.66	2.61
% Savings	-	-5.61%	-7.37%

According to Table 4.7, daily travel time savings of 5.1% to 6.8% are estimated for ridesharing scenarios. On average, a **traveler gains** 1.95 min per trip for scenario A and 2.6 min per trip for scenario B, over the BAU scenario. Assuming an average value of time of 8 €/h (IBI and NAMA, 2009), there correspond to average typical day monetary savings of 1.7M € and 2.2M € for scenarios A and B. Similarly, for travel costs, both the full-licensed and light licensed ridesharing scenarios yield an increased average cost for travelers, over existing conditions. Annual user cost savings in that case would be approximately 374M € and 491M for year 2030 respectively.

4.2.3 A note on carpooling services

So far, the analysis has focused on real-time ridesharing services which allow exclusive usage of hired vehicles with drivers by a single passenger or a group of passengers. However, other ridesharing services, such as carpooling allow multiple hiring of vehicles in the same direction and thus exploit excess vehicle capacity.

Such services (for example UberPOOL) offer qualitative benefits both from a user and operator perspective. First and foremost, carpooling offers significant cost savings for travelers, with fares reduced by 40% compared to a standard real-time ridesharing fare. Further, carpooling helps to alleviate congestion in urban centers, as fewer vehicles are deployed to serve customers. Third, economies of scale are achieved by service providers as dead-head seat-km are minimized. Overall, carpooling provides a more sustainable alternative to private car service and contributes to the livability of urban centers by reducing the amount of transport-related greenhouse gas emissions.

4.3 Summary

The economic impact of ridesharing is estimated by combining existing mobility and transport related data for the Athens transport system and a specially designed mode choice developed as part of this study. To estimate personal mobility impact from introducing ridesharing services in Athens survey data was exploited. A further statistical analysis of traveler preferences and consumer surplus estimates for the two ridesharing scenarios were exploited for that purpose.

Results revealed that **ridesharing could offer up to an additional net 17.4K to 36K equivalent full-time and part-time jobs respectively** in the Athens area in 2030. Travelers will mostly shift from private cars and to a lesser extent from public transport. The taxi market will be marginally affected, as its share is currently low compared to the pre-crisis era. Furthermore, jobs expected to be lost in the taxi business will probably be replaced by equivalent jobs in ridesharing.

The **impact to the transport system on the other hand are marginal**, as gains in produced vehicle-trips due to reduced use of private vehicles and taxis are counterbalanced by latent demand and ridesharing trips generated from travelers shifting from public transport. As for urban space impacts, savings in parking space requirements are estimated to be equivalent to 4.2%-5.3% of the Athens downtown area.

Also, flexibility was found to be of particular importance to respondents; real-time ridesharing, which is based on web-based applications, is suited towards offering flexible services and low travel times. Ridesharing users savings with respect to **travel time** ranged from 5.1% to 6.8% by introducing ridesharing services; these corresponded to daily value-of-time related savings of 1.7M € and 2.2M € for scenarios A and B, and year 2030. Similarly, both ridesharing scenarios yielded user cost savings, which on an annual basis are estimated at around 374-491M €, for year 2030.

5. Socio-Economic Analysis

In this section socioeconomic analysis for the full deployment of ridesharing services in Athens is performed for a time horizon 2024-2030, following European Commission guidelines for Cost Benefit Analysis (CBA) of investment projects (Sartori et al., 2020). The sosio-economic analysis is conducted for the following two ridesharing scenarios: (a) a scenario requiring full licensing of services (Scenario A) and (b) a light-licensing scenario (Scenario B). For each alternative ridesharing scenario, the investment and operational cost with respect to ridesharing drivers as well as the following direct socio-economic benefits are considered and measured:

Costs (-)	Benefits (+)
C1 Initial Investment Cost	**B1 Ridesharing Users Surplus**
C1.1 Professional Driver License Fees	**B1.1** Travel Time Savings
C1.2 Vehicle Purchase Costs	**B1.2** Private Vehicle Operating Cost Savings (VOC)
C1.3 Administrative Costs (Starting a Car Rental Company)	**B2 Ridesharing Income tax**
C2 Ridesharing Service Costs	**B3 Externalities**
C2.1 Ridesharing Operational Costs	**B3.1** Reduction in Road Casualties
C2.2 Ridesharing Platform Costs	**B3.2** Environmental Impact (CO_2, NO_x)
C2.3 Vehicle Leasing	

Finally for each ridesharing scenario, appropriate economic performance indicators are derived for assessing the economic performance of introducing ridesharing services in Athens.

5.1 Traffic Conditions in Athens

To carry out the socio-economic analysis, key traffic indicators were collected and exploited using the Athens Urban Transport Organization (OASA) travel demand model for the Athens metropolitan area. The demand analysis is carried out based on the developed mode choice model presented earlier.

The following table summarizes the main traffic performance indicators by transport mode in 2019 used in the current analysis (derived by the OASA travel demand model).

***Table 5. 1** Traffic indicators in Athens metropolitan area in 2019 (Source: OASA traffic simulation model)*

	Person-Trips	Veh-km	Person-hours
Private Cars	1,642,422,313	10,837,786,751	410,970,765
Taxi		877,804,343	33,286,494
Public Transport (O.S.Y.& Urban Rail Transport)		130,408,025	584,080,800

Traffic data from the OASA travel demand model for 2019, combined with GDP forecasts for Greece through 2030, provide the basis for calculating traffic conditions in the metropolitan area of Athens for 2024, the initial year of analysis. Taking into account the **percentage changes in mode choice** from current conditions (BAU scenario), as detailed in Table 3.5, traffic conditions for ridesharing scenarios in the first year of analysis are estimated.

***Table 5. 2** Vehicle-kilometers by mode and scenario in Athens metropolitan area in 2024*

	BAU scenario	Scenario A (full)	Scenario B (light)
Private Cars	11,596,431,824	11,109,381,687	10,981,820,937
Taxi	939,250,647	932,675,893	931,736,642
Public Transport (O.S.Y.& Urban Rail Transport)	139,536,587	139,536,587	139,536,587
Ride Sharing	0	493,624,891	622,124,892
Total	**12,675,219,058**	**12,675,219,058**	**12,675,219,058**

***Table 5. 3** Person-trips by mode and scenario in Athens metropolitan area in 2024*

	BAU scenario	Scenario A (full)	Scenario B (light)
Private Cars	1,056,192,517	982,382,058	963,050,748
Taxi	128,289,607	115,987,864	114,230,472
Public Transport (O.S.Y.& Urban Rail Transport)	572,909,751	532,489,738	525,460,171
Ride Sharing	0	126,532,215	154,650,485
Total	**1,757,391,875**	**1,757,391,875**	**1,757,391,875**

For the estimation of the traffic conditions in Athens with and without the introduction of the ridesharing for the years 2024-2030 the following **assumptions** were made:

- The traffic conditions in the Athens metropolitan area in 2024 are projected using 2019 traffic conditions and the GDP growth forecast.
- The demand and supply (veh-km, person hours and trips) system remain the same across all scenarios.
- Mode shares remain relatively constant up to year 2030.

- Forecasts are made for 2030 using the NTUA traffic simulation model (NTUA, 2021) and linear interpolation was used to forecast the remaining years. The following annual traffic increase is assumed:
    - 1.7% for private cars and taxi trips
    - 2.05% for the person-hours
    - 1% for the veh-km
- For ridesharing trips an annual increase of 2.6% is assumed, 1.5 as high as the other transport modes under consideration.
- Public Transport vehicle kilometers (veh-km) and vehicle hours (veh-h) do not change because of the introduction of ridesharing services.

5.2 Travel Time Savings

Travel time savings refer to the monetized time gains because of traffic diverted to ridesharing services. In the current analysis, the annual impacts on the diverted travel time from private cars (PC), taxi, Public Transport to ridesharing cars as well as the Value Of Travel Time (VOT) are taken into account.

The remaining private car, taxi and PT users will not experience time savings, since it is expected that the ridesharing services will not improve road capacity and travel times for these modes. The figure below summarizes the impact on travel time, in person trips for the first year of operation.

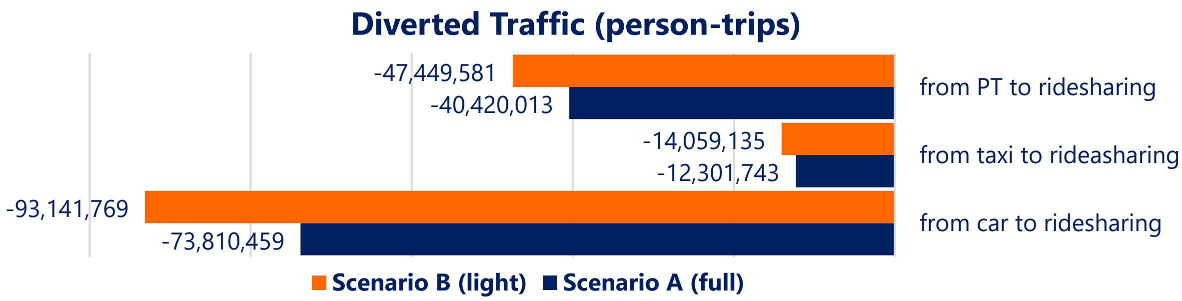


Figure 5. 1 Diverted traffic in person trips to ridesharing services

The annual travel time savings are estimated using the following equation in which **i** represents the transport mode under consideration (i= private car, Public Transport).

$$\textbf{Travel Time Savings}\ (€/year) = \sum_i \left(\frac{Diverted\ Person - trips}{year}\right)_i * \left(\frac{Travel\ time\ saving}{trip}\right) * (VOT)_i$$

The **travel time saving per trip** for the diverted users from private cars to ridesharing cars is assumed to be equal with the average parking search time per trip in Athens. Also, the travel time saving per trip for the diverted users from Public Transport to ridesharing cars is assumed to be equal with the estimated average travel time difference from the market sampling approach. Regarding the diverted traffic from taxis, it is assumed that no time savings will occur.

Regarding **Greece, the VOT for passengers** commuting with private car for the purpose of work is 9 €/ hour while for other purpose is 4.1 €/ hour (Schroten et al., 2019). Taking into account that the distribution of distance travelled for work, education and for other purpose in Greece is 58% and 42%, respectively (Eurostat, 2021), it is estimated that the weighted average of the VOT for passengers is 6.74 €/ hour. It is generally recommended that value of both work and non-work time be treated as increasing over time in proportion to GDP per capita, unless there is local evidence to the contrary. For the sake of prudency, it is however recommended to use the lower elasticity values illustrated above: 0.7 and 0.5 for, respectively, work and non-work time (Sartori et al., 2020).

Table 5. 4 *Parameters for the estimation of travel time savings*

Parameter	Value	Source
$VOT_{PrivateCar}$ for work	9 €/ h	Schroten et al., 2019
$VOT_{PrivateCar}$ for other purposes	4.1 €/ h	Schroten et al., 2019
Share of trips by travel purpose:	58% work trips 42% non-work trips	Eurostat, 2021
$VOT_{PrivateCar}$ / VOT_{PT}	1	Assumption
Escalation factor for VOT	GDP per capita growth, with elasticity factor of 0.7	Sartori et al., 2020
Travel time saving for Private Car	10 min/ trip	Deloukas et al., 2020
Travel time saving for PT	27.7 min/ trip	Market sampling

5.3 Vehicle Operating Costs (VOCs)

Vehicle Operating Costs (VOCs) are defined as the costs borne by owners of road vehicles to operate them, including fuel consumption, lubricants consumption, tires deterioration, repair and maintenance costs, etc. (Sartori et al., 2020). This section presents the avoided VOCs for the users switching from private cars to ridesharing services (diverted users) as well as the generated VOCs for the ridesharing drivers due to the introduction of the ridesharing services in Athens.

Fuel consumption is expressed as the fuel in liters required for a vehicle to travel a distance unit (liters/100 km). The **annual fuel cost consumed** by the vehicles in each scenario is estimated with the following equation in which **i** represents the mode of transport (i= private car, and ridesharing car).

$$\boldsymbol{Fuel\ Cost}\ (€/\boldsymbol{year}) = \sum_i \left(\frac{€}{\text{litre}}\right)_i \times \left(\frac{Veh-km}{year}\right)_i \times \left(\frac{\text{litres}}{veh-km}\right)_i$$

For the estimation of the average **fuel consumption of a private car, and a ridesharing car** the average age of the fleet of each transport mode is considered for the case of Athens along with fuel economy standards for passenger cars. Figure 5.2 shows the European fuel economy standards for new registered passenger cars in terms of liters per 100 km adjusted to the European NEDC test cycle. All fuel economy values presented in gasoline equivalent units.

According to ACEA, 2021 report, the **average age** of private passenger cars in Greece is 16 years while the current fleet of ridesharing cars in Greece is assumed to be of a newer technology with an average age of 10 years. It is also assumed that the fleet average age will remain constant up to 20230.

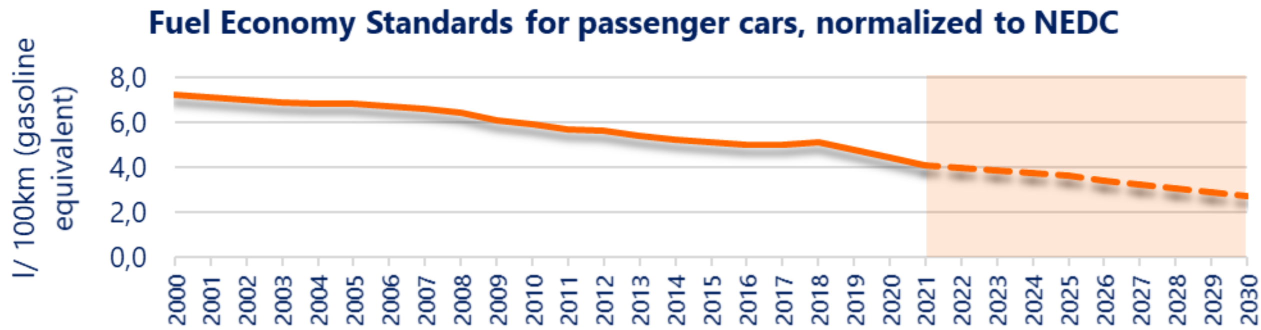


__Figure 5. 2__ Fuel economy standards for passenger cars, normalized to NEDC cycle (Edit: NTUA, Source: Yang, Z. and Bandivadekar, A., 2017)

The following figure was taken into account to calculate the fuel consumption for diverted traffic from private cars to ridesharing services and for ridesharing drivers.

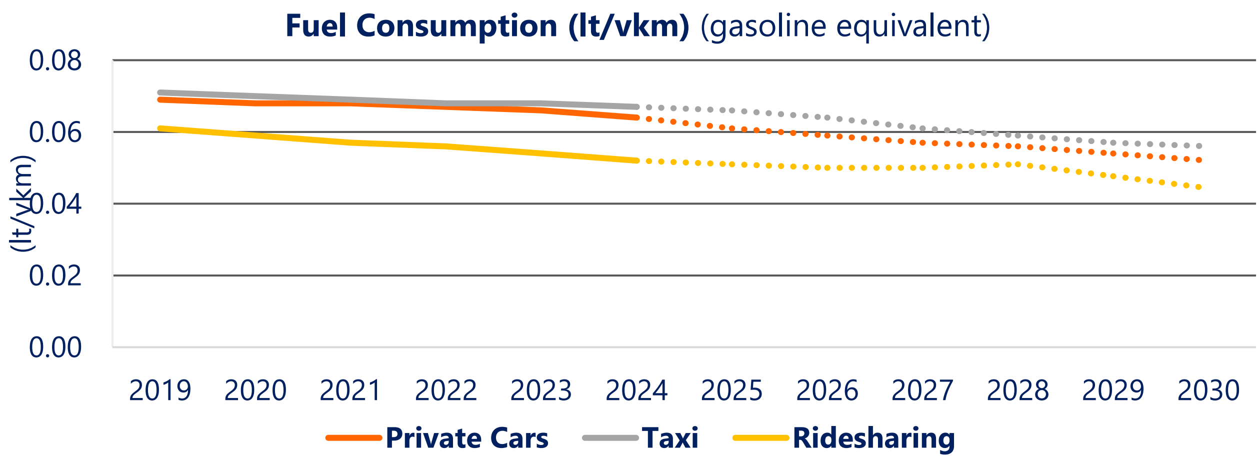


__Figure 5. 3__ Average fuel consumption (lt/vkm) for private cars and ridesharing cars

In order to calculate the annual cost of fuel consumption in Athens by private cars, and ridesharing cars in each scenario, it is necessary to collect the **gasoline prices** in Athens for the year 2022. Since fuel prices are influenced by various technical, political and economic factors, the price escalation over time is difficult to assess. However, according to Sartori et al.(2020), by taking into account the evolution of the efficiency on the vehicles' consumption, no price escalation is suggested.

For the purposes of the analysis, an **average price of 95 octane gasoline for the analysis period 2024-2030** of 1.8 €/l (plus VAT) is taken into account. The final retail price (shadow price) of gasoline is derived by imposing the fuel taxes (oil refinery cost, State's petroleum fee, Regulatory Authority for Energy fee, VAT etc.) (ACEA, 2021) and is estimated equal to 0.8 €/l.

Non-fuel VOCs include the costs of oil, tires, maintenance and repairs, and depreciation. The **costs of tires and maintenance** represent a relatively small share of the total transport costs (Persyn et al., 2019; Zofío et al., 2014). Specifically, it is assumed that tire and maintenance costs for all trips are related to fuel costs in the same proportion. Thus, it is assumed that for every euro spent on fuel during a trip, tireCS=0.17 additional euros are spent on tires and maintCS=0.15 euros are spent on maintenance costs (Persyn et al., 2019; Zofío et al., 2014).

Therefore, the following **parameters** have been adopted for the estimation of VOCs for ridesharing drivers and avoided VOCs for the users switching from private cars to ridesharing services.

Table 5. 5 *Parameters for the estimation of VOCs*

Parameter	Value	Source
Gasoline shadow cost	0.9 €/l	ACEA, 2021a
Av. age of private cars in Athens	16 years	ACEA, 2021b
Av. age of ridesharing cars in Athens	10 years	Assumption
Fuel consumption for private car	Figure 6. 3	Yang, Z. & Bandivadekar, A., 2017
Fuel consumption for ridesharing car		
Tires cost/ Fuel consumption cost	17%	Persyn et al., 2019; Zofío et al., 2014
Maintenance cost/ Fuel consumption cost	15%	

5.4 Externalities

5.4.1 Road Crashes Costs

The economic benefit arises not only as a result of directly improving the road safety conditions, but also indirectly, e.g. by diverting passengers to other **safer modes**. This benefit should be included in the economic analysis, distinguishing between fatalities, severe injuries and slight injuries avoided.

To calculate the economic impact on road safety from the full deployment of ridesharing services in Athens, the number of road fatalities and injuries in each scenario as well as the Value of Statistical Life (VOSL) are taken into account.

The following table presents the total number of road fatalities, serious and light injuries in the Region of Attica in 2019, according to recently published EL.STAT data.

Table 5. 6 Number of road casualties by severity and transport mode, Attiki, 2019 (Source: ELSTAT, Data Processing: NTUA)

	Fatalities	Serious Injuries	Slight Injuries
Private Passenger Car	32	47	1.473
Public Passenger Car	1	0	90
Public Transport (City Bus)	0	0	47

Taking into consideration the number of road casualties by severity and transport mode, in the Region of Attica, and the veh-km by mode of transport (Table 5.1), the following risk indicators are estimated. For ridesharing services it is assumed that they are as safe as taxis, mainly due to the fact that the ridesharing and taxis drivers are professional drivers.

Table 5. 7 Risk indicators by transport mode

	Light Injuries/ mil. veh-km	Serious Injuries/ mil. veh-km	Fatalities/ 10^6 mil. veh-km
Private Car	0.136	0.004	0.003
Taxi	0.103	0.000	0.001
Public Transport	0.360	0.000	0.000
Ridesharing	0.103	0.000	0.001

Kourtis et al. (2018) calculated the unit prices for each type of crash as presented in the following table. It is highlighted that the costs of crash victims suggested are in line with the other similar calculations in Europe, such as the European H2020 project SafetyCube in collaboration with the project InDeV (Wijnen et al., 2018; InDeV, 2016), where the road crash costs where estimated for 31 European countries, and found that total costs per fatality range from 0.7M€ to 3M€, with Greece being in 9th place, with a cost around 2M€ (ITF, 2020).

Table 5. 8 Cost of crash victims per severity category

Cost (Euros 2016)	Per fatality	Per serious injury	Per slight injury
A. Material Damage cost	**10,128. 39 €**	**6,492. 07 €**	**5,937.83 €**
B. Generalised cost	**376,751.43 €**	**38,195.10 €**	**27,823.32 €**
Police	3,919.08 €	1,419.95 €	1,561.82 €
Fire brigade	473.04 €	410.89 €	147.87 €
Insurance companies	15,247.94 €	9,797.11 €	7,949.01 €
Court cost	48,650.98 €	8,562.16 €	1,226.14 €
Lost production output	308,376.00 €	4,680.62 €	780.10 €
Rehabilitation	0.00 €	10,760.00 €	12,170.00 €
Hospital Treatment	0.00 €	2,480.00 €	3,904.00 €
First aid & Transportation	84.38 €	84.83 €	84.83 €
C. Human cost	**1,761,154.39 €**	**228,950.07 €**	**17,611.54 €**
Total cost (A+B+C)	**2,148,034.20 €**	**273,574.25 €**	**51,372.70 €**

It is noted that based on the analysis of road crashes trends in Greece and Europe (nrso.ntua.gr/data/), the road fatalities and injuries in Greece are estimated to **decrease annually by 2.5%**. Specifically, the number of road fatalities and injuries observed in Greece is expected to decrease annually by 2.5%, which has resulted from the evaluation of road safety data per year for the countries of the European Union. This assessment to improve road safety takes into account future improvements in vehicle technology, driving behavior and road infrastructure.

5.4.2 Environmental Impacts

Transport investments can considerably affect **air quality and climate change** either by reducing or increasing the level of air pollutant and GHG emissions. With respect to transport, the main GHG emissions are carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) while the main air pollutants are particles (PM_{10}, $PM_{2.5}$), acidifying pollutants (NO_x, SO_2) and ammonia (NH_3) (Sartori et al., 2020).

The air pollutant and GHG **emissions investigated in this study** are nitrogen oxides (NO_x) and carbon dioxide (CO_2), respectively. To estimate the total volume of emissions additional generated or avoided from the full deployment of ridesharing services in Athens, the following parameters are taken into account:

- annual veh-km per mode
- emission factors expressed in gr/ km
- unit costs per pollutant expressed in €/ ton

The annual environmental cost of vehicles in each scenario is calculated with the following equation in which **i** represents the mode of transport (i= private car, taxi, and ridesharing).

$$\boldsymbol{Environmental\ Cost}\ (€/\boldsymbol{year}) = \sum_i \left(\frac{€}{\text{ton of pollutant}}\right) \times \left(\frac{Veh - km}{year}\right)_i \times \left(\frac{\text{tones of pollutant}}{km}\right)_i$$

The following table shows the **emission factors** for NO_x and CO_2 for **private cars, taxi and ridesharing cars**. The exhaust emission factors expressed in gr/km. The NO_x factors forecast for the next decade takes into account that the vehicles technology is renewed every five years through the introduction of new European emission Standards (Euro Class). The CO_2 factors forecast takes into account the fleet-wide targets for 2025 and 2030 for the CO_2 performance of new passenger cars in Europe, namely a 15% reduction from 2021 emission levels by 2025 and a 37.5% reduction by 2030 (EU Regulation, 2019).

***Table 5. 9** Exhaust emission factors for CO_2, PM and NO_x for private cars, taxi and ridesharing vehicles (2020-2030) (Source: Yang and Bandivadeka., 2017; EEA, 2019)*

Year	Private Cars		Taxi		Ridesharing cars	
	CO_2	NO_x	CO_2	NO_x	CO_2	NO_x
	gr/ vkm		gr/ vkm		gr/ vkm	
2022	163.4	0.0020	167.2	0.0020	140.3	0.0020
2023	162.4	0.0020	165.5	0.0020	135.7	0.0013
2024	161.3	0.0020	163.4	0.0020	132.2	0.0013
2025	158.7	0.0020	162.4	0.0020	126.7	0.0013

2026	153.5	0.0020	161.3	0.0020	123.4	0.0013
2027	145.7	0.0020	158.7	0.0020	119.5	0.0013
2028	140.3	0.0020	153.5	0.0020	118.1	0.0013
2029	135.7	0.0013	145.7	0.0020	118.5	0.0013
2030	132.2	0.0013	140.3	0.0020	120.8	0.0013

A reduction of the environmental burden is expected due to traffic diversion from private cars and taxis to ridesharing cars, which generate a reduction of air pollutant emissions mainly due to the newer technology of ridesharing cars.

To sum up, the following **parameters** have been adopted for the estimation of the reduction of the environmental burden due to the introduction of ridesharing services in Athens.

Table 5. 10 *Unit cost of the pollutants (€/ton of pollutant) for 2022*

Parameter	Value	Source
Shadow cost of CO_2	114 €/ ton	DG CLIMA, 2021
Shadow cost of NO_x	5,100 €/ ton	Korzhenevych et al., 2014

5.5 Investment Costs

In the current socio-economic analysis **two alternative scenarios** are considered for introducing ridesharing services, Scenario A (fully licensed service provision) and Scenario B (light licensed service provision). Scenario A assumes that ridesharing services are offered by car-rental companies and travel agencies, as a car-hiring service with professional drivers. On the other hand, Scenario B considers ridesharing services offered by properly licensed individuals in the form of small businesses.

Considering the **different business structure** of each scenario under consideration, the initial investment cost is estimated taking into account the following costs.

Table 5. 11 *Investment costs*

Costs	Description/ Equation	Scenario A (full)	Scenario B (light)
Professional driver licenses	$= (\text{New ridesharing drivers}) \times (\text{License cost})$	●	
New Car purchase	$= (\text{Av. shadow price of a new } passenger \text{ car}) \times (\text{Ridesharing drivers}) \times (\text{\%Drivers who will buy a new car})$		●
Market entrance	$= (\text{Ridesharing drivers}) \times (\text{Market entrance } fee)$		●

The following **parameters** have been adopted for the estimation of the initial investment cost for ridesharing drivers.

Table 5. 12 Parameters for the estimation of initial investment cost

Cost	Parameter	Description	Value	Source
Professional driver licenses	**Professional driver license cost**	The license cost includes specific fees	300 €	Market research
Buy new ridesharing cars	**Average Net Retail Price of an new passenger car in Greece, 2019**		23,500€	Statista, 2022
	Shadow price of new passenger car	Excluding 24% VAT of the net retail price of a new passenger car and the registration tax	14,107 €	Market research; ACEA, 2021a
	Drivers who will buy a new passenger car	Ridesharing drivers who will buy a new passenger car in case they don't have already one which meet minimum requirements (1st registration, seats etc.)	70%	Assumption
Market entrance	**Market entrance fee**	Administrative and licensing costs	1,000 €	Market research

5.6 Ridesharing Driver Costs

Considering the different business structure of each scenario under consideration, the operational cost is estimated taking into account the following costs.

Table 5. 13 Operation costs for ridesharing drivers

Costs	Description/ Equation	Scenario A (full)	Scenario B (light)
VOCs	This cost includes the fuel, maintenance & tires costs for ridesharing drivers.	●	●
Platform fee	$= (\text{Platform fee\%}) \times (\text{Shadow ride cost}) \times (\text{Ridesharing veh} - \text{trips})$		●
Leasing	$= (\text{Ridesharing drivers}) \times (\text{Leasing cost}) \times (\text{Leasing months/year}) \times \left(\frac{\text{Drivers}}{\text{Leasing}}\right)$	●	●

In Scenario A (full) which assumes that ridesharing services undertaken by companies hiring private vehicles with drivers, the ridesharing drivers lease cars from these companies. However, Scenario B (light) considers licensed, self-employed individuals offering these services with their private car, which meet some minimum requirements (1st registration, number of seats etc.). Given that leasing offers financial coverage on the car maintenance & tires costs, in Scenario A (full) these costs are deducted from VOCs since they have been taken into account in the leasing cost per month.

The following **parameters** have been adopted for the estimation of the operational cost for ridesharing drivers.

Table 5. 14 Parameters for the estimation of operation costs for ridesharing drivers

Cost	Parameter	Description/ Equation	Value	Source
Platform fee	**Platform fee %**	The platform fee is what ridesharing drivers pay the ridesharing platform to use it per ride.	20-25%	Market research
	Shadow ride cost	$= (\text{Conversion factor for shadow wage for Athens})x(€/\text{ trip})$		
	Conversion factor for shadow wage for Athens		0.8	Sartori et al., 2020
	Income taxation for taxi drivers		13%	Market research
	€/ trip	Scenario A	14	Mode choice model
		Scenario B	12	
Leasing	**Ridesharing drivers**	$= (\text{Person} - \text{Ridesharing Trips})/(\text{Av. Occupancy}) /(\text{Average daily rides for each driver})$		
	Av. daily rides for each ridesharing driver	Scenario A	20	Assumption
		Scenario B	12	
	Leasing cost (€/month)		600	Market research
	Drivers/ Leasing		60%	Assumption

5.7 Economic Evaluation

To estimate the economic performance of the two ridesharing scenarios, the socioeconomic benefits from the operation of ridesharing services in Athens and the investment and operational costs with respect to ridesharing drivers are quantified up to 2030.

The resulting flows and their present values for each ridesharing scenario are shown in the following tables.

Table 5. 15 Economic performance of Scenario A (full)

Costs & Benefits		NPV (5%)	2023	2024	2025	2026	2027	2028	2029	2030
				Ridesharing Operation						
C1 Initial Investment cost	mEUR	-4.8	-5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1.1 Professional driver licenses	mEUR	-4.8	-5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1.2 Buy new cars	mEUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1.3 Starting Rental Car Company	mEUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C2 Ridesharing Drivers Costs	mEUR	-1,800.5	0.0	-306.0	-313.0	-320.2	-328.1	-336.5	-343.2	-350.1
C2.1 VOCs	mEUR	-121.6	0.0	-22.5	-22.3	-22.1	-22.3	-23.0	-21.7	-20.4
C2.2 Platform	mEUR	-1,246.1	0.0	-210.4	-215.8	-221.3	-226.9	-232.7	-238.7	-244.8
C2.3 Leasing	mEUR	-432.7	0.0	-73.1	-74.9	-76.9	-78.8	-80.8	-82.9	-85.0
Total economic costs	mEUR	-1,805.3	-5.1	-306.0	-313.0	-320.2	-328.1	-336.5	-343.2	-350.1
B1 Ridesharing Users Surplus	mEUR	1,037.7	0.0	175.6	179.7	184.3	188.9	194.0	198.7	203.3
B1.1 Travel Time	mEUR	853.4	0.0	139.7	145.1	150.5	155.8	161.3	166.7	172.3
B1.2 VOCs	mEUR	184.3	0.0	36.0	34.6	33.8	33.0	32.8	31.9	31.0
B2 Ridesharing Income tax (13%)	mEUR	716.8	0.0	121.0	124.1	127.3	130.5	133.9	137.3	140.8
Externalities	mEUR	53.5	0.0	10.0	10.0	9.9	9.5	9.0	8.2	11.3
B3 Road Accidents	mEUR	42.7	0.0	7.8	7.8	7.8	7.8	7.7	7.7	7.6

Costs & Benefits		NPV (5%)	2023	2024	2025	2026	2027	2028	2029	2030
				Ridesharing Operation						
B4 Environment	mEUR	10.8	0.0	2.2	2.2	2.1	1.8	1.3	0.5	3.7
Total economic benefits	mEUR	1,808.0	0.0	306.7	313.8	321.4	328.9	336.9	344.1	355.5
ENPV / Net benefits	mEUR	2.7	-5.1	0.7	0.8	1.2	0.9	0.4	0.9	5.3
IRR		15%								

Table 5. 16 *Economic performance of Scenario B (light)*

Costs & Benefits		NPV (5%)	2023	2024	2025	2026	2027	2028	2029	2030
				Ridesharing Operation						
C1 Initial Investment cost	mEUR	48.0	-374.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1.1 Professional driver licenses	mEUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1.2 Buy new cars	mEUR	-324.1	-340.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C1.3 Starting Rental Car Company	mEUR	-32.8	-34.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C2 Ridesharing Drivers Costs	mEUR	-1,467.2	0.0	-251.0	-256.1	-261.3	-267.5	-274.5	-278.3	-282.4
C2.1 VOCs	mEUR	-201.8	0.0	-37.3	-37.0	-36.6	-37.0	-38.1	-36.0	-33.8
C2.2 Platform	mEUR	-1,265.5	0.0	-213.7	-219.2	-224.7	-230.5	-236.3	-242.4	-248.6
C2.3 Leasing	mEUR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total economic costs	mEUR	-1,824.1	-374.7	-251.0	-256.1	-261.3	-267.5	-274.5	-278.3	-282.4
B1 Ridesharing Users Surplus	mEUR	1,275.3	0.0	216.0	220.9	226.5	232.1	238.4	244.0	249.7
B1.1 Travel Time	mEUR	1,042.7	0.0	170.7	177.3	183.8	190.4	197.0	203.7	210.5
B1.2 VOCs	mEUR	232.6	0.0	45.4	43.7	42.7	41.7	41.3	40.3	39.2
B2 Ridesharing Income tax (13%)	mEUR	727.9	0.0	122.9	126.1	129.3	132.6	136.0	139.4	143.0
Externalities	mEUR	58.8	0.0	11.1	11.0	10.9	10.5	9.8	8.8	12.5
B3 Road Accidents	mEUR	45.2	0.0	8.3	8.3	8.3	8.2	8.2	8.1	7.8
B4 Environmental impacts	mEUR	13.6	0.0	2.8	2.7	2.6	2.2	1.6	0.7	4.7
Total economic benefits	mEUR	2,062.0	0.0	350.1	358.0	366.7	375.1	384.1	392.2	405.1
ENPV / Net benefits	mEUR	237.9	-374.7	99.1	101.9	105.3	107.6	109.7	113.9	122.8
IRR		21%								

It is observed that both ridesharing scenarios yield positive Net Present Value and Internal Rate of Return indicators, which are greater than the considered social discount rate (5%). However, **Scenario B (light) is more desirable** than Scenario A (full) since it shows the highest NPV and IRR indicator and therefore the best economic performance over time.

The following chart illustrates the weight of the benefit categories in the overall impact.

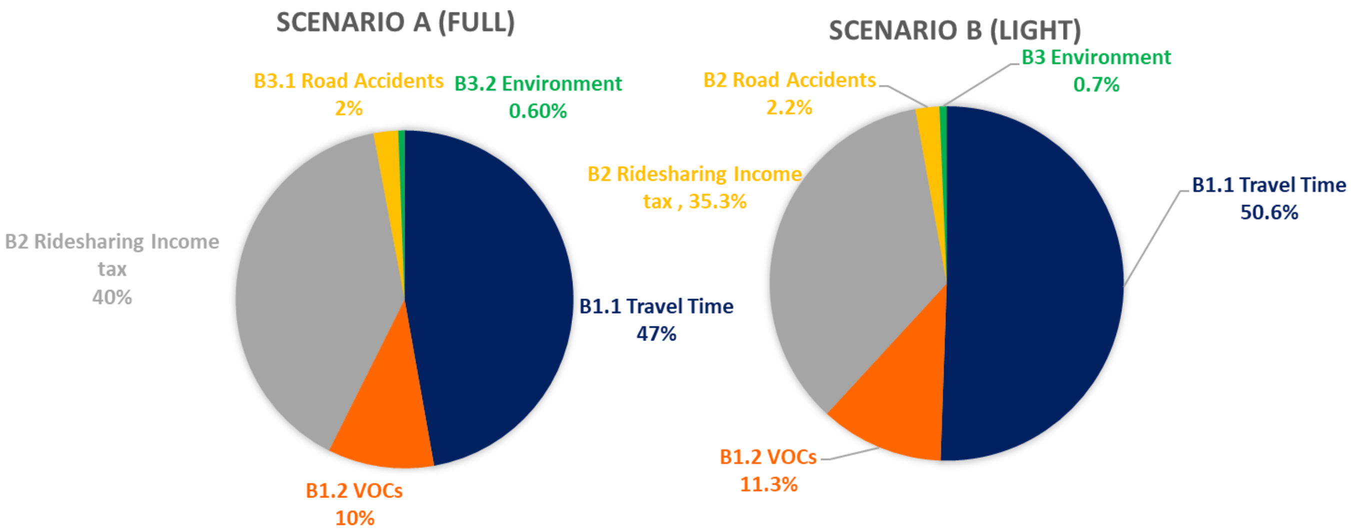


Figure 5. 4 *The weight of the benefit categories in the overall impact*

The above figure shows that the diverted travel time mainly from private cars to ridesharing cars causes the most important economic benefit (40%-50%), compared to the overall impact.

A **sensitivity analysis** is undertaken to understand the impact of a range of input variables on the IRR index for Scenario B (light). The following table presents the sensitivity analysis considering as input variables, the annual percentage change of private cars trips and ridesharing trips.

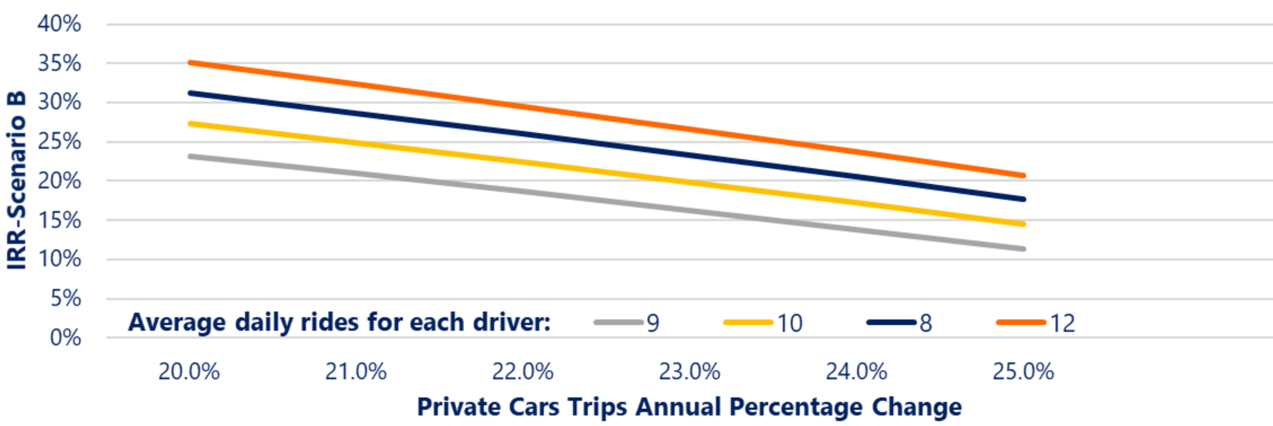


Figure 5. 5 *Sensitivity Analysis – Platform fee/ ride and average daily rides for each driver*

As can be seen from Figure 5.5, the IRR index decreases as the platform fee increases while the IRR index increases as the considered average daily rides for each driver decrease. However, it is observed that the IRR index remains positive and greater than the considered social discount rate (5%).

6. Conclusion

The scope of this study is the **socioeconomic and market analysis for the full deployment of real-time, fee-based ridesharing services in Athens**. Within the context of the study, possible, generated opportunities of the city's economic and social development, deriving from ridesharing services are explored and discussed. The objective of this study is the assessment of ridesharing impacts in the economy and society of Athens.

Socio-economic conditions of the decade have had a strong impact to the mobility conditions and transportation services in Greece and more precisely, in the Athens metropolitan area. While vehicular traffic seems to recover, alternative transportation modes (particularly public transport) are still challenged. The taxi market is strongly regulated and limited (if any) options are available for attracting travelers to taxis.

Current mobility services in the Athens metropolitan area tend to create preferential conditions for private vehicles traffic. Innovative mobility services could act as an additional barrier towards private vehicle usage, possibly combined with improving performance of the city's public transportation system. In addition, such services could possibly allude spatio-temporal supply gaps in the city's transportation system.

Ridesharing is among those services considered by the users to contribute towards improving mobility conditions in the Athens metropolitan area. Therefore, opportunities of ridesharing if it is added to the existing transport players of the city, in a recovering transportation market, are worth investigating.

As part of this study, **a survey on the state of mobility in Athens** revealed the following:

- Athens travelers are not very satisfied by travel times and costs but exhibit a slightly higher satisfaction with taxi services.
- Parking access is the mobility aspect obtaining the lowest average satisfaction rate.
- Travelers seem to have an idea of what ridesharing is and state that ridesharing services differ from taxis.
- Travelers reported that they would be willing to use ridesharing services in the future.

A **mode-choice model** was developed for assessing the impacts of introducing ridesharing services in Athens. Following a market projection approach, the model was applied to two ridesharing scenarios: (a) a scenario requiring full licensing of services (Scenario A) and (b) a light-licensing scenario (Scenario B) following the example of Estonia.

The analysis revealed that ridesharing services could attract from 647K to 772K daily travelers by year 2030, depending upon the ridesharing scenario considered. This is translated to 380-454K daily vehicle rides. Also, travelers would mostly shift from private car usage (4.3% to

5.3%) and to a much lesser extend by public transport (2.1%-2.7%) and taxis (0.7%-0.8%). While being a substitute mode for ridesharing, taxis do not seem to be significantly affected.

The **impact analysis** offered insights on the potential impacts of introducing ridesharing services in employment, the transportation system and the urban space. Key findings are the following:

- The number of new equivalent full-time jobs generated in Athens by ridesharing could reach 17.4K to 36K equivalent full and part-time jobs respectively, by 2030.
- Jobs will be mostly created by the market shifting from private cars to ridesharing while the impact to taxi employment will be minimal.
- The change in vehicle trips is marginal, as reduction in private vehicle trips is counterbalanced by produced trips due to latent demand and travelers shifting to ridesharing from public transportation.

With respect to **personal mobility attributes** such as travel cost, time, safety, comfort and so on are obviously of importance to travelers. In Athens, ridesharing would have a net positive impact on personal mobility, by offering faster and lower cost services compared to the other transport modes. Depending upon the ridesharing scenario considered systemwide travel time savings range from 5.1% to 6.8%. These correspond to daily value-of-time related savings of 1.7M € and 2.2M € for year 2030. As for cost savings, these are estimated to be 5.6% and 7.4% per scenario and correspond to annual values of 374M € and 491M for year 2030 respectively.

Based on the **socioeconomic results**, the diverted travel time from private cars to ridesharing yields the most important economic benefit (40%-50%), compared to the overall impact. The avoided VOCs for users switching from private cars to ridesharing services are also considerable. It should be noted that the ridesharing costs that are taken into account in this socioeconomic analysis are the costs that ridesharing drivers are required to cover annually the operation of ridesharing services in Athens. These investment and operational costs are determined to a large extent by the car leasing cost and platform fee per ride in Scenario A and by the platform fee per ride and the occasional purchase of a new ridesharing car in Scenario B.

To sum up, the socioeconomic analysis outcomes shows that the introduction and operation of both ridesharing scenarios for the period 2024-2030 **contribute to social welfare** since they show a positive NPV and a high IRR indicator. However, Scenario B (light) is more desirable than Scenario A (full) since it shows the highest NPV=237M€ and IRR=21% and therefore the best economic performance over time. Also, even in extreme price changes over a 7-years period, the IRR remains positive, ensuring the feasibility of the investment.

In Greece, real-time ridesharing services are currently under **restricting regulatory schemes**, which somehow limit the potential of implementing a shared economy. However, this study shows that the introduction of ridesharing in Athens, in a fair regulated manner, could benefit the economy and the society by creating new jobs, have a marginal impact to the transportation system and offer a better environmental and life quality. As for personal mobility impacts, ridesharing services seems to offer gains with respect to consumer surplus of travelers in the city. Overall, the outcome of this study could be useful in a possible discussion for the further development of ride sharing services in Athens and possibly other regions like the Greek islands.

Alongside Athens, the Greek islands are also witnessing a need for ridesharing services to improve the local road transport service, particularly in light of a significant 20% increase in tourist arrivals compared to the previous year, 2022. The transportation needs vary widely across the islands, yet a common challenge emerges: local road transport services struggle to meet transportation demand due to high seasonality. While traditional taxis, public buses and rental cars have long been the mainstay of public use transportation within these islands, the need for more flexible, efficient, and cost-effective travel options is increasingly apparent. The availability of taxis is critically low, with Ionian islands and South Aegean islands, including the islands of Rhodes and Mykonos, dropping to only 12 taxi available per day and per 10,000 travelers during July to September. Crete exhibits the lowest ratio of available taxis per travelers compared to other islands and is also lower than the national average. This low availability, coupled with the stringent taxi market regulations and the inadequate frequency and coverage of public buses, leads to a reduced quality of public transport services. **The introduction of ridesharing services in the Greek Islands is a matter of vital upgrading of tourists convenience, supporting** sustainable tourism and economic growth.

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Annex 1

NATIONAL TECHNICAL UNIVERSITY OF ATHENS
SCHOOL OF CIVIL ENGINEERING
DEPARTMENT OF TRANSPORTATION PLANNING AND ENGINEERING

Investigation of the potential and acceptance of introducing ridesharing services in Athens

Questionnaire

This questionnaire survey is part of a research project undertaken by the Department of Transportation Planning of the National Technical University of Athens. The survey aims at investigating the the potential and acceptance of introducing ridesharing services in Athens. This is an anonymous questionnaire survey

Section A: Traveller Characteristics

1. Your usual trip purpose is…

   ….work /education ______ …. other ______

2. What is the major travel model that you use for the following trip purposes?

	Private Vehicle (Car, Motorcycle)	Taxi	Public Transportation	Other
Work / Education	☐	☐	☐	☐
Other	☐	☐	☐	☐

3. How many vehicles (cars, motorcycles etc) do you own or have access to?

   0 _____ 1______ 2______ >2______

4. How many journeys do you take in the greater Athens Area per week?

Trip Purpose	0	1-2	3-4	5-6	6-7	<7
Work / Education	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

5. How often do you use

	Never	Rarely	1-2 times per week	Daily
Public Transportation?	☐	☐	☐	☐
Taxi?	☐	☐	☐	☐

6. How much do you spend for transportation per week?
   <20 € ______ 20 € - 40 € ______ 40 € - 60 € ______ >60 € ______

7. How much time do you need to access your work place from home?
   <10 min_____ 10 – 20 min ______ 20 - 30 min ______ >30 min ______

8. Which of the following attributes do you consider important for choosing a travel mode?

	Not important	**Somewhat Important**	**Important**	**Very Important**	**Extremely important**
Cost					
Travel time					
Reliability					
Comfort					
Safety					
Flexibility					
Availability					

Section B: Satisfaction

With respect to your typical daily trip, please rate your experience on the following:
(1: Extremely dissatisfied, 2: Dissatisfied, 3: Neutral, 4: Satisfied, 5: Very satisfied)

a. Daily Travel Time 1___ 2___ 3___ 4___ 5___

b. Daily Travel Cost 1___ 2___ 3___ 4___ 5___

c. Accessibility to Public Transport 1___ 2___ 3___ 4___ 5___

d. Access to taxi services 1___ 2___ 3___ 4___ 5___

e. Parking conditions at your destination 1___ 2___ 3___ 4___ 5___

f. Traffic safety and security 1___ 2___ 3___ 4___ 5___

g. Alternative travel options for your destination 1___ 2___ 3___ 4___ 5___

h. The transport mode you use the most 1___ 2___ 3___ 4___ 5___

Section C: Knowledge Level of Ridesharing Services

1. Would you mind sharing a ride in a private car with people you may not know?
   Yes _____ Maybe _____ No _____

2. Would you mind hiring a private car for a ride instead of a taxi?
   Yes _____ Maybe _____ No _____

3. Do you use cell phone applications for calling for a taxi ride?
   Yes _____ Maybe _____ No _____

4. Are you aware of ridesharing services?
   Yes _____ Maybe _____ No _____

5. Have you heard of Uber?
   Yes _____ Maybe _____ No _____

6. Is Uber a ridesharing service?
   Yes _____ Maybe _____ No _____

7. Are you aware of Uber's existence in Greece?
   Yes _____ Maybe _____ No _____

8. Have you ever used ridesharing services in the past?
   In Greece _____ Abroad _____ No_____

9. Do you think that ridesharing is different from a taxi?
   Yes _____ Maybe _____ No _____ I don't know _____

10. Do you think that ridesharing would be useful for the case of Athens?
    Yes _____ Maybe _____ No _____ I don't know _____

11. Do you think that you may consider using ridesharing in the future?
    Yes _____ Maybe _____ No _____ I don't know _____

12. Do you feel that you could replace private car usage with ridesharing in the future?
    Yes _____ Maybe _____ No _____ I don't know _____

Section D: Scenarios

For a hypothetical journey from Halandri (Athens suburb) to the Athens downtown area (Syntagma Square) at 8:00 am, available modes are private vehicle, taxi, public transport and ridesharing (eg Uber). In the following tables, total travel time per mode and costs per mode for the particular trip are presented. For each of the following scenarios, which alternative would you prefer?

	Car	**Taxi**	**PT**	**Ridesh**
Time	30	60	70	30
Cost	5	8	1.4	10
Comfort	Yes	No	Yes	Yes
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	70	60	55	30
Cost	8	15	0.5	10
Comfort	No	Yes	Yes	No
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	30	30	40	60
Cost	10	12	0.5	6

	Car	**Taxi**	**PT**	**Ridesh**
Time	70	45	40	60
Cost	8	8	1.4	10

Comfort	No	No	Yes	No
Select				

Comfort	Yes	Yes	Yes	No
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	50	30	40	30
Cost	5	8	1.4	6
Comfort	Yes	Yes	No	Yes
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	50	60	70	45
Cost	8	15	0.5	6
Comfort	Yes	No	No	No
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	70	45	55	60
Cost	5	12	1.4	12
Comfort	No	No	No	Yes
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	70	60	40	45
Cost	10	12	0.5	12
Comfort	Yes	Yes	No	No
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	30	30	70	45
Cost	10	15	1.4	6
Comfort	Yes	Yes	No	Yes
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	50	45	55	30
Cost	10	15	0.5	12
Comfort	No	No	No	No
Select				

	Car	**Taxi**	**PT**	**Ridesh**
Time	30	45	70	45
Cost	8	12	0.5	10
Comfort	No	Yes	No	Yes
Select				

Section E: Demographics

1. Sex:
   Male _____ Female _____

2. Age
   18-30 _____ 31-45 _____ 46-65 _____ >65 _____

3. Annual income
   <10,000 € _____ 10,000-25,000 € _____ >25,000 € _____

4. Education level
   Elementary School ___ High school ___
   Junior College ___ University ___