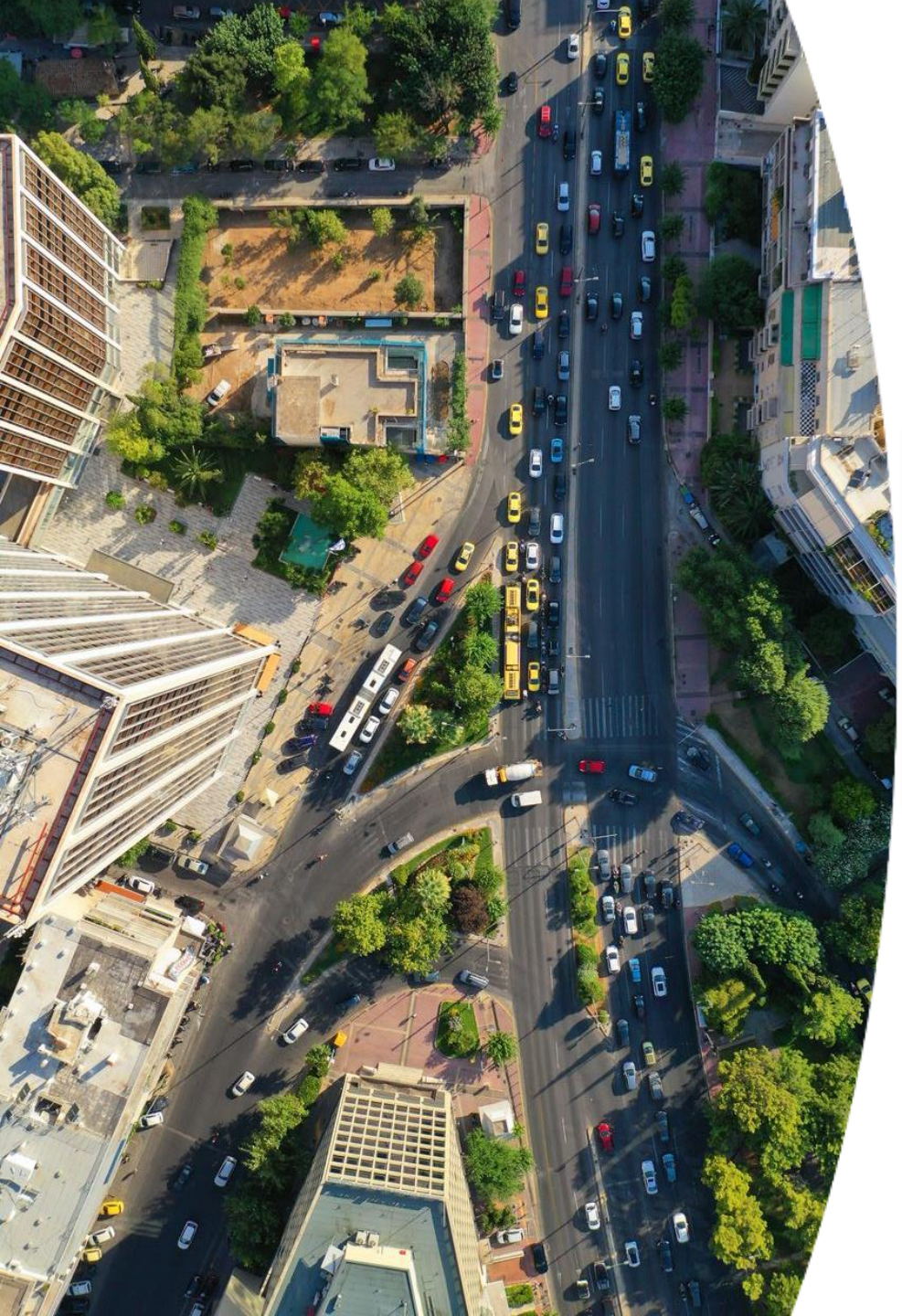


RSS 2022
8th Road Safety & Simulation International Conference
Road Safety and Digitalization
08-10 June, 2022 • Athens, Greece

How environmental charging policies affect urban road safety?

Virginia Petraki

Transportation Engineer, PhD Candidate

Together with:
Panagiotis Papantoniou and George Yannis

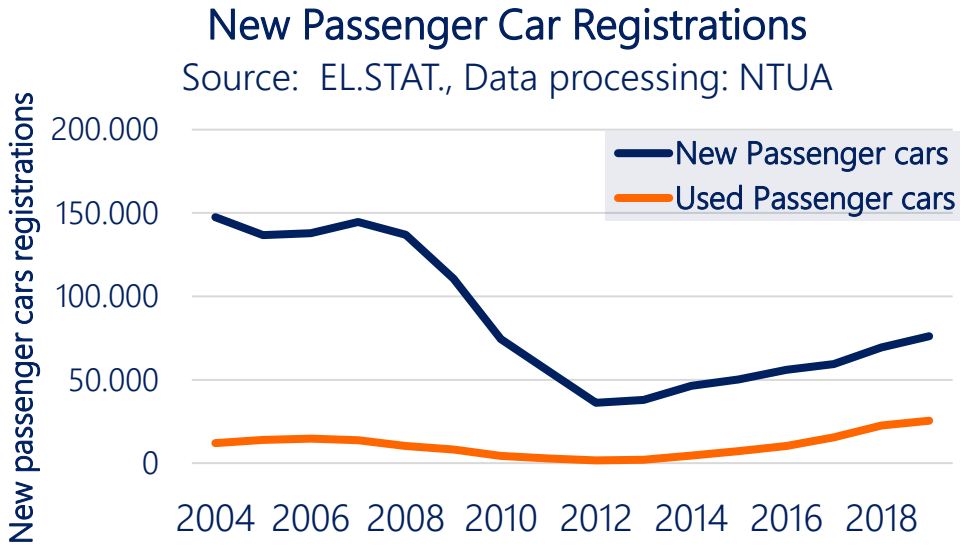
National Technical University of Athens
Department of Transportation Planning and Engineering

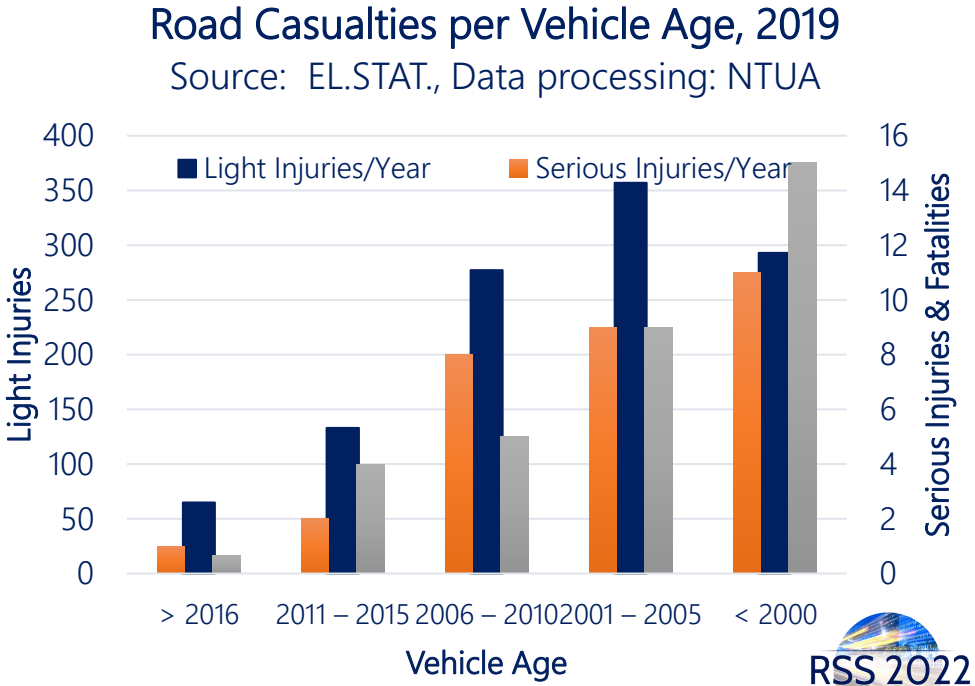
Introduction

- Considering that the majority of European citizens live in urban environment, with **over 60% living in urban areas** of over 10,000 inhabitants, the life quality in urban areas is of vital importance
- Several cities apply **traffic access regulations** into urban areas such as Congestion Charging Zones, Low Emission Zones or a combination of both
- **Road safety** is considered great importance for sustainable mobility in urban environments since it appears that crash fatalities have platooned during the recent years
- Road accidents cost most countries **3% of their GDP**
- However, the impact on road safety from the implementation of traffic management policies **is explored partially** by the literature

Background

- Athens is the capital and largest city of Greece and sprawls across the central plain of Attica, with population of 664,046 people and an area of 38.96 km^2
- Passenger cars constitute 69% of the total vehicle fleet, while two-wheelers constitute 24%
- Considering passenger cars there is a steady annual increase (1.2% on average) after the year 2013
- Car drivers constitute the largest road user group among road fatalities and together with car passengers they account for 70% of all fatalities
- The current management traffic system called Athens Ring controls the private car access in the city according to an odd/even system which correspond the last number of a vehicle's license plate number to the calendar date
- Athens Ring allows environmentally friendly vehicles to circulate without restriction on any day at any hour





Objective

- The objective is to investigate the road safety impact from the implementation of an environmental transport charging policy called Green Car Access Card (GCAC) in the center of Athens

- GCAC aims to restrict the access of old technology passenger cars in the centre of Athens with a charging being adjusted according to the Euro class of the car

Critical Factors of Road Accidents

- The three main factors of a road accident are:
  - driver/road user behavior,
  - road environment/design and
  - vehicle
- Speed can be characterized as a driver behavior factor but can be significantly affected by the road environment, vehicle, traffic and whether conditions
- According to Nilsson, the relationship between speed and accident risk is a power function; with increasing speed, the accident risk increases more as the absolute speed is higher
- A driver of an older vehicle is more likely to be fatally injured as compared to a driver of a newer vehicle
- Due to the technological improvements that can be applied to the newest vehicles, the renewal of the passenger vehicle fleet is expected to contribute to the road safety improvement

Methodology

- A personal interview, questionnaire-based survey was undertaken, aiming at collecting information on the level of understanding and accepting environmental charging policies for private cars access in Athens

- Specifically, it targeted at identifying the public acceptance of the GCAC policy through a stated preference analysis

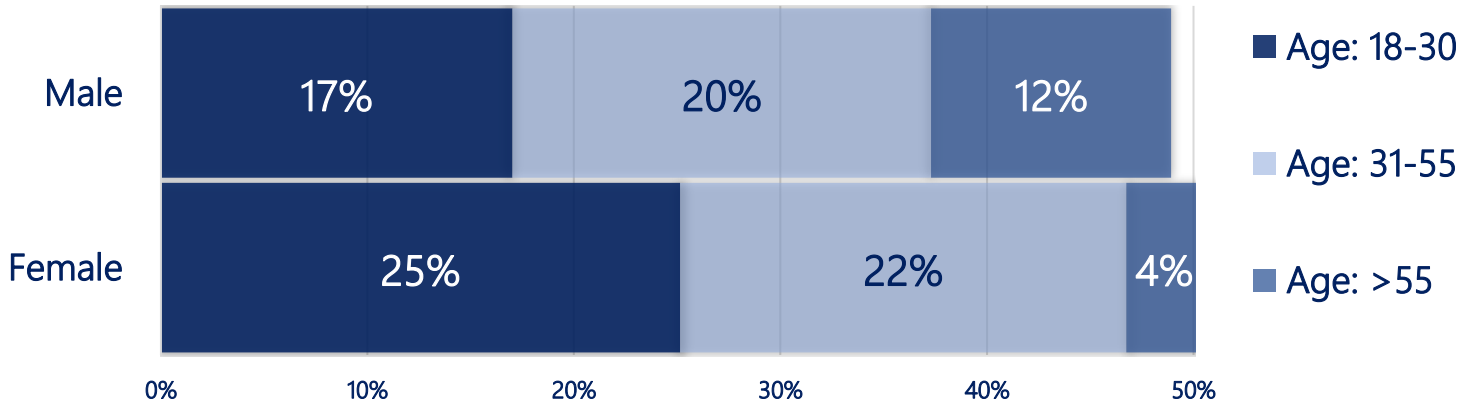
- The number of road fatalities and injuries in the "Do nothing" Scenario and in the "GCAC" Scenario are estimated in a time horizon of 15 years taking into account:
  - the change of the average age of the fleet and
  - the mean speed in the center of Athens

due to the implementation of the GCAC policy

  - the road casualty cost

Survey

- A questionnaire-based survey
- Study Area: Athens
- 370 valid answers
- Questionnaire Structure



Section A: Drivers' Travel Profile

- Main transport mode
- Weekly Trips & Travel Cost
- Drivers' satisfaction on their typical daily trip
- Car's characteristics (Euro standard, cc, fuel type)

Section B: Environmental Awareness

- General environmental questions
- **Environmental problems** related to road transport
- Acceptance level of **environmental transport charging** policies

Section C: GCAC Scenarios

- Depending on the age of the vehicle (1st Registration), **3 possible Annual Access Card fees** (low, medium, high) have been set
- The driver is asked to answer if she/he is willing to pay the 3 possible annual card fees to reduce by **5, 10 or 15 minutes** her/his daily typical trip

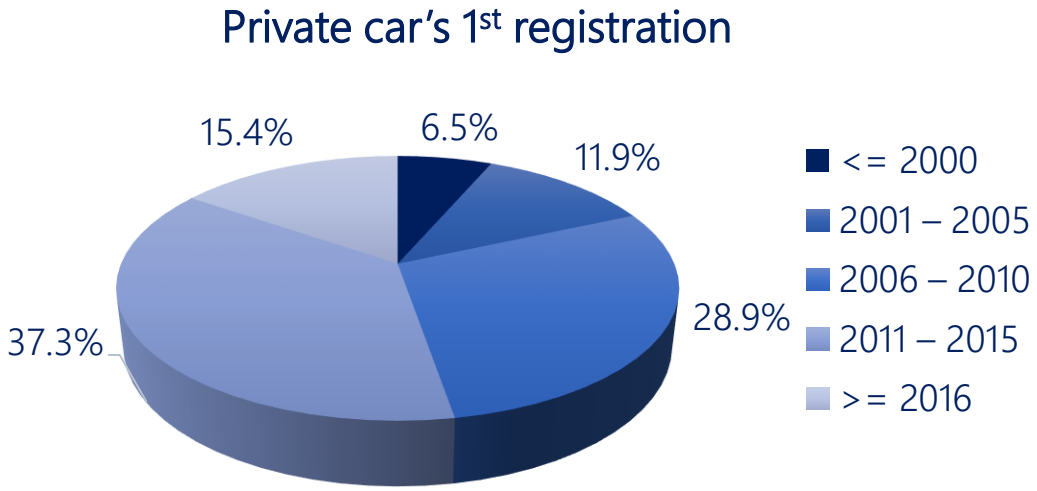
Section D: Demographic Characteristics

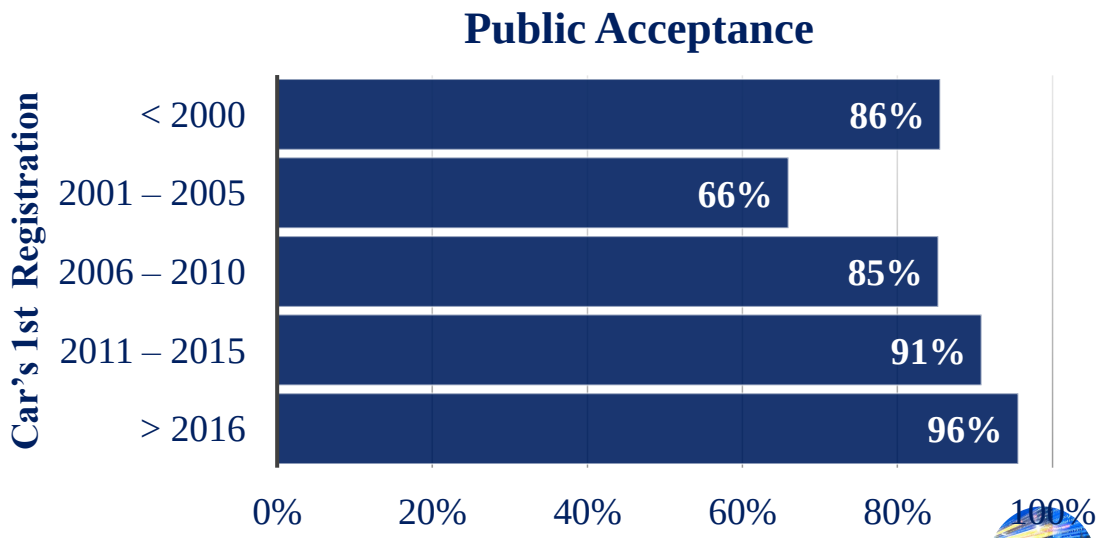
- Gender
- Age
- Annual Income
- Education Level

Public Acceptance

- A mixed binary logistic regression model was developed to identify the public acceptance of the GCAC policy
- Travel time and GCAC cost have been determined negatively correlated with public acceptance of the GCAC

	Parameter	Coefficient	Std. Error	t-test	Sig.
	Intercept	10.337	1.042	9,924	0
	GCAC annual cost	-0.032	0.005	-6.235	0
	Travel Time	-0.408	0.026	-15.774	0
Car's 1st Registration	>= 2016	-1.906	0.824	-2.313	0.021
	2011 – 2015	-2.041	0.781	-2.613	0.009
	2006 – 2010	-1.300	0.849	-1.532*	0.126*
	2001 – 2005	-1.756	0.869	-2.021	0.043
	=< 2000	0	-	-	-





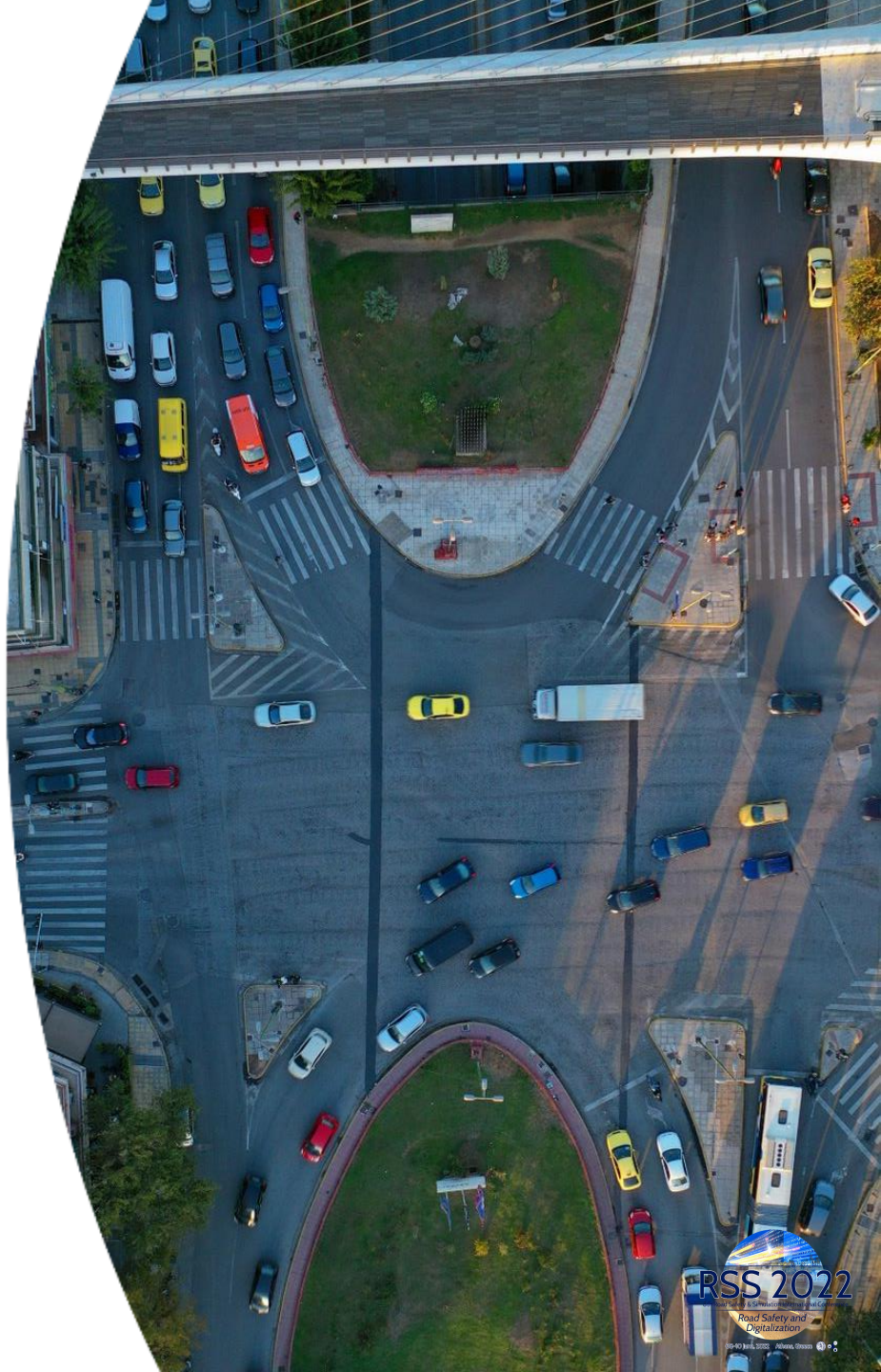
Road Safety Impact

The annual road safety impact in the "GCAC" Scenario is estimated with the following equation in which i represents the year under examination (i=2020,…2030) and k the vehicle's age group (k= > 2016, 2011 – 2015, 2006 – 2010, 2001 – 2005, < 2000)

$$Casualty_{i,k} = Casualty_{i-1,k} \times \left(\frac{\%PassengerCars_{i,k}}{\%PassengerCars_{i-1,k}}\right) \times \left(\frac{V_{GCAC_i}}{V_{Do\_nothing_i}}\right)^2$$

where:

- %PassengerCars: the percentage of private passenger cars in Attica by age group (1st registartion)
- V_{GCAC}: the average speed in the "GCAC" Scenario
- $V_{Do\_nothing}$: the average speed in the "Do nothing" Scenario



Assumptions & Parameters

	Value	Source
Fatality cost in Greece	2,148,034€	ITF, 2020
Serious Injury cost in Greece	273,574€	ITF, 2020
Light Injury cost in Greece	51,373€	ITF, 2020
Annual growth of the Athens passenger car fleet	1%	National Energy and Climate Plan; EL.STAT.
Mean Speed "Do Nothing" Scenario	15 km/h	Simulation model
Mean Speed "GCAC" Scenario 1st year	21 km/h	Simulation model
Mean Speed after 3rd year of GCAC operation	15 km/h	Simulation model
Annual car withdraw "Do Nothing" Scenario	1.5%	EL.STAT.
Annual car withdraw "GCAC" Scenario	2.3%	Assumption

Results

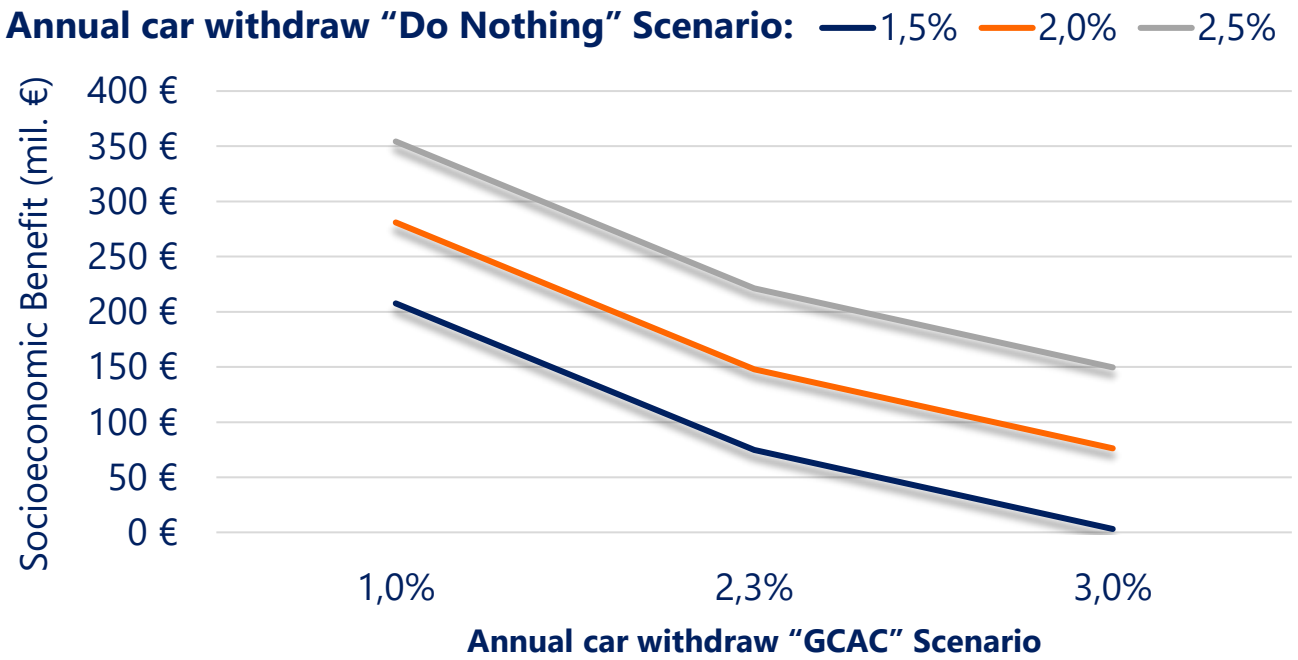
- During the first 2 years of the GCAC policy operation there is a significant higher cost in the "GCAC" Scenario compared to the "Do nothing" Scenario due to the increase in average speed
- However, in the following years of operation the road safety benefit in terms of road casualties as well as in monetary terms increases notably in relation to the "Do nothing" Scenario
- The examined policy is expected to lead to decrease of 303 injuries and 34 fatalities during the time period under consideration

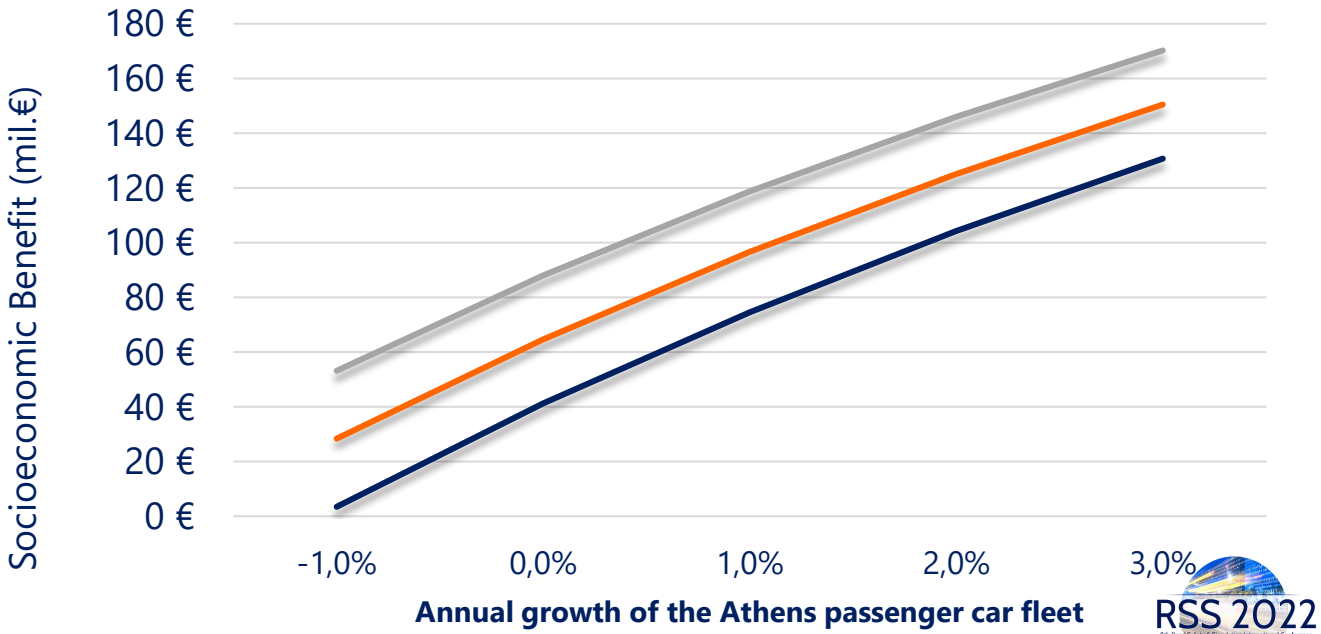
Year	Socioeconomic Benefit (mil. €)
0	-119.7
1	-19.5
2	9.0
3	10.2
4	11.4
5	12.6
6	13.8
7	14.9
8	16.0
9	17.2
10	18.3
11	19.4
12	20.5
13	21.6
14	22.6
15	23.7
Present Value (Social Discount Rate=3%)	**74.6**

Sensitivity Analysis

- When the annual car withdraw in the "Do Nothing" Scenario increases and in the "GCAC" Scenario decreases, the socioeconomic benefit increases

- When the annual growth of the passenger car fleet of Athens increases the socioeconomic benefit increases



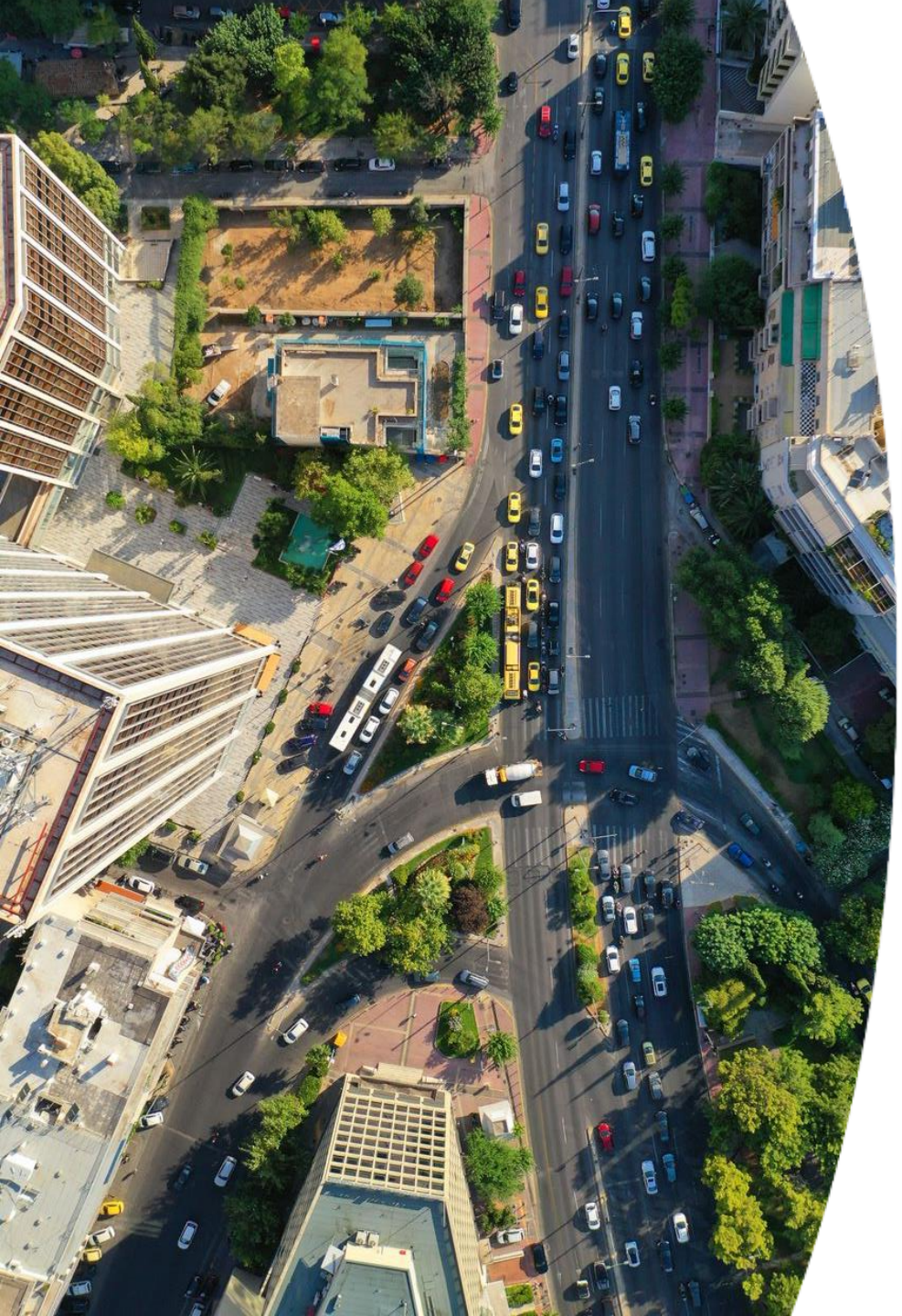


Conclusion

- Travel time and GCAC cost have been determined negatively correlated with public acceptance of the examined policy
- Athenians driving old technology cars (>20years), are more likely to accept the implementation of GCAC system compared to respondents who own newer technology cars
- The first two years of the GCAC policy operation it is estimated a negative impact in road safety mainly due to the possible increase in the mean speed while in the following years it is estimated a positive impact mainly due to the faster renewal of the vehicle fleet compared to "Do Nothing" Scenario
- The examined policy is expected to lead to a socioeconomic benefit equal to 75 mil. €
- Even in extreme price changes over a 15-years period, the road safety impact remains positive, ensuring the feasibility of the examined policy

Future Challenges

- The environmental pollution risks on urban centers need to be addressed through concrete and targeted actions and scientifically sound decisions to turn them into opportunities for the future
- Environmental charging policies that have a positive impact on the environment and society must be integrated into a more general strategic plan adapted to the characteristics of each city
- The road safety impact on the feasibility of environmental charging transport policies is significant and should therefore be a key factor in developing a socio-economic analysis
- Urban road safety should be integrated into the urban mobility policies, equally with environment, energy and mobility concerns
- Environmental charging transport policies should be tailored to the specific mobility and safety problems and needs of each city



RSS 2022
8th Road Safety & Simulation International Conference
Road Safety and Digitalization
08-10 June, 2022 • Athens, Greece

How environmental charging policies affect urban road safety?

Virginia Petraki

Transportation Engineer, PhD Candidate

Together with:
Panagiotis Papantoniou and George Yannis

National Technical University of Athens
Department of Transportation Planning and Engineering