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# Economic Assessment of Free Public Transport in Athens

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Together with:

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# The MetaCCaze project

## ➤ 43 Project partners:

- [National Technical University of Athens](#)

[MaasLab](#), [Bable](#), [Factual Consulting](#), [Steinbeis Innovation](#), [TRT](#), [Gemeente Amsterdam](#), [AMS Institute](#), [TU Delft](#), [ZoevCity](#), [Townmaking Institute](#), [Argaleo](#), [Technolution](#), [Landeshauptstadt Munchen](#), [TUM](#), [Stadtraum](#), [OXYGONO](#), [Nextbike CY](#), [Tampereen Kaupunki](#), [Remoted](#), [Anaplassis Athina](#), [Organismos Astikon Sygkoinonion Athinon](#), [Universita Ta Malta](#), [AMAT Milano](#), [NEX T SRL](#), [MVK Miskolc Varosi Kozlekedesi Zrt](#), [Institut Vedecom](#), [Agenzia TPL](#), [Mobilysis SARL](#), etc.

## ➤ Duration of the project:

- 48 months (January 2024 – December 2027)

## ➤ Framework Program:

- [Horizon 2020](#) - The EU Union Framework Programme for Research and Innovation – Climate, Energy and Mobility



# Introduction

- **Free Public Transport (FTP)** is being explored as a potential path for the control and reduction of environmental, social and economic problems.
- **More than 100 cities** around the world offer a form of FPT to their citizens, such as Taihung in Taiwan, Miami in USA and Verenje in Slovenia .
- The three **main benefits of FPT** interventions are:
  - Encouragement of **modal shift** from private cars to Public Transport (PT).
  - Improvement of **social inclusion**.
  - Enhancement of the **urban and economic development** of cities.



# Objectives

The investigation of the **socio-economic feasibility** of introducing FPT in Athens

- The investigation of the **Athenians' acceptance** towards FPT.
- The estimation of the **socio-economic impacts** from the FPT operation in Athens regarding:
  - Travel Time
  - Fuel Consumption
  - Road Safety
  - Environmental Pollution
- The estimation of **investment and operating costs** for the FPT operation in Athens.





# Data Description

- Main data source to depict the current situation of PT was the annual reports of the **Athens Urban Transport Organization (OASA)**, responsible for the operation and maintenance of all Athens PT. These reports include:
  - Financial data
  - Fleet size
- **Traffic data** obtained through the OASA traffic simulation model for 2018
  - Vehicle-kilometers
  - Passenger hours
  - Trips
- **Modal shift to FPT** estimation through a stated preference questionnaire survey



# Binomial Logistic Model

- A binomial logistic model was developed to quantify the modal shift from private passenger cars to FPT, using a stated preference questionnaire survey

<https://www.nrso.ntua.gr/geyannis/wp-content/uploads/vagdatli-ad138c.pdf>

## Part of excel data used in R-Studio

ID	Gender	Age	Income	Education	Travel Time	Mode	Shift
1	1	35	1500	1	15	1	0
2	1	45	2000	2	20	1	1
3	2	30	1200	1	10	1	0
4	1	55	2500	3	25	1	1
5	1	40	1800	2	18	1	0
6	2	25	1000	1	8	1	0
7	1	60	3000	4	30	1	1
8	1	38	1600	2	12	1	0
9	2	42	2200	3	22	1	1
10	1	50	2800	3	28	1	0
11	1	32	1400	1	10	1	0
12	2	48	2400	3	24	1	1
13	1	58	3200	4	32	1	1
14	1	36	1700	2	14	1	0
15	2	44	2100	3	21	1	1
16	1	52	2900	3	29	1	0
17	1	34	1500	1	11	1	0
18	2	46	2300	3	23	1	1
19	1	54	3100	4	31	1	1
20	1	37	1600	2	13	1	0

## Analysis results

Dependent variable: modal shift from private cars to FPT

Independent Variable	Estimate b	z-value	Pr(> z )
Γραμμικό όρος	-0.402	-1.549	0.121
Εκπαίδευση κομίστρου (έκπτωση%)	-0.683	-1.945	0.05184 *
Χρόνος ταξιδιού	-1.712	-4.571	0.000 ***
Χαμηλό επίπεδο άνεσης	-0.121	-1.423	0.155 *
Υψηλό επίπεδο άνεσης	0.683	7.719	0.000 ***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 '.' 1

Log-Likelihood: -1381.3  
 McFadden R<sup>2</sup>: 0.14207  
 Likelihood ratio test: chisq = 457.48 (p.value = < 2.22e-16)

## Acceptance

	-5%	Εκπαίδευση κομίστρου	-100%
U=	-0.4007	-0.2480	-0.0610
P=	40.1%	43.8%	48.5%

## Utility Function U

$$U = -0,402 - 0,683*(\text{Εκπαίδευση κομίστρου}) - 1,712*(\text{Χρόνος ταξιδιού}) - 0,121*(\text{Χαμηλό επίπεδο άνεσης}) + 0,683*(\text{Υψηλό επίπεδο άνεσης})$$



# Socio-economic Analysis (1/2)

- For each scenario the investment and operating costs, and the socio-economic benefits have been **calculated in monetary terms**.
- Impact of FPT on **travel time** estimated based on the annual passenger-hours spent on private cars and PT, and the value of time (VOT).
- Impact of FPT on **fuel consumption** estimated based on the composition of the vehicles by fuel type, the average consumption of vehicles, as well as the price of fuels per year.
- Impact of FPT on **road safety** estimated based on the number of road fatalities and injuries in each Scenario, as well as the social cost per fatality and injury.





# Socio-economic Analysis (2/2)

- Impact of FPT on **the environment** estimated based on the cost of emissions and the emissions per vehicle type.
- **Investment cost (initial)** for scenarios S1-S3 estimated considering the cost of the required study and the purchase of new or used buses.
- **Operating costs** of FPT estimated based on the operating and maintenance costs of the system, mechanical equipment, as well as costs related to the additional human resources and fuel consumption of the new buses.



# CBA Scenario 1

Costs and Benefits	Present Value (SDR=0.8%)	2023 Implementation	2024 Operation	2025	2026	2027	2028	2029	2030
C1. Investment Cost (mil.€)	-11.43	-11.52	0	0	0	0	0	0	0
C2. Operating Costs (mil.€)	-83.13	0	-19.48	-18.08	-13.28	-11.41	-9.60	-7.04	-7.09
<b>Total Costs (mil.€)</b>	<b>-94.56</b>	<b>-11.52</b>	<b>-19.48</b>	<b>-18.08</b>	<b>-13.28</b>	<b>-11.41</b>	<b>-9.60</b>	<b>-7.04</b>	<b>-7.09</b>
B1. Travel time (mil.€)	- 237.31	0	-53.35	-54.44	-38.89	-34.02	-28.93	-17.71	-18.08
B2. Fuel consumption (mil.€)	655.30	0	178.58	164.71	105.67	82.56	67.04	39.34	38.28
B3. Road Safety (mil.€)	82.37	0	22.17	21.62	13.13	10.62	8.36	4.60	4.49
B4. Emissions (mil.€)	110.11	0	26.27	26.27	18.19	15.38	12.87	7.42	7.36
<b>Total Benefits (mil.€)</b>	<b>610.47</b>	<b>0</b>	<b>173.69</b>	<b>158.16</b>	<b>98.10</b>	<b>74.54</b>	<b>59.33</b>	<b>33.65</b>	<b>32.05</b>
<b>NPV (SDR=0.8%) (mil.€)</b>	<b>515.92</b>	<b>-11.52</b>	<b>154.21</b>	<b>140.08</b>	<b>84.82</b>	<b>63.13</b>	<b>49.73</b>	<b>26.06</b>	<b>24.96</b>
<b>IRR</b>	<b>1,327.6%</b>								
<b>Benefits/Costs Ratio</b>	<b>6.46</b>								



# Economic Feasibility Results

- Investigation of the economic performance of all scenarios **until the year 2030**.
- Identification of beneficial FPT scenarios using specific **criteria**:
  - ✓ Net Present Value (NPV) of the investment must be **positive NPV>0**.
  - ✓ Internal Rate of Return (IRR) should be **greater than the Social Discount Rate (SDR)**.
  - ✓ Ratio of benefits to costs should be greater than unity, **B/C>1**.
- All FPT scenarios are **economically viable** over time based on the criteria.
- The implementation of FPT in Athens has a significant **positive influence** on road safety, the environment and society.

Scenario	NPV	IRR	B/C
S1 50% fare reduction	516 mil. €	>100%	6.46
S2 72.5% fare reduction	540 mil. €	>100%	5.24
S3 100% fare reduction	593 mil. €	>100%	4.52

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# Discussion

- The introduction and operation of partially and fully FPT in the urban network of Athens is expected to **significantly improve road safety**. By the year 2030:
  - Reduced road fatalities by 20 (S1) – 25 (S3)
  - Reduced severe injuries by 38 (S1) – 46 (S3)
  - Reduced light injuries by 622 (S1) – 733 (S3)
- Significant **environmental improvement**:
  - Fuel consumption reduction by 1.3 (S1) – 1.4 (S3) billion liters of gasoline-equivalent fuel
  - Reduction of CO<sub>2</sub> pollutants by 2.5 (S1) – 3.1 (S3) mil. tons
- The FPT intervention in the network of Athens is a **socio-economically sustainable** investment.



# Conclusions

- The introduction and operation of partially and fully FPT in the urban network of Athens is expected to **significantly improve road safety**, the environment and the quality of life.
- To ensure the successful introduction and operation of FPT in Athens, a **pilot operation** is proposed as trailhead, to fully assess the effectiveness and efficiency of the system.
- **Upgrading the existing infrastructure and PT fleet**, as well as the level of service of PT, by increasing itineraries, purchasing new environmentally friendly buses is suggested to attract more commuters to PT and **ensure a smoother transition to the FPT**.





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