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**University students and mobility. A sustainability analysis**

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**Abstract.** This paper outlines the urban mobility as one of the most current challenges towards sustainable metropolitan mobility. In the context, university students play a central role in the issue of mobility because as commuters reach their campus in order to attend the didactic-training activities. Therefore, constantly pressures are generated on the environment in terms of greenhouse gas emissions, particulate matter, consumption of natural resources and fossil fuels. The methodological path addresses three objectives: firstly, to map the current university students’ mobility; secondly, to quantify the impacts associated with their mobility in terms of greenhouse gases emissions; thirdly, to provide more sustainable alternatives to be implemented for the student community by stakeholders. The administration of a questionnaire survey to a sample of students from the Campus of Economics in Bari and the elaboration of data through statistical tools allowed the building of a database in order to address the objectives of the paper and to build the basis of identification of some more sustainable alternatives for the students' mobility. The outcomes of this analysis aim to stimulate efforts towards priority areas of sustainable transformation and to enlarge the scientific literature.

**Keywords.** Urban mobility, university students, emissions, transport, sustainable behaviors.

# Introduction

The population growth in metropolitan and urban areas provokes critical issues of congestion, environmental pollution and worsening of the quality of life. At the European level, the Commission has promoted the Sustainable Urban Mobility Plans to address the unsustainable mobility policies (Sgarra et al., 2022) and others Programmes which affect both national and local development. Some of these consist of an integrated planning approaches that analyze modes and forms of transport in the cities and metropolitan areas (Niglio and Comitale, 2015). At national level, Italy has a consolidated transport planning due to the excellent regulatory support and the availability of guidelines for stakeholders (Orchi and Valentini 2014). Lastly, at a local level, Bari, which is the second metropolitan city in Southern Italy after Naples, has adopted a wide range of urban transformation solutions to discourage the massive use of private cars and to increase the achievement of sustainability. It must to be underline that more than 70% of inhabitants of Bari still use private car and only 30% uses public transport system (Niglio and Comitale, 2015).

For these reason, nowadays, the pursue of sustainable mobility is one of the greatest environmental challenges that involves the population from global to local level. Particularly, roughly 33% of the population that uses transport on a daily basis consist of students, consequently this paper analyzed the attitudes of university students towards the environment practicing sustainable mobility. In particular, this study stems from the need to comprehend and improve the travel arrangements of students who attend the Bari Economics Campus in the Apulia Region. The methodology used in this first research was the survey carried out through the use of a questionnaire online addressed to the students of the University Campus.

# Literature Review

University Campuses are considered *“small cities”* characterized by large size, population and various activities provided, with different direct and indirect impacts on the environment (Alshuwaikhat and Abubakar, 2008).

For this reason, since the last decade many universities have been striving to achieve full sustainability (Velazquez et al., 2006) in terms of energy used, waste, water consumed, materials used, infrastructure and mobility promoted (Bayas Aldaz and Sandoval Hamón , 2019). Furthermore, mobility to university campuses is a key factor because it represents a significant part of urban mobility and involves many stakeholders in various capacities (Longo et al., 2015). Additionally the authors stressed that universities and campuses are institutions that train students and influence government policies at the same time. In particular, universities train students who directly participate in the transformation process of a sustainable future and transition towards the Circular Economy (Bayas Aldaz and Sandoval Hamón, 2019). In conclusion, the transition to sustainable mobility requires a mental change of people, where the use of private means gives way to different modes of public transport (such as buses, bicycles, car sharing, electric cars and bicycles) as pointed out by Sgarra et al. (2022). This is the reason why this paper investigated the sustainable behaviour of the university students towards mobility.

# Material and methods

*1.3.1 Questionnaire survey*

Considering the model proposed by Sgarra et al. (2022), we conducted an exploratory empirical research, oriented towards *“internal”* stakeholders choices: we observed a part of 3000 university students that attend the different courses of the Department of Economics, Management and Business Law in Bari. These observations were conducted through a survey questionnaire submitted to students through a Google Form. In particular, we elaborated 22 questions divided into three sections of the questionnaire: Section 1: General Information; Section 2: Mobility; Section 3: Preferences and environmental awareness. Notwithstanding the survey model used is based on Larran and Andrades (2015), a collection of key variables proposed by Eurobarometer (2014) and the questions were focused mainly on sustainable mobility behaviors and actions in the context of university campuses. Moreover, some possible answers have been formulated on the basis of a five-point Likert scale. Furthermore, according Hair et al. (2014) the statistic sample must be equal almost of 200 respondents.

* + 1. *Estimation of impacts*

In order to estimate the impacts generated by university students mobility, we quantified the emissions generated by a car powered by different fuels or by alternative power supply, on the basis of the distance covered by the students. Considering a typical city car used in Italy by students for urban mobility (Fiat Panda) we elaborated four different scenarios. Particularly, we present the emissions generated by: Fiat Panda gasoline powered and 1.2 of displacement; Fiat Panda diesel powered, 1.3 of displacement and Multiject; Fiat Panda mild hybrid powered and 1.2 of displacement; Fiat Panda liquefied natural gas (LNG) powered and 1.2 of displacement. For these cars we quantified the emissions considering the different location of departure of economics students as in Table 1.

*1.3.3 Goal and scope definition*

In this context, the aim of the paper is, firstly, to analyze the perception and the environmentally sustainable attitudes of the students who attend the Economics Campus of the Aldo Moro University of Bari; secondly, to provide an estimation of CO2 emissions generated using a city car to arrive at Campus of Economics in Bari, powered into different methods (gasoline, diesel, mild hybrid and LNG) in order to propose environmental enhancements in a further research step.

* 1. **Results and discussion**

*1.4.1 Outcomes from the survey*

The sample was investigated submitting a questionnaire survey through a Google form, shared among the students by the professors of the Department during classroom lessons. Considering 3,000 students enrolled in the degree courses of the Department of Economics, Management and Business Law of the University of Bari Aldo Moro, we quantified the significant sample required equal of 300 answers according Hair et al. (2014). Particularly, in our case we have 335 answered questionnaires. Statistically, the values considered in the operation was confidence interval=5.06, confidence level=95%, population=3000.

The results showed that the sample was composed by 60.30% of women and 39.70% of men, most of them (67.76%) with an age between 21 and 24 years. Analyzing student mobility preferences: only 27.20% of respondents prefer public transport, whilst 72.80% the private transport. These percentages confirms the estimation by Niglio and Comitale (2015), as already mentioned in the Introduction section. Most of the interviewees come from Bari, the rest mainly from BAT, Taranto and Brindisi (Fig.1). Furthermore only few units, come from neighbouring regions, particularly Basilicata and Calabria.



 Fig. 1. Location of origin of the students sample

 Sources: Authors’ elaboration.

Moreover, 62.7% of students arrive in the city where they attend the course of study, moving from a different municipality/region (this kind of student is named commuter students), 20.6% live in the city where the university is located (this kind of student is named on-site student) and 16.7% live in the city where they attend the study course, but reside in another municipality/province/region (this kind of student is named off-site). The sample has an almost equally distributed willingness to pay for their mobility: most students (76%) have a budget of between 20-50 euros to cover monthly transport costs. Additionally, 57.6% of students changed their transport habits following the Covid-19 pandemic. For the question n. 10: *How much do you spend on average per day on public/private transport to get to your university campus?* 39.1% answered less than 30 minutes, 30.4% maximum 1 hour, 22.4% between 1-2 hours and 8.1% more than 2 hours. For the question n. 11: *If you were to prefer public transport, which means would you mainly use?* 42.4% of students would use bus, 26.3% state railways trains, 8.4% railway tram, 6% a multimodal transport with more than 2 means, 5.7% local public transport, 4.8% regional railways trains, 3.9% bike, and only 2.7% bike and other means (e.g. train). According question n. 12: *What reason would you prefer private transport over public transport?* 47.5% of the sample prefer it for the reduced travel times, 40.6% prefer private transport for comfort and suitable study-travel time, 7.5% prefer it for economic saving, and 4.5% would prefer the car sharing. Moreover, 39.70 % of the sample agree on the fact that circumstances oblige them to frequently use the car and 43.88% agree on the difficulty in managing travel only by means of alternative transport to the car. However, more than 29% would be willing to buy a hybrid or electric car or electric bicycle respectively in the future. The interviews also shown that 45.07% would prefer car sharing if they had to opt for an alternative transport to the public/private one. Unfortunately, more than 60% of the sample prefers the private way to reach the Economics campus. Finally, analyzing preferences and environmental awareness: 34.63% give up sustainable public transport and prefer private transport to reduce delays, considering the private vehicle the greatest guarantor of autonomy (72.84%). However, more than 80% of the sample are aware of the fossil fuel impacts associated with the use of means of transport and about 60% are aware of the lower impacts generated by the use of public transport. In conclusion, 96% of the sample highlights that sustainable student mobility can improve environmental conditions and, for this reason, of which 87% ask for more cycle paths for the Economics Campus and 97% ask for greater economic incentives for the transition from traditional transport to less polluting alternative transport.

*1.4.2 Snapshot of the impact associated to Bari students’ mobility*

The quantification of the CO2 emissions associated with the use of a common city car (like Fiat Panda produced by FCA), for the arrival at the Economics Campus, shown that urban mobility in the metropolitan area generates a greater impact than mobility from other areas as most of the students live nearby its (Table 1).

Table 1. Estimation impact of students’ mobility

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Location of departure** | **% of students per location** | **number of students** | **CO2 emissions\_gasoline/students (kg)** | **CO2 emissions\_diesel/students (kg)** | **CO2 emmisions\_hydrid/students (kg)** | **CO2emmisions\_LNG/students (kg)** |
| Bari | 69.6 | 2088 | 1,651.608 | 1,666.224 | 1,300.824 | 1,753.920 |
| BAT | 11.6 |  348 | 5,112.120 | 5,157.360 | 4,026.360 | 5,428.800 |
| Taranto |  5.7 |  171 | 3,284.910 | 3,313.980 | 2,587.230 | 3,488.400 |
| Brindisi |  5.1 |  153 | 4,183.938 | 4,220.964 | 3,295.314 | 4,443.120 |
| Basilicata |  5.1 |  153 | 2,109.258 | 2,127.924 | 1,661.274 | 2,239.920 |
| Foggia |  2.1 |  63 | 1,879.416 | 1,896.048 | 1,480.248 | 1,995.840 |
| Calabria |  0.6 |  18 | 1,448.208 | 1,461.024 | 1,140.624 | 1,537.920 |
| Lecce |  0.3 |  9 |  309.168 |  311.904 |  243.504 |  328.320 |

Source: Authors’ elaboration on data TerraUp (2022).

Analyzing the kind of power supply for the city car, the more sustainable is represented by the hybrid power supply; conversely, the most polluting is the LNG as it is not suitable for short distances.

**1.5 Conclusion and future perspectives**

The main outcomes of the questionnaire showed that students mainly use private transport (72.8%) and most of them live in the metropolitan area as the campus is located (69.6%). However, the results suggested that university students that attending the Bari Economics campus are willing to purchase alternative means provided that infrastructure is improved and economic incentives are provided. In order to provide more sustainable alternatives that must be implemented for the student community by public and private administration, considering that most of them lives in the metropolitan area of Bari (about 70% of students), it is essential to increase the number of cycle paths, increase the city bus rides that connect all the neighbourhoods and discourage the use of the car to cover a few kilometres to/from the Economics Campus. The future perspectives of this research consists of an enlargements of the sample investigated, of quantifying the greenhouse gas emissions associated with other public and private transports, with the aim of presenting a complete overview to the stakeholders involved in urban mobility. Furthermore, on the basis of the critical hotspots identified, environmental improvements will be provided.

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**CRediT author statement**

T. Crovella contributed in software, data curation, validation, methodology, writing-original draft and supervision. S. Burdi contributed in review editing. A. Pontrandolfo contributed in methodology. A. Paiano contributed in conceptualisation, writing original draft and supervision.