Journal of Sustainability Perspectives 5 (2), 2025, 308-319

Journal of Sustainability Perspectives

journal homepage: https://ejournal2.undip.ac.id/index.php/jsp/

Understanding Academic Transport Emissions – Insights from an Italian Medium-Size Public University

Anna Claudia Caspani, Elena Maggi, Michela Rosselli*

University of Insubria, Department of Economics, Italy

*Corresponding author: elena.maggi@uninsubria.it

Article Info

Received:
30 June 2025
Accepted:
16 December 2025
Published:
30 December 2025

DOI:
10.14710/jsp.2025.29838

Abstract. Universities play a significant role in advancing sustainability and achieving carbon neutrality. This study presents a case analysis of an Italian medium-size university located in Lombardy, focusing on the assessment of CO_2 emissions from the transport sector, with particular attention to commuting patterns as a significant source. By applying standardized methodologies and survey data, the research estimates CO_2 emissions and evaluates the potential for reduction through targeted policies, considering self-reported willingness to adopt sustainable transport modes incentivized by specific interventions. Results show that commuting substantially contributes to the university's carbon footprint, underscoring the need for integrated mobility strategies that combine environmental, social, and economic benefits. The study highlights the university's potential as a catalyst for behavioral change and innovation in sustainable transport, offering scalable solutions that improve wellbeing, accessibility, and institutional reputation, while delivering positive impacts both within and beyond the campus community. These findings provide actionable insights and a replicable model for universities aiming to reduce their environmental impact and progress toward carbon neutrality through innovative, data-driven sustainability governance.

Keywords:
CO_2 emissions, Commuting, Sustainable Transition, Transport, University

1. Introduction

Universities represent strategic contexts for the development of sustainable mobility practices and to experiment Travel Demand Management Policies able to reduce their carbon footprint [1]. Their significance within the ecological transition landscape stems not only from the size of the communities that revolve around them daily but also from their potential to serve as living laboratories for low-impact transport policies. Among the main emission factors related to university transportation, two distinct yet complementary areas can be identified: daily commuting between home and university, and medium-to-long distance academic mobility, including international exchange programs such as Erasmus.

Numerous studies have demonstrated that commuting constitutes a significant component of the university carbon footprint. Perez-Neira et al. [2], analyzing the University of León, highlight that over 90% of daily trips occur within 6 km; nevertheless, private car use accounts for 34% of trips and is responsible for 95% of transport-related emissions. Sobrino and Arce [3], at the Polytechnic University of Madrid, show that public transport is widely used (over 75%), yet the small number of private car users generate more than half of the total commuting emissions. Similar trends have been observed in Portugal [4], underscoring the need for targeted local policies.

Additional case studies reinforce the weight of local commuting in institutional emissions. For example, the emissions inventory at the University of Central Florida [5] demonstrated that mobile sources, primarily commuting vehicles, represented a major contributor to total campus emissions. Even at Universiti Kebangsaan Malaysia, Zakaria [6] quantified emissions from campus transportation, finding that internal combustion vehicles remain predominant despite the short travel distances involved. Similarly, Kabit [7] estimated significant on-campus CO_2 emissions at UNIMAS, mainly from petrol cars, with average emissions per kilometre exceeding European standards. The study stresses the need to address private vehicle use through improved parking policies and enhanced public transport connections to promote sustainable mobility on campus.

Geographic and behavioral analyses add further depth to this issue. Sultana [8] emphasized that psychological factors like perceptions, habits, and motivations significantly influence low-carbon transport choices, with perceived distance affecting walking and cycling more than actual distance. Universities can partner with cities to provide accessible housing and efficient, zero-emission transit within 2 km of campus. Such collaborations support sustainable urban planning and promote multimodal, low-impact mobility. In the context of Slovenia, Mesarec and Trček [9] explored infrastructural and motivational barriers to active commuting among students at the University of Maribor, offering targeted solutions for enhancing walking and cycling practices. These findings collectively suggest that the success of sustainable transport strategies hinges on their ability to integrate behavioral, infrastructural, and institutional dimensions.

Furthermore, Pantelaki et al. [10] analyze how commuting mode choices influence personal carbon footprints. Their study shows that private car use is a major source of emissions, but shifting to active mobility (walking, cycling) and shared transportation (public transit, carpooling) can substantially lower environmental impact. They emphasize that effective policies should be tailored to local contexts and supported by infrastructure improvements. Additionally, behavioral change initiatives, such as awareness campaigns and incentives, are crucial to encourage sustainable travel habits.

A critical aspect concerns occasional academic mobility, often overlooked in emission inventories but increasingly significant in recent years. Prior research, including those coordinated by Reyes-García [11] and the investigation by Hölbling [12], reveal that international travel by researchers and academics constitutes a considerable share of universities' indirect emissions. These patterns are particularly evident in high-level research institutions, as shown by Arsenault et al. [13], who demonstrate that both academic and student mobility significantly contribute to institutional environmental footprints. For instance, at the Université de Montréal, professors generate an average of 10.76 tonnes of CO_2 and 2.19 kg of nitrogen (N) per year due to travel, while international and study-abroad students contribute approximately 3.85 tonnes of CO_2 and 0.53 kg of N annually. With air travel as the dominant source of these emissions, similar patterns have been observed in other contexts. Ciers et al. [14] examined the academic air travel of Swiss universities, concluding that even a relatively small number of long-distance trips can account for a disproportionately large share of institutional carbon emissions. Their analysis of travel data revealed that the carbon footprint of academic travel increases drastically with researcher seniority—rising tenfold from PhD students to full professors.

Yang et al. [15] highlight those uncertainties related to commuting and business travel have the most significant impact on overall campus carbon emissions, underlining the need for more accurate monitoring and targeted strategies. Despite their growing relevance, these component remains underrepresented in many environmental reports, yet it is gaining increasing importance in both individual and collective carbon footprints.

Despite the breadth of studies addressing both commuting and academic travel, most research has focused on large metropolitan campuses or international research hubs, leaving a gap concerning medium-sized, regionally embedded institutions. This study contributes to filling that gap by focusing on the University of Insubria, a medium-sized public institution located in the Italian Lombardy region. The university is embedded in a predominantly suburban and semi-rural area, where transport options and mobility patterns differ significantly from those of large urban centers. As several other cases of suburban colleges, at the suburban campus of Varese the large availability of free parking lots, poor public transport connections and a long distance from the rail station favor the car dominance [16]. By analyzing the environmental impact of student and academic staff mobility through a survey of daily travel habits, this research estimates the contribution of commuting and travelling for Erasmus to total transport emissions and explores the community's willingness to adopt alternative, more sustainable travel modes. Moreover, it considers the potential environmental benefits deriving from the implementation by the University governance of different mobility management policies aiming at increasing transport sustainability. Particular attention is given to the benefits that could arise from a future, hoped-for reduction in the use of private motorized vehicles, which remain the dominant mode of transport in the area. The objective is to provide useful tools for developing integrated university mobility policies that combine environmental efficiency, accessibility, and behavioral innovations, fostering a shift toward more sustainable transport practices within medium-sized, regionally situated campuses.

By implementing sustainable policy measures, universities can effectively optimize and reshape mobility patterns, particularly for commuters, unlocking a broad spectrum of long-term benefits. First of all, the benefits impact directly the academic population in its different components (students and staff) and the whole university, in its educational role, and indirectly the local community. The benefits cover all the three dimensions of the Sustainable Development Approach: environmental, social and economic. The environmental benefits include reduction of pollution, noise, congestion and adverse impacts on eco-system, while the social one regards the growth of quality of life both for the academic and local community, the improvement of individual and collective health and the increase of social interactions (using collective means or sharing services or carpooling solutions. Finally, the economic gains comprise mainly the reduction of travel costs, of sanitary costs and the increase of staff productivity. In this work, the focus is on the reduction of climate-changing emissions that cover a key role, considering the urgent challenge to combat climate change.

The paper is organized as follows: after this introduction, the methodology in terms of data collection and environmental impact estimation both of present and potential future transport habits is explained. Section 3 presents and discusses the main findings, while the last section draws some conclusions and future perspectives.

2. Methodology

The case study was conducted at the University of Insubria, a public, medium-sized Italian university officially established in 1998. True to its name, the university is deeply embedded in the historical-geographical region of Insubria, which spans the area in Lombardy region between the Po River, the pre-Alpine lakes, and the Swiss Canton of Ticino.

The university is organized into eight departments and serves a community of over 12,000 students, approximately 700 doctoral candidates and medical trainees, and 130 research fellows and collaborators. It is supported by around 420 faculty members and 330 technical and administrative staff. The academic population is primarily distributed across three main campuses: Varese (76%), Como (23%), and Busto Arsizio (1%). All the three cities are served by rail and bus connections, connecting them to the close Switzerland in the north, to Milan in the south and to other important urban areas of Lombardy or other neighboring regions.

However, although the three cities are located relatively close to one another - approximately 20 to 30 kilometers apart as the crow flies - mobility between the different campuses, as well as between different buildings within the same urban district, still presents logistical and infrastructural challenges. This regional configuration, combining semi-urban settings and short-to-medium travel distances, offers a meaningful context for analyzing everyday commuting practices and their environmental impacts in a non-metropolitan academic institution.

2.1. Data collection

Regarding the mobility data, both daily commuting and Erasmus-related travel were collected and analyzed. Staff business trips were excluded due to difficulties in collecting consistent and complete information from the administrative offices of individual departments.

Commuting data were collected through a survey conducted between December 2022 and January 2023, targeting the entire academic community of the University of Insubria (students, academic and technical-administrative staff) with access via institutional account. The questionnaire was developed according to the national guidelines by Italian Ministry of Transport for "Home-Work Commuting Plan" [17], as well as the methodological framework provided by the Italian University Network for Sustainable Development (RUS) to adapt the "Home-Work Commuting Plan" to the "Home-University Commuting Plan" (HUCP), including the students' community. This Plan can be essentially defined as an instrument for planning, implementing and monitoring sustainable transport policies to drive commuters' flows to and from university. A set of data-driven and tailored-to-the-local-community measures are designed and implemented to encourage modal shift from private motor vehicles to cleaner transport modes. The drafting of such a strategic document is a legal obligation for university institutions and large public bodies located in rather highly urbanised areas.

In this context, the investigation of commuting habits explored various aspects of daily mobility to and from university campuses, including questions on origin and destination of trips, modes of transport, travel distance and frequency, reasons behind modal choices, and willingness to shift to more sustainable alternatives. The survey yielded a response rate of 23.3%, resulting in 2,915 valid observations. For car trips, respondents were asked to report the number of passengers, allowing for an adjustment in emission calculations.

As for Erasmus-related travel, data were gathered on all trips undertaken by students and staff during the 2022 and 2023 calendar years. Since travel costs for these trips are typically not reimbursed, it was not possible to determine the exact mode of transport used. Therefore, it was assumed that long-distance travel was conducted primarily by air, with the exception of short routes (<300 km), for which train use was assumed. Moreover, official documentation does not account for any short-term return trips to Italy during the Erasmus period. Starting from the 2022/23 academic year, "green travel" incentives were introduced, in line with recommendations from the National Erasmus Agency. These incentives apply to low-emission or shared transportation modes (e.g., train, coach, carpooling). Because declaration of the transport mode is required to obtain reimbursement, alternative-to-air travel has only been consistently recorded since the second half of 2022.

2.2. Transport data analysis

CO_2 emissions related to academic mobility were estimated by applying standardized emission factors to the reported travel data. Specifically, emissions from commuting and Erasmus-related trips were calculated using a linear model based on the following formula:

$$E_i = D \times FE_i \qquad (1)$$

where:

E_i represents the CO_2 emissions (g/year) associated with transport mode i,

D is the distance traveled annually using that mode (km/year),

FE_i is the emission factor for mode i (g CO_2/km).

Emission factors were differentiated by transport mode (e.g., car, train, airplane), fuel type, and – where applicable – vehicle occupancy. For private car use, a correction was applied based on an average occupancy of 1.2 passengers per vehicle. This calculation framework enabled a consistent and comparable assessment of emissions across different types of university-related travel.

Emission factors for the modes used both for commuting and Erasmus trips, were selected in accordance with the methodological guidelines provided by RUS. Specifically, coefficients for road transport (car, motorcycle, bus) were sourced from the Italian Institute for Environmental Protection and Research (ISPRA), which distinguishes between vehicle-level and per-passenger emissions. Rail (including metro) and waterborne (e.g., ferries, ships) transport coefficients were drawn from the Mobitool database, while air travel factors were based on data provided by the International Civil Aviation Organization (ICAO).

As regards rail transport, regional train and underground emission factors were applied to commuting trips, while high-speed rail coefficients were used to estimate Erasmus-related emissions. This methodological distinction reflects the different energy performance and average occupancy rates associated with various types of rail service.

2.3. Estimation of potential environmental benefits of mobility management measures

The present study also attempts to outline preliminary evaluations of potential CO_2 reductions (expressed in tonnes per year) deriving from a successful implementation of different mobility management policies by the University of Insubria in the context of its home-university commuting plan. In this view, this key metric serves as a benchmark for future monitoring and evaluation activities, rather than as a simple validation of the selected policy approaches.

Policies under consideration in the analysis are predominantly aimed to promote the use of public transport and active (or micro) mobility; other complementary strategies include the promotion of shared transportation services, carpooling and the reduction of travel demand. These macro-directions were primarily (although not exclusively) determined by the orientations that emerged from the survey on the openness of the academic community towards different kinds of modal shifts.

Emission reductions are computed in accordance with the procedures delineated in Annex 4 of the national guidelines for "Home-Work Commuting Plan" [17] and on the basis of the picture drawn by the results of the survey about the willingness to change by the academic community. This annex suggests two different procedures, according to the type of mobility management measure applied (table 1). Procedure 1 aims to quantify the CO_2 savings achieved in a year by policies encouraging employees and students to abandon the use of private cars in favour of active travel (by bicycle or on foot), micro-mobility and local public transport or to estimate the environmental benefits of smart working schemes participation. Procedure 2, instead, has been designed to calculate the annual environmental benefit generated when travellers opt for carpooling to reach university and/or to come back to their home.

The subsequent table provides a concise view of the measures that have been identified by the University of Insubria in its "Home-University Commuting Plan", that was approved by the academic bodies at the end of 2024 and have been considered compliant with the University Strategic Plan 2019-2024, including the need to reduce greenhouse gas emissions.

According to the guidelines, both Procedure 1 and Procedure 2 should start from an estimation of the daily reduction in kilometres (*Δkmauto*), obtained from the shift of employees and students from car to cleaner transport solutions applying the following formula. *Ind* indicates the number of individuals opting for the measure; δ (set equal to 1.2) the average car occupancy rate and *MLG* the average daily mileage (round trip sum, expressed in km).

$$\Delta kmauto = (Ind/\delta) \times MLG \qquad (2)$$

To then calculate the annual reduction in pollutant emissions (*ΔPollEm*) following Procedure 1, the value of *Δkmauto* should be multiplied by the average CO_2 emission factor expressed in g/km ($EFCO_2$, in 2020 estimated for the Italian car fleet by ISPRA at just below 163 g/km) and by the number of days the measure is operational (*Op*), then divided by 1,000,000 to obtain the value in tonnes/year.

$$\Delta PollEm = (\Delta kmauto \times EFCO_2 \times Op)/\, 1{,}000{,}000 \qquad (3)$$

Table 1. The Mobility Management Measures and Procedure for CO_2 Savings Estimation

Procedure 1	Procedure 2
Discounted local public transport tickets for students/staff	University internal carpooling service
Urban bus lines directly connecting the (railway) stations and the inner cities to university sites	Free parking spaces within university site for car-poolers
Establishing new lines/stops linking local public transport hubs and university sites	Gamification and/or rewards applied to carpooling initiatives
Security interventions on pedestrian/cycle crossings and paths in the surrounding of university sites	
Increase of protected bicycle parking areas and provision of a (guarded) depot for e-scooters	
Charging stations for e-bikes/e-scooters	
Renovation and expansion	
of the internal bike sharing service	
Signing agreements with bike and e-scooter sharing companies for discounted tickets and subscriptions	
Smart working for technical-administrative staff	

Starting from *Δkmauto* as above, but following Procedure 2 instead, shared car mileage (*KMshared*) should be firstly calculated by multiplying the number of daily rentals of shared/pooled vehicles (*Rent*) by the estimated average mileage (in km) of a shared/pooled vehicle during a rental (*KMrent*).

$$KMshared = Rent \times \ KMrent \qquad (4)$$

Subsequently, to calculate the net reduction in pollutant emissions resulting from the replacement of private car use by sharing mobility/carpooling (ΔPollEm), where *NDays* indicates the average number of working days per year on which the service is used (). the following formula is applied.

$$\Delta PollEm = \frac{(\Delta kmauto \times EFCO_2 \times Ndays) - (KMshared \times EFCO_2 \times Ndays)}{1{,}000{,}000} \qquad (5)$$

As previously anticipated, in the adopted approach, the share of survey respondents (out of the sub-sample of habitual car or motorcycle commuters) who stated their willingness to switch to one of the sustainable modes of transport supported by the proposed measures indicated in table 1 (e.g. public transport in the case of application of the mobility management measure “discounted local public transport tickets for students/staff”) was taken into account to approximate the number of users potentially involved by each measure. In fact, the questionnaire used for the survey included a list of Likert-based questions to assess the level of appreciation for the different measures. For example, as regards the measure indicated in the first row of table 1 ("Discounted local public transport tickets for students/staff"), to estimate the number of potential adopters it has been considered the number of interviewees who stated that a form of economic support would strongly incentivize them to shift from car to public transport.

It should be noted that, in the specific case of carpooling, due to the nature of the question within the survey, the respondents who indicated a medium-to-high level of interest (4 or 5 on a five-point Likert scale) were considered as potential users of the service. Moreover, for the sake of simplicity, it was supposed that each shared trip would transport two people, thus rendering the number of daily trips in shared vehicles equal to the total number of the estimated interested individuals divided by two.

Conversely, in the case of smart working, the potential user base was obtained from the actual number of individuals among the technical-administrative staff who made use of this flexible working approach in the considered year (2023), assuming 2 days each per working week (maximum number of smart working days generally granted to the staff according to the job contract). For all other measures examined, the number of operational days of the intervention was set equal to 250 (as an estimate of working days in a year).

3. Results and Discussions

The selection of the transport mode for commuting to the university constitutes a key behavioral leverage point for sustainable mobility interventions, as it embodies the interplay between structural constraints and individual decision-making processes. The modal share revealed by the survey highlights a strong tendency toward car dependency within the University's community, confirming the findings of previous investigations [1, 16]. Approximately 60% of respondents reported using a private car for at least part of their commute (figure 1). Although this group represents a portion of the commuting population, it is responsible for approximately 94% of total greenhouse gas emissions associated with academic commuting (table 1). While this pattern is consistent across campuses and demographic groups, it is slightly more prevalent among men and administrative staff. The remaining respondents use different means of public transport: about 27% train followed by urban bus for shorter trips and extra urban bus for longer trips. Only a very low percentage of commuters use the other transportation modes. It has to be specified that in the three cities in which the university is located (Varese, Como and Busto Arsizio) the underground infrastructure is not available; thus, this mode is used only by the commuters (typically academic staff) departing from cities, such as Milan (located at a distance of about 60 km), with a metro system and only for the initial part of the O-D (origin-destination) trip.

The estimated annual greenhouse gas emissions associated with commuting by the university community amount to approximately 11,919 tons of CO_2 (table 2).

In contrast, emissions linked to Erasmus-related travel were estimated at 86 tCO_2 in 2022 and 65 tCO_2 in 2023, considering only student mobility. These values suggest that while commuting remains the predominant source of mobility-related emissions, international academic travel—though less frequent—still contributes notably to the institution's environmental footprint.

However, the emissions associated with Erasmus travel likely represent a conservative estimate, as the analysis includes only student mobility and excludes staff travel due to incomplete data availability. This limitation may result in a significant underestimation of the university's actual international travel emissions. As highlighted by Arsenault et al. [13], it is crucial to quantify emissions from academic staff as well, since their international mobility typically generates considerably higher emissions compared to students. This, being a limitation of the current study, a cause of data unavailability, underscores the need to expand data collection efforts to encompass all categories of travelers for a more accurate and comprehensive assessment of mobility-related emissions in academic institutions.

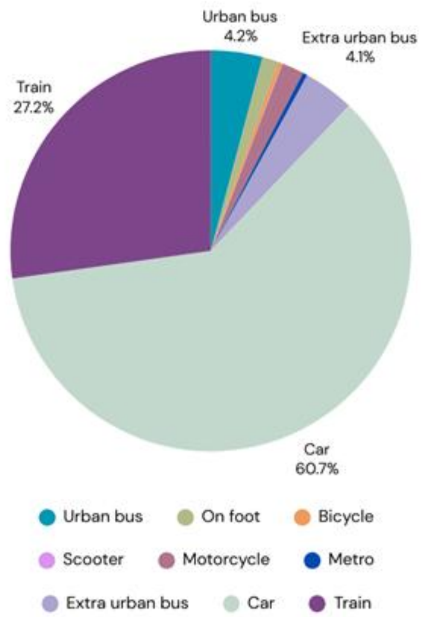

Figure 1. Distribution of the total annual km travelled by survey respondents

Table 2. Distribution of Academic Mobility by Transport Mode, Annual Distance Travelled, and CO_2 Emission Intensity

Mode of transport	Annual distance travelled (km)	tCO_2/km
On foot	1.779.005	0
Bicycle	460.224	0
Scooter	64.629	0
Urban bus	5.723.765	80
Extra urban bus	5.643.181	79
Train	37.411.828	311
Metro	534.523	4
Motorcycle	2.440.689	264
Car	83.444.637	11.182
Total	**137.502.481**	**11.919**

Despite the availability of alternative transport options—known to 77% of car users—several barriers persist. Respondents cited the greater accessibility, flexibility, and comfort of private cars compared to public transportation, which is often hampered by limited schedules, inconvenient transfers, and frequent delays or strikes. Other justifications included the need to perform personal errands or the impracticality of active or micro mobility modes for longer or complex commutes.

Table 3. Estimation of The Expected Annual CO_2 Savings of The Mobility Management Measures

Mobility management intervention	**Tonnes of CO_2 savings/year**
Discounted local public transport tickets for students/staff	~ 1,798.5 tCO_2/year
Urban bus lines directly connecting the (railway) stations and the inner cities to university sites	~ 2,504 tCO_2/year
Establishing new lines/stops linking local public transport hubs and university sites	
Security interventions on pedestrian/cycle crossings and paths in the surrounding of university sites	~ 1,378.7 tCO_2/year
Increase of protected bicycle parking areas and provision of a (guarded) depot for e-scooters	
Charging stations for e-bikes/e-scooters	~ 128.9 tCO_2/year
Renovation and expansion of the internal bike sharing service	~ 176.2 tCO_2/year
Signing agreements with bike and e-scooter sharing companies for discounted tickets and subscriptions	
Smart working for technical-administrative staff	~ 140.5 tCO_2/year
University internal carpooling service Free parking spaces within university sites for car-poolers	~ 942.4 tCO_2/year
Gamification and/or rewards applied to carpooling initiatives	

From the perspective of behavioral intentions, however, the data reveal a substantial subset of the university population—nearly 65% overall and approximately 67% among current car or motorcycle users—who express a willingness to partially modify their commuting habits. This "target group," comprising both those who already use alternative modes and those constrained by a lack of viable options, represents a valuable starting point for promoting a shift toward more sustainable practices.

As regards the estimation of the potential environmental benefits in terms of tonnes of CO_2 saving per year coming from the application of the measures described in table 1 and included in “Home-University Commuting Plan” of University of Insubria, the results are indicated below (Table 3).

4. Conclusions and Future Perspectives

The present study advances the understanding of the environmental impact of academic mobility by quantifying CO_2 emissions associated with commuting and Erasmus-related travel within a university community. While the university itself does not exert direct control over mobility-related emissions, which are predominantly driven by individual choices, this research highlights the substantial contribution of transport behaviors to the institution’s overall carbon footprint and, indirectly, to the entire local community with global implications in combating climate changes. An advanced knowledge about individual commuting choices and real data estimation of carbon footprint are a fundamental requirement to orientate the decisions of the university governance in identifying the most appropriate policies to encourage environmentally friendly trips, using efficiently its financial resources. By identifying the prevailing car dependency and simultaneously revealing a significant portion of the community's willingness to adopt more sustainable transport alternatives, the study provides a scientifically grounded basis for targeted policy interventions.

These findings underscore the university's potential strategic role in facilitating a behavioral shift through coordinated actions. The evidence supports the prioritization of policies aimed at improving the accessibility and reliability of public transport services, enhancing connectivity between campuses and transit hubs, and offering financial incentives to encourage transit use. Additionally, complementary measures such as promoting hybrid teaching models, expanding remote work opportunities, and fostering internal carpooling can further contribute to reducing emissions.

This work contributes to the growing body of knowledge on sustainable university mobility by integrating both behavioral intention data and environmental impact assessments, thus offering a comprehensive framework for future mobility planning. Moving forward, longitudinal studies are recommended to monitor the effectiveness of implemented measures and to refine strategies based on evolving travel patterns and emerging technologies. Furthermore, expanding data collection to include other forms of academic travel, such as research missions and conferences, will provide a more holistic understanding of the university's mobility footprint and inform broader sustainability goals.

Acknowledgment

The authors wish to thank the University of Insubria that have financially supported in 2024 the project "Uninsubria Sostenibile" with the post-doctoral scholarship won by Anna Claudia Caspani and the young researcher scholarship obtained by Michela Rosselli. Moreover, a special thanks should be addressed to the staff of the administrative university office on sustainability, and to all the people who were involved in data collection.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors Contribution

All authors contributed substantially to the work. **E.M.** conceived the research idea and made the funding acquisition; the design of the methodology has been carried out by all the authors. **A.C.C.** and **M.R.** conducted data collection, analysis and interpretation, under the supervision of **E.M**. **A.C.C.** and **M.R.** contributed to the initial manuscript writing and **E.M.** made a critical revision, writing some conclusions and policy implications. All authors reviewed and approved the final version of the manuscript.

References

1. Crotti D, Grechi D, Maggi E. Reducing the carbon footprint in college mobility: The car commuters' perspective in an Italian case study. Environmental Impact Assessment Review. 2022;92:106702.
2. Pérez-Neira D, Rodríguez-Fernández MP, Hidalgo-González C. The greenhouse gas mitigation potential of university commuting: A case study of the University of León (Spain). J Transp

Geogr.2020;82:102550.
3. Sobrino N, Arce R. Understanding per-trip commuting CO2 emissions: A case study of the Technical University of Madrid. Transp Res Part D. 2021;96:102895.
4. Ribeiro PJG, Fonseca F. Students’ home-university commuting patterns: A shift towards more sustainable modes of transport. Case Stud Transp Policy. 2022;10:954–64.
5. Clifford JM, Cooper CD. A 2009 Mobile Source Carbon Dioxide Emissions Inventory for the University of Central Florida. J Air Waste Manag Assoc. 2012 Sep;62(9):1050–60.
6. Zakaria NF, Yazid MR, Yaacob NF. Quantifying Carbon Emission from Campus Transportation: A Case Study in Universiti Kebangsaan Malaysia. IOP Conf Ser Mater Sci Eng. 2020;1101:012011.
7. Kabit MR, Siong JTL, Yassin A. Towards Campus Sustainability: Estimating On-Campus Vehicle CO2 Emissions in UNIMAS. J Sustain Sci Manag. 2022;17(6):193–206.
8. Sultana S, Kim H, Pourebrahim N, Karimi F. Geographical Assessment of Low-Carbon Transportation Modes: A Case Study from a Commuter University. Sustainability. 2018;10(8):2696.
9. Mesarec B, Trček B. Suggestions and Solutions for Enhancing Active Commuting to the University of Maribor and Advancing CO2 Emission Reduction. Sustainability. 2024;16(2):520.
10. Pantelaki E, Caspani AC, Maggi E. Impact of home-school commuting mode choice on carbon footprint and sustainable transport policy scenarios. Case Stud Transp Policy. 2024;15:101110.
11. Reyes-García V, Graf L, Junqueira AB, Madrid C. Decarbonizing the academic sector: Lessons from an international research project. J Clean Prod. 2022;368:133174.
12. Hölbling S, Kirchengast G, Danzer J. Unmasking mobility patterns: international travel behavior and emissions of scientists in a higher research institution. Int J Sustain High Educ. 2023;24(9):355–71.
13. Arsenault J, Talbot J, Boustani L, Gonzalès R, Manaugh K. The environmental footprint of academic and student mobility in a large research-oriented university. Environ Res Lett. 2019;14(9):095001.
14. Ciers J, Mandic A, Toth LD, Op ’t Veld G. Carbon Footprint of Academic Air Travel: A Case Study in Switzerland. Sustainability. 2019;11(1):80.
15. Yang C, Yao T, Shiming D, Jiang W. Carbon emissions accounting and uncertainty analysis in campus settings: A case study of a university in Sichuan, China. PLOS ONE. 2025;20(4):e0321216.
16. Crotti D, Grechi D, Maggi E. Proximity to public transportation and sustainable commuting to college. A case study of an Italian suburban campus. Case Studies on Transport Policy. 2022;10(1):218-226.
17. Ministero della Transizione Ecologica and Ministero delle Infrastrutture e della Mobilità Sostenibili. Decreto Attuativo Interministeriale MiTE-MiMS n° 179, 12 maggio 2021, Allegato 4 - Metodologia di valutazione dei benefici ambientali [Internet]. Available from: https://www.gazzettaufficiale.it/eli/id/2021/05/26/21A03111/SG.