Student Carbon Footprint: A Literature Review of Composition, Scale and Reduction Strategies

A review of student mobility, housing, food and digital consumption as drivers of individual carbon footprints

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Abstract—Climate change driven by anthropogenic greenhouse gas emissions has placed individual and institutional carbon accounting at the centre of sustainability research. University and college students form a distinct and sizeable population whose daily choices in mobility, housing, food and digital consumption contribute meaningfully to national emission inventories. This paper reviews published literature retrieved through Google Scholar, Elsevier (ScienceDirect), Emerald Insight and the Taylor & Francis Group to examine how a student's carbon footprint is defined, measured and reduced, drawing on campus-level assessments, lifestyle-based consumption studies, validated awareness scales and curriculum-based intervention studies from Germany, China, Thailand, Turkey, the United States and India. Reported per-student annual emissions range from under 1 tonne CO2-equivalent on resource-constrained developing-country campuses to nearly 11 tonnes on campuses in industrialized nations, with mobility, housing energy and diet consistently the three dominant contributing categories. Awareness of one's carbon footprint does not automatically translate into low-carbon behaviour; structured educational interventions, such as dedicated sustainability seminars, produce measurable double-digit percentage reductions in dietary carbon footprint within a single academic term. The paper concludes with a working model of student footprint formation and management, practical low-cost reduction strategies, and the Sustainable Development Goals most relevant to this area of research.

Index Terms—carbon footprint, sustainability, greenhouse gas emissions, higher education, climate action, behaviour change

I. Introduction

A carbon footprint is the total amount of greenhouse gases, expressed in tonnes of carbon-dioxide equivalent (CO2e), generated directly or indirectly by an individual, organization, product or activity. For individuals, the footprint accumulates through everyday choices in housing energy use, mobility, food consumption and general purchasing behaviour. Universities and colleges bring together large, semi-permanent populations of young adults whose collective consumption patterns are sizeable enough to influence an institution's overall emissions profile, yet distinct enough from the general population to merit separate study.

Unlike full-time working adults, many students depend on hostel or shared accommodation, canteen-based food systems, public or campus transport, and digital infrastructure for academic work, which shapes a footprint that differs in composition from a typical household footprint. Students are also often more receptive to behavioural change and more exposed to sustainability education than older populations, making them an important target group for low-carbon interventions and future climate leadership. This paper reviews academic literature on student carbon footprints sourced from Google Scholar and major publisher databases, consolidating findings on the scale, composition and drivers of student carbon footprints, surveying methods used to measure them, and summarizing evidence on what reduces them.

II. Problem Identification

Despite growing institutional commitment to campus sustainability, most published carbon-footprint work in higher education focuses on the operational footprint of the institution itself — electricity use in buildings, fuel use in campus vehicles and waste generation — while the footprint generated by student lifestyle choices is comparatively under-studied and inconsistently measured.

Existing student-level studies use different system boundaries, emission factors and survey instruments, making reported figures difficult to compare across institutions and countries. Many studies are concentrated in Europe, China and South-East Asia, while standardized, India-specific student carbon-footprint assessments remain limited. Several studies also note a gap between students' awareness of climate issues and their actual day-to-day behaviour, indicating that information alone is an incomplete lever for emission reduction. The problem this paper addresses is therefore twofold: to consolidate the fragmented literature on what constitutes and drives a student's carbon footprint, and to identify which categories of intervention have demonstrated measurable, low-cost reductions.

III. Literature Survey

Seven primary studies and two supporting reviews were examined; Table I summarizes the key findings.

Ref.	Study / Region	Key Finding

Ref.	Study / Region	Key Finding
[1]	Sippel et al., 2018 — Germany	~10.9 tCO2e/student/yr; housing & mobility dominant
[2]	Li et al., 2015 — China	~3.84 tCO2e/student/yr; 65% daily living, 20% transport
[3]	Aroonsrimorakot et al., 2013 — Thailand	Electricity & solid waste are leading sources
[4]	Kulkarni, 2019 — India	Low-cost bottom-up method feasible for Indian HEIs
[5]	Pekel et al., 2025 — Turkey	Validated awareness scale (CFAS); awareness ≠ behaviour
[6]	da Silva et al., 2023 — Global	Bibliometric mapping of leading regions & green-campus initiatives
[7]	Malan et al., 2020 — USA	~14% reduction in dietary footprint after seminar

TABLE I. Summary of Key Literature

A. Summary

The literature reviewed shows broad agreement that mobility, housing energy and diet are the three categories that most consistently drive a student's carbon footprint, while the absolute scale of that footprint varies widely with national income, infrastructure and campus context. Most existing assessments are concentrated in Europe and East/South-East Asia; standardized, comparable Indian student-level studies remain comparatively scarce. A recurring theme is that raising awareness, while necessary, is not sufficient on its own, and that structured, curriculum-embedded interventions produce more reliable behavioural reductions than information campaigns alone.

IV. Objectives

The aim of this paper is to consolidate published research on student carbon footprints into a single reference that identifies their composition, magnitude and the most effective reduction strategies. The specific objectives are:

1) To define the concept of a student carbon footprint and distinguish it from institutional or household carbon footprints.

2) To identify, through Google Scholar, Elsevier, Emerald and Taylor & Francis databases, the major categories that contribute to a student's footprint.

3) To compare reported average annual student carbon-footprint values across different countries and study contexts.

4) To evaluate the effectiveness of awareness-based versus curriculum/behaviour-based interventions in reducing student carbon footprints.

5) To recommend practical, low-cost reduction strategies suitable for adoption by student communities.

V. Methodology

The review followed a five-stage process. First, the problem was identified by consolidating fragmented literature on the drivers of student carbon footprints and locating categories of intervention with demonstrated, low-cost reductions. Second, peer-reviewed sources were retrieved from Google Scholar, Elsevier (ScienceDirect), Emerald Insight and Taylor & Francis Group using search terms including "student carbon footprint," "campus carbon footprint" and "carbon footprint awareness students." Third, objectives were set to evaluate awareness-based versus curriculum/behaviour-based interventions and to recommend practical, low-cost reduction strategies. Fourth, findings were grouped into four contributing categories — mobility, housing/energy, food/diet, and digital/academic consumption — and reported footprint magnitudes and percentage contributions were tabulated across studies for comparative synthesis. Finally, results were consolidated into a working model linking student activity, footprint formation, environmental impact and mitigation, mapped against relevant Sustainable Development Goals (SDGs).

VI. Working Model

This section presents a working model of how a student's carbon footprint forms, how it contributes to environmental impact, and how it can be managed or reduced, consolidating the categories and intervention evidence identified in the literature review.

A. Composition of a Student's Carbon Footprint

Fig. 1 presents an illustrative breakdown of the categories contributing to a student's carbon footprint, based on the relative weightings reported across the reviewed studies. Mobility and housing/energy together account for the majority share, followed by food/diet, with digital and academic consumption forming a smaller but growing component.

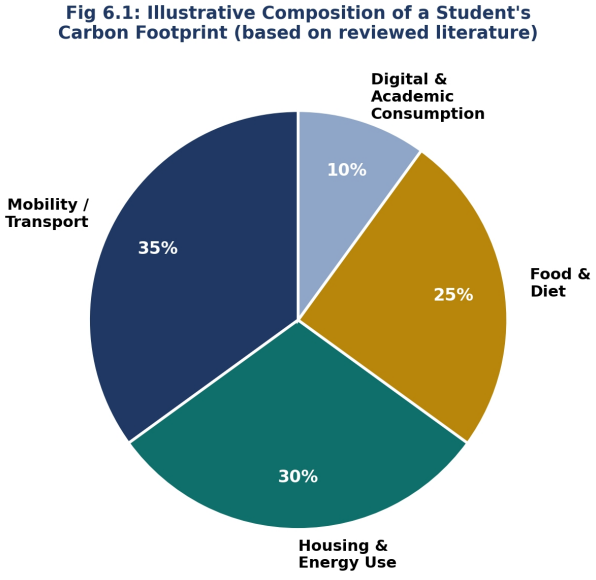


Fig. 1. Illustrative composition of a student's carbon footprint.

B. Comparative Scale Across Studies

Fig. 2 compares the average annual student carbon footprint reported in two key studies against a global per-capita reference value. The wide variation reflects differences in electricity-grid carbon intensity, transport infrastructure and dietary patterns rather than a single universal figure.

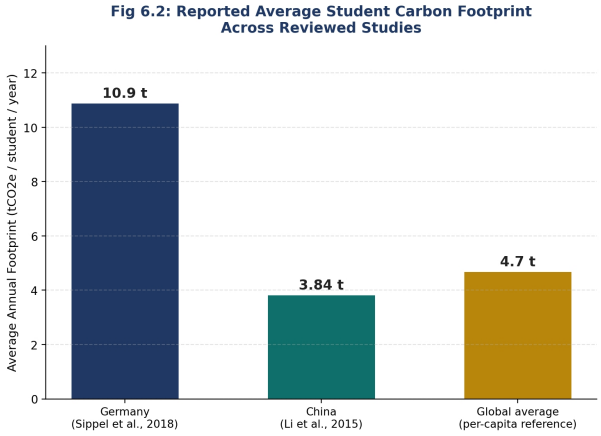


Fig. 2. Reported average student carbon footprint across reviewed studies.

C. Formation, Impact and Management

Fig. 3 models the working relationship between student activities, the resulting carbon footprint, the environmental impact it contributes to, and the mitigation loop that can reduce it. Student activities across mobility, housing, food and digital use generate a measurable carbon footprint (tCO2e), which adds to the broader environmental impact of climate change. This impact, once measured and communicated, can inform mitigation and management strategies — awareness programmes, sustainability education, behaviour change and supporting infrastructure — which feed back to reduce the footprint generated by future student activity, closing the loop.

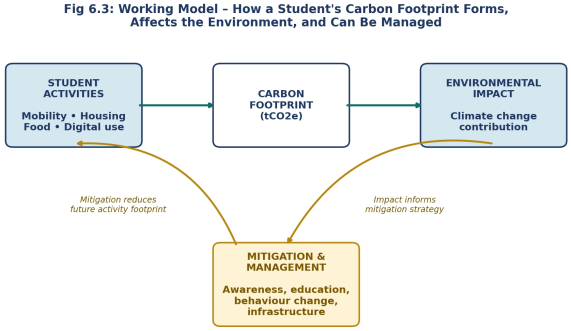


Fig. 3. Working model — formation, impact and management of student carbon footprint.

VII. Results and Discussion

The consolidated literature indicates three consistent patterns. First, mobility, housing energy and diet together account for the large majority of a student's carbon footprint across every reviewed context, even though their relative weighting differs by country. Second, absolute footprint values scale closely with national income and infrastructure: students in industrialized, car-dependent settings such as Germany report footprints roughly three times higher than students in comparable studies from China, while campus-level studies from Thailand and India emphasize electricity and solid-waste management as the more tractable near-term levers in developing-country contexts. Third, and most significant for intervention design, awareness of one's carbon footprint, even when reliably measured through validated instruments such as the CFAS scale, does not by itself guarantee a reduction in emissions. The strongest documented behavioural result in the reviewed literature comes from a structured, curriculum-embedded seminar rather than an awareness campaign, which produced an estimated 14 percent reduction in dietary carbon footprint within a single academic term.

Intervention	Category	Reported Effect
Curriculum-based seminar	Diet	~14% reduction/term [7]
Awareness scale/education	All	Improves awareness only [5]
Shift to public transport/cycling	Mobility	Largest single lever [1]
Plant-forward, local canteen menus	Diet	Lower than meat-heavy diets
Efficient hostel appliances, solar	Housing	Directly reduces emissions [3],[4]
Green-campus programmes	Institutional	Supports individual reduction [6]

TABLE II. Interventions and Their Effects on Carbon Footprint

A. Advantages of Measuring and Reducing Student Carbon Footprint

1) Provides institutions with a more complete sustainability picture beyond operational (building) emissions alone.

2) Low-cost behavioural and dietary interventions can achieve measurable reductions without major capital investment.

B. Limitations

1) Methodological inconsistency across studies (different system boundaries and emission factors) limits direct comparability.

2) Self-reported lifestyle data used in most surveys is subject to recall and social-desirability bias.

3) Standardized, India-specific student-level footprint studies remain limited compared with European and Chinese literature.

VIII. Conclusion

This review consolidates published research on student carbon footprints drawn from Google Scholar, Elsevier, Emerald and Taylor & Francis sources, establishing that mobility, housing energy and diet are the consistently dominant contributing categories, while the absolute magnitude of the footprint varies several-fold with national infrastructure and income context. The evidence indicates that measuring awareness alone is insufficient to change behaviour, whereas structured, curriculum-embedded interventions and practical infrastructure or menu changes have demonstrated measurable double-digit percentage reductions within short timeframes. The most promising near-term opportunities lie in electricity-use efficiency, sustainable canteen sourcing, and embedding a short sustainability module within the curriculum, while a standardized, India-specific student carbon-footprint survey

would help close an identified gap in the literature. The reduction of student carbon footprints aligns with several United Nations Sustainable Development Goals, most directly SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

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