Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Drivers, Barriers, and Outcomes of Green Practice Adoption and Management in Higher Education Institutions: A Systematic Review and Framework for Sustainable Campuses

Ajay Thakur
17010ajay@gmail.com
Himachal Pradesh University
Dr.Vinod Negi
Himachal Pradesh University
Dr. Puneet Bhushan
Himachal Pradesh University
Shephali Shyam
Himachal Pradesh University
Dr. Shubham kaushal
Himachal Pradesh Technical University

Systematic Review

Keywords:

Posted Date: November 3rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11392129/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Higher education institutions (HEIs) are increasingly adopting green practices to reduce environmental impacts, improve resource efficiency and strengthen institutional sustainability. However, prior research remains fragmented regarding the conditions that facilitate or constrain adoption, the progression of practices from initial adoption to institutionalized routines, and the outcomes associated with their implementation. This systematic literature review (SLR) synthesizes evidence on the Drivers, Barriers, Adoption/Implementation and Outcomes of green practices in HEIs and develops a Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework for sustainable-campus transformation. The review was structured according to the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) protocol and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework. Two complementary Scopus searches were conducted on 22 July 2026 for studies published between 2006 and 2026. Following deduplication, 254 unique records were screened, 153 full-text articles were assessed and 40 studies were included in the final qualitative synthesis. The evidence identifies stakeholder participation, resources, leadership, institutional and policy support, knowledge and behavioural conditions as recurrent Drivers, while financial constraints, fragmented governance, limited knowledge and communication, resistance to change and infrastructure-related limitations emerge as important Barriers. Adoption is conceptualized as a multi-stage process involving initial adoption, operational implementation, organizational integration and institutionalization. Reported Outcomes span environmental and resource, economic and operational, social and behavioural, and institutional domains; however, the evidence comprises observed, perceptual and modelled outcomes and should therefore not be interpreted uniformly as realized causal effects. DBAO is consequently proposed as an evidence-informed, stage-ordered explanatory framework with a primary forward pathway and a theoretically proposed recursive feedback mechanism. The framework integrates antecedent conditions, implementation depth and multidimensional Outcomes and provides a foundation for longitudinal, comparative and multi-institutional empirical testing.

1. Introduction

Higher education institutions (HEIs) have a unique place to play in the transition to sustainability, as they are also large institutions with considerable consumption and a community that can set an example for the rest of society in adopting sustainable practices. The high energy and water usage, travel, infrastructure, various operations on the campuses that lead to waste production create direct environmental impacts. In this context, there has been a shift from environmental education to the greening of university operations in energy efficiency, waste and circularity, water conservation, sustainable transportation, green buildings, environmental governance and stakeholder participation (Alshuwaikhat and Abubakar, 2008; Gu et al., 2019). Recent studies further illustrate that campuses are also living laboratories to test and learn campus infrastructure and operational systems as opportunities for sustainability experimentation, education and institutional learning (Cianfrani et al., 2018; Shange et al., 2025). Moving towards a sustainable campus, however, requires institutional, financial, behavioural and stakeholder related conditions. On a broader organizational level, such organizational HR approaches can be also used to facilitate organizational sustainability-related transitions by increasing organizations' capacity, empowering employees and enhancing their environmental knowledge and pro-environmental behaviour (Anshima, Sharma, et al., 2025). Thus, leadership commitment, strategic governance, government support, financial resources and stakeholder participation and awareness of environmental issues are found to have facilitated the implementation of green-practice (Liu and Gao, 2021; Nunayon et al., 2020). Government support, faculty involvement and pressure from stakeholders can facilitate the adoption of green initiatives at HEIs (Tan et al., 2015), and collaborative structures and stakeholder's empowerment can enhance participation and institutional commitment (Adomßent et al., 2019; Too and Bajracharya, 2015). Behavioral factors are also important. Awareness about environmental issues and/or social influences/cultural pressures might impact on environmental behavior (Fu et al., 2018) and Students' intentions to adopt sustainable mobility practices are associated with attitudes, subjective norms and perceived behavioural control (Ibrahim et al., 2022). Moreover, recent studies reveal that there is a close relationship between sustainability knowledge, attitudes and practices in university communities (Said et al., 2026). In addition to institutional structures, Mohamad et al. (2018) also emphasize on "heartware", that is, shared values, voluntary commitment and attachment to community, as the foundation for durable campus sustainability efforts. These conditions may support HEIs in adopting the best practices, yet when it comes to putting commitments into action, HEIs meet with significant barriers. Restrictions in implementation can be financial constraints, high start-up cost, lack of environmental knowledge, hesitation to change, weak leadership, unclear policies, complex administrative requirements and fragmented institutional structure (Alsharif et al., 2020; Amaral et al., 2023; Gholami et al., 2020). Lack of financial resources can significantly hinder the uptake of renewable energy systems, similarly as lack of incentives and ambiguity about policy direction in renewable-energy endeavors (Geh et al., 2024), lack of strategic planning can limit the capacity of green building transformation (Herzanita et al., 2024). Convenience, lack of awareness, lack of engagement and resistance to existing practice are also behavioral barriers that can further hamper sustainability initiatives (Horhota et al., 2014). Recent studies have also pointed to the gap between institutional sustainability aspiration and implementation due to the varied level of awareness, lack of adequate funding, strained cooperation and insufficient commitment from senior-management in the institutions (Thondhlana and Nkosi, 2024). In accordance with the research conducted on green HRM, the role of sustainability cannot be achieved through technological solutions or modernization without integrating environmental goals with people management. Integration of environmental goals with people management as well as organizational processes and employee's participation instead of technology interventions is the key for the role of sustainability (Anshima, Bhardwaj, et al., 2024). Good green practice, if implemented properly, can deliver multi-faceted benefits. It is possible to achieve electricity savings, carbon savings and even operating cost savings from energy-efficiency interventions, and resource-management and recycling improvements through a waste-management system that integrates (Bahçelioğlu et al., 2020; Soares et al., 2015). In this regard, adopting sustainable transportation strategies can not only decrease fuel use and greenhouse-gas emissions, but also contribute to campus well-being (Cruz et al. 2017), while the installation of water refill stations can also decrease the use of disposable plastics and their carbon emissions and influence pro-environmental behavior (Uehara and Ynacay-

Nye, 2018). Renewable-energy projects can have environmental, economic and community-resilience impacts (Teah et al., 2019), while incentives are another method that can enhance expected carbon reductions from a campus-wide space-by-space approach (Xue et al., 2024). Sustainability practices might also boost stakeholder satisfaction and sense of quality of life (Tiyarattanachai and Hollmann, 2016), and have potential positive effects on environmental management, organizational responsibility and institutional quality (Hernandez-Diaz et al., 2020). Regrettably, however, the fact that such sustainability programs exist does not always mean that they are working well for the environment. But, in Lang's research (2015), few correlations were seen between programs announced by schools in reported campus sustainability activities and actual measures of performance and outcome, indicating that greater attention needs to be paid to the distinction between adoption and effective implementation and realization of outcomes.

2. Background and Prior Reviews

To reflect on the current level of knowledge in the field of green-practice adoption in higher education institutions (HEIs), it is necessary to examine and review existing literature reviews on different aspects of campus sustainability. Table 1 presents a comparison of the key reviews of sustainability in higher education in terms of their focus of research, time of publication, review scope/final sample and methodology. This comparison shows that this has led to some of the previous reviews assessing only certain issues of campus sustainability, such as sustainable campus assessment, green campus, environmental management, or higher education for sustainable development.

Table 1
Summary and Comparison Between Existing Review Articles and the Present Review

Study	Research focus	Period	Review scope/final sample	Method	Primary contribution	Remaining gap relative to DBAO
Blanco-Portela et al. (2017)	Drivers and barriers to sustainability integration in HEIs	2000–2016	HEI organizational change and comparison with companies	SLR; Scopus and Web of Science	Synthesized organizational drivers and barriers affecting sustainability integration in HEIs and highlighted conditions influencing institutional change.	Concentrates mainly on antecedent enabling and constraining conditions; does not integrate these systematically with distinct stages of adoption, implementation, integration and institutionalization and their multidimensional outcomes.
Sugiarto et al. (2022)	Sustainable-campus dimensions	2011–2021	100 studies; behavioural, educational and physical dimensions	Qualitative SLR; meta-aggregation	Consolidated sustainable-campus research into behavioural, educational and physical dimensions and provided a structured understanding of the major dimensions of campus sustainability.	Primarily classifies sustainability dimensions; does not explain how Drivers and Barriers shape progression from adoption through implementation and institutionalization or how implementation depth relates to Outcomes.
Oliveira and Proença (2025)	Sustainable campus operations	No fixed period	130 studies; major operational sustainability domains	SLR; Scopus and Web of Science	Synthesized major operational domains through which universities pursue campus sustainability and provided a broad overview of sustainable-campus operations.	Emphasizes *what* operational practices occur rather than a process explaining *how and under what conditions* they are adopted, integrated and institutionalized and subsequently associated with sustainability Outcomes.
Munaro and John (2025)	Sustainable university practices	2012–2024	670 studies; four sustainability dimensions	SLR; Web of Science	Provided a large-scale synthesis of sustainable-university practices across four major sustainability dimensions, demonstrating the breadth of practices reported in the literature.	Offers broad coverage and classification of sustainability practices but does not integrate antecedent Drivers and Barriers with implementation depth and subsequent multidimensional Outcomes in a single process framework.
Ankareddy et al. (2025)	Sustainability practices and challenges in HEIs	Broad coverage	Broad synthesis of practices and challenges	Critical/integrative review	Brought together major sustainability practices and challenges affecting HEIs and highlighted the diverse issues confronting institutional sustainability efforts.	Integrates practices and challenges at a broad level but does not distinguish systematically between adoption, operational implementation, integration and institutionalization or connect these stages with measurable Outcomes.

Study	Research focus	Period	Review scope/final sample	Method	Primary contribution	Remaining gap relative to DBAO
Hassan and Ahmad (2025)	Sustainability dimensions, practices and research gaps	2005–2025	180 studies; multidimensional HEI sustainability	PRISMA-based SLR; thematic and bibliometric analysis	Provided a multidimensional synthesis of HEI sustainability practices and research gaps using thematic and bibliometric approaches.	Maps the multidimensional sustainability literature and its gaps but does not explicitly integrate enabling/constraining antecedents, implementation depth and environmental, economic, operational, social/behavioural and institutional Outcomes as a process pathway.
Ogbolu et al. (2026)	Sustainability integration and institutional maturity	2014–2025	406 studies; SHE-IMM framework	PRISMA 2020/PICo SLR; thematic synthesis	Advanced the understanding of sustainability integration by emphasizing stages of institutional maturity through the SHE-IMM framework.	Provides a maturity-oriented perspective but does not explicitly connect Drivers and Barriers with the movement through adoption/implementation stages and the realization of multidimensional sustainability Outcomes.
Present Study	Drivers, Barriers, Adoption/Implementation and Outcomes	2006–2026	40 studies; complete DBAO process	SPAR-4-SLR + PRISMA 2020; thematic synthesis	Integrates antecedent enabling and constraining conditions with adoption, implementation, integration, institutionalization and multidimensional sustainability Outcomes in a single process-oriented DBAO framework.	The framework is evidence-informed rather than causally validated; relationships concerning implementation depth, Driver–Barrier interaction and recursive feedback require longitudinal, comparative and multi-institutional empirical testing.

Source: Author's own compilation.

As illustrated in Table 1, previous reviews have contributed substantially to understanding sustainability in higher education by examining organizational Drivers and Barriers, sustainable-campus dimensions, operational practices, sustainability challenges and institutional maturity. However, their principal contributions address different components of sustainable-campus transformation rather than integrating the complete process. Reviews focusing on Drivers and Barriers provide insight into antecedent conditions, while practice- and operations-oriented reviews primarily identify what universities do. More recent maturity-oriented work advances understanding of institutional integration, but the literature still provides limited integration of antecedent conditions, differences in implementation depth and multidimensional Outcomes within a single explanatory structure. The present review addresses this process-integration gap through the DBAO framework, which links Drivers and Barriers with adoption, implementation, integration and institutionalization and subsequently with environmental/resource, economic/operational, social/behavioural and institutional Outcomes. The framework is nevertheless presented as evidence-informed rather than causally validated, and several of its proposed relationships require further empirical testing.

Terminological Scope

In this review, sustainability practices are understood as the broader set of environmental, social and economic actions undertaken by higher education institutions (HEIs) in pursuit of sustainable development. Green practices refer more specifically to environmentally oriented institutional actions intended to reduce environmental impacts, improve resource efficiency or enhance environmental performance, including practices related to energy, water, waste, buildings, mobility and campus operations. Because the present review focuses primarily on environmentally oriented institutional action, green practices is used as the principal analytical term. The term initiative refers to a programme, project or organized intervention introduced to promote a green practice, whereas practice refers to the action or routine itself once adopted or implemented. Accordingly, the existence of a sustainability or green initiative does not necessarily establish that the corresponding practice has been effectively implemented, integrated or institutionalized.

Research Gap and Research Questions:

Although there is increasing maturity in research focusing on sustainability in Higher Education in both individual areas and in a linked way, three interconnected gaps exist. First, a process-integration gap exists, as the previous reviews have yielded important drivers, barriers, sustainability dimensions and operational domains but generally focused separately in the elements discussed, but not integrated as a complex adoption process. Limited attention has been given to synthesizing how Drivers and Barriers interact, how enabling conditions may help address implementation constraints, and how these antecedent conditions relate to the progression of green practices from adoption through implementation, integration and institutionalization. Second, there is an implementation–outcome gap, implying that the expression of formal adoption or presence of a sustainability initiative is not necessarily associated with effective implementation or institutionalization of the initiative, or to substantive outcomes of sustainability change measured by changes in the human or built environment. A greater level of differentiation between adoption, implementation, integration, institutionalization and real outcomes of sustainability change is thus required. Third, even though there have been some efforts in conceptualizing sustainability development in HEIs in the past years, including the SHE-IMM framework of Ogbolu et al. (2026) with an exclusive emphasis on phases of institutional maturity, there is still a gap with regard to the positioning of the framework. The present study attempts to answer different explanatory questions in relation to the current study on the driving and constraining factors for adoption of green practice, the factors affecting the implementation and institutionalization of green practice and at what point does measurable outcomes occur. This review thus builds on the past works by developing a process-oriented Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework that does not create another classification of sustainability practices or factors but sheds trivium on the interaction between drivers and barriers, the translation possible through the implementation and institutionalization process, and the transformation that this process produces or that it can be blocked, resulting in multidimensional sustainability outcomes, or not.

RQ1

What drivers facilitate green-practice adoption and implementation?

RQ2

What barriers constrain adoption and implementation?

RQ3

What green practices are adopted and what implementation patterns exist?

RQ4

What environmental, economic, operational, social/behavioral and institutional outcomes result?

RQ5

How can these findings be integrated into a DBAO framework, and what research gaps emerge?

Research Objectives:

1. To identify the key drivers that facilitate the adoption and implementation of green practices in higher education institutions.
2. To identify the major barriers that constrain the adoption and implementation of green practices in higher education institutions.
3. To classify the green practices adopted by higher education institutions and examine the major patterns of their implementation.
4. To examine the environmental, economic, operational, social/behavioural, and institutional outcomes resulting from green-practice adoption and implementation.
5. To integrate the identified drivers, barriers, implementation patterns, and outcomes into a Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework and identify key gaps and directions for future research.

Study Contribution

This review makes three principal contributions to the sustainable-campus literature. First, it extends the treatment of green-practice adoption beyond a binary decision by distinguishing initial adoption, operational implementation, organizational integration and institutionalization. This distinction enables the review to differentiate the existence of an initiative from the depth with which a practice becomes embedded in organizational systems and routines. Second, the review integrates evidence concerning enabling and constraining antecedent conditions rather than treating Drivers and Barriers as isolated lists of factors. Leadership, financial resources, knowledge, communication and stakeholder participation may function as enabling conditions when present and as constraints when absent; however, the extent to which particular Drivers mitigate corresponding Barriers is treated as an integrative proposition requiring further empirical testing. Third, DBAO links antecedent conditions and implementation depth with environmental and resource, economic and operational, social and behavioural, and institutional outcomes. Its contribution therefore lies primarily in process integration rather than in proposing another taxonomy of campus-sustainability practices. The framework should be interpreted as an evidence-informed explanatory structure rather than as a fully validated causal model.

3. Materials and Methods

This study employed a systematic literature review (SLR) to synthesize evidence concerning the Drivers, Barriers, Adoption/Implementation processes and Outcomes of green practices in higher education institutions (HEIs). The review process was structured using the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) protocol (Paul et al., 2021), while the identification, screening, eligibility and inclusion of studies were reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework (Page et al., 2021). SPAR-4-SLR provided the procedural logic for assembling, arranging and assessing the literature, whereas PRISMA 2020 was used to enhance transparency and reproducibility in reporting the study-selection process. The resulting evidence was synthesized thematically to develop the Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework.

3.1. PRISMA Framework

The PRISMA 2020 framework was used to enhance transparency and reproducibility in reporting the identification, screening, eligibility and final inclusion of studies in the review (Page et al., 2021). PRISMA was incorporated within the SPAR-4-SLR process so that record identification, duplicate removal, screening decisions, full-text eligibility and final inclusion could be reported systematically.

3.2. SPAR-4-SLR Protocol

The review was developed based on the suggested SPAR-4-SLR protocol by Paul et al., 2021. Since then, the protocol has been adapted for use in modern structured reviews in management fields in order to improve the methodological transparency and rigor of reviews (Kumari et al., 2026). SPAR-4-SLR is a framework of three steps: Assembling, Arranging, and Assessing, each of which gives a rationale for related decisions regarding the acquisition, purification, evaluation, synthesis and reporting of literature.

3.2.1. Assembling

In the assembling stage, books and other related publications were identified and procured. To search for the peer-reviewed literature sources on green and sustainable campuses Scopus database were used. Scopus was selected as the bibliographic database because of its broad multidisciplinary coverage across environmental sciences, engineering, management, social sciences and higher-education research, which reflects the interdisciplinary character of sustainable-campus scholarship. The use of one database also allowed the two complementary searches to be conducted using consistent indexing fields, search syntax and filtering procedures. Both Scopus searches were completed on **22nd July,2026**. The search spanned 2006–2026. The review period began in 2006, following the beginning of the UN Decade of Education for Sustainable Development (2005–2014) and the increasing visibility of scholarly publications on sustainability integration in HEIs. (Chakraborty et al. 2019) similarly observed a noticeable emergence of HEI sustainability studies from 2006 onwards, subsequent to the DESD declaration. The 2006–2026 period is thus representative of the changes to HEI sustainability over 20 years after the launch of this major international sustainability project.

Two search strategies were used, complementary to each other, to be sure of both precision and good literature coverage.

Search A – Precision Search

TITLE ("green campus" OR "sustainable campus" OR "campus sustainability") AND TITLE-ABS-KEY (adopt* OR implement* OR integrate* OR initiative* OR practice* OR operation*) AND TITLE-ABS-KEY (driver* OR enabler* OR barrier* OR challenge* OR outcome* OR impact* OR effectiveness OR performance)

The initial search retrieved 243 records. Restricting the publication period to 2006–2026 retained all 243 records. Limiting the results to journal articles reduced the set to 140 records. Applying the English-language criterion retained 139 records, and application of the publication-stage criterion produced a final set of 131 records from Search A.

A second broader search was done to enhance the sensitivity of the search and ensure that studies including but not limited to the green-campus concept were retrieved.

Search B – Sensitivity Search

TITLE-ABS-KEY (("green campus" OR "sustainable campus" OR "campus sustainability") AND (adopt* OR implement*) AND (driver* OR enabler* OR barrier* OR challenge* OR outcome* OR impact* OR effectiveness))

Search B initially retrieved 359 records. Restricting the publication period to 2006–2026 reduced the set to 357 records. Limiting the records to journal articles resulted in 199 records, of which 197 were published in English. Application of the publication-stage criterion yielded a final set of 191 records.

Search A and Search B therefore produced 131 and 191 records, respectively, resulting in 322 records before duplicate removal.

Development of Search Terms

The search terminology was developed from three concept blocks derived from the research questions. The first represented the sustainable-campus context through terms including “green campus,” “sustainable campus” and “campus sustainability.” The second represented adoption and

implementation processes through terms including adopt*, implement*, integrate*, initiative*, practice* and operation*. The third represented enabling, constraining and outcome-related conditions through terms including driver*, enabler*, barrier*, challenge*, outcome*, impact*, effectiveness and performance. Search A was designed as a precision-oriented search, whereas Search B was used as a broader sensitivity-oriented search. The search strings were constructed specifically for the objectives of the present DBAO review rather than reproduced verbatim from a single earlier review.

3.2.2 Eligibility Criteria

Eligibility criteria were defined before the final full-text synthesis to ensure consistent decisions regarding the institutional context, type of green practice and relevance to the DBAO dimensions. Studies were retained when they concerned an identifiable higher education institution, examined an environmentally oriented institutional practice and provided substantive evidence relevant to at least one of the four DBAO dimensions. The criteria applied are summarized in Table 2.

Table 2
Inclusion Exclusion Criteria

Criterion	Inclusion	Exclusion
Context	Universities, colleges or identifiable HEIs	Schools, firms, households, municipalities or non-HEI settings
Green-practice relevance	Environmentally oriented institutional practice	General sustainability discussion without identifiable institutional practice
DBAO relevance	Evidence relevant to Driver, Barrier, Adoption/Implementation or Outcome	No substantive evidence relevant to any DBAO dimension
Practices	Energy, water, waste, buildings, mobility, environmental management, circular economy, campus operations, living laboratories and related practices	Topics without clear campus green-practice relevance
Technical/modelling studies	Retained where directly connected with HEI implementation or outcomes	Pure technical simulation/design without institutional adoption or implementation relevance
Awareness/perception studies	Retained where clearly linked with adoption, implementation or outcomes	Awareness/perception only, without green-practice adoption relevance
Publication type	Peer-reviewed journal article	Reviews, editorials and other secondary/non-journal material
Language	English	Non-English
Publication period	2006–2026	Outside review period

Source: Author's own compilation.

A study was not required to provide evidence for all four DBAO dimensions. Studies could contribute evidence to one or more dimensions where supported by the findings.

3.2.3. Arranging

The outputs of Search A (131 records) and Search B (191 records) were combined to produce 322 records. Sixty-eight duplicates were identified using bibliographic information including article titles, DOI and Scopus identifiers and were removed, leaving 254 unique records for screening. Initial title-and-abstract screening excluded 41 records, leaving 213 records for a second eligibility-focused abstract assessment. At this stage, records were retained only where the abstract indicated an identifiable HEI-level green practice and substantive relevance to at least one DBAO dimension: a Driver, Barrier, Adoption/Implementation process or Outcome. A further 60 records were excluded because they focused on education, awareness, perception or communication without sufficient green-practice adoption evidence; purely technical modelling, simulation or design without an institutional implementation mechanism; assessment/ranking without clear adoption relevance; secondary reviews; or adjacent/non-specific HEI contexts. This resulted in 153 records for full-text assessment.

Table 3
Reasons for Exclusion during the Eligibility-Focused Abstract Assessment

Reason for exclusion	Studies
Education, awareness, perception, or communication focus without sufficient green-practice adoption evidence	26
Purely technical, modelling, simulation, or design studies	18
Assessment, ranking, or measurement studies without a clear adoption mechanism	9
Secondary review papers	5
Adjacent or non-specific HEI green-practice context	2
Total excluded	60

Source: Author's own compilation.

3.2.4. Assessing

The 153 full-text publications were assessed against the eligibility criteria described above. Particular attention was given to whether each study addressed an identifiable green practice in an HEI and provided substantive evidence relating to one or more DBAO dimensions. Following full-text eligibility assessment, 113 studies were excluded and 40 were retained for final qualitative synthesis. The final number of 40 studies was determined by application of the predefined eligibility criteria rather than by a predetermined target sample size. The present review addresses a comparatively narrow process-oriented question concerning Drivers, Barriers, Adoption/Implementation and Outcomes; therefore, broader sustainability studies, technical studies lacking an institutional adoption mechanism, secondary reviews and studies without substantive DBAO evidence were excluded. Consequently, the final sample should not be compared directly with broader higher-education sustainability reviews that included substantially larger literature domains.

3.3 Data extraction and coding

Studies selected for full-text synthesis were systematically reviewed using a structured evidence matrix. Extracted information included author(s), publication year, country and institutional context, research focus, green practice examined, research design, key findings and evidence relevant to the DBAO dimensions. Evidence was coded across four conceptually distinct but non-mutually exclusive dimensions: Drivers, Barriers, Adoption/Implementation and Outcomes. Drivers included institutional, regulatory, stakeholder, financial, behavioural, technological and environmental conditions that enabled sustainability action. Barriers included financial, organizational, behavioural, knowledge-based, technological, infrastructural and policy-related constraints. Adoption/Implementation captured evidence relating to initial adoption, operational deployment, integration and institutionalization. Outcomes captured environmental and resource, economic and operational, social and behavioural, and institutional consequences. Individual studies were permitted to contribute evidence to more than one DBAO dimension where substantively supported by their findings. Table 4 provides a summary of the reasons for excluding full text.

Table 4
Provides a summary of the reasons for exclusion following full-text eligibility assessment.

Reason for exclusion	Studies excluded
Insufficient substantive evidence on DBAO drivers, barriers, implementation depth, or outcomes	47
Assessment, ranking, or measurement focus without a clear adoption/implementation mechanism	23
Awareness, perception, or behavioural focus without sufficient evidence of actual institutional implementation	12
Technical, modelling, design, or feasibility focus without sufficient institutional adoption evidence	11
Conceptual or framework-oriented studies without sufficient evidence of implemented green practices	10
Broader sustainability or education focus without sufficient campus operational green-practice evidence	5
Contextual or descriptive evidence without sufficient linkage across DBAO components	5
Total excluded	**113**

Source: Author's own compilation.

Screening and coding were conducted collaboratively by Ajay Thakur and Shephali Shyam using the predefined eligibility and coding criteria. Differences in judgement concerning study eligibility, interpretation or DBAO classification were discussed and, where necessary, referred to Dr. Vinod Negi for consensus resolution. Reviewer agreement was therefore managed through consensus-based verification rather than reported as a quantitative reliability statistic.

Source: Authors own compilation

4. Results

A total of 40 studies were included at the end of the systematic review following the sequence: 322 records identified, 254 unique records screened, 153 full-text studies assessed, 40 studies included. The last searches for Scopus were performed on 22 July 2026 and the results included articles published between 2006 and 2026.The studies included in the present study focused on a variety of activities addressing the greening of HEIs, such as energy management, energy from renewables, green buildings, waste management and recycling, circular economy, water management, sustainable mobility, environmental governance, stakeholder engagement, green offices and living laboratories. The body of evidence reflecting the methodological variety included case studies, survey, structural equation modelling, Delphi studies, interpretive structural modelling and environmental assessments as well as a combination of methods. An important cross-cutting theme was that the formal implementation of a green programmes does not guarantee the realization of better sustainability. The results show that the process of depth of implementation, organization, involving stakeholders, and institutionalization are related to whether the adopted practices bring measurable results. The empirical findings from this study are used to define the Drivers, Barriers, Adoption/Implementation, and Outcomes of the Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework described in the next section.

4.1 Methodological Quality of the Included Studies

The included studies were methodologically heterogeneous and comprised qualitative case studies, cross-sectional surveys, quantitative modelling and environmental assessments, mixed-method investigations, Delphi studies and other applied empirical designs. Because the evidence base included highly diverse research designs, institutional contexts, interventions and outcome measures, a single formal risk-of-bias instrument was not applied across all studies. Instead, methodological characteristics were considered during interpretation of the findings, particularly when distinguishing observed or measured Outcomes from perceptual and modelled or projected evidence. The absence of a formal study-level quality appraisal is acknowledged as a limitation of the review.

4.2 Theoretical Foundation of the DBAO Framework

The Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework was informed by five complementary theories: Institutional Theory, the Resource-Based View (RBV), Stakeholder Theory, Diffusion of Innovation Theory, and the Technology–Organization–Environment (TOE) framework. The perspectives are applied as supporting lenses for the understanding of why HEIs choose to employ ‘green practices' and why there is variation in their extent of introduction and level of achievement and why similar ‘green practices' can result in different effects.

4.2.1 Institutional Theory

The Institutional Theory is a theory that deals with the impact of pressure from institutions on the behavior of organizations (DiMaggio and Powell, 1983). In HEIs, these pressures can come from government policies, funding demands, professional and exemplary university standards and practices, and stakeholder expectations. Studies like Tan et al. (2015), Lo (2015), and Liu and Gao (2021) provide examples of how external pressures from legitimacy, groundings in regulations and institutional pressures can encourage green-practice adoption. Formal adoption, however, may be achieved but not implemented, due to institutional pressure and thus depth of adoption and institutionalization is important in building a connection between external pressure and sustainability outcomes.

4.2.2. Resource-Based View

The RBV offers insights into how different institutions can respond in the same ways under similar conditions of sustainability stress. The implementation capability is influenced by organizational resources and capabilities, such as finance, technology, infrastructure, sustainability knowledge, leadership and monitoring processes (Barney, 1991). On the one hand, financial and managerial resources support sustainability implementation (Liu and Gao, 2021; Nunayon et al., 2020) and, on the other hand, resource shortages and limited knowledge and infrastructural deficits weaken its implementation (Geh et al., 2024; Gholami et al., 2020). Thus, within DBAO, resources or capabilities may therefore either act as a Driver (if present) or Barriers (if absent).

4.2.3. Stakeholder Theory

The Stakeholder Theory emphasizes that students, faculty, institutions and administrators, along with governments and communities, have had impacts on how institutions meet their sustainability needs and how sustainability is put into practice throughout the institution (Freeman, 1984). Stakeholder pressure, participation and collaborative set-ups can empower sustainability initiatives as seen in the work of Tan et al. (2015), Too and Bajracharya (2015) and Adomßent et al. (2019). Stakeholder involvement is, therefore, germane not simply as a Driver of implementation, but also in the relaxation of resistance and collective ownership of institutional change.

4.2.4. Diffusion of Innovation Theory

This theory of diffusion of innovations, or innovations curve, describes the spread of innovations over time and into social systems (Rogers, 2003). Green practices can be a small-scale or experimental approach, but can only bring institutional value when they are adopted, scaled up, incorporated into routines and institutionalized. Figuring out how to use them is a step-by-step process that is captured in the work of Zen et al. (2016), Cianfrani et

al. (2018) and Bai et al. (2012). This approach is in line with the DBAO distinction between adoption, implementation, integration and institutionalization.

4.2.5. Technology–Organization–Environment Framework

Technological, organizational and external environmental conditions affect organizational innovation is related to the TOE framework (Tornatzky and Fleischer, 1990). For campus sustainability, the technological context includes cost, compatibility and availability of green technologies, the organizational context includes leadership, resources, knowledge and institutional structures, and the environmental context include regulation, funding, and stakeholder expectations. Data from Geh et al. (2024), Herzanita et al. (2024), Amaral et al. (2023) and Alsharif et al. (2020) further indicated that implementation constraints can occur at all three levels, which assists in understanding why there are diverse implementation pathways of similar green practices among HEIs.

4.2.6. Integrative Theoretical Logic of DBAO

All in all, these views, when summarizing, offer complementary explanations of the process of adopting sustainability. Explanations for external pressures for adoption come from Institutional Theory, organizational capacity from RBV, participation and influence from the Stakeholder Theory, progression towards institutionalization from the Diffusion of Innovation Theory, and the contextual conditions shaping the implementation from the TOE. These viewpoints amount to a framework of the institutional factors, organizational capacities, stakeholder factors, processes of innovation, and contextual features that inform the next development of the DBAO framework.

4.3 DBAO Evidence Synthesis

4.3.1 Drivers of Green-Practice Adoption and Implementation

Based on the evidence it can be claimed that adoption of green practice in higher education institutions (HEIs) is facilitated by a mix of institutional, financial, governmental, stakeholder-related and behavioral conditions. Institutional commitment and institutional governance support is important as a whole group of enabling conditions, but these drivers are not functioning independently to drive towards institutional action leadership: institutional commitment and institutional governance support is an important group of enabling conditions. Tan et al. (2015) confirm that both government programs and faculty engagement and pressure are important factors shaping green measures in private HEIs in the region, while Nunayon et al. (2020) show that the variables affecting efficient electricity management practices in public universities are primarily awareness, top-management support and risk management, and participation of stakeholders. In the Chinese context it shows too that it is government-influenced. Indeed, the works of Lo (2015) demonstrate the influence of government and financial pressures on the adoption of water and energy saving measures by HEIs, and Liu and Gao (2021) clearly emphasize the role of the government ministries, public investments and policy schemes in facilitating university sustainability projects. Another key driver is stakeholder participation. Too and Bajracharya (2015) specifies psychological needs, physical facilities, personal motivations, public perceptions, price mechanisms and policies in their 6-P approach to the involvement of university communities in sustainability. In addition, Adomßent et al. (2019) highlight opportunities for empowering students and staff to become involved in sustainability transformation by using self-efficacy, peer learning, collaboration and formal Green Office structures. In supporting this argument, Mohamad et al. (2018) list the need to have shared values, voluntary commitment, community involvement and emotional bonding to help maintain campus environmental programs. Adoption is also affected by behavioral and cognitive issues. Fu et al. (2018) conclude that among the students, faculty and administration, pro environmental attitude, pro-environmental motives, in-session obstacles, and culture (including group pressure) influence on environmental behavior. Based on the Theory of Planned Behavior, Ibrahim et al. (2022) demonstrate that attitude and subjective norms and perceived behavioral control are all positive determinants on student's usage intention of bicycles for sustainable commuting in campus, while perceived barriers indirectly weaken students' usage intention. In the same vein, Said et al. (2026) show that KASP and sustainable actions of the university are interconnected with people on campus such as students and instructors, meaning that knowledge, attitudes, and behavior of the people involved in the university must ultimately be translated into real action, demonstrated through these three drivers. For the first, institutional support in leadership, policy, and government support and funding provides for the structural capacity of sustainability action. Secondly Stakeholder drivers, such as faculty involvement, participation, collaboration, and community engagement, build upon "collective ownership". Thirdly, willingness to participate is shaped by behavioral drivers such as knowledge, awareness of environment, social norms, shared values and self-efficacy. This is in alignment with previous research on sustainability in organizations, where organizational capacities and organizational environmental knowledge along with employee empowerment are stressed as key precursors to sustainable organizational practices (Anshima, Sharma, et al., 2025).

4.3.2 Barriers to Green-Practice Adoption and Implementation

There are significant barriers to the implementation of sustainability despite the increased expressions of commitment from HEIs. The Barrier studies span financial, organizational, policy-related, behavioral, knowledge-based and infrastructural types of constraints, many of which are interrelated. Limited finances are one of the many recurring challenges. Geh et al. (2024) cite high initial investment, lack of financial resource, financial and policy uncertainty as the main limiting factors for the deployment of solar photovoltaics in public universities in South Africa. In their discussion of the problem of single-use plastic bottles, AlKaabi et al. (2025) list infrastructure and environmental knowledge and consumption habits as other challenges, in addition to those involving costs. Another significant challenge that is reported is financial constraints for implementing green-campus practices as reported by Mohd Isa et al. (2021) aside from the challenges of awareness and maintenance. The second major barriers category is the organizational weakness. Drawing on a study by Amaral et al. (2023), it is well proved that weak internal cooperation, lack of communication between

one another, rigid administrative procedures and fragmented organizational structure can negatively impact sustainability activities despite there being technical solutions within the institution. This leaves a knowledge divide between the knowledge that the University possesses and how it translates to the running of the campus. Similarly, fragmentation and lack of a whole-campus approach are problems cited by Simão et al (2022) as impediments to campus greening. During the COVID-19 crisis, the outside crisis reinforced the importance of changing priorities and limiting environmental programmes within the institutions. Limited strategic direction and leadership also hinder this. The lack of a clear strategic plan is cited by Herzanita et al. (2024) as a key problem in the implementation of green building. Alsharif et al (2020) also point to cost as a factor, low level of supportive leadership, lack of knowledge and skills in sustainability, and lack of policies and strategic direction specifically related to sustainability. More recently, Thondhlana and Nkosi (2024), however, show low and varying awareness of sustainability, gaps in policy–implementation, funding and cooperation, and a lack of commitment from senior management. In addition to these institutional barriers, there are behavioural barriers and knowledge barriers. Horhota et al. (2014) list communication and awareness issues, inconvenience, economic issues and lack of engagement as common behavioral barriers to campus sustainability. Gholami et al. (2020) uncover a broader set of overlapping obstacles, and they illustrate how lack of awareness, lack of knowledge, resistance to change and inefficient communication can have a particularly strong influence upon the implementation of other obstacles. This is the Barrier evidence and so it is not sufficient to say that implementation failure is due to lack of money. Weak leadership, lack of clarity in policy, responsibilities and communication, lack of knowledge, resistance to change and lack of infrastructure further reinforce financial limitations. Such barriers may be interdependent; and therefore, tackling one of these barriers may not be enough to bring about lasting institutional change.

4.3.3 Green Practices Adopted and Implementation Patterns

These sought to prove that there are a number of paths to achieving sustainable-campus transformation from formal environmental-management systems to specific operational interventions, from collaborative governance to living laboratories, and from iterative sustainability-management frameworks. Alshuwaikhat and Abubakar (2008) offer an early integrated strategy for campus sustainability that incorporates environmental-management systems into the planning process, social responsibility and public participation, and embedding sustainability in education and research. This whole-institution orientation is supported by Zen et al. (2016) who have illustrated the institutionalization of waste minimization with a Green Office case which involves decentralized governance, participatory involvement, monitoring, co-production of knowledge and linkages between research, education, and campus operations. Second, an institutional collaboration could be an implementation pattern. Xiong and Mok (2020) present a methodology of sustainable-campus consortium, illustrating how universities can cooperate to implement this approach, whereas Mohd Muhiddin et al (2023) present universities' efforts in implementing initiatives in several categories of the UI Green Metric, although achievements can be uneven or insufficient and take time to achieve consistency and further advances, they also require support from institutions and local communities. A third pattern is using extent of campus as living lab. Cianfrani et al. (2018) illustrate how the R.W. Kern Center combines sustainable building systems and the learn-by-doing approach with the role of the institution as a teaching place, assisting students, faculty and practitioners in learning directly from the energy, water, waste and building operations. In the case of Keio University, after the Great East Japan Earthquake, the Sustainable Campus Initiative involves energy-management projects, real-time monitoring, student involvement, experimental solar technologies and project-based learning, changing the campus into an "transforming the campus into a platform for sustainability and resilience experimentation" (Bai et al. 2012). Other studies illustrate processes for structuring and iterative implementation. Mendoza et al. (2019) suggest an implementation framework for the circular economy based on the analysis of the situation, stakeholder engagement, the development of circular economy strategies, implementation, monitoring and continuous improvement. Moqbel et al. (2020) findings highlight an operational recycling process at the University of Jordan, starting with assessing waste, creating awareness and conducting experiments for the implementation of segregation infrastructure. In looking at a university green-building initiative, Owens and Halfacre-Hitchcock (2006) demonstrate how the physical campus environment can represent an environmental change and also serve as a lever to set a change in stakeholder attitudes and behaviors. Other practices identified by Shange et al. (2025) as essential parts of the deployment of a green campus are stakeholder involvement, sustainability education, environmental policies, and conservation programmes together with institutional involvement. The evidence revealed several patterns of implementation: (1) whole-institution environmental management, (2) collaborative and participatory governance, (3) specific operational interventions, (4) living-laboratory and project-based implementation, and (5) iterative implementation, whereby planning, engaging in stakeholders, monitoring, and continued improvement occur in repeated cycles. This means that it's not just a decision for adoption. Instead, it is a process that is going from initiation to implementation, integration and when it has continued and become embedded in the organization, institutionalization.

4.3.4 Outcomes of Green-Practice Adoption and Implementation

The Outcomes studies show how effects can flow from the implementation of green-practice, both environmental and economic, operational, social/behavioural and institutional. Importantly, the evidence that is reviewed is observed or modelled/projected evidence; this distinction should be taken into account when interpreting the effectiveness of sustainability initiatives. The outcomes that can be measured are most commonly reported in the field of environmentalism. At Keele University, using a nexus approach, Gu et al. (2019) calculate an annual energy footprint at 42202 MWh equating to 14393 tonnes CO_2e and water usage of 532,415 m^3 which illustrate the interdependencies between energy, water, food, waste and carbon management decisions. Rabie Bahçelioğlu et al. (2020) assess the waste management process in METU campus by analyzing the waste quantity and types collected from the campus, they identify about 13% of the collected wastes as recyclable waste materials and design the strategies to improve waste management behaviors, structures and management by using these findings. The potential outcomes with energy and carbon interventions are also considerable. Proposed lighting improvements could result in an annual electricity reduction of approximately 26,123 kWh (approximately 3,704 kg/year of CO_2 emissions avoided and a payback period of approximately 3.7 years), according to Soares et al. (2015). Based on an on-campus solar

photovoltaic (PV) system, Teah et al., (2019) estimate the system can offer a level of approximately 31% electricity self-sufficiency from the campus, saves around 27% annual GHG emissions from electricity use, and delivers also additional disaster-resilience benefits to the community with a 12.9-year payback period. More recently, Xue et al. (2024) estimate a carbon saving of around 560 tonnes per year with intervention measures alone, and of about 800–1045 tonnes per year if interventions are paired with incentive measures. Environmental-social effects also incurred in the connection of the green mobility. Using integrated traffic, parking and life-cycle cost analysis, Cruz et al. (2017) show that control of traffic in the campus combined with changes to modes of transport benefit the campus environment and can also lead to a reduction of fuel consumption, energy demand and greenhouse-gas emissions. The importance of social and behavioural outcomes is demonstrated in a number of studies. The authors of Uehara and Ynacay-Nye (2018) estimate that water-bottle refill stations eliminated the use of around 45,191 disposable plastic bottles and 10,846 kg of associated CO_2 per year, while also enhancing the acceptance of the stations by students, who were more willing to pay a subscription fee for the stations and purchase refilled bottles on them. The results from Tiyarattanachai and Hollmann (2016) indicate that the higher satisfaction with sustainability practices and perceived quality of life from the stakeholders of the two analyzed Green Campus of the studied Green Campus, compared with the Non-Green Campus, were statistically significant. Institutional outcomes include semi-targeted outcomes focused on going beyond resource conservation. Significant correlations are found between university sustainability implementation and the quality of the university, notably, environmental management, organizational responsibility, and physical-plant, as well as long-term, social and economic benefits (Hernandez-Diaz et al., 2020). But the evidence also warns against expecting to see performance decrease when adopting. Lang (2015) only observes weak linkages between a high number of campus sustainability projects and the indicators of environmental performance. The discovery is especially valuable to the DBAO framework and indicates that the presence of an initiative is not a measure for effective implementation or actual performance of sustainability. As a whole, the Outcomes evidence demonstrates that green practice can have significant environmental, financial, operational and social outcomes, but the impact of such practice can vary depending on how well it is implemented, what kind of response it receives from the stakeholder, the context of the institution and the way in which practice is measured and valued.

4.3.5 Relative Prominence of DBAO Components

To complement the qualitative synthesis, the relative prominence of the principal DBAO subcomponents was examined using study-level occurrence frequencies. Because individual studies could contribute evidence to more than one subtheme, the frequencies are non-mutually exclusive and represent prominence within the reviewed literature rather than effect size or causal importance. Among the Driver studies, behavioural/cognitive and stakeholder/social drivers were the most frequently represented, each occurring in 7 of 10 studies (70%), followed by institutional/policy/leadership and resource/structural drivers, each occurring in 5 studies (50%). The Barrier evidence showed a similarly multidimensional pattern: financial/resource constraints, organizational/governance/policy barriers, and knowledge/awareness/communication barriers were each identified in 7 of 10 studies (70%), while behavioural/resistance-related constraints occurred in 5 studies (50%) and infrastructure/maintenance constraints in 2 studies (20%).

With regard to implementation depth, implementation was represented in 7 of the 10 Adoption/Implementation studies (70%), integration in 6 (60%), institutionalization in 3 (30%), and initial adoption as a distinct stage in 2 (20%). The outcome evidence was dominated by environmental and resource consequences, reported in 8 of 10 studies (80%). Social/behavioural outcomes were represented in 5 studies (50%), economic/operational outcomes in 4 (40%), and institutional/organizational outcomes in 1 study (10%). These distributions indicate that the reviewed literature more frequently documents environmental outcomes and operational implementation than institutionalization and institutional-level outcomes.

Table 5
DBAO dimension and themes

DBAO dimension	Subcomponent/themes	n	%
Drivers	Behavioural/cognitive	7	70
Drivers	Stakeholder/social	7	70
Drivers	Institutional/policy/leadership	5	50
Drivers	Resource/structural	5	50
Barriers	Financial/resource	7	70
Barriers	Organizational/governance/policy	7	70
Barriers	Knowledge/awareness/communication	7	70
Barriers	Behavioural/resistance/engagement	5	50
Barriers	Infrastructure/maintenance	2	20
Adoption/Implementation	Implementation	7	70
Adoption/Implementation	Integration	6	60
Adoption/Implementation	Institutionalization	3	30
Adoption/Implementation	Initial adoption	2	20
Outcomes	Environmental/resource	8	80
Outcomes	Social/behavioural	5	50
Outcomes	Economic/operational	4	40
Outcomes	Institutional/organizational	1	10

Source: Author's own compilation.

Note

Percentages are calculated within the ten studies principally synthesized under each DBAO dimension. Because individual studies may contain more than one subtheme, percentages are non-mutually exclusive and do not sum to 100%. Frequency indicates prominence in the evidence base and not effect size or causal importance.

4.4 Relationships among Drivers, Barriers, Adoption/Implementation and Outcomes

The synthesis indicates a primary stage-ordered pathway linking antecedent conditions with implementation and outcomes. Drivers and Barriers shape the conditions under which green practices progress through adoption, implementation, integration and institutionalization, after which environmental and resource, economic and operational, social and behavioural, and institutional outcomes may be observed. DBAO is therefore sequential in its core analytical structure but not strictly linear. A theoretically proposed feedback mechanism allows realized outcomes to influence the conditions surrounding subsequent sustainability initiatives through legitimacy, stakeholder support, managerial commitment and resource mobilization. The forward pathway is more directly grounded in the reviewed evidence, whereas the feedback pathway represents a theory-informed proposition requiring longitudinal empirical testing.

Table 6
Evidentiary Status of Relationships Proposed in the DBAO Framework

DBAO relationship	Status
Institutional/policy/stakeholder support → adoption/implementation	Directly supported by multiple included studies
Knowledge, attitudes and social norms → behavioural adoption	Directly supported
Financial/resource constraints → implementation difficulty	Directly supported
Organizational fragmentation/weak communication/knowledge limitations → implementation difficulty	Directly supported
Adoption → implementation → integration → institutionalization	Cross-study synthesized process pattern
Green practices → environmental/resource outcomes	Supported, but includes observed and modelled evidence
Green practices → social/behavioural/institutional outcomes	Supported, but evidence is more heterogeneous
Initiative presence → improved performance	Not consistently supported
Greater implementation depth → stronger/persistent outcomes	Partially supported; interpretive proposition
Drivers mitigate corresponding Barriers	Integrative conceptual proposition
Outcomes → legitimacy/resources/support → next adoption cycle	Theory-informed proposition requiring empirical testing

Source: Author's own compilation.

Accordingly, DBAO should be interpreted as an evidence-informed explanatory framework rather than a fully validated causal model. Some relationships are directly supported across multiple studies, whereas other pathways represent cross-study synthesis or theory-informed propositions that require further longitudinal and comparative testing.

5. Discussion

The results observed in this systematic review highlighted that the decision to implement a green practice strategy is not just an institutional one, but rather a process that is influenced by interdependent organizational, financial, stakeholder, behavioural and policy issues. Leadership commitment, financial backing, stakeholder involvement, environmental awareness and sustainable policies support implementation (Tan et al., 2015; Liu and Gao, 2021; Nunayon et al., 2020); on the other hand, insufficient resources, management with weak leadership, and poorly-structured organizations, lack of sustainability knowledge, and resistance to change constitute the factors that hinder progress (Alsharif et al., 2020; Gholami et al., 2020; Amaral et al., 2023). Importantly, these conditions are interdependent, for the same factor may be an enabling factor if present in abundance (or if very rare) a limitation The synthesis suggests that the existence of a sustainability initiative alone should not be treated as evidence of effective implementation or improved performance. The reviewed literature indicates meaningful differences between initial adoption, implementation, integration and institutionalization, although the association between greater implementation depth and stronger outcomes has not been tested uniformly across the included studies. DBAO therefore treats implementation depth as an evidence-informed explanatory mechanism rather than as an established causal determinant of sustainability performance. Such a distinction is especially relevant as the formal inclusion of sustainability programmes does not always result in an improvement in environmental outcomes (Lang, 2015). The proposed Drivers – Barriers – Adoption/Implementation – Outcomes (DBAO) framework, therefore, connects and extends these relationships in a process-oriented explanatory framework of sustainable-campus transformation. Inspired by Institutional Theory, Resource-Based View, Stakeholder Theory, Diffusion of Innovation and Technology–Organization–Environment, DBAO not only fills the gaps in previous sustainability research by identifying the green practices, but also provides reasoning for how and the conditions under which those practices make it into the institutionalized systems that result in various environmental, economic, operational, social/behavioural, and institutional outcomes.

5.1 Proposed Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) Framework

The DBAO framework is conceptualized as a stage-ordered process framework with a primary forward pathway and a theoretically proposed recursive feedback mechanism. The framework is comprised of four components that are interconnected with and can be described as Drivers, Barriers, Adoption/Implementation, and Outcomes. The Drivers and Barriers work side by side at the antecedent level. Institutional pressures, leadership, policy support, financial resources, stakeholder engagement, environmental awareness and organization capability all are drivers. Resource limitations, leadership problems, poor organizational integration and coordination, lack of knowledge, unwillingness to change, infrastructure needs and external support are barriers. These factors need not be mutually exclusive; the same factor used in the absence of the other can have different effects. For instance, the implementation can be enhanced by having strong leadership while poor leadership can be a restricting factor in the implementation. The central process in DBAO is Adoption/Implementation, conceptualized as a four-stage progression involving initial

adoption, operational implementation, organizational integration and institutionalization. Adoption refers to the initial decision to introduce a green practice. Implementation refers to its operational deployment. Integration occurs when the practice becomes connected with wider organizational systems, stakeholders and routines, while institutionalization occurs when it becomes embedded within formal policies, responsibilities, resources and routine institutional practices. This is crucial as the mere presence of a sustainability initiative does not indicate that the action has been implemented effectively or that performance is being bettered. The evidence shared shows that some sustainability projects are not linked to actual measurable performance results (as suggested by some correspondence that was only partial and ad hoc, as was found by Lang 2015 for example), and that the depth of implementation and the degree of institutionalization play an important role in whether the up-take of sustainability projects has resulted in concrete changes. Outcomes are the results of the adopted green practices which manifest in environmental, economic, operational, social/behavioural and institutional outcomes. This can include means of reduction in consumption of resources, reduction in emission, financial savings, efficiencies, behavioural change, better institutional benefits and better experiences for stakeholders. The magnitude and persistence of these depend on quality, continuity and institutionalization of implementation. The framework also features a feedback mechanism. Positive results could build institutional 'legitimacy', 'stakeholder support', managerial commitment and resources, which in turn could shape subsequent adoption and implementation cycles. DBAO is thus not a linear process strictly speaking, but rather recursive.

Source: Authors' conceptualization based on the systematic literature review.

This consists of the basic structure within which the process of translating enabling and constraining conditions into institutional action and ultimately into achieving sustainability performance is explained.

5.2. Theoretical Implications

From a theoretical perspective, the DBAO framework extends sustainable-campus research by treating green-practice adoption as a process rather than as a binary decision. The distinction among adoption, operational implementation, organizational integration and institutionalization helps explain why institutions that formally adopt similar sustainability initiatives may differ considerably in the extent to which those initiatives become embedded in organizational routines and are associated with measurable outcomes.

Second, DBAO conceptualizes Drivers and Barriers as related antecedent conditions rather than as completely separate categories. Factors such as leadership, financial resources, knowledge, communication and stakeholder participation may operate as enabling conditions when sufficiently present and as constraints when inadequate or absent. However, the extent to which particular Drivers directly mitigate corresponding Barriers is treated as an integrative proposition derived from the synthesis rather than as a universally established causal relationship.

Third, the framework links antecedent conditions with implementation depth and multidimensional Outcomes. The synthesis suggests that differences in implementation, integration and institutionalization may help explain variation in environmental and resource, economic and operational, social and behavioural, and institutional Outcomes. However, this relationship is not uniformly tested across the included studies and should therefore be regarded as an evidence-informed explanatory proposition requiring further empirical validation.

Fourth, DBAO is intended to complement rather than replace existing theoretical perspectives. Institutional Theory helps explain external and normative pressures surrounding adoption; the Resource-Based View (RBV) highlights organizational capabilities and resources; Stakeholder Theory explains participation, influence and competing interests; Diffusion of Innovation informs the progression of practices through adoption and implementation; and the Technology–Organization–Environment (TOE) framework captures technological, organizational and environmental conditions affecting implementation. DBAO integrates these complementary perspectives around the institutional process through which green practices move from enabling and constraining conditions toward implementation and multidimensional Outcomes.

Finally, DBAO incorporates a recursive theoretical extension in which realized Outcomes may influence legitimacy, stakeholder support, managerial commitment and resource mobilization, thereby shaping subsequent sustainability action. This feedback pathway is conceptually grounded but is not directly tested across the full evidence base and therefore requires longitudinal and multi-institutional validation. The theoretical contribution of DBAO consequently lies primarily in **process integration** rather than in proposing another taxonomy of sustainability factors.

5.3. Practical Implications

The DBAO framework offers practical guidance for university leaders, sustainability managers and other institutional decision-makers involved in the adoption and implementation of green practices. The findings indicate that effective campus sustainability requires attention to both enabling and constraining conditions rather than focusing on individual factors in isolation. The frequency analysis further suggests that universities should avoid treating implementation difficulty primarily as a financial problem. Financial/resource, organizational/governance/policy, and knowledge/awareness/communication barriers were each represented in 70% of the studies principally synthesized within the Barriers dimension. At the same time, behavioural/cognitive and stakeholder/social factors were the most frequently represented Driver themes, each occurring in 70% of the Driver studies. These patterns suggest that institutional sustainability strategies should combine resource provision with governance reform, communication, knowledge development and stakeholder participation rather than relying only on technological or financial interventions.

HEIs may therefore benefit from assessing Drivers and Barriers together before introducing or scaling sustainability measures. Where financial limitations, weak coordination, limited knowledge, poor communication or stakeholder resistance are evident, implementation strategies should address these constraints alongside enabling conditions such as leadership support, policy commitment, training, stakeholder involvement and

access to resources. Such a combined approach may strengthen institutional capacity for implementation and reduce the risk that green initiatives remain isolated or temporary projects.

The findings also indicate that universities should distinguish formal adoption from deeper stages of implementation. HEIs should give attention not only to whether a green practice has been introduced, but also to whether it is operationally implemented, integrated with wider organizational systems and eventually institutionalized through strategic plans, budgets, governance structures, routine responsibilities and stakeholder practices. This distinction is important because the reviewed evidence suggests that the presence of a sustainability initiative alone does not necessarily correspond with improved environmental or organizational performance.

Technological interventions should also be supported by organizational and behavioural measures. Investments in renewable energy, green buildings, waste-management systems, sustainable mobility and resource-efficient infrastructure may be strengthened through stakeholder engagement, training, communication, incentives, monitoring and clearly defined institutional responsibilities. Universities should therefore approach campus sustainability as a combination of technical, organizational and behavioural change rather than as an infrastructure investment alone.

Finally, HEIs should evaluate sustainability through measurable outcomes rather than the presence of initiatives alone. Baseline and performance indicators can be used to assess environmental and resource, economic and operational, social and behavioural, and institutional Outcomes. Continuous monitoring may also help institutions determine whether practices are becoming sufficiently embedded to support sustained improvement. Positive Outcomes may, in turn, strengthen institutional legitimacy, stakeholder support and managerial commitment; however, this feedback pathway remains a theory-informed proposition within the DBAO framework and requires further empirical validation. Accordingly, the practical value of DBAO lies in helping institutions move from isolated green initiatives toward coordinated, monitored and progressively institutionalized sustainability practices.

5.4. Limitations of the study

Several limitations should be considered when interpreting the findings. First, the literature search was restricted to Scopus. Although two complementary searches were used to balance precision and sensitivity, relevant studies indexed exclusively in Web of Science, ERIC, Dimensions or other databases may have been omitted. The review should therefore be interpreted as a systematic synthesis of the Scopus-indexed evidence base rather than an exhaustive census of all relevant literature. Second, the review was limited to English-language peer-reviewed journal articles published within the predefined period, which may have excluded relevant non-English or grey literature. Third, screening and coding were conducted using consensus-based reviewer verification, but a formal statistical measure of inter-rater reliability was not calculated. Fourth, the included studies were methodologically and contextually heterogeneous in terms of countries, institutional settings, sustainability practices and research designs. Accordingly, the evidence was synthesized qualitatively rather than through meta-analysis, and the strength of evidence differs across DBAO dimensions. Fifth, the frequency analysis represents prominence of themes within the reviewed literature rather than effect size or causal importance. Finally, several relationships incorporated in DBAO—particularly the proposed effects of implementation depth on outcomes, the mitigation of Barriers by corresponding Drivers, and the recursive feedback pathway—are interpretive or theory-informed propositions and require longitudinal, comparative and multi-institutional empirical validation. The review did not apply a formal study-level risk-of-bias or methodological-quality instrument across the heterogeneous evidence base; therefore, differences in methodological quality should be considered when interpreting the synthesized findings.

5.5. Future Research Directions

Future research should test the DBAO framework using longitudinal, comparative and multi-institutional designs. Existing studies often examine Drivers, Barriers, implementation processes and Outcomes separately; therefore, future work should assess how these elements interact across different institutional contexts.

The evidence also shows an implementation-depth gap. Implementation appeared in 70% and integration in 60% of the Adoption/Implementation studies, whereas institutionalization was reported in only 30%. Future studies should examine how green practices become embedded in formal policies, budgets, governance structures and routine organizational practices.

An outcome-measurement gap is also evident. Environmental and resource Outcomes were reported in 80% of the Outcome studies, compared with 50% for social/behavioural, 40% for economic/operational and only 10% for institutional/organizational Outcomes. Future research should therefore examine broader effects such as institutional learning, governance change, organizational capability and stakeholder commitment.

Finally, the relationships between implementation depth, performance and the recursive feedback mechanism require further testing. Future studies should distinguish clearly between adoption, implementation, integration, institutionalization and measured Outcomes, and examine whether realized Outcomes strengthen legitimacy, stakeholder support and resources for subsequent sustainability action

6. Conclusion

This systematic review addressed five objectives concerning green-practice transformation in higher education institutions. First, the synthesis identified institutional and policy support, leadership, financial and structural capacity, stakeholder participation, knowledge, awareness, shared values and other behavioural conditions as recurrent Drivers of adoption and implementation. Second, the principal Barriers included financial and resource constraints, fragmented governance and responsibilities, weak strategic direction and leadership, limited sustainability knowledge and

communication, behavioural resistance and infrastructure-related constraints. Notably, financial/resource, organizational/governance/policy and knowledge/awareness/communication barriers were equally prominent within the Barrier evidence, indicating that implementation difficulty cannot be reduced to financial constraints alone.

Third, the evidence indicates that green-practice adoption should not be treated as a binary decision. Practices may progress from initial adoption to operational implementation, organizational integration and, in some cases, institutionalization within formal systems and routines. Implementation and integration were more frequently represented in the evidence than institutionalization, highlighting the need for longitudinal research on how practices become embedded over time. Fourth, reported Outcomes extended across environmental and resource, economic and operational, social and behavioural, and institutional domains. Environmental/resource outcomes were the most frequently represented, whereas institutional/organizational outcomes were comparatively rare. In addition, the evidence included observed, perceptual and modelled outcomes, which should not be treated as equivalent forms of performance evidence.

Fifth, these findings were integrated into the Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) framework. DBAO conceptualizes a primary stage-ordered pathway in which enabling and constraining antecedent conditions shape the implementation of green practices and are associated with multidimensional outcomes. A secondary feedback mechanism is theoretically proposed whereby realized outcomes may influence legitimacy, stakeholder support, managerial commitment and resources available for subsequent sustainability action. The framework is therefore evidence-informed but not causally validated. The relationships identified in this review should be interpreted as synthesized associations, cross-study patterns and conceptual linkages rather than universally established causal mechanisms. Future research should test these propositions using longitudinal, comparative and multi-institutional designs.

Declarations

Author Contribution

A.T. and V.N. conceptualized the study and developed the research design. A.T. conducted the literature search, data extraction, evidence synthesis, and preparation of the original manuscript. A.T. and S.S. performed the screening, eligibility assessment, and coding of the included studies. V.N. supervised the study, provided methodological guidance, and contributed to the resolution of screening and coding disagreements. P.B. contributed to methodological refinement, interpretation of the findings, and critical revision of the manuscript. S.S. contributed to data verification, thematic synthesis, and review of the manuscript. S.K. contributed to the theoretical interpretation of the findings, refinement of the DBAO framework, and critical review and editing of the manuscript. A.T. prepared the figures and tables. All authors reviewed and approved the final manuscript.

Acknowledgement

The authors would like to acknowledge the support of the Himachal Pradesh University Business School (HPUBS) in facilitating this research. The authors also thank the anonymous reviewers for their constructive feedback, which significantly improved this manuscript.

Data Availability

The data supporting the findings of this study are derived from the published articles included in the systematic literature review. The study-level evidence extracted and synthesized for the review is provided in the Supplementary Material. No new primary research data were generated.

References

1. Adomßent M, Grahl A, Spira F (2019) Putting sustainable campuses into force: Empowering students, staff and academics by the self-efficacy Green Office Model. Int J Sustain High Educ 20:470–481. 10.1108/IJSHE-02-2019-0072
2. AlKaabi A, Orak NH, AlJaradin M, Elsergany M (2025) Identifying the barriers and drivers towards limiting the single-use plastic water bottles at universities in the UAE. Environ Ecol Res 13:768–777. 10.13189/eer.2025.130602
3. Alsharif MA, Peters MD, Dixon TJ (2020) Designing and implementing effective campus sustainability in Saudi Arabian universities: An assessment of drivers and barriers in a rational choice theoretical context. Sustainability 12:5096. 10.3390/su12125096
4. Alshuwaikhat HM, Abubakar I (2008) An integrated approach to achieving campus sustainability: Assessment of the current campus environmental management practices. J Clean Prod 16:1777–1785. 10.1016/j.jclepro.2007.12.002
5. Amaral AR, Rodrigues E, Gaspar AR, Gomes Á (2023) How organizational constraints undermine sustainability actions in a university's campuses: A case study. J Clean Prod 411:137270. 10.1016/j.jclepro.2023.137270
6. Ankareddy S, Dorfleitner G, Zhang L, Ok YS (2025) Embedding sustainability in higher education institutions: A review of practices and challenges. Clean Environ Syst 17:100279. 10.1016/j.cesys.2025.100279
7. Anshima, Bhardwaj B, Sharma D, and others (2024) Ensuring sustainability through green HRM practices: A review, synthesis and research avenues. J Organizational Effectiveness: People Perform 12:57–90. 10.1108/JOEPP-10-2023-0493

8. Anshima, Sharma D, Bhardwaj B (2025) Green human resource management practices and sustainable development in India: A systematic literature review and future research agenda. Social Sci Humanit Open 11:101420. 10.1016/j.ssaho.2025.101420
9. Bai Y, Ikeda Y, Ota S, Kobayashi H (2012) Sustainable campus initiative at Keio University after the Great East Japan Earthquake disaster. Int J Disaster Risk Sci 3:123–130. 10.1007/s13753-012-0012-4
10. Bahçelioğlu E, Buğdaycı ES, Doğan NB, Şimşek N, Kaya SÖ, Alp E (2020) Integrated solid waste management strategy of a large campus: A comprehensive study on METU campus, Turkey. J Clean Prod 265:121715. 10.1016/j.jclepro.2020.121715
11. Barney J (1991) Firm resources and sustained competitive advantage. J Manag 17:99–120. 10.1177/014920639101700108
12. Blanco-Portela N, Benayas J, Pertierra LR, Lozano R (2017) Towards the integration of sustainability in higher education institutions: A review of drivers of and barriers to organisational change and their comparison against those found of companies. J Clean Prod 166:563–578. 10.1016/j.jclepro.2017.07.252
13. Chakraborty A, Singh MP, Roy M (2019) Engaging stakeholders in the process of sustainability integration in higher education institutions: A systematic review. Int J Sustain Dev 22:186–220. 10.1504/IJSD.2019.105330
14. Cianfrani CM, Hews S, Tor J, Jewhurst JJ, Shillington C, Raymond M (2018) The R.W. Kern Center as a living laboratory: Connecting campus sustainability goals with the educational mission at Hampshire College, Amherst, MA. J Green Building 13:123–145. 10.3992/1943-4618.13.4.123
15. Cruz L, Barata E, Ferreira J-P, Freire F (2017) Greening transportation and parking at University of Coimbra. Int J Sustain High Educ 18:23–38. 10.1108/IJSHE-04-2015-0069
16. DiMaggio PJ, Powell WW (1983) The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. Am Sociol Rev 48:147–160. 10.2307/2095101
17. Freeman RE (1984) Strategic Management: A Stakeholder Approach. Pitman
18. Fu L, Zhang Y, Xiong X, Bai Y (2018) Pro-environmental awareness and behaviors on campus: Evidence from Tianjin, China. Eurasia J Math Sci Technol Educ 14:427–445. 10.12973/ejmste/77953
19. Geh N, Emuze F, Das DK (2024) Barriers to the deployment of solar photovoltaic in public universities in South Africa: A Delphi study. Int J Building Pathol Adaptation 42:957–981. 10.1108/IJBPA-11-2021-0147
20. Gholami H, Bachok MF, Saman MZM, Streimikiene D, Sharif S, Zakuan N (2020) An ISM approach for the barrier analysis in implementing green campus operations: Towards higher education sustainability. Sustainability 12:363. 10.3390/su12010363
21. Gu Y, Wang H, Xu J, Wang Y, Wang X, Robinson ZP, Li F, Wu J, Tan J, Zhi X (2019) Quantification of interlinked environmental footprints on a sustainable university campus: A nexus analysis perspective. Appl Energy 246:65–76. 10.1016/j.apenergy.2019.04.015
22. Hassan MM, Ahmad AR (2025) Systematic literature review on the sustainability of higher education institutions (HEIs): Dimensions, practices and research gaps. Cogent Educ 12:2549789. 10.1080/2331186X.2025.2549789
23. Hernandez-Diaz PM, Polanco J-A, Castaño SM (2020) Do sustainability practices influence university quality? A Colombian case study. Int J Sustain High Educ 21:1525–1543. 10.1108/IJSHE-03-2020-0087
24. Herzanita A, Lestari RT, Dewi AP (2024) Assessing green building implementation and barriers in campus settings. Int J Environ Impacts 7:593–601. 10.18280/ijei.070320
25. Horhota M, Asman J, Stratton JP, Halfacre AC (2014) Identifying behavioral barriers to campus sustainability: A multi-method approach. Int J Sustain High Educ 15:343–358. 10.1108/IJSHE-07-2012-0065
26. Ibrahim ANH, Borhan MN, Darus NS, Yunin M, N. A., and, Ismail R (2022) Understanding the willingness of students to use bicycles for sustainable commuting in a university setting: A structural equation modelling approach. Mathematics 10:861. 10.3390/math10060861
27. Kumari B, Sharma D, Bhardwaj B (2026) Revisiting masstige marketing: A structured literature review and future research agenda using SPAR-4-SLR and S-O-R model. Int J Consumer Stud 50:e70192. 10.1111/ijcs.70192
28. Lang T (2015) Campus sustainability initiatives and performance: Do they correlate? Int J Sustain High Educ 16:474–490. 10.1108/IJSHE-01-2014-0009
29. Liu L, Gao L (2021) Financing university sustainability initiatives in China: Actors and processes. Int J Sustain High Educ 22:44–58. 10.1108/IJSHE-11-2019-0333
30. Lo K (2015) Campus sustainability in Chinese higher education institutions: Focuses, motivations and challenges. Int J Sustain High Educ 16:34–43. 10.1108/IJSHE-04-2013-0032
31. Mendoza JMF, Gallego-Schmid A, Azapagic A (2019) A methodological framework for the implementation of circular economy thinking in higher education institutions: Towards sustainable campus management. J Clean Prod 226:831–844. 10.1016/j.jclepro.2019.04.060
32. Mohamad ZF, Kadir SNA, Nasaruddin A, Sakai N, Zuki M, Hussein F, Sulaiman H, A. H., and, Mohd Salleh MSA (2018) Heartware as a driver for campus sustainability: Insights from an action-oriented exploratory case study. J Clean Prod 196:1086–1096. 10.1016/j.jclepro.2018.06.111
33. Mohd Isa H, Sedhu DS, Lop NS, Rashid K, Nor M, O., and, Iffahd M (2021) Strategies, challenges and solutions towards the implementation of green campus in UiTM Perak. Plann Malaysia 19:60–71. 10.21837/pm. v19i16.952

34. Mohd Muhiddin AA, Isa M, Md Sakip H, Nor SRM, O., and, Sedhu DS (2023) Green campus implementation in the Malaysian public universities: Challenges and solutions. Plann Malaysia 21:274–298. 10.21837/pm. v21i25.1239
35. Moqbel S, Abu-Zurayk R, Bozeya A, Alsisan R, Bawab A, A (2020) Assessment of sustainable recycling at The University of Jordan. Int J Sustain High Educ 21:1111–1129. 10.1108/IJSHE-11-2019-0334
36. Munaro MR, John VM (2025) Towards more sustainable universities: A critical review and reflections on sustainable practices at universities worldwide. Sustainable Prod Consum 56:284–310. 10.1016/j.spc.2025.03.022
37. Nunayon SS, Olanipekun EA, Famakin IO (2020) Determining key drivers of efficient electricity management practices in public universities in Southwestern Nigeria: An empirical study. Int J Sustain High Educ 21:281–314. 10.1108/IJSHE-03-2019-0125
38. Ogbolu G, Hague S, Adelaja A, Ohanagorom M, Amala M, Adedeji O (2026) Sustainability in higher education: A systematic review and conceptual framework of institutional maturity (SHE-IMM). Trends High Educ 5:26. 10.3390/higheredu5010026
39. Oliveira MC, Proença J (2025) Sustainable campus operations in higher education institutions: A systematic literature review. Sustainability 17:607. 10.3390/su17020607
40. Owens KA, Halfacre-Hitchcock A (2006) As green as we think? The case of the College of Charleston green building initiative. Int J Sustain High Educ 7:114–128. 10.1108/14676370610655904
41. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S et al (2021) The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ 372:n71. 10.1136/bmj. n71
42. Paul J, Lim WM, O'Cass A, Hao AW, Bresciani S (2021) Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). Int J Consumer Stud 45:O1–O16. 10.1111/ijcs.12695
43. Rogers EM (2003) *Diffusion of Innovations*, 5th Edn. Free Press
44. Said MH, Hamed NM, Haridy D, Moustafa S, Al-Ghtanyi S, Metwally DS, Abdel-Rahman S (2026) Determinants of knowledge, attitudes, and practices regarding campus sustainability: A field study at Cairo University. Sci Afr 31:e03126. 10.1016/j.sciaf. 2025.e03126
45. Shange HS, Zogli L-KJ, Dlamini BI (2025) Green campus initiatives and strategies for sustainability in higher education. Transformation High Educ 10:a364. 10.4102/the. v10i0.364
46. Sima M, Grigorescu I, Bălteanu D, Nikolova M (2022) A comparative analysis of campus greening practices at universities in Romania and Bulgaria: Sharing the same challenges? J Clean Prod 373:133822. 10.1016/j.jclepro.2022.133822
47. Soares N, Pereira LD, Ferreira J, Conceição P, da Silva PP (2015) Energy efficiency of higher education buildings: A case study. Int J Sustain High Educ 16:669–691. 10.1108/IJSHE-11-2013-0147
48. Sugiarto A, Lee C-W, Huruta AD (2022) A systematic review of the sustainable campus concept. Behav Sci 12:130. 10.3390/bs12050130
49. Tan CL, Goh YN, Chan HS (2015) A model linking institutional factors and green initiatives: A study among the private higher education institutions. J Sustain Sci Manage 10:52–64
50. Teah HS, Yang Q, Onuki M, Teah HY (2019) Incorporating external effects into project sustainability assessments: The case of a green campus initiative based on a solar PV system. Sustainability 11:5786. 10.3390/su11205786
51. Thondhlana G, Nkosi B-S (2024) Campus sustainability at Rhodes University, South Africa: Perceptions, awareness level, and potential interventions. Front Sustain 5:1390061. 10.3389/frsus.2024.1390061
52. Tiyarattanachai R, Hollmann NM (2016) Green campus initiative and its impacts on quality of life of stakeholders in green and non-green campus universities. SpringerPlus 5:84. 10.1186/s40064-016-1697-4
53. Too L, Bajracharya B (2015) Sustainable campus: Engaging the community in sustainability. Int J Sustain High Educ 16:57–71. 10.1108/IJSHE-07-2013-0080
54. Tornatzky LG, Fleischer M (1990) The Processes of Technological Innovation. Lexington Books
55. Uehara T, Ynacay-Nye A (2018) How water bottle refill stations contribute to campus sustainability: A case study in Japan. Sustainability 10:3074. 10.3390/su10093074
56. UNESCO (2005) United Nations Decade of Education for Sustainable Development (2005–2014): International Implementation Scheme. UNESCO
57. Xiong W, Mok KH (2020) Sustainability practices of higher education institutions in Hong Kong: A case study of a sustainable campus consortium. Sustainability 12:452. 10.3390/su12020452
58. Xue L, Xu H, Zhang Z, Li N (2024) Quantifying the impact of carbon reduction interventions and incentive mechanisms in campus buildings: A case study from a Chinese university. Buildings 14:1262. 10.3390/buildings14051262
59. Zen IS, Subramaniam D, Sulaiman H, Saleh AL, Omar W, Salim MR (2016) Institutionalize waste minimization governance towards campus sustainability: A case study of Green Office initiatives in Universiti Teknologi Malaysia. J Clean Prod 135:1407–1422. 10.1016/j.jclepro.2016.07.053

Figures

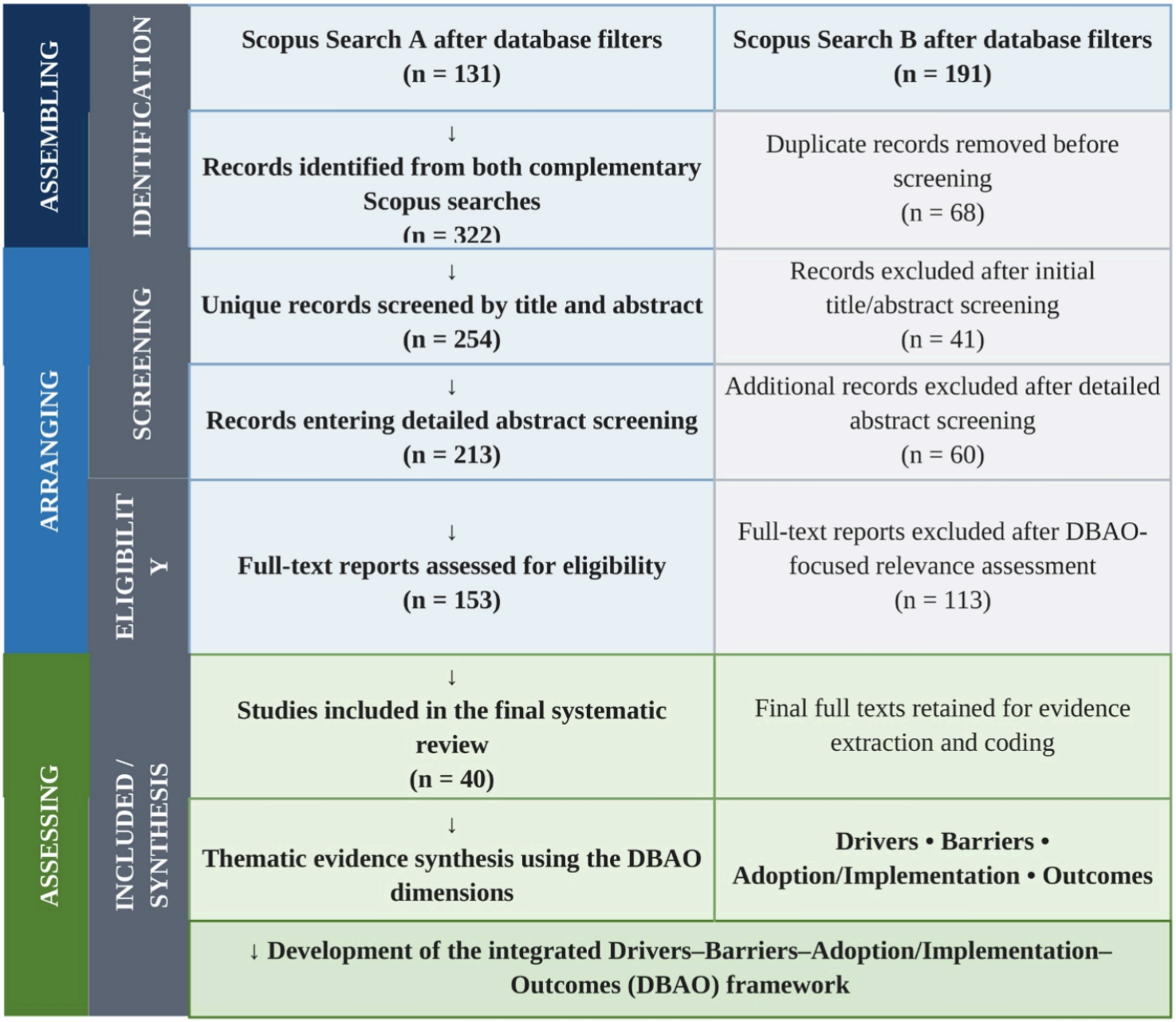


Figure 1

Integrated PRISMA 2020 and SPAR-4-SLR study-selection and synthesis process.

Source: Authors own compilation

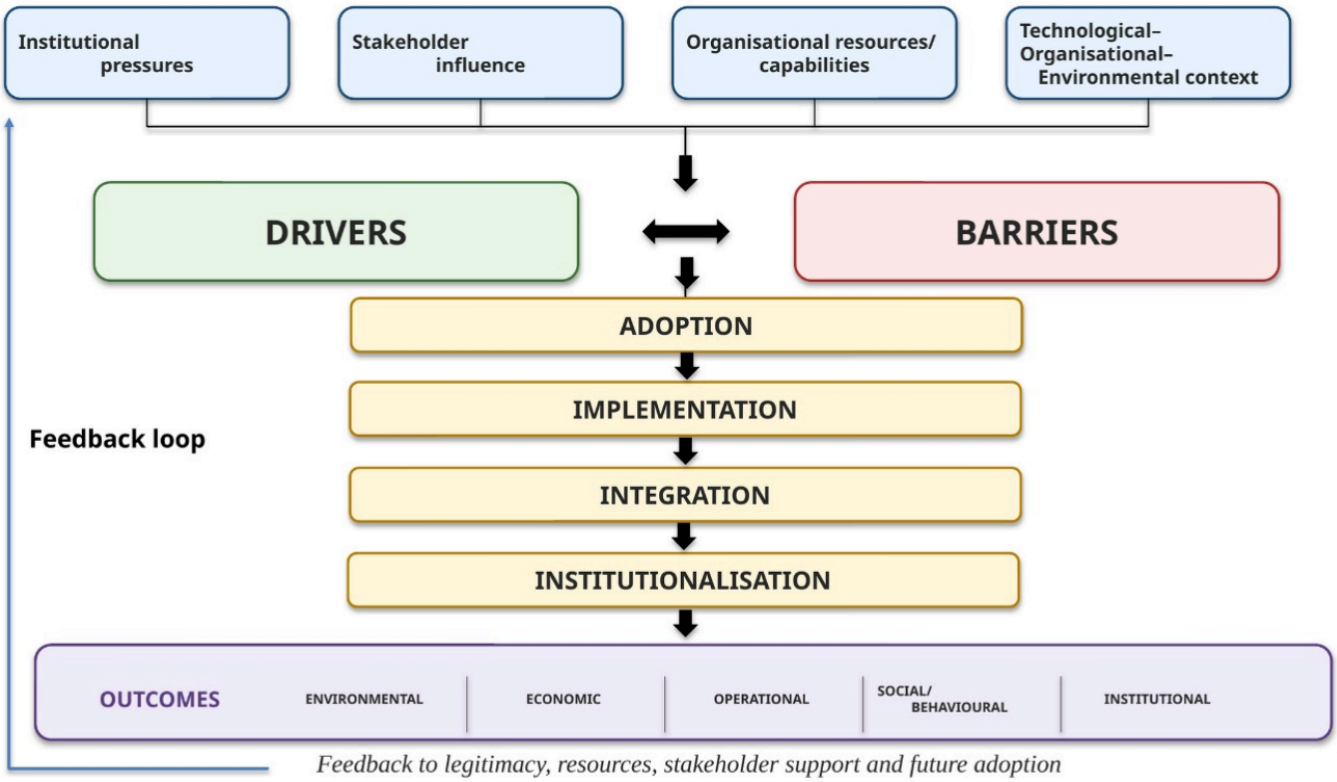


Figure 2

Proposed Drivers–Barriers–Adoption/Implementation–Outcomes (DBAO) Framework for Sustainable-Campus Transformation. Solid pathways represent the primary evidence-informed process, while the feedback pathway represents a theory-informed proposition requiring longitudinal empirical validation.

Source: Authors' conceptualization based on the systematic literature review.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryMaterial.docx