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Integrating ESD, SDGs, and UI GreenMetric: Strategic Pathways toward a Sustainable University

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Abstract

This article presents strategic approaches to integrating Education for Sustainable Development (ESD), the United Nations Sustainable Development Goals (SDGs), and the UI GreenMetric ranking system as a means to advance universities toward sustainability. Although higher education institutions (HEIs) worldwide have increasingly adopted sustainability-oriented policies, significant challenges remain in terms of educational practices, institutional policies, and performance indicators.

This study employed a comprehensive literature synthesis, comparative policy analysis, and global conceptual frameworks to propose a conceptual model that frames the integration of ESD, SDGs, and UI GreenMetric as an actionable roadmap for HEIs. The proposed model emphasizes critical success factors, including leadership, stakeholder engagement, curriculum innovation, research integration, and institutional assessment, all of which support the transition toward sustainability. The findings provide practical guidelines and policy recommendations for HEIs, along with directions for future research on contextualized applications within diverse educational systems.

Keywords: Education for Sustainable Development (ESD), Sustainable Development Goals (SDGs), UI GreenMetric, sustainable universities, strategic framework, higher education policy

Introduction

Sustainability has become a critical agenda in higher education worldwide. Universities act as catalysts for addressing pressing global challenges such as climate change, environmental degradation, and social inequality, necessitating a shift toward sustainability

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not only in administration but also in teaching and learning, research, community engagement, and governance (Lozano et al., 2015; Filho et al., 2022).

Higher education institutions (HEIs) have adopted sustainability initiatives in multiple forms, including green campus management, curricula emphasizing Education for Sustainable Development (ESD), and alignment with the United Nations Sustainable Development Goals (SDGs). Moreover, global ranking systems such as UI GreenMetric serve as quantitative tools to monitor university sustainability performance (Tayossyingyong et al., 2025). Nevertheless, challenges persist in aligning pedagogy, institutional operations, and assessment mechanisms. Existing practices often remain fragmented for instance, curriculum reform is frequently disconnected from operational improvements, while ranking systems tend to emphasize infrastructure rather than transformative educational change (Albareda-Tiana et al., 2018; Sonetti et al., 2016).

This article addresses these gaps by proposing a holistic strategic framework that integrates ESD, SDGs, and UI GreenMetric, thereby linking institutional strategies with global sustainability goals. By connecting educational innovations, governance mechanisms, and assessment tools, the framework provides HEIs with a comprehensive, measurable, and contextually adaptable pathway for advancing the transition toward sustainability.

Literature Review

1. Education for Sustainable Development (ESD). Education for Sustainable Development (ESD) aims to cultivate learners' knowledge, skills, values, and attitudes that enable them to contribute meaningfully to a sustainable society (UNESCO, 2017). Within higher education, the integration of ESD encompasses curriculum design, pedagogical approaches, extracurricular activities, and lifelong learning programs. Embedding ESD promotes critical thinking, problem-solving abilities, and social responsibility, thereby equipping students to address sustainability challenges (Barth & Rieckmann, 2012; Leal Filho et al., 2018). Effective implementation of ESD requires transformative teaching methodologies, faculty capacity building, and interdisciplinary integration for example, embedding sustainability concepts across science, engineering, and the humanities to enable students to connect global issues with local contexts. Furthermore, ESD supports experiential learning, such as community service, collaborative projects, and sustainability practices, which enhance student engagement and foster responsible citizenship.

2. Sustainable Development Goals (SDGs). The 17 Sustainable Development Goals (SDGs), launched in 2015, provide a global framework to address social, environmental, and economic challenges. Universities worldwide contribute to the SDGs through research, education, community engagement, and governance. However, implementation has been uneven: many institutions prioritize specific goals such as climate action (SDG 13) and

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quality education (SDG 4), while others such as gender equality (SDG 5) and reducing inequalities (SDG 10) are often overlooked (SDSN Australia/Pacific, 2020). Effective integration of the SDGs requires multidimensional strategies, including aligning curricula with SDG-related competencies, embedding sustainability-focused research, fostering community partnerships, and adopting SDG indicators in institutional planning. Beyond academic impacts, such integration enhances institutional reputation, attracts funding, and supports evidence-based policymaking (Filho et al., 2022).

3. UI GreenMetric Ranking. The UI GreenMetric ranking evaluates universities based on sustainability indicators covering infrastructure, energy usage, waste management, transportation, water usage, and education (UI GreenMetric, 2023). This ranking provides benchmarks for performance comparison and encourages continuous improvement. Nonetheless, critiques suggest that UI GreenMetric overemphasizes infrastructure and operational indicators while underestimating the importance of teaching innovation and research impact (Sonetti et al., 2016). Integrating GreenMetric with ESD and SDGs can help universities strike a balance between quantitative operational performance and qualitative educational and societal impacts, thereby creating a comprehensive sustainability strategy.

Table 1. Comparative Summary of ESD, SDGs, and UI GreenMetric in Higher Education

Dimension	Education for Sustainable Development (ESD)	Sustainable Development Goals (SDGs)	UI GreenMetric Ranking
Primary Focus	Developing knowledge, skills, values, and attitudes for sustainability (UNESCO, 2017)	Global framework of 17 goals addressing social, environmental, and economic challenges (UN, 2015)	Institutional sustainability performance across infrastructure, energy, waste, transport, water, and education (UI GreenMetric, 2023)
Scope of Application	Curriculum design, pedagogy, extracurricular activities, lifelong learning (Barth & Rieckmann, 2012)	Research, teaching, community engagement, governance (SDSN Australia/Pacific, 2020)	Campus operations and resource management; performance benchmarking (Sonetti et al., 2016)
Strengths	Promotes critical thinking, problem-solving, social	Provides a universal framework with measurable targets;	Encourages continuous improvement and international

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Dimension	Education for Sustainable Development (ESD)	Sustainable Development Goals (SDGs)	UI GreenMetric Ranking
	responsibility, experiential learning	enhances institutional reputation and funding (Filho et al., 2022)	benchmarking; increases visibility
Limitations	Requires faculty capacity building and interdisciplinary integration; implementation challenges	Uneven adoption—focus often on SDG 4 and 13, neglecting SDG 5 and 10	Overemphasis on infrastructure and quantitative indicators; limited attention to pedagogy and research impact
Strategic Relevance for HEIs	Prepares graduates for sustainability challenges; fosters responsible citizenship	Aligns universities with global policy agendas; supports evidence-based decision-making	Provides measurable data for rankings, enabling institutional comparison and monitoring
Integration Potential	Embedding sustainability into curricula and pedagogy	Embedding sustainability into research, governance, and policy	Operational alignment with academic and societal impacts when integrated with ESD and SDGs

Strategic Conceptual Framework for Integrating Sustainability in Universities

The conceptual framework for integrating sustainability in higher education institutions (HEIs) is structured around three interrelated pillars: Education for Sustainable Development (ESD), Sustainable Development Goals (SDGs), and the UI GreenMetric ranking system. Each pillar plays a distinct yet complementary role, forming a holistic foundation for advancing sustainability within universities.

1.1 Education for Sustainable Development (ESD). ESD emphasizes transformative pedagogical approaches that enhance students' critical thinking, sustainability awareness, and social responsibility. Beyond providing knowledge of environmental and social issues, ESD fosters creative problem-solving and sustainable decision-making skills. Moreover, it encourages community engagement and civic responsibility, positioning students as active contributors to sustainable societies (Sterling, 2011; UNESCO, 2020).

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1.2 Sustainable Development Goals (SDGs). The SDGs serve as a global-local framework that aligns institutional policies and initiatives with international sustainability agendas. By embedding SDGs into research, teaching, and community engagement, universities enhance their social and environmental accountability while promoting cross-sectoral collaboration. The SDGs also encourage HEIs to translate global targets into tangible, context-specific initiatives that strengthen their role as agents of sustainable transformation (United Nations, 2015).

1.3 UI GreenMetric Ranking. The UI GreenMetric provides a benchmarking and assessment tool for evaluating the sustainability performance of universities across infrastructure, operations, and resource management. By utilizing GreenMetric indicators, universities can design sustainability strategies, monitor progress, and enhance institutional visibility in global rankings. Importantly, the GreenMetric serves as a mechanism to link institutional practices with broader sustainability goals (UI GreenMetric, 2024).

1.4 Strategic Integration and Intersection. The intersection of these three pillars creates a strategic pathway through which universities can embed sustainability into their institutional missions. This pathway can be operationalized across four key domains:

Institutional Mission. Defining long-term visions and goals aligned with sustainability.

Operations. Managing resources, personnel, and policies to support sustainable practices.

Research. Generating knowledge that addresses environmental, social, and economic sustainability.

Curriculum and Pedagogy. Designing programs that cultivate critical thinking, sustainability competencies, and social responsibility.

Through this integrated approach, HEIs can cultivate a sustainable campus culture and foster student development characterized by comprehensive sustainability awareness and responsible citizenship.

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Figure 1. Integrated Conceptual Framework Linking ESD, SDGs, and UI GreenMetric for Advancing University Sustainability

Key Factors Influencing Integration

1. **Leadership and Governance.** Leadership plays a crucial role in embedding sustainability into an institution's strategic plan and culture. Senior administrators must articulate a sustainability vision, allocate resources, and incentivize faculty and staff participation (Velazquez et al., 2006).

2. **Stakeholder Engagement.** The participation of faculty, students, local communities, government agencies, and industry partners enhances sustainability planning (Lozano et al., 2013). Co-creating projects improves legitimacy, fosters innovation, and amplifies outcomes. For example, collaboration with local municipalities on waste management or renewable energy initiatives can generate broader impact.

3. **Curriculum Innovation.** Integrating sustainability across disciplines strengthens student competencies and reinforces ESD practices. Curriculum enhancement strategies include embedding sustainability-related learning outcomes in all programs, offering

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interdisciplinary modules that cover environmental, social, and economic dimensions, and promoting project-based and community service learning aligned with the SDGs.

4. **Research Integration.** Research aligned with sustainability priorities increases universities' societal impact. Institutions can establish sustainability research centers, interdisciplinary research groups, and partnerships with industries or NGOs. Tracking research outputs with SDG-aligned indicators enhances both relevance and academic reputation.

5. **Institutional Assessment.** Monitoring progress using tools such as the UI GreenMetric fosters accountability and provides data for continuous improvement. Universities can complement performance indicators with qualitative evaluationssuch as curriculum innovation, community engagement, and sustainability research to build more contextually appropriate assessment frameworks.

The integration of ESD, SDGs, and UI GreenMetric creates multidimensional pathways for sustainable universities, differing from earlier approaches that focused solely on curriculum improvement (Albareda-Tiana et al., 2018) or performance ranking (Sonetti et al., 2016). This conceptual framework interlinks educational, operational, and societal missions. However, higher education institutions often face challenges such as resource constraints, fragmented governance, and inconsistent policies (Leal Filho et al., 2022). Genuine integration requires balancing performance assessment with transformative educational change.

Conceptual Challenges and Implementation Barriers Obstacles include internal resistance rooted in traditional academic culture and low initial awareness, financial limitations since sustainability projects require dedicated budgets and the complexity of monitoring and evaluation, which demands a balance between quantitative and qualitative indicators. Practical strategies include incentivizing faculty participation, leveraging public–private partnerships, adopting phased implementation plans, and fostering a sustainability-oriented culture at all institutional levels.

Comparative Analysis of SDGs, ESD, and UI GreenMetric Indicators

The application of ESD and SDGs concepts to the UI GreenMetric requires an understanding of the alignment and gaps among the indicators of the three systems.

Table 2. Comparison of Key Indicators and Strategic Relationships

Dimension	SDG Alignment	ESD Focus	UI GreenMetric Indicators	Strategic Impact for HEIs
Energy &	SDG 7, SDG	Knowledge and skills in renewable	Energy consumption,	Invest in green infrastructure,

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Dimension	SDG Alignment	ESD Focus	UI GreenMetric Indicators	Strategic Impact for HEIs
Climate	13	energy, climate literacy	renewable energy use, CO_2 emissions	integrate climate-related courses
Waste & Recycling	SDG 12	Critical thinking on resource use	Waste management, recycling rate	Promote campus recycling projects and experiential learning
Water & Environment	SDG 6, SDG 14	Environmental stewardship values	Water management, green space	Develop water-saving technologies and student-led environmental projects
Transportation	SDG 11	Social responsibility, sustainable mobility	Public transport use, bicycle infrastructure	Integrate sustainable mobility into green campus planning and student initiatives
Curriculum & Learning	SDG 4, SDG 17	Competency-based ESD, transformative learning	Integration of sustainability into curricula	Embed SDG-aligned learning outcomes across all programs
Research & Innovation	SDG 9	Interdisciplinary problem-solving	Sustainability research output	Support interdisciplinary sustainability research clusters
Community Engagement	SDG 1, SDG 2, SDG 3, SDG 10	Social engagement, social responsibility	Social activities, partnership programs	Build community partnerships for learning and real-world impact

1. Strategic Insights from the Comparative Analysis

1.1 Opportunities for Alignment. GreenMetric covers structural and operational aspects (energy, waste, water) but is not yet fully integrated with curricula. ESD emphasizes student competencies and transformative learning, helping to fill GreenMetric's qualitative gaps.

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1.2 Challenges in Integration. Some SDGs, such as SDG 5 and SDG 10, are not directly measured by GreenMetric. Gaining faculty buy-in and embedding ESD across disciplines requires institutional policies and incentives.

1.3 Practical Recommendations. Establish a sustainability committee to link management, curriculum design, and research. Use GreenMetric data to identify operational strengths and gaps, and connect them with ESD and SDG initiatives.

1.4 Incorporate Project-Based Learning and Community Engagement. These should be measurable outcomes for both ESD and ranking purposes.

2. Overview Presentation: Integrated Sustainability Scorecard

The Integrated Sustainability Scorecard enables institutions to track and communicate progress. It combines indicators from ESD, SDGs, and GreenMetric.

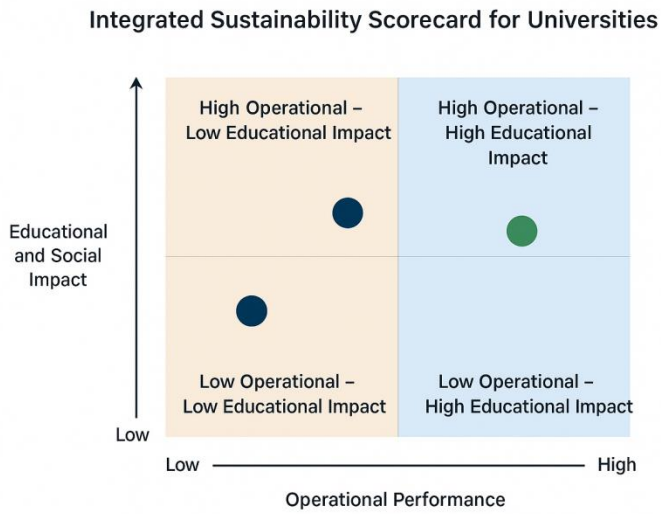

Figure 1. Integrated Sustainability Scorecard for Universities

The X-axis represents quantitative performance (GreenMetric indicators: energy, waste, water, transportation).

The Y-axis represents educational and social impact (learning outcomes, research, community engagement).

The four corners of the graph can be interpreted as follows:

High in both dimensions. A model university in sustainability.

High operational performance but low educational impact. Focus

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should be on curriculum improvement and integrating ESD (Education for Sustainable Development).

Low operational performance but high educational impact.

Emphasize infrastructure development and enhance evaluation processes.

Low in both dimensions. Implement a comprehensive integrated strategy.

This graph model helps administrators and policymakers visualize the overall situation and develop strategies to improve both infrastructure and educational outcomes simultaneously.

Comparative International Case Studies

1. **European Universities – Integration of SDGs and Green Campus**

Examples: University of Amsterdam (Netherlands), University of Helsinki (Finland)

Highlights: Emphasis on designing curricula integrated with the SDGs and implementing sustainability assessment systems (Green Campus Metrics).

Key Strategies: Strong support from top management, building partnerships with communities, and developing extracurricular learning activities.

2. **Asian Universities – Application of ESD and UI GreenMetric**

Examples: Shinawatra University (Thailand), National University of Singapore (Singapore), Tsinghua University (China)

Highlights: ESD concepts are applied in both curricula and community activities, with outcomes monitored through UI GreenMetric.

Key Strategies: Long-term strategic planning, faculty training, and the development of dashboards for monitoring both quantitative and qualitative results.

3. **North American Universities – Integration of Research and Sustainability Innovation**

Examples: University of British Columbia (Canada), Arizona State University (USA)

Highlights: Environmental and social research is integrated with the SDGs and sustainability assessments.

Key Strategies: Establishment of interdisciplinary research centers, engagement with private sectors and NGOs, and strategic monitoring mechanisms.

4. **South American Universities – Community Engagement and Equity**

Examples: Universidade de São Paulo (Brazil), Pontificia Universidad Católica de Chile (Chile)

Highlights: Focus on community engagement and local development,

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integrating SDGs—particularly SDGs 1, 2, 3, and 10.

Key Strategies: Community service projects, partnerships with municipalities and local organizations, and social impact assessments.

5. Middle Eastern and African Universities – Green Infrastructure and Energy

Examples: American University of Beirut (Lebanon), University of Cape Town (South Africa)

Highlights: Focus on improving infrastructure, using renewable energy, and managing water and waste sustainably.

Key Strategies: Investment in green infrastructure, monitoring through GreenMetric, and integrating ESD activities with the curriculum.

Summary and Recommendations for Higher Education Institutions

The integration of ESD, SDGs, and GreenMetric into the sustainability agenda of higher education institutions at national and regional levels can enhance social impact, improve global competitiveness, and support the achievement of the SDGs by 2030. The conceptual framework that integrates ESD, SDGs, and UI GreenMetric provides guidance for sustainable university development. This model identifies leadership, stakeholder engagement, curriculum innovation, alignment of research, and institutional assessment as key factors. Future research should empirically examine this framework in different regional contexts, considering the impact of governance structures, cultural factors, and resource readiness (Tayossyingyong, Bangbon, Naude, Zhang, Siribensanont, & Suwanchotnate, 2025). Furthermore, longitudinal studies can evaluate the effects of sustainability integration on student competencies, research outputs, and community development.

Key Recommendations

1. **Policy Integration.** Align sustainability goals within institutional strategies, curricula, and operations.

2. **Capacity Building.** Provide training for faculty and administrators on sustainability teaching, SDG alignment, and GreenMetric reporting.

3. **Monitoring and Evaluation.** Utilize a hybrid dashboard combining quantitative indicators (GreenMetric) and qualitative assessments (ESD & SDGs).

4. **Community and Industry Collaboration.** Promote partnerships to enhance learning, research, and social impact.

5. **Long-term Planning.** Implement stepwise action plans with measurable indicators to ensure sustained institutional sustainability.

Policy and Practical Recommendations. Policymakers and institutional administrators can apply this conceptual framework to:

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1. **Integrate sustainability indicators.** into institutional evaluation and ranking systems.

2. **Promote collaboration.** among universities and facilitate knowledge exchange.

3. **Allocate government incentives.** to support infrastructure, research, and the continuous monitoring and improvement of curriculum innovations.

4. **Encourage student and community engagement.** in sustainability initiatives.

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