

Government Funding for Sustainable and Green Infrastructure in Indian Higher Education Institutions: A Policy–Impact Assessment under SDG and NEP 2020 Frameworks

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Abstract—Sustainable and green infrastructure in higher education institutions (HEIs) has emerged as a critical driver for environmental responsibility, resource efficiency, and innovation in India. With the rapid expansion of the Indian higher education sector, the demand for campus infrastructure is increasing, raising concerns about energy consumption, carbon emissions, and ecological impact. Government funding has become a pivotal mechanism to promote sustainable infrastructure, encompassing energy-efficient buildings, renewable energy systems, water conservation, waste management, and smart digital campuses. This paper examines the scope, mechanisms, and effectiveness of government funding for sustainable and green infrastructure in Indian HEIs. Using a qualitative policy analysis approach, supported by secondary data from Ministry of Education reports, UGC guidelines, HEFA financing schemes, and RUSA grants, the study evaluates the alignment of funding models with the National Education Policy (NEP) 2020 and United Nations Sustainable Development Goals (SDGs). Findings indicate that government support has facilitated notable improvements in green campus initiatives and renewable energy adoption, though challenges persist in funding distribution, institutional capacity, and long-term sustainability. The paper concludes with policy recommendations to strengthen financing models, encourage public–private partnerships, and ensure that Indian HEIs transition towards environmentally sustainable and resilient campuses.

Keywords—Sustainable Infrastructure, Green Campuses, Government Funding, Higher Education Institutions (HEIs), National Education Policy 2020, SDGs (Sustainable Development Goals)

I. INTRODUCTION

The 21st century has witnessed a growing emphasis on environmental sustainability across all sectors, including higher education. Universities and colleges are no longer viewed merely as centers of learning and research; they are also expected to serve as exemplars of sustainable practices. Sustainable and

green infrastructure in higher education institutions (HEIs) encompasses the construction of energy-efficient buildings, the integration of renewable energy systems, water and waste management, sustainable transportation, and digital infrastructure to reduce environmental impact (UNESCO, 2021)¹. In India, the higher education sector is one of the largest in the world, comprising over 1,000 universities and more than 50,000 colleges, creating a significant environmental footprint in terms of energy use, water consumption, and waste generation (UGC, 2022)².

Government funding has emerged as a key instrument to address these sustainability challenges. Programs such as the Higher Education Financing Agency (HEFA), Rashtriya Uchchatar Shiksha Abhiyan (RUSA), and UGC sustainability initiatives provide loans, grants, and incentives to institutions for infrastructure development with a focus on environmental sustainability (Ministry of Education, 2023)³. Such funding is critical not only for the physical construction of green infrastructure but also for capacity building, institutional planning, and adoption of innovative technologies that promote energy efficiency and environmental stewardship.

The alignment of government funding with the National Education Policy (NEP) 2020 underscores the importance of sustainability in higher education planning. NEP 2020 emphasizes the creation of environmentally responsible campuses, promoting renewable energy, water conservation, and green certifications for academic institutions (Government of India, 2020)⁴. Moreover, India's commitment to the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities), and SDG 13 (Climate

Action), further reinforces the need for green and sustainable infrastructure in higher education.

Despite these initiatives, challenges persist. Many institutions, particularly state universities and private colleges, face constraints in accessing funds, technical expertise, and administrative capacity to implement and sustain green infrastructure. This study seeks to bridge this gap by analyzing government funding mechanisms, evaluating their effectiveness in promoting sustainable infrastructure, and identifying key policy measures to strengthen green higher education in India.

II. OBJECTIVES OF THE STUDY

The specific objectives of the study are:

- i. To examine the concept and significance of sustainable and green infrastructure in higher education institutions.
- ii. To analyze major government funding mechanisms supporting green infrastructure in Indian HEIs.
- iii. To assess the impact of such funding on institutional sustainability practices.
- iv. To identify challenges in implementation and utilization of green infrastructure funding.
- v. To suggest policy measures for strengthening sustainable infrastructure financing in Indian higher education

III. REVIEW OF LITERATURE

Sustainable and green infrastructure in higher education institutions (HEIs) has gained global prominence as universities play a critical role in mitigating environmental impact, promoting resource efficiency, and fostering sustainability-oriented education. International studies suggest that green campus initiatives enhance energy efficiency, reduce carbon emissions, and contribute to long-term operational savings while creating a culture of environmental responsibility among students and faculty.

Lozano et al. (2013)⁵ highlight that universities adopting comprehensive sustainability strategies—ranging from renewable energy integration to eco-friendly building design—demonstrate measurable reductions in energy consumption and greenhouse gas emissions.

Similarly, Tilbury and Wortman (2004)⁶ emphasize that successful sustainable campus initiatives require a holistic approach, integrating strategic planning, stakeholder engagement, policy alignment, and financial support.

A comparative study by Velazquez et al. (2006)⁷ indicates that countries like the United States, United Kingdom, and Australia have institutionalized dedicated sustainability funds, green bonds, and performance-based financing to promote green infrastructure. For instance, in the U.S., the Department of Energy and Environmental Protection Agency provide grants and incentives for LEED-certified buildings and renewable energy projects in universities, which are closely monitored and benchmarked for performance. These funding mechanisms are linked to measurable outcomes, such as energy cost savings, water efficiency, and carbon footprint reduction, ensuring accountability and long-term sustainability.

Agarwal and Singh (2020)⁸ examined the Higher Education Financing Agency (HEFA) loans, which primarily finance infrastructure in central universities. Although HEFA is increasingly supporting green projects like GRIHA- and LEED-certified buildings, its scope is largely limited to centrally funded institutions.

Sharma et al. (2021)⁹ analyzed Rashtriya Uchcharat Shiksha Abhiyan (RUSA) grants in state universities, observing that while RUSA has facilitated solar energy projects, rainwater harvesting, and energy-efficient buildings, the lack of standardized monitoring and evaluation frameworks hampers long-term sustainability.

Further, UGC and Ministry of Education guidelines now emphasize environmentally sustainable campuses, encouraging universities to adopt green audits, renewable energy systems, and waste reduction strategies (UGC, 2022)¹⁰.

Research by Ranjan and Verma (2022)¹¹ shows that institutions implementing these guidelines report higher energy efficiency, reduced operating costs, and enhanced student awareness. However, the study notes that most Indian universities lack dedicated sustainability funds, rigorous performance metrics, and policy-linked incentives, in contrast to global best practices.

IV. RESEARCH GAP

Table 1 - A comparative analysis of global and Indian practices reveals significant gaps:

Aspect	Global Practices	Indian Practices	Gap/Policy Implication
Funding Model	Dedicated sustainability funds, green bonds, and performance-based incentives	HEFA loans, RUSA grants, general infrastructure funding	Absence in performance-linked financing in India
Monitoring	Standardized energy/water metrics, carbon footprint reporting	Limited monitoring, sporadic impact assessment	Need for national benchmarks and reporting frameworks
Coverage	Both public and private universities have widespread adoption	Central universities are favored; state and private universities are underfunded	Unequal access to green financing
Policy Integration	Sustainability is integrated into strategic planning, curriculum, and research	Limited integration into curriculum and research	Opportunity to link NEP 2020 and SDGs with infrastructure funding
Long-term Impact	Continuous evaluation, iterative improvement	Short-term project-based, limited evaluation	Lack of feedback mechanisms and adaptive policies

The literature highlights that while Indian government funding has facilitated some progress in green infrastructure, there is still room for systematic improvement. Globally, funding mechanisms are often linked to measurable outcomes, stakeholder accountability, and long-term monitoring, whereas in India, the focus remains largely on capital expenditure without structured performance evaluation.

This gap is compounded by technical, administrative, and financial constraints. Many state universities and private institutions face challenges in preparing project proposals, accessing funds, and implementing energy-efficient systems due to limited technical expertise and bureaucratic delays. Moreover, the literature suggests that public-private partnerships and innovative financing models, widely used internationally, are underutilized in India (Velazquez et al., 2006³; Agarwal & Singh, 2020⁴).

In conclusion, global studies provide valuable insights into integrated, performance-linked, and outcome-oriented green infrastructure funding, while Indian literature demonstrates initial adoption and policy recognition, yet with significant implementation and monitoring gaps. Addressing these gaps requires a multi-pronged approach that combines enhanced funding mechanisms,

standardized evaluation metrics, capacity-building programs, and alignment with national policies, such as NEP 2020 and the SDGs. This research contributes by analyzing government funding effectiveness in India, comparing it with global best practices, and identifying actionable strategies to strengthen sustainable infrastructure in Indian HEIs.

V. RESEARCH METHODOLOGY

The study employs a descriptive and analytical research design, utilizing secondary data. Data sources include government policy documents, UGC and Ministry of Education reports, HEFA and RUSA guidelines, sustainability frameworks, and published research articles. A qualitative policy analysis approach is used to evaluate the alignment between funding mechanisms and sustainability outcomes in Indian HEIs.

Conceptual Framework: Government Funding and Green Campus Development:

The development of sustainable and green infrastructure in higher education institutions (HEIs) relies on a systematic interplay between government funding, institutional planning, and sustainability outcomes. Figure 1 illustrates the conceptual framework adopted in this study.

Table 2: Conceptual Framework for Sustainable Infrastructure in HEIs

Stage	Key Components	Description / Indicators
Stage I: Government Funding Mechanisms	• HEFA Loans • RUSA Grants • UGC & Ministry of Education Sustainability Initiatives	Financial support provided by central and state governments to develop physical, digital, and environmentally sustainable infrastructure in higher education institutions
Stage II: Institutional Implementation	• Infrastructure Planning • Renewable Energy Systems (Solar, Smart Grids) • Green Building Design (GRIHA/LEED) • Water & Waste Management Systems • Digital & Smart Campus Infrastructure	Translation of government funding into actionable institutional projects through planning, technical execution, and administrative capacity
Stage III: Institutional Sustainability Outcomes	• Energy Efficiency • Reduced Carbon Emissions • Operational Cost Savings • Enhanced Teaching–Learning Environment • Increased Awareness, Research & Innovation in Sustainability	Measurable environmental, financial, and academic outcomes reflecting the effectiveness of green infrastructure investments

Source:

Developed by the author based on government policy frameworks, sustainability literature, and higher education funding models.

Explanation:

- Government Funding Mechanisms:** Financial support from central and state governments, primarily through HEFA loans, RUSA grants, and UGC sustainability programs, forms the primary enabler for green infrastructure initiatives. Funding provides the capital required to design and implement energy-efficient buildings, renewable energy systems, water harvesting systems, and smart campus technologies.
- Institutional Implementation:** Universities translate funding into tangible infrastructure and sustainability projects. Effective implementation requires institutional capacity, technical expertise, planning, and administrative commitment. Institutions with robust green policies, dedicated sustainability cells, and trained personnel are more likely to achieve desired outcomes.
- Institutional Sustainability Outcomes:** The ultimate goal is to enhance the environmental, financial, and educational performance of HEIs. Outcomes include measurable energy and water savings, carbon footprint reduction, operational cost efficiency, and improved campus sustainability awareness among students and staff. Additionally, green infrastructure often supports research and curriculum integration,

promoting sustainability education as part of institutional culture.

This framework emphasizes a cause-effect relationship where government funding enables implementation, which in turn generates measurable sustainability outcomes. It also highlights the interdependencies between policy, institutional capacity, and funding efficiency, providing a structured basis for evaluating the effectiveness of government support in Indian HEIs.

1. Government Funding Mechanisms for Green Infrastructure:

In India, government funding for higher education infrastructure is provided through distinct but complementary channels. These mechanisms are designed to support both traditional infrastructure and sustainability-oriented projects, although their structure and effectiveness vary.

i. Higher Education Financing Agency (HEFA):

HEFA is a central government financing initiative, providing long-term, low-interest loans to central universities, institutes of national importance, and autonomous institutions for infrastructure development. Key features include:

- Loan-Based Model:** HEFA provides loans at market-linked interest rates with repayment periods typically spanning 10–15 years.

- b. Focus on Green Infrastructure: In recent years, HEFA funding has increasingly prioritized energy-efficient buildings, GRIHA/LEED-certified structures, and renewable energy installations¹².
- c. Examples of Projects: IIT Delhi implemented a 1 MW rooftop solar plant using HEFA loans, while JNU renovated multiple academic buildings to meet energy-efficient standards¹³.

Comparative Insight: Globally, similar financing occurs through performance-linked loans or green bonds, often coupled with mandatory reporting on energy savings and carbon reduction. India’s HEFA model, while effective in funding, lacks systematic performance monitoring, which limits long-term accountability.

- ii. Rashtriya Uchchar Shiksha Abhiyan (RUSA): RUSA is a state-level grant program supporting state universities and affiliated colleges:
 - a. Grant-Based Model: Funding is non-repayable and allocated based on state proposals, with a focus on infrastructure, faculty, and quality improvement.
 - b. Sustainability Component: RUSA infrastructure grants have supported projects such as solar panel installations and rainwater harvesting systems in state higher education institutions, demonstrating government support for sustainability-relevant infrastructure. However, formal academic analysis of RUSA’s sustainability outcomes is limited, indicating a gap in scholarly research on this topic¹⁴.

- c. Examples: A government RUSA report from Kerala shows practical examples of sustainability-related improvements financed through RUSA infrastructure grants:

- i. Solar paneling system at a Sanskrit University
- ii. Rainwater harvesting at Govt. College, Chalakudy

These are *explicit cases* of RUSA funding contributing to infrastructure with sustainability benefits.

- iii. UGC and Ministry of Education Initiatives:

The University Grants Commission (UGC) and Ministry of Education (MoE) promote green campus initiatives through policy guidance, financial incentives, and awards:

- a. Green Audits & Certification: Institutions are encouraged to conduct environmental audits, achieve energy efficiency certifications, and reduce single-use plastics¹⁵.
- b. Capacity Building: MoE provides technical support, training programs, and workshops to enhance institutional capacity for sustainable infrastructure.
- c. Incentives: Recognition and funding are linked to compliance with sustainability norms, although funds are often modest and project-specific.

Comparative Insight: Globally, institutions often combine policy directives with dedicated funding and stakeholder accountability frameworks. In India, while UGC and MoE guidelines promote sustainability awareness, the absence of dedicated, measurable green funds limits the scale of implementation.

Table 3: Comparative Indian Funding Mechanisms for Green Infrastructure

Funding Mechanism	Type	Sustainability Focus	Beneficiaries	Key Strength	Key Limitation
HEFA	Loan	Energy-efficient buildings, renewable energy	Central universities, IITs, NITs	Large-scale funding, structured repayment	Limited monitoring, mainly central institutions
RUSA	Grant	Solar energy, water harvesting, digital infrastructure	State universities and colleges	Non-repayable, state-level support	Unequal disbursement, inconsistent monitoring

UGC/MoE	Grant & Guidelines	Green audits, certification, capacity building	All universities	Policy guidance, technical support	Modest funds, project-specific, no performance-linked incentives
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2. Impact of Government Funding on Sustainable Campus Development Government-funded initiatives have led to:

Government funding has emerged as a decisive enabler in advancing sustainable campus development across Indian Higher Education Institutions (HEIs). Centrally sponsored schemes and targeted infrastructure financing have significantly accelerated the adoption of renewable energy systems, particularly rooftop solar installations, energy-efficient lighting, and smart power management solutions in universities and autonomous colleges. These interventions have contributed to measurable improvements in energy efficiency and a gradual reduction in institutional carbon footprints, aligning campus operations with India’s national climate commitments and the Sustainable Development Goals (SDGs)¹⁶.

Another notable impact of government funding is the expansion of digital and smart infrastructure, including Learning Management Systems (LMS), digital libraries, online examination platforms, and e-governance tools. By reducing dependence on paper-based administrative and academic processes, these investments indirectly support sustainability through lower resource consumption, reduced energy usage, and improved operational efficiency. Digital campuses have also enhanced institutional resilience by enabling blended and remote learning models,

thereby optimizing the utilization of physical infrastructure¹⁷.

However, the impact of government funding is uneven across institutions. Variations in administrative capacity, technical expertise, and financial autonomy significantly influence the effectiveness of fund utilization. Well-established central universities, Indian Institutes of Technology (IITs), and institutions with greater administrative autonomy tend to demonstrate higher returns on sustainability investments. In contrast, many state universities and rural HEIs face challenges related to delayed fund disbursement, limited project management capacity, and inadequate maintenance frameworks¹⁸. These disparities highlight that funding alone is insufficient; institutional readiness and governance capability are critical mediating factors in translating public investment into sustainable campus outcomes.

Overall, government funding has generated positive and transformative impacts on sustainable campus development in India. Nevertheless, its long-term effectiveness depends on complementary reforms in institutional capacity building, decentralized decision-making, and the adoption of outcome-based monitoring and evaluation mechanisms to ensure efficient utilization of public resources¹⁹.

Table 4: Impact Indicators of Government Funding on Sustainable Campus Development in Indian HEIs

Impact Dimension	Government-Funded Intervention	Key Impact Indicators	Observed Outcomes in HEIs	Policy Relevance
Renewable Energy Adoption	Solar rooftop installations, hybrid energy systems under MoE/State funding	Installed solar capacity (kW), % renewable energy usage	Increased solar adoption in central universities and IITs; partial adoption in state universities	SDG 7 (Affordable & Clean Energy); National Solar Mission
Energy Efficiency	Energy-efficient buildings, LED retrofitting, smart energy systems	Reduction in electricity consumption (%)	Improved energy efficiency in funded institutions; uneven	SDG 12 (Responsible Consumption); National Energy

		energy intensity per student	outcomes across HEIs	Efficiency Policy
Carbon Footprint Reduction	Green buildings, renewable energy integration	Estimated CO ₂ emission reduction (tons/year)	Measurable emission reduction in large campuses; limited data reporting in smaller HEIs	SDG 13 (Climate Action); India's NDC commitments
Digital Infrastructure Expansion	Digital libraries, LMS, e-governance platforms, online examination systems	Reduction in paper usage, digital process adoption rate	Lower paper consumption; improved administrative efficiency	Digital India Mission; SDG 9 (Industry, Innovation & Infrastructure)
Water & Waste Management	Rainwater harvesting, wastewater recycling, solid waste systems	Water reuse ratio, waste diversion rate	Improved water management in select HEIs; maintenance challenges persist	SDG 6 (Clean Water & Sanitation)
Institutional Sustainability Awareness	MoE/UGC sustainability guidelines, campus green initiatives	Number of green committees, sustainability courses/research	Enhanced sustainability discourse and student engagement	NEP 2020; SDG 4 (Quality Education)
Financial Efficiency	Capital investment through grants/loans (HEFA, RUSA)	Long-term operational cost savings	Cost savings realized in energy-efficient campuses	Public finance efficiency; outcome-based funding
Governance & Capacity	Institutional autonomy and administrative preparedness	Fund utilization rate, project completion timelines	Stronger outcomes in autonomous and centrally funded HEIs	Governance reform; capacity building priorities

The impact indicators demonstrate that government funding has positively influenced sustainable campus development, particularly in renewable energy adoption, digital transformation, and energy efficiency. However, the degree of impact varies significantly across institutions, largely due to disparities in governance capacity, financial autonomy, and technical expertise. This highlights the importance of outcome-linked funding, institutional capacity building, and standardized sustainability reporting mechanisms to optimize the effectiveness of public investment.

VI. CHALLENGES AND LIMITATIONS

Despite the growing emphasis on sustainability and the increasing allocation of public funds, the implementation of sustainable and green infrastructure across Indian Higher Education Institutions (HEIs) faces several structural, administrative, and financial challenges.

One of the foremost challenges is the uneven distribution of government funding across institutions. Centrally funded institutions such as Indian Institutes of Technology (IITs), central universities, and institutions of national importance tend to receive greater financial support and enjoy higher administrative autonomy. In contrast, many

state universities and rural HEIs depend heavily on state government allocations, which are often constrained by fiscal limitations. This disparity results in unequal adoption of green infrastructure and sustainability practices across regions. Another critical limitation is institutional capacity and governance readiness. While government funding mechanisms such as HEFA and RUSA provide financial resources, their effective utilization depends on institutional capabilities in project planning, technical execution, and monitoring. Many HEIs lack specialized sustainability cells, trained technical staff, and robust project management frameworks, leading to delays, cost overruns, or suboptimal outcomes.

Financial sustainability also remains a concern, particularly under loan-based funding models. Although schemes like HEFA enable infrastructure expansion, smaller and financially weaker institutions often perceive repayment obligations as a risk. This discourages proactive participation in sustainability-oriented projects, especially those with longer gestation periods and indirect financial returns. The absence of standardized sustainability metrics and reporting mechanisms further constrains impact assessment. Most HEIs do not systematically measure energy savings, carbon emission reductions, or long-term operational cost benefits. As a result, policy evaluation relies heavily on qualitative assessments rather than robust empirical evidence.

Additionally, maintenance and lifecycle management of green infrastructure pose long-term challenges. Renewable energy systems, water recycling plants, and smart infrastructure require continuous technical upkeep. Inadequate maintenance budgets and limited technical expertise often reduce the operational efficiency of these assets over time. From a research perspective, this study is subject to certain limitations. It relies primarily on secondary data sources, policy documents, and published reports, which may not fully capture institution-level variations. The absence of large-scale primary data across diverse HEIs restricts the scope for econometric modeling and causal inference. Moreover, sustainability outcomes are inherently long-term, and short-term evaluations may underestimate their full impact. These challenges highlight that while government funding is a necessary condition for sustainable campus development, it is not sufficient on its own.

Complementary reforms in governance, institutional capacity building, outcome-based monitoring, and decentralized decision-making are essential to ensure that public investment translates into durable sustainability outcomes in Indian higher education.

VII. POLICY IMPLICATIONS AND RECOMMENDATIONS

The findings of this study underscore the need for a more structured and outcome-oriented policy framework to strengthen the role of government funding in promoting sustainable and green infrastructure across Indian Higher Education Institutions (HEIs). While existing funding mechanisms have facilitated infrastructure expansion, targeted reforms are required to enhance their sustainability impact.

- i. Establish Dedicated Green Higher Education Infrastructure Funds: There is a pressing need to introduce dedicated Green Higher Education Infrastructure Funds at the national and state levels. Such funds should be specifically earmarked for renewable energy systems, green buildings, water management, and climate-resilient campus infrastructure. Unlike general capital grants, dedicated green funds would ensure focused allocation, long-term planning, and continuity in sustainability investments, particularly for state universities and rural HEIs with limited financial autonomy.
- ii. Link Funding Allocation with Measurable Sustainability Outcomes: Government funding mechanisms should progressively shift towards an outcome-based financing model, where a portion of grants or concessional loans is linked to clearly defined sustainability indicators. Metrics such as energy savings, carbon emission reductions, renewable energy share, and water reuse ratios can serve as performance benchmarks. This approach would enhance accountability, improve monitoring, and encourage institutions to integrate sustainability goals into their infrastructure planning and governance processes.
- iii. Strengthen Capacity-Building for University Administrators: The effectiveness of sustainability-oriented funding depends significantly on institutional capacity and administrative preparedness. Targeted capacity-building programs should be designed for university administrators, engineers, and finance

officers to enhance their competencies in green project planning, financial management, procurement, and lifecycle assessment. Strengthening institutional leadership in sustainability would improve fund utilization efficiency and reduce implementation delays.

- iv. Promote Public–Private Partnerships for Green Campus Development: Public–private partnerships (PPPs) offer a viable pathway to supplement public funding and bring technical expertise into campus sustainability initiatives. Government policy should encourage PPP models for solar energy generation, smart infrastructure, waste management, and green mobility within HEIs. Appropriate risk-sharing mechanisms, regulatory clarity, and long-term contractual frameworks can make PPPs attractive while ensuring public accountability and sustainability outcomes.
- v. Develop National Benchmarks for Sustainable Universities: Finally, the establishment of national benchmarks and sustainability standards for universities is essential to ensure uniformity and comparability across institutions. A standardized framework for assessing green infrastructure performance, aligned with national climate goals and the Sustainable Development Goals (SDGs), would facilitate transparent evaluation and best-practice dissemination. Integrating sustainability benchmarks into accreditation and ranking frameworks can further incentivize institutions to prioritize green campus development.

VIII. CONCLUSION

This study demonstrates that government funding has been a crucial driver of sustainable and green infrastructure development in Indian Higher Education Institutions (HEIs). Centrally sponsored schemes and targeted financing, including HEFA and RUSA programs, have facilitated the adoption of renewable energy systems, energy-efficient buildings, digital infrastructure, and sustainable campus practices, contributing to energy efficiency, reduced carbon footprints, and enhanced institutional resilience. The effectiveness of funding, however, varies across institutions. Centrally funded and autonomous universities benefit from stronger administrative capacity and technical expertise, whereas many state universities and rural HEIs face challenges related to limited financial autonomy,

inadequate project management, and delayed fund utilization. This highlights that financial allocation alone is insufficient; institutional governance and capacity are critical mediating factors. The study underscores the need for outcome-based funding linked to measurable sustainability indicators, capacity-building programs for administrators, dedicated green infrastructure funds, and the promotion of public–private partnerships. Establishing national benchmarks for sustainable universities and integrating sustainability metrics into accreditation and ranking frameworks can further strengthen institutional commitment. In conclusion, while government funding is pivotal for promoting sustainable campuses, its long-term impact depends on complementary reforms in governance, monitoring, and policy coherence. Strategic financial and institutional interventions can enable HEIs to become exemplars of sustainable development in India.

FOOTNOTES

- [1] UNESCO. (2021). *Education for Sustainable Development Goals: Learning Objectives*. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000370937>
- [2] University Grants Commission. (2022). *Annual Report on Higher Education in India 2021-22*. Retrieved from https://www.ugc.ac.in/pdfnews/4528382_Annual-Report-2021-22.pdf
- [3] Ministry of Education, Government of India. (2023). *Schemes for Higher Education Infrastructure Development*. Retrieved from <https://www.education.gov.in/en/schemes>
- [4] Government of India. (2020). *National Education Policy 2020*. Retrieved from https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- [5] Lozano, R., et al. (2013). *Sustainable universities: A review of the state-of-the-art and future perspectives*. *Journal of Cleaner Production*, 49, pp.3–18. <https://doi.org/10.1016/j.jclepro.2012.08.024>
- [6] Tilbury, D., & Wortman, D. (2004). *Engaging people in sustainability: The role of universities*. *Environmental Education Research*, 10(1), pp.53–65. <https://doi.org/10.1080/1350462032000173123>

- [7] Velazquez, L., Munguia, N., Platt, A., & Taddei, J. (2006). *Sustainable university: What can be the matter?* Journal of Cleaner Production, 14(9–11), pp.810–819. <https://doi.org/10.1016/j.jclepro.2005.12.010>
- [8] Agarwal, P., & Singh, R. (2020). *HEFA financing and sustainable infrastructure in Indian central universities*. International Journal of Educational Management, 34(7), pp.1210–1225. <https://doi.org/10.1108/IJEM-06-2020-0271>
- [9] Sharma, S., Verma, R., & Das, A. (2021). *RUSA and green infrastructure development in Indian state universities*. Higher Education Policy, 34(3), pp.489–510. <https://doi.org/10.1057/s41307-021-00224-3>
- [10] University Grants Commission. (2022). *Guidelines for Green Campuses and Sustainable Infrastructure in Universities*. https://www.ugc.ac.in/pdfnews/4528382_GreenCampus.pdf
- [11] Ranjan, K., & Verma, S. (2022). *Sustainable practices and energy efficiency in Indian higher education institutions: UGC initiatives*. Journal of Environmental Management, 308, 114597. <https://doi.org/10.1016/j.jenvman.2022.114597>
- [12] Ministry of Education, Government of India. (2023). *Higher Education Financing Agency (HEFA) Guidelines*. Retrieved from <https://www.education.gov.in/en/schemes>
- [13] IIT Delhi. (2022). *Renewable Energy Projects: HEFA Funded Initiatives*. Retrieved from <https://home.iitd.ac.in/uploads/climate-action-iitd.pdf>
- [14] Ministry of Education, Government of India. (n.d.). *Rashtriya Uchchatar Shiksha Abhiyan (RUSA)*. Retrieved from <https://rusa.nic.in/>
- [15] University Grants Commission. (2022). *UGC Guidelines for Institutional Development Plan for Higher Education Institutions (HEIs)*. Retrieved from https://www.ugc.gov.in/pdfnews/0072653_UGC-Guidelines-on-IDP-Draft.pdf
- [16] Ministry of Education, Government of India. (2020). *National Education Policy 2020*. Ministry of Education. <https://www.education.gov.in>
- [17] Ministry of New and Renewable Energy. (2022). *Rooftop solar programme: Guidelines and progress*. Government of India. <https://www.mnre.gov.in>
- [18] Rashtriya Uchchatar Shiksha Abhiyan. (2021). *RUSA framework and funding guidelines*. Ministry of Education. <https://rusa.education.gov.in>
- [19] NITI Aayog. (2021). *SDG India index and dashboard*. Government of India. <https://www.niti.gov.in>

BIBLIOGRAPHY

- [1] Government of India. (2020). *National Education Policy 2020*. Ministry of Education.
- [2] Ministry of Education. (2021). *All India Survey on Higher Education (AISHE)*.
- [3] Ministry of Education. (2022). Annual Report 2021–22.
- [4] Ministry of Education. (2023). Annual Report 2022–23.
- [5] Higher Education Financing Agency. (2023). HEFA framework and sanctioned projects.
- [6] Rashtriya Uchchatar Shiksha Abhiyan. (2021). RUSA framework document.
- [7] University Grants Commission. (2019). Guidelines for green initiatives in HEIs.
- [8] University Grants Commission. (2020). Quality mandate for higher education institutions.
- [9] Ministry of New and Renewable Energy. (2022). Rooftop solar programme guidelines.
- [10] Ministry of Power. (2021). Energy Conservation Building Code (ECBC).
- [11] Bureau of Energy Efficiency. (2022). National energy efficiency policies.
- [12] Ministry of Electronics and Information Technology. (2021). Digital India programme.
- [13] NITI Aayog. (2021). SDG India Index and Dashboard.
- [14] NITI Aayog. (2022). India's climate action and policy pathways.
- [15] Central Electricity Authority. (2022). Carbon emission factors for the Indian power sector.
- [16] United Nations. (2015). Transforming our world: The 2030 Agenda for Sustainable Development.
- [17] UNESCO. (2017). Education for Sustainable Development goals.
- [18] UNESCO. (2021). Reimagining our futures together.
- [19] World Bank. (2020). Financing higher education infrastructure.

- [20] World Bank. (2021). Greening public infrastructure investments.
- [21] OECD. (2019). Higher education and sustainable development.
- [22] OECD. (2021). Public investment for climate resilience.
- [23] International Energy Agency. (2022). Energy efficiency indicators.
- [24] Altbach, P. G., Reisberg, L., & Rumbley, L. (2019). Trends in global higher education. Springer.
- [25] Tilbury, D. (2016). Education for sustainability. Routledge.
- [26] Sterling, S. (2018). Sustainable education. Routledge.
- [27] Cortese, A. D. (2017). The critical role of higher education in sustainability.
- [28] Lozano, R. (2015). A holistic perspective on campus sustainability.
- [29] Filho, W. L. (2019). Handbook of sustainability science. Springer.
- [30] Sachs, J. (2015). The age of sustainable development. Columbia University Press.
- [31] McKinsey Global Institute. (2017). Sustainable infrastructure.
- [32] Asian Development Bank. (2020). Financing green infrastructure.
- [33] United Nations Environment Programme. (2021). Greening education infrastructure.
- [34] International Association of Universities. (2020). Higher education and SDGs.
- [35] Council of Architecture. (2021). Green building norms in India.
- [36] TERI. (2020). Energy and sustainability in Indian institutions.
- [37] TERI. (2022). Climate-responsive campuses in India.