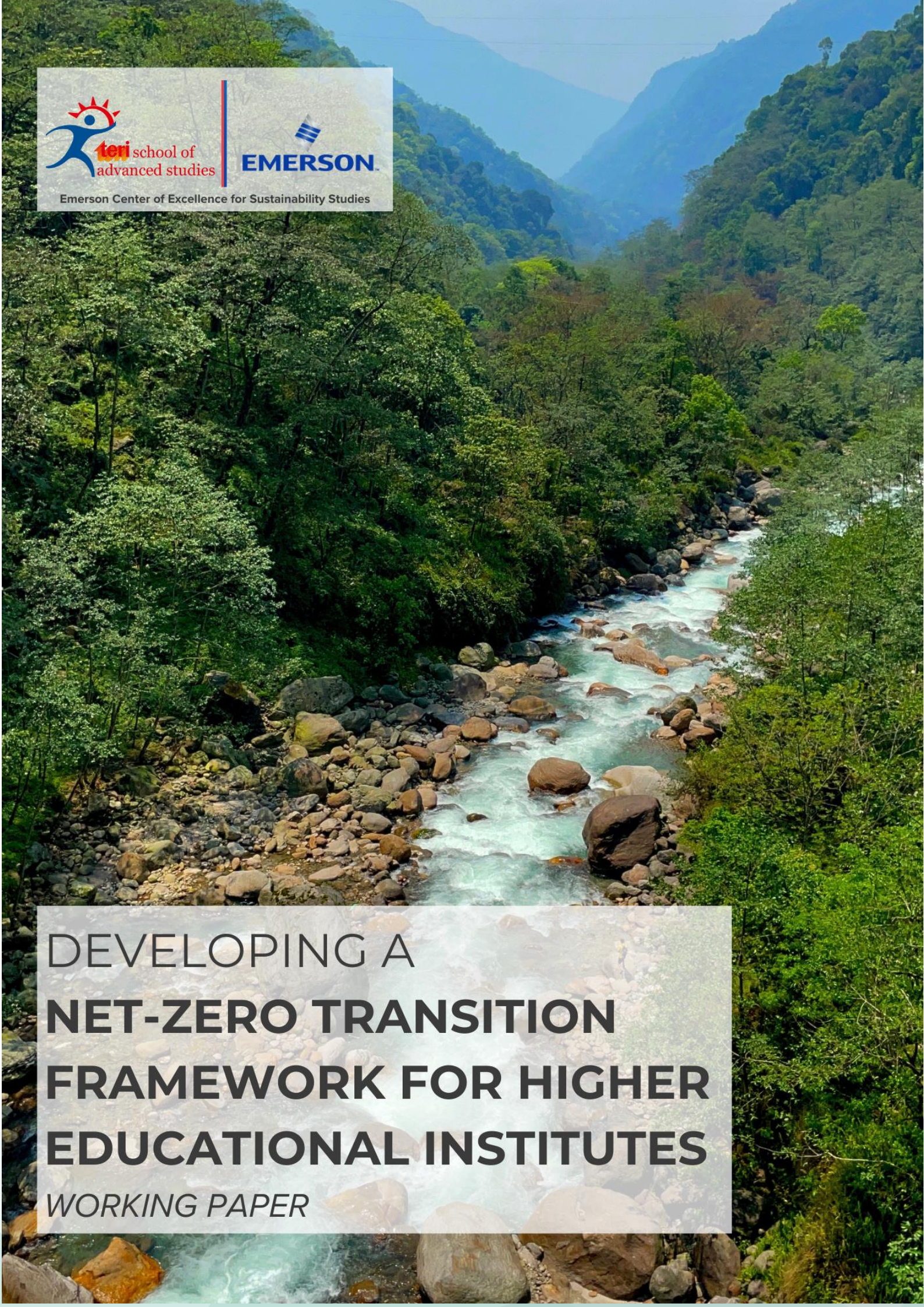

teri school of advanced studies

EMERSON

Emerson Center of Excellence for Sustainability Studies

DEVELOPING A **NET-ZERO TRANSITION FRAMEWORK FOR HIGHER EDUCATIONAL INSTITUTES**

WORKING PAPER

As India moves toward its Net Zero goals, Higher Educational Institutes (HEIs) can play a crucial role in shaping to drive net-zero action on campuses. We propose a co-production-based three-pronged strategy by bringing change in a) physical infrastructure and allied; b) encouraging behavioural changes in stakeholders (students, faculties and staff); and c) strengthening institutional policies for long-term impact by addressing emissions across 8 sectors: energy, transport, materials, waste, water, land use, curriculum, and research. Through this HEIs can become carbon-neutral hubs, inspiring change within and beyond their campuses.

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Net Zero and Higher Education Institutions

The urgency to act on the '*Climate Crisis*' has never been greater! The year 2024 saw the average global temperature surpassing the 1.5°C mark above pre-industrial levels for the first time (NOAA, 2025). It is scientifically established that every increment in temperature above this mark shall significantly impact human systems, and terrestrial, freshwater and coastal ecosystems (IPCC, 2022). In 2015 under the Paris Agreement, the global society pledged to reduce GHG emissions by 45% in 2030 and achieve full carbon neutrality by 2050 (Kalluri *et al.*, 2023). Responding to this Agreement, India has made progress in acting towards mitigating climate change, however achieving carbon neutrality is a distant goal. For instance, to meet the energy demand of 3000 kWh per year per capita by 2040, India aims to meet 60% of its energy demand through renewable energy (RE) sources (Kalluri *et al.*, 2023). However, India's challenges for RE transition lie in the scale of the transformation needed in the power system, the rate of annual RE addition (Rodrigues *et al.*, 2023) coupled with its vast population and their limited purchasing power.

To meet the commitment of India becoming net zero by 2070, programmes such as the *Shunya* was started by the Bureau of Energy Efficiency (BEE, 2023) focusing on Net Zero Energy Buildings and Net Positive Energy Buildings, for their efforts towards transitioning to net zero. However, achieving net-zero emissions requires a combination of efficient energy use, resource efficiency, and behavioural changes (Ferdous, Rakeeb and Wakefield, 2024). The Mission LiFE launched by the Prime Minister, aims to bridge this gap by promoting a *'Pro-Planet People'* approach to sustainable living (NITI Aayog, 2022). In transitioning towards net zero, the Higher Education Institutions (HEIs) of India can play a transformative role in driving practices, build capacities and skills of future generations, and inspire behavioural change at societal level. Net zero broadly refers to a state in which the greenhouse gases going into the atmosphere from operations of an HEI are balanced by active removal (Oxford, 2022)

Globally, over 1,000 HEIs from 68 countries have committed to rally leadership and take bold action towards net zero under the UN Environment Programme, Environmental Association of Colleges and Universities & Second Nature's powered 'Race to Zero for Universities and Colleges' (Race to Zero, 2024). These HEIs have pledged to halve emissions by 2030 and to reach net zero by 2050. In India, in 2023, the government launched the *'University Grants Commission's (UGC) U75: Not Zero-Net Zero'* initiative in synergy with the *Race to Zero initiative*, aimed to encourage HEIs to participate in transitioning towards carbon neutrality by 2030 (Joshi, 2023). The initiative involves collaboration between government institutions such as UGC, All India Council for Technical Education (AICTE) and think tanks like the Green TERRE Foundation (SCCN, 2023). Further, India's National Education Policy (NEP) 2020 directs educational institutions to integrate environmental sustainability into their curriculum and operational strategies. Various sections of NEP, such as 4.23, 4.24, 4.27, and 17.2 (and many more), emphasise the need for sustainability education and

campus-based climate actions, making HEIs pivotal in the national climate adaptation efforts (MHRD, 2020). HEIs can play a crucial role in aiding the transition to net zero such as through advanced research engagement and training future leaders to contribute across various sectors for the nation to achieve its net zero targets. HEIS need to create exemplars by adopting best practices from global sustainability approaches. This calls for developing guidelines and frameworks to enable HEIs to systematically assess environmental, social, and economic performance to ensure data-driven strategic decision-making for transitioning to net zero.

Conceptualising a Net Zero Transition Framework for HEIs

The strategies that systematically integrate key dimensions of energy efficiency, resource management and behavioural shifts are vital for HEIs to minimise carbon footprint while fostering sustainability leadership (Berquin, 2021; Kourgiozou *et al.*, 2021). There is a need for developing approaches to assist in evaluating and promoting the shift in activities towards net zero. For conceptualising such approaches and frameworks, HEIs need to pay attention to their emissions from various physical infrastructures, provide impetus to changes required in stakeholder behaviour, and drive enabling institutional mechanisms. A structured and flexible framework for transitioning to net zero can assist in collating and reporting structured, transparent, and verifiable information for policy decisions by HEIs (Christou et al., 2024). Sustainability and net zero frameworks globally emphasise physical infrastructures and allied dimensions in HEI campuses (Alalawi and Omar, 2024). Further, stakeholder behaviour and institutional and governance mechanisms are essential for driving sustainable transformations in HEIs. Stakeholders like students can be a driving force behind creative sustainability initiatives to introduce innovative perspectives to the institution's sustainability efforts. Likewise, HEIs can noticeably influence the behaviour of its internal stakeholders (students, faculty, and staff) (Case Study 1) while external stakeholders can be motivated to adopt sustainable practices through proactive engagement by the institution (Starik and Shrivastava, 2024).

Case Study 1: Transition 2026 - Stakeholder engagement and co-construction of a climate strategy in a French business school (Castillo et al., 2024)

Castillo *et al.*, (2024) evaluated a French Business School where they integrated their transition to net zero through a comprehensive stakeholder engagement strategy, ensuring sustainability is deeply integrated across all aspects of the institution. Through their transition plan, the school adopted a multi-stakeholder co-construction process. The case demonstrated the significance of transforming behaviours, institutional commitment, and collective action alongside technical solutions. The institute designed a co-creation climate strategy to engage its community in co-designing the net-zero transition plan which helped in enhancing ownership, accountability, and motivation for an impactful transition action. The institution embedded sustainability principles into curriculum, research, operations, and partnerships, ensuring a holistic transformation. Resistance to change, lack of awareness, and competing priorities were addressed by fostering inclusive dialogue and capacity-building initiatives. This was achieved through engagement activities e.g., workshops and collaborative projects, encouraging long-term behavioural shifts.

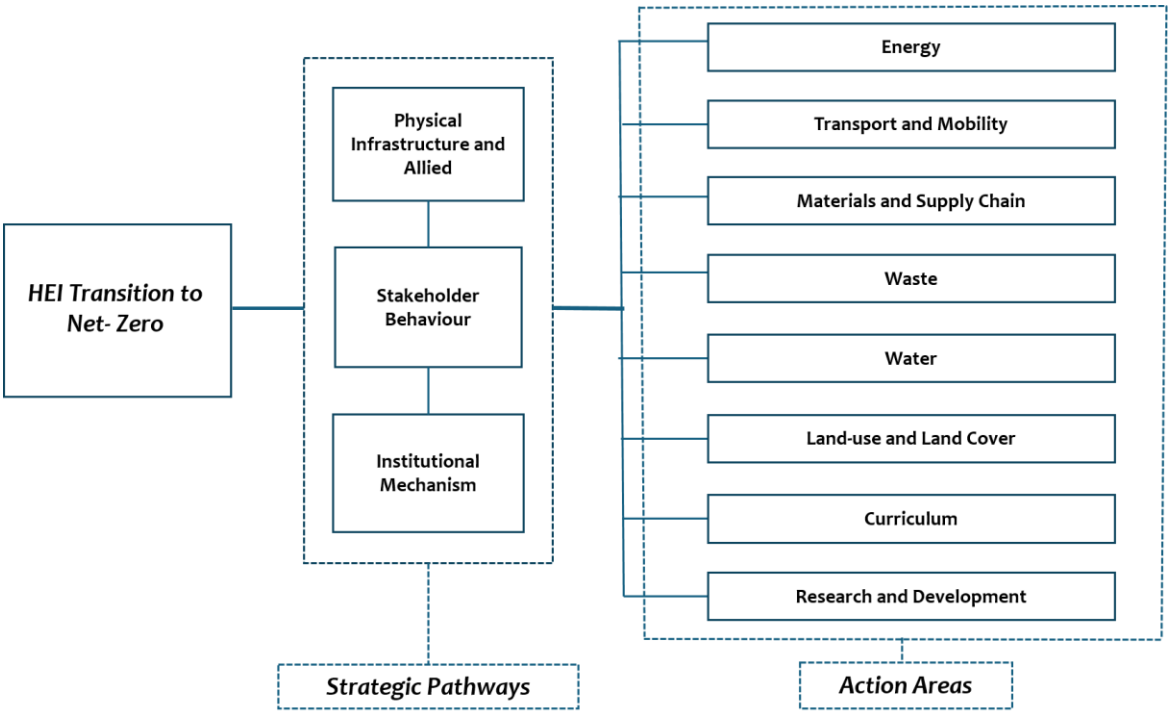
The HEIs key institutional mechanisms such as the institution's governance and policy, administrative support, and financial management and planning play a vital role in materialising the transition to net zero. Effective institutional planning can assist in better decision-making towards such a transition. For example, in 2009 Yale University's administration took the initiative to construct Kroon Hall with integrated sustainability features (Case Study 2).

Case Study 2: Yale University's role in establishing Kroon Hall as a sustainable building and net-zero transition

Kroon Hall, Yale University

Yale University's administration played a pivotal role in developing Kroon Hall, a LEED Platinum-certified building, as part of its broader net-zero transition agenda. With a target of reducing GHG emissions by 43% from 2005 levels by 2020, Yale positioned Kroon Hall as a flagship project for sustainability. The administration engaged renowned architects and sustainability consultants to ensure a critical focus on energy efficiency, carbon neutrality, and resource conservation. The Kroon Hall consumes 61.1% less energy than comparable buildings, incorporating geothermal heating, passive solar design, and high-performance insulation. It reduces water use by 81% through rainwater harvesting and greywater recycling while generating 25% of its electricity on-site. Its heat recovery system further optimises energy use. This case study highlights how an HEI can drive a net-zero transition by integrating sustainability into operations and governance. Yale's Kroon Hall initiative demonstrates the importance of strategic planning through institutional leadership.

A three-pronged strategy focusing on change in Physical Infrastructure and allied, Stakeholder Behaviour and Institutional Mechanism (Strefler *et al.*, 2024) is essential for the aspired net zero transition by an HEI. HEIs must integrate Curriculum and Research & Development as integral operational areas into their transition strategies (Chatterton *et al.*, 2015) as these dimensions can also assist them to fast-track the transition. A net zero transition framework also needs to account for diverse sectors that directly or indirectly contribute to the emissions by HEI. A set of 8 key sectors formulating a structured and actionable approach to net zero have been indicated in the literature as - energy, transport, materials, waste, water, land use, curriculum, and research & development. Comprehensive actions in these sectors can be undertaken through - changes in the physical and built infrastructure of an HEI changes in stakeholder behaviour and executing institutional policies and planning that encourage the transition.



Net Zero Transition Framework for HEI's: Linking Strategic Pathways with Key Action Areas

Transitioning to Net Zero

Our preliminary research indicates that global efforts are being undertaken by HEIs to track and mitigate their emissions. These efforts are difficult, and meeting targets can often be challenging. A case study (Case Study 3) of Australian HEIs' commitment to net zero indicated that even the leading HEIs struggle to meet their commitments (Bothwell, 2021; Melville-Rea and Arndt, 2024). For aspired transition to net zero, HEIs need to have well-structured plans and strategies (Klein *et al.*, 2022).

Case Study 3: Climate Change Mitigation Efforts and Strategies across Australian Group-of-Eight Universities (Melville-Rea and Arndt, 2024)

Eight Australian universities also known as the Group of Eight (Go8) universities; University of Melbourne, Australian National University, University of Sydney, University of Queensland, University of Western Australia, University of Adelaide, Monash University and University of New South Wales in Australia, are working towards net zero through various strategies, however their actual emission reductions have not kept pace with their commitments. The challenge faced by the Go8 Australian Universities was a lack of standardised requirements to report, especially Scope 3 emissions. Another challenge faced by these universities is the lack of clear strategies or measurable targets for reducing emissions, along their value chains. These cases highlight the necessity for structured emissions accounting frameworks.

We recommend the adoption of a knowledge co-production approach for developing strategies and net zero transition plans for HEIs and to ensure capacity building and training of stakeholders. The knowledge co-production is an iterative and collaborative process (Singhal and Kumar, 2024) that

involves the convergence of diverse sets of expertise across varied stakeholders to produce context-specific knowledge and pathways for transition to net zero. This process shall aid in refining strategies while being guided towards the most plausible actions that HEIs can undertake. A few steps that may be initiated by HEIs for transition to net zero include:

- Setting up a committee that is represented by all internal stakeholders of an HEI i.e., students, faculties and other staff along with role allocation.
- Establishing inventory boundaries, scopes and baseline year of reporting (HEIs can refer to protocols such as GHG Protocol and ISO14064).
- Gathering and recording information on data sources and their availability.
- Estimating emissions across the 8 key emission sectors through engagement with stakeholders.
- Establishing annual targets and making tangible and actionable yearly strategies by developing a Net Zero Transition Plan. Consulting stakeholders and experts for refining strategies in the Net Zero Transition Plan.
- Undertaking periodical reviews (around 3-4 times a year) to assess progress and impact of actions.

Strategic approach to developing Net Zero Transition Plans for HEIs

This is an opportune time for the HEIs in India to initiate the development of their net zero transition plans. The HEIs can work towards such plans through strategic pathways addressing physical infrastructure and allied, stakeholder behaviour, and institutional mechanisms, across the 8 emission sectors through emphasis on:

1. Energy efficiency and transition to RE

The energy-related emissions are predominantly from electricity used for building services such as lighting, air-conditioning, and heating in classrooms and other spaces on the HEI campus. To optimise such usage and minimise the emissions, HEIs need to upscale activities that promote necessary behavioural changes by the user community, initiate a gradual transition to energy-efficient appliances, and adopt energy-saving plans that can assist in the transition from gas/oil-based fuels to renewables (Herth and Blok, 2022; Prasara-A *et al.*, 2024). Further, regular maintenance and eco-friendly alternatives shall assist in managing the fugitive emissions from appliances (Herth and Blok, 2022). Shift to RE through assistance from existing government schemes and subsidies shall assist in generating clean energy and reducing reliance on fossil fuels (MNRE, 2023; Goldberg *et al.*, 2025). HEIs can avail of schemes such as Solar Roof Top Subsidy from GoI to install solar panels.

2. Sustainable transport measures

To reduce emissions from the transport and mobility sector, need to encourage and incentivise low-emission travel by facilitating subsidised public transport passes and initiate carpooling schemes among students and staff (Islam *et al.*, 2023; Alalawi and Omar, 2024). Further HEIs must facilitate an effective last mile connectivity to encourage increased usage of public transport. HEIs with large campuses can encourage non-motorised transport systems by dedicating walking and cycling lanes (Cruz *et al.*, 2017; Baig *et al.*, 2022).

3. Materials and supply chain

HEIs can initiate the adoption of sustainable procurement practices and green supply chain management by prioritising the use of low-carbon materials and engaging with local suppliers (Zahra et al., 2024) to reduce their indirect emissions.

The sustainable procurement practices shall induce sustainability consciousness in external stakeholders including material suppliers and canteen vendors. HEIs can also take up initiatives that promote recycling, retrofitting and repairing to avoid frequent purchases of new products, thus aiming to reduce embodied carbon in materials (Vishnu Dharssini, Charles Raja and Manoharan, 2023).

4. Waste management

Waste is one of the critical emission sectors for HEIs and the characteristics of waste being generated depend on predominant academic disciplines (such as medical, science, engineering, humanities, etc.) and their associated activities within the HEI. HEIs must work towards the development and adoption of comprehensive waste management systems that are aligned with state-of-the-art practices following standards such as ISO 14001 (Jaglan *et al.*, 2022). HEIs should encourage segregation and recycling through clearly labelled bins for dry, wet, plastic, and electronic waste, ensuring efficient sorting and processing (Maris Lima Cruz *et al.*, 2024). Establishing composting systems on campus shall assist in managing the emissions from organic waste.

5. Water management

As HEIs are locations with larger numbers of people gathering for long hours each day, water conservation initiatives are vital to be implemented to minimise and reduce stress on ground and municipal water sources. Sustainable water management strategies can assist in lowering direct and indirect water usage while promoting environmental responsibility. HEIs should measure and track direct water consumption in campus activities while encouraging staff and students to reduce water wastage, minimise paper printing, and adopt water-efficient practices through water sustainability workshops and seminars. The HEIs must encourage research staff to conduct advanced research on water conservation and management practices and share findings with the scholarly community and wider stakeholders.

6. Land use and land cover

Emissions from the Land Use and Land Cover sector are generated through deforestation, soil disruption, and infrastructure expansion within the HEI campuses and surrounding catchment (Liu, Moshi and Awuor, 2019). HEIs can expand their green cover to enhance carbon sequestration, a pathway to reduce emissions. In the case of HEIs that lack space for further increase in green cover, they can opt for options such as *Azolla* based carbon capture mechanism with limited space requirements.

7. Consciousness generating curriculum

While HEIs focus on infrastructure and energy efficiency, curriculum-related carbon emissions remain an overlooked challenge. Academic activities such as energy-intensive lab experiments, field trips, and research using high-powered equipment contribute significantly to an institution's carbon footprint (Okanović *et al.*, 2021; Ferdous, Rakeeb and Wakefield, 2024). Even digital learning, with data centres powering online platforms, adds to emissions. HEIs must integrate sustainability education across disciplines to foster consciousness among youth. Furthermore, stakeholders must be encouraged to take virtual labs, use digital resources instead of printing, and adopt energy-efficient research methodologies (Okanović *et al.*, 2021). HEIs must take the lead in training professionals, young researchers, faculty members and students focusing on key dimensions relating to net zero and sustainability.

8. Research and development

Research and Development at HEIs plays a crucial role in driving sustainability solutions for accelerated transition to net zero. The research activities directly or Indirectly contribute to emissions that also need to be accounted for. In this sector, HEIs can reduce emissions by aligning research projects with low-carbon innovations such as renewable energy solutions, carbon capture technologies, and circular economy innovations within and beyond their campuses (Chatterton *et al.*, 2015; Coone,

2017; Cooney *et al.*, 2021). HEIs can engage in undertaking policy-oriented sustainability research on themes such as sustainable governance, low-emission urban planning, and climate policy frameworks at state, national, or international levels.

Case 4: TERI School of Advanced Studies net zero transition efforts

The TERI School of Advanced Studies (TERI SAS) and its governance mechanism have been promoting sustainability education and aspiring towards net-zero carbon emissions, adopting a holistic approach through:

Academic Programs Focused on Sustainability: TERI SAS offers a diverse range of academic UG and PG programs strongly aligned with sustainability principles. These programs are designed to equip students with the knowledge, and practical and transferable skills necessary to implement sustainable practices including business practices.

Stakeholder Engagement: TERI SAS engages with the broader community through training, workshops, and cultural and technological events; and brings together government bodies, academics, industry professionals, and other practitioners to discuss prospects promoting sustainability.

Physical and Infrastructure: The university has energy-efficient physical infrastructure using technologies such as an earth air tunnel system, solar installations and Azolla carbon capture tower.

Conclusion

The HEIs can come together to enhance the requisite knowledge exchange for the creation and execution of much-needed net zero transition plans. Such convergence, through support from industries and think tanks in synergy with the enabling policy environment, shall accelerate the momentum towards India's net zero goals.

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