किर IITH

the crowning glory

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భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Sustainability Research@IITH

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EDITORIAL EPISTLE

Dear Esteemed Readers,
Greetings!!

It is with great enthusiasm that we present Issue 25 of किरIITH, themed "Sustainability Research at IIT Hyderabad"—a reflection of our collective commitment to building a resilient, inclusive, and environmentally responsible future.

As the world confronts pressing challenges such as climate change, resource scarcity, and rapid urbanization, sustainability has emerged not merely as a choice, but as a necessity. At IIT Hyderabad (IITH), sustainability is deeply embedded in our academic vision, research priorities, and campus practices. Our approach goes beyond isolated solutions, embracing systems thinking that integrates science, engineering, policy, and society.

This edition showcases IITH's extensive and interdisciplinary sustainability research—ranging from renewable energy systems, green hydrogen, and advanced battery technologies to water resources management, climate modeling, sustainable materials, circular economy, smart infrastructure, and environmentally conscious AI. It also highlights innovations inspired by nature, community-centric solutions, and technologies designed for real-world impact, particularly in the Indian and global contexts.

IITH's living laboratory campus, with its emphasis on energy efficiency, water stewardship, waste management, and ecological conservation, stands as a testament to how research and practice can seamlessly converge. Through the dedication of our faculty, students, researchers, and collaborators, sustainability at IITH is not confined to laboratories—it is translated into actionable knowledge that serves society and the planet.

We gratefully acknowledge the continued support and engagement of our readers, contributors, and well-wishers who make किरIITH a meaningful platform to share the institute's journey. We invite you to explore this issue and discover how IIT Hyderabad is advancing sustainability-driven research to enable a greener, smarter, and more equitable future.

Access all previous issues of किरIITH at: *https://pr.iith.ac.in/newsletter/about.html*

Read, reflect, and join us in shaping a sustainable tomorrow!

Warm regards,
The Editorial Team
किरIITH – IIT Hyderabad

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Dear Friends,

It gives me immense pleasure to present Issue 25 of किराIITH, which captures a vibrant snapshot of IIT Hyderabad's expanding footprint in sustainability, research excellence, global collaboration, and societal impact. This edition reflects not only our academic progress, but also our collective resolve to align cutting-edge science and technology with national priorities and global challenges.

IITH's growing stature on the world stage is reaffirmed by the recognition of our faculty in the Stanford–Elsevier Top 2% Scientists in the World 2025 list, with 46 positions secured across career-long and single-year impact categories. This significant rise from the previous year underscores the depth of sustained scholarship at IITH and the accelerating momentum of our research contributions.

Our commitment to sustainability and energy transition is further strengthened through IITH's participation in the Si-Zero Research Program, a major international consortium led by Swinburne University of Technology, Australia, aimed at developing zero-carbon and circular silicon recycling technologies for end-of-life solar panels. Such initiatives exemplify how IITH is contributing meaningfully to global climate and sustainability goals.

Equally important is our focus on inclusive growth and societal development. The inauguration of the Next Bharat Ventures Skilling Centre by the Rural Development Centre reflects our dedication to empowering rural and semi-urban youth through skill development, innovation-driven learning, and entrepreneurship. Programs such as Prerna 2025 further strengthen our engagement with surrounding communities, inspiring students and parents to pursue education with confidence and long-term vision. This issue also celebrates milestones in institution-building and partnerships. Our improved QS Asia University Ranking 2026, with a remarkable 50-rank jump, reinforces IITH's position among the top institutions in India and Asia.

IITH continues to serve as a hub for international collaboration, as reflected in the successful hosting of the Japan Academic Day 2025 and the Japan–India Universities Forum, strengthening bilateral cooperation in science, technology, and innovation. Our academic offerings are also evolving to be globally relevant, exemplified by the launch of the Integrated Product–Service System (IPSS) Design Certificate Programme in collaboration with POLI. design, Milan.

The institute's leadership in advanced materials, critical minerals, and energy research is evident through the hosting of the 79th Annual Technical Meeting of the Indian Institute of Metals, bringing together over 1,600 participants from academia, industry, and research institutions worldwide. Complementing academic rigor, events such as the IITH Half Marathon and Inter-IIT Sports Meets showcase the spirit of wellness, teamwork, and community that defines our campus life.

Finally, IITH's strong emphasis on liberal and creative arts, with nearly 10% of the undergraduate curriculum dedicated to creative and liberal disciplines, continues to nurture well-rounded, empathetic, and socially conscious engineers and scientists.

I extend my heartfelt appreciation to our faculty, students, staff, alumni, collaborators, and supporters who make these achievements possible. I invite you to explore this issue of किराIITH and witness how IIT Hyderabad is advancing sustainability-driven research, global partnerships, and inclusive innovation to shape a better future.

Prof B S Murty
Director, IIT Hyderabad

Advancing Sustainability in Rice Farming through Life Cycle Assessment and Climate-Smart Approaches

KID: 20250401 | Mr Rahul Kumar Yadav, Dr Ambika S


[1]


[2]

Rice is a staple food for more than half of the world's population, and India is one of its largest producers. However, rice cultivation is also a major contributor to greenhouse gas emissions, high water use, and energy consumption, posing serious challenges to sustainable and climate-resilient agriculture (MoEFCC, 2023). Addressing these challenges requires scientifically grounded, field-based evidence on how different rice production systems perform from both environmental and socio-economic perspectives.

My research focuses on evaluating the sustainability of major rice cultivation systems in India using an integrated Life Cycle Assessment (LCA) and climate-smart agriculture framework. The study compares organic rice farming, conventional flooded rice systems, and Direct Wet Seeded Rice (DWSR) to identify pathways for reducing environmental impacts while maintaining productivity and farmer viability.

A key strength of this research is the use of primary, field-level data collected directly from farmers and institutions.

Fig 1: KVK Organic Agricultural Field

Detailed agronomic data for organic rice farming are collected from Krishi Vigyan Kendra (KVK), Medak, including information on seed rate, seed treatment methods, organic fertilizers (farmyard manure, vermicompost, green manure), biofertilizers, botanical and biological plant protection measures, irrigation practices, energy use, and labor inputs. This allows a realistic assessment of organic rice systems as practiced on the ground.

For conventional rice farming and DWSR, primary agronomic and management data are obtained from ICAR–Indian Institute of Rice Research (ICAR-IIRR), Hyderabad.

These datasets include chemical fertilizer application rates, pesticide and insecticide use, irrigation and electricity consumption, mechanization, and labor requirements, representing standard and improved rice production practices in India.

Using the Life Cycle Assessment methodology, all rice systems are evaluated from input production to on-farm operations and emissions. Primary field data are integrated with secondary data from internationally recognized databases such as ecoinvent and Agribalyse, and the analysis is conducted using openLCA software. This combined approach ensures scientific robustness while maintaining strong regional relevance.

KVK Organic Agricultural Field

Fig 2: ICAR-IIRR

The study compares environmental indicators such as greenhouse gas emissions, energy use, and resource intensityacross organic, conventional, and DWSR systems. A major focus is hotspot analysis, which identifies processes contributing the highest environmental impacts. Preliminary insights show that synthetic fertilizers and electricity-intensive irrigation are major hotspots in conventional rice systems, whereas organic systems generally exhibit lower environmental impacts due to reduced external inputs.

Beyond comparison, the research actively explores improvement scenarios—such as replacing high-impact fertilizers and plant protection products with lower-impact alternatives—while ensuring that crop productivity and farmer income are not compromised. This approach supports practical, implementable solutions rather than theoretical comparisons.

By integrating environmental LCA with socio-economic and Social Life Cycle Assessment (S-LCA) perspectives, the research also considers labor requirements, input costs, and farmer well-being, recognizing that sustainability must be environmentally sound, economically viable, and socially acceptable.

Overall, this research contributes to IIT Hyderabad's sustainability mission by providing evidence-based insights for low-emission, resource-efficient, and climate-resilient rice farming systems. The findings are expected to support policy formulation, institutional decision-making, and farmer-level adoption of sustainable rice cultivation practices aligned with national climate goals and global sustainability targets.

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ICAR-IIRR

Biomass to Pharma: The Sustainable Catalytic Approach Towards Bio-based Amines

KID: 20250402 | Mr Palanivel Subha, Dr Putla Sudarsanam

Biomass valorization for the pharma industry

The depletion of fossil resources and their adverse environmental impact have prompted the modern research community to consider the comprehensive utilization of biomass as a renewable carbon feedstock for producing fine chemicals, bulk chemicals, polymer precursors, biofuels, and pharmaceutical precursors.[1-3] Efficient biomass valorization reduces our dependence on depleting fossil fuels and boosts carbon neutrality.

In this context, the necessity of using non-edible lignocellulosic biomass instead of edible biomass (starch and lipids) for the synthesis of chemicals and biofuels is crucial for a sustainable future. The non-edible lignocellulose consists of three polymeric components: cellulose (30-50 wt.%), hemicellulose (20-35 wt.%), and lignin (15-30 wt.%).[3,4] It is abundantly available from waste resources (e.g., sugarcane, bagasse, and corn stover) and forest residues. Catalysis provides industrial solutions for lignocellulose biorefinery.

The use of heterogeneous solid catalysts over homogeneous catalysts offers several advantages, including easy synthesis, high hydrothermal stability, and efficient reusability.

A large number of secondary amines are still produced from fossil-based resources, which may not be available in the near future due to the continuous depletion of fossil fuels.

Hence, it is crucial to develop sustainable catalytic strategies for producing secondary amines from non-edible lignocellulosic biomass and its derived platform molecules.

Sustainable Catalysis Research at SP HeteroCat Lab, IIT Hyderabad

Dr. Sudarsanam's group (SP HeteroCat Lab) at IIT Hyderabad is actively working on developing practically viable catalytic methods to valorize non-edible lignocellulosic biomass and its platform molecules into high-value fuels and chemicals.

Specifically, the SP HeteroCat Lab focuses on producing secondary amines from lignocellulose-based platform molecules, namely furfural (derived from hemicellulose) and vanillin (derived from lignin), through novel and sustainable catalytic methods (Figure 1).

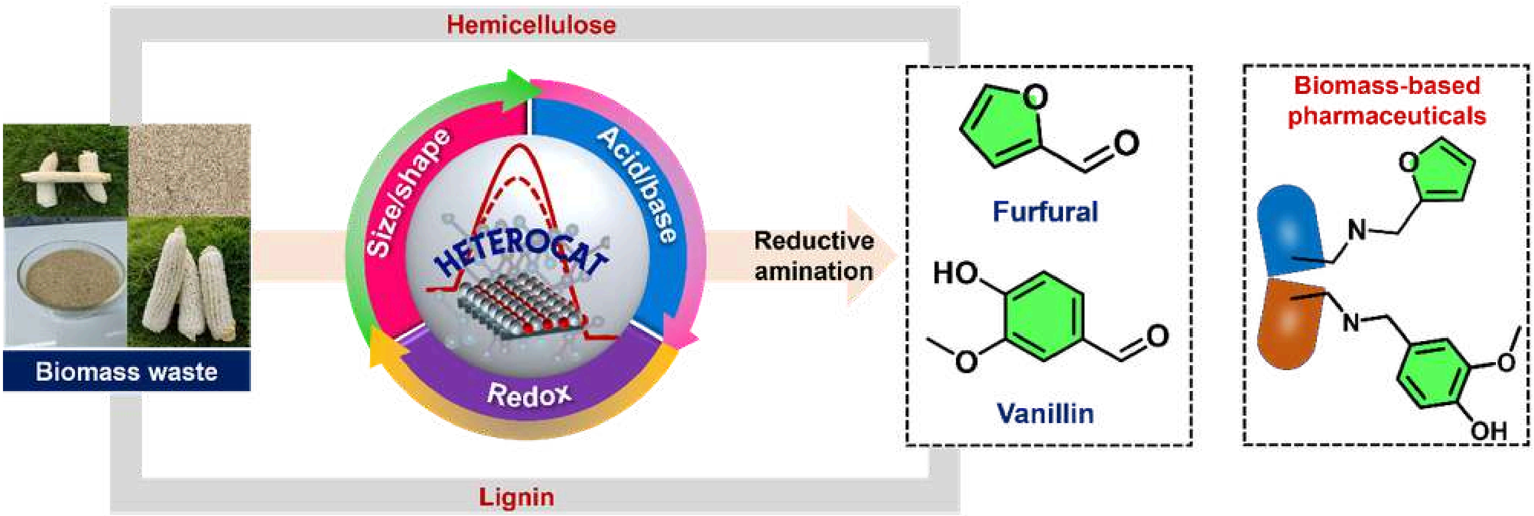

Figure 1. Overview of the research progress in Dr. Sudarsanam's Lab on the production of pharmaceuticals from biomass-based platform molecules.

Controlling the particle size and shape, as well as engineering the surface structure of heterogeneous solid catalysts, can optimize the active sites for target applications in lignocellulose valorization. Secondary amines hold significant importance in drug design and development, as they serve as versatile structural scaffolds in various pharmaceuticals, including anticancer, antiviral, and antibacterial agents.[5,6] Besides, they are potential monomers for the production of valuable polymers and vitrimers at a commercial level.

"The use of heterogeneous solid catalysts over homogeneous catalysts offers several advantages, including easy synthesis, high hydrothermal stability, and efficient reusability"

The reductive amination strategy has received significant importance for producing biomass-derived secondary amines, as it is promising and can be extended to chemicals with versatile functionalities for the pharmaceutical industry.

The reductive amination involves carbon-nitrogen coupling and the subsequent hydrogenation using a hydrogen source (molecular hydrogen or hydrogen donors). For this, a suitable heterogeneous catalyst with an optimum amount of acid sites (for carbon-nitrogen coupling) and redox sites (for hydrogenation) is necessary.

With continuous efforts, Mr. Subha P, a PhD student in Dr. Sudarsanam's group, has developed a novel catalytic strategy to produce furfural-based secondary amines at room temperature using a PdNi-based nanoalloy catalyst with a mixture of triethylsilane and methanol as a hydrogen donor.[5] These amines hold significant importance in the pharmaceutical industry and serve as cost-effective precursors for several anticancer drugs.

The catalyst consists of alloyed ultrafine PdNi nanoparticles with optimal acid-redox synergy, which accelerates hydrogen generation from the triethylsilane-methanol couple, as well as the efficient hydrogenation of imine intermediates at ambient conditions.

Challenges and Prospects

Although we have developed an efficient catalytic strategy for producing furfural-based secondary amines using a mixture of triethylsilane and methanol as a hydrogen donor, the industrial viability of this process primarily relies on the number of byproducts formed during the reaction and how efficiently they can be separated from the targeted amines. To address these challenges, Dr. Sudarsanam Putla and

Mr. Subha P are currently working on the use of molecular hydrogen gas instead of hydrogen donors for the reductive amination of furfural and vanillin, aiming to produce pharmaceutical precursors at mild pressures (<10 bar) and near-room temperature.

On the other hand, we also focus on replacing precious metals (Pd and Ru) with earth-abundant metals (Ni, Cu, and Co) without compromising activity and mild reaction conditions.

Thus, we strongly believe that the strategies being explored in our lab will lead to a sustainable pathway for producing renewable secondary amines as next-generation pharmaceuticals with versatile applications, thereby boosting both the biorefinery and pharmaceutical industries.

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> *"Secondary amines hold significant importance in drug design and development, as they serve as versatile structural scaffolds in various pharmaceuticals, including anticancer, antiviral, and antibacterial agents. Besides, they are potential monomers for the production of valuable polymers and vitrimers at a commercial level"*

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Circular Manufacturing Roadmap: Hybrid Processes for Rapid Response and Resource Efficiency

KID: 20250403 | Prof Suryakumar S and Prof N Venkata Reddy

Introduction

Circular manufacturing is becoming a key paradigm for creating sustainable, resilient, and resource-efficient manufacturing systems. Contrary to the traditional linear manufacturing model of single life-cycle usage, circular manufacturing aims to keep materials, components, and products in use for as long as possible through reuse, repair, remanufacturing, and recycling. To realize the full potential of circular manufacturing, production systems must adapt quickly to changing conditions, use materials more responsibly (including recycled materials), and respond effectively to disruptions in supply and demand. Flexible and hybrid processes are becoming central to achieving these goals, as they combine adaptability, precision, and efficient resource use to support circular practices.

This notion of a hybrid approach providing better advantages than the individual processes is also true in the case of Manufacturing and its three broad approaches, viz., additive, subtractive, and formative. Material is added, removed, and deformed in each of these processes. While each of them individually have a lot of advantages, they also suffer from certain limitations. To make the most efficient use of the material and energy involved, each of them must be harmonized with other manufacturing processes. The purpose of these hybrid processes is to enhance their advantages whilst at the same time reducing their disadvantages. By combining these processes, Hybrid-Manufacturing technologies can not only enlarge the geometrical configurations possible but also enhance overall process capabilities, particularly with respect to component quality and the efficient utilization of resources (materials, energy, time etc.).

Numerous hybrid manufacturing processes are possible; however, this article presents selected hybrid approaches developed by the authors' groups at IIT Hyderabad.

These efforts focus on the hybridization of additive–subtractive and additive–forming processes to demonstrate the potential of hybrid manufacturing in terms of enhanced productivity, increased geometrical complexity, and improved material properties

Additive and Subtractive

The combination of CNC machining and additive processes may provide a new substantial solution to the limitations of additive processes due owing to the high accuracy that machining processes offer. Generally, hybrid additive and subtractive manufacturing processes' methods use an additive process to build a near-net shape which will be subsequently machined to its final shape with desired accuracy by a subtractive process.

In this setup, a Gas Metal Arc Welding (GMAW) torch is mounted in proximity to a CNC (Computer Numerical Control) machine, enabling the system to perform both material deposition and machining operations within a single platform. This integration is achieved through a combination of mechanical and electrical modifications. During the integration, changes to the mechanical and electrical systems are done without the need for any proprietary information from the machine builder or the control developer.

Mechanically, the welding torch is positioned near the milling spindle so that deposition and milling can be carried out sequentially without repositioning the workpiece. The welding unit is electronically interfaced with the CNC controller, typically through existing relays such as the coolant or additional CNC relay, allowing the welding system to be switched on and off as required. Together, these mechanical and electronic integrations enable integration of additive and subtractive manufacturing within a single workstation.

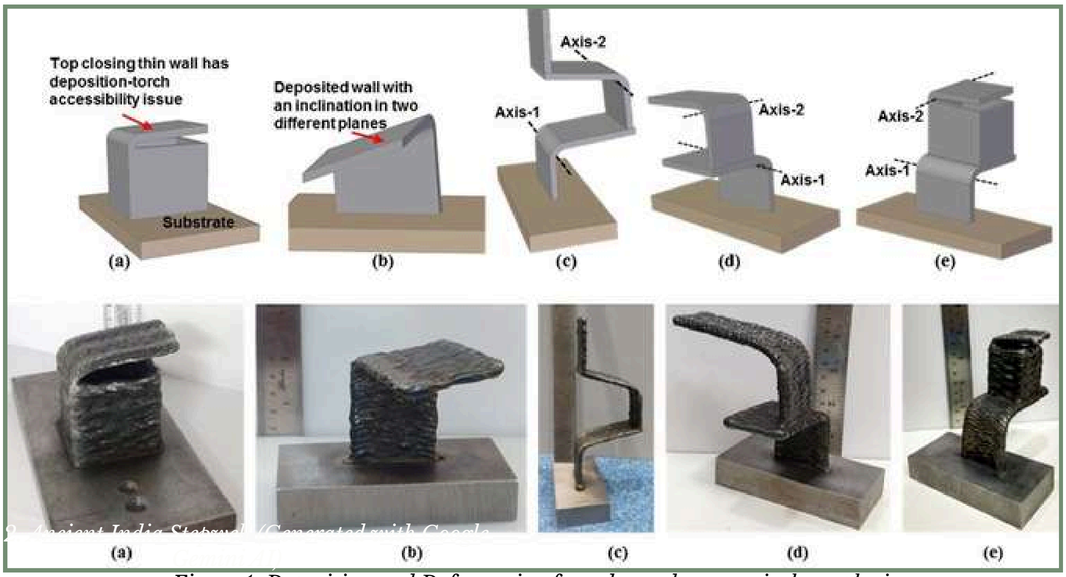

Figure 1: Deposition and Deformation for enhanced geometrical complexity

Additive followed by Deformation
Wire-Direct Energy Deposition (W-DED) techniques in Metal AM allow part-fabrication at higher deposition rates and lower costs. Due to the lack of any support mechanism, these processes face challenges in fabricating overhanging features. Inherent overhang capability of weld-beads and higher-order kinematics can help realize certain complex geometries. However, significant challenges like non-uniform slicing, constrained deposition-torch accessibility, etc., limit the efficacy of these approaches.

This facet of research at IITH, describes a Deformation aided Deposition process to overcome some of those limitations and manufacture complex metallic components. It is based on a sequential combination of deposition and bending processes: a shape fabricated through W-DED (Wire based Directed Energy Deposition) is bent to realize the required shape (in addition to shape complexity, this approach can also be used by others for material property enhancement).

The Deformation- aided- Deposition process consists mainly of two stages. The first stage is meant for deposition in the form of a GMAW welding torch and the second station corresponds to the bending which is to be carried out with a hydraulic press employing customized dies and punches. The component deposited in the first stage can move to the second station to bend the component to a required shape/geometry. After this step, the component can again move back to the deposition stage for further processing. The desired shape can be obtained through this series of activities. Figure 1 shows a few set of sample geometries fabricated using this approach.

Forming Followed by AM
The proceeding section presents work where deposition precedes deformation. This helps in enhancing the mechanical and/or geometrical complexity of AM made parts. The inverse is also possible, ie., deposition happening on a formed component. This approach is beneficial when required to fabricate complex geometries. When overhang features are involved, deposition become difficult due to gravity and torch accessibility constraints. Hence, the current research has been focused work package attempts on hybridization of forming and deposition with focus on product complexity by exploiting the geometrical freedom possible in both processes. To this end, Double Sided Incremental Forming (DSIF) and W-DED (Wire-based Direct Energy Deposition) are used in the present work.

Figure 2 shows one of the geometries chosen to illustrate this approach. In first stage, the various features DF1 and DF2, in the geometry are extracted (DF1 and DF2 in this case). The feature DF2 can be fabricated on a three-axis AM machine, whereas the feature DF1 has a limitation in the conventional W-DED process due to lower surface inclination (lack of support structure). Hence, the deformation/form feature FF1 (which corresponds to DF1) is realized first to act as the non-planar substrate for the subsequently deposition process. Figure 2 illustrates the fabricated part, demonstrating the potential of this method to provide non-planar surfaces for deposition.

Conclusions
The objective of the present work is to demonstrate the potential benefits of hybrid manufacturing techniques as enablers of circular manufacturing. By combining additive manufacturing with complementary conventional processes, these hybrid approaches expand capabilities for repairing worn components, extending product lifetimes, and incorporating recycled or alternative materials into new or existing parts.

Furthermore, by facilitating rapid response manufacturing, improving resource efficiency, and reducing environmental impact, hybrid manufacturing methods directly support sustainability objectives and provide a practical roadmap for implementing circular manufacturing practices.

Acknowledgements
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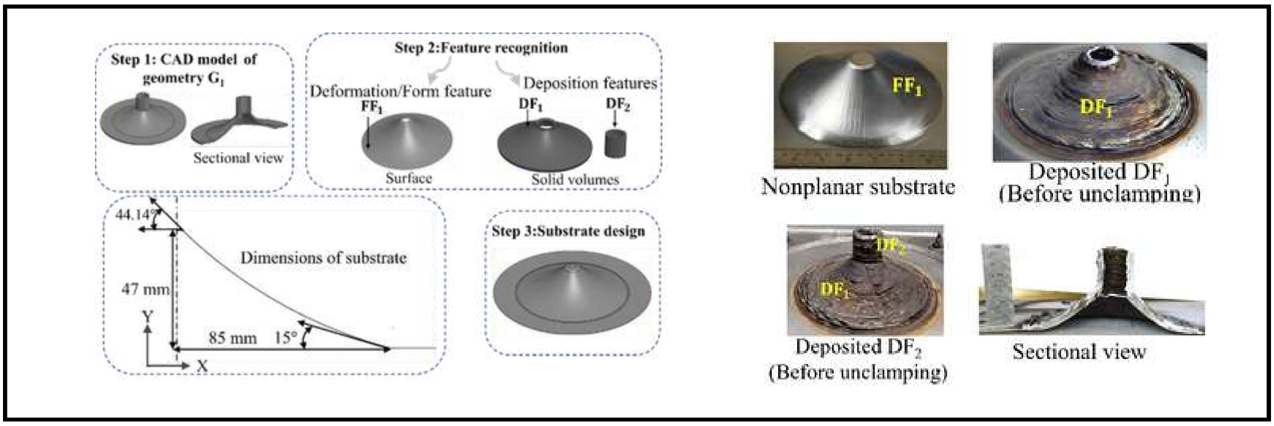


Figure 2: Steps in the substrate design for forming process (to act as starting point for AM) ; Fabrication of the component with deposition on DSIF formed substratermation for enhanced geometrical complexity

Cultivating Hope: Practicing Sustainability on IITH Campus in a Time of Ecological Crisis

KID: 20250404 | Dr Rashmi Singh

Writing as the Faculty-in-Charge of the Green Office at IIT Hyderabad, and as someone who teaches Environment and Society and Biodiversity and Conservation to undergraduate, master's, and doctoral students, my understanding of sustainability is shaped as much by the accelerating crises unfolding beyond the campus as by the possibilities within it. At a time when the world is witnessing unprecedented rates of species extinctions, intensifying climate extremes, growing water scarcity, and multiple forms of environmental pollution, sustainability can no longer be approached as an abstract ideal or a distant policy objective. Instead, it demands grounded, place-based responses that acknowledge both the scale of global challenges and the responsibility of institutions of higher education to act meaningfully within their own spaces.

Within this broader context, initiatives at IIT Hyderabad, ranging from commitments towards net-zero goals and water management to biodiversity-sensitive landscape and waste practices, represent attempts to translate global sustainability concerns into everyday institutional action. While another contribution in this issue reflects on the steps being taken towards making IIT Hyderabad a net-zero campus by 2030, the motivations for envisioning IITH as a sustainable green campus extend well beyond carbon metrics alone. These efforts are rooted in commitments to ecological regeneration through thoughtful plantation practices, in building meaningful and responsible waste management practices, in actively engaging and motivating students to participate in greening initiatives and in fostering a culture of biodiversity coexistence.

It is from this position of cautious hope that this article reflects on how sustainability is imagined, approached, and practiced on the campus.

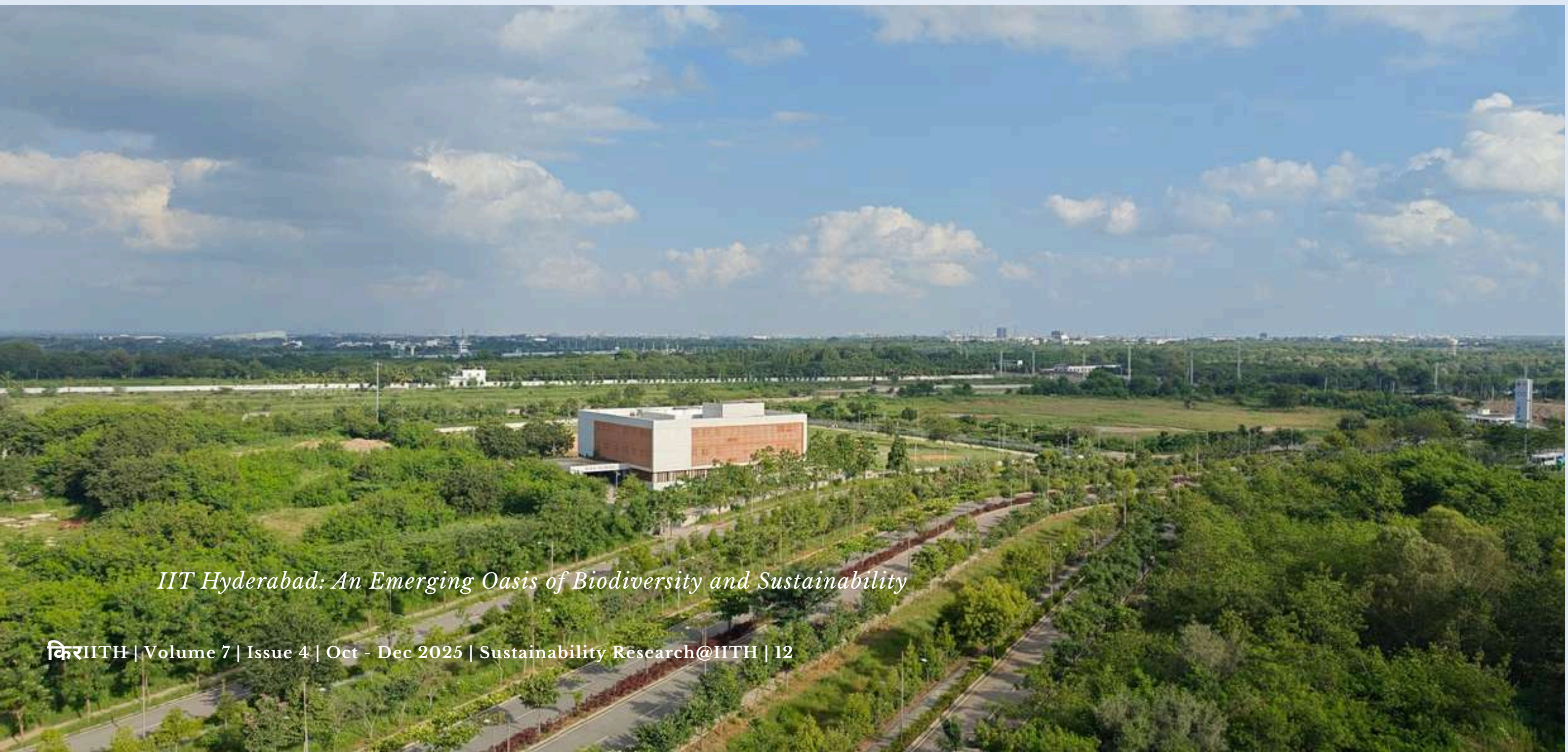
In this article, sustainability is understood not as a singular goal or a set of isolated green interventions, but as a multi-dimensional and evolving practice embedded within the everyday functioning of the campus.

Ecological Regeneration through Thoughtful Plantations

First, at IITH, sustainability is approached through the lens of ecological regeneration, emphasising long-term processes of restoring and nurturing ecological systems rather than short-term aesthetic greening.

Spread across nearly 600 acres amidst the rapidly transforming landscape of Telangana, and home to close to 5,000 students who encounter some of their earliest life lessons on campus, IIT Hyderabad has consciously nurtured a culture that encourages students to remain attentive to nature. Monthly tree plantations done by the team of Green offiice has gradually become both a practice and a tradition, marking the beginning of international conferences, academic gatherings, and even cultural festivals. These are not symbolic gestures alone, but carefully planned efforts, where trees are thoughtfully selected either for their contribution to the campus landscape or for their ecological significance in strengthening local biodiversity.

The SPIC MACAY National Convention 2025 stands as a notable example, during which over 2,000 trees were planted across the campus. This initiative with the Green office Horticulture expert, Vamshi Mashetti created a mosaic of small ecological patches, including fruit gardens with trees like Mango, Java plum, Sapogilla, Cherry, Guava, a dedicated Ficus spp. island, and flowering trails lined with Butea monosperma Golden shower tree (Amaltas) and Cassia fistula, Flame of forest tree (Palash).



IIT Hyderabad: An Emerging Oasis of Biodiversity and Sustainability

These plantations are envisioned to soften the campus landscape over time, offering seasonal colour along walking paths and shaded stretches beneath the closed canopy of Indian Rosewood, Shisham trees. Alongside such large-scale efforts, it has also become a quiet ritual to mark the visit of distinguished guests by planting a tree, embedding ecological care into moments of institutional significance.

These practices have, in turn, begun to shape student sensibilities. During the inauguration of ELAN, the annual cultural festival, students themselves approached the Green Office with a request to include tree plantation as part of the inauguration. The first sapling was planted by the Director, Prof. Murty, an act that symbolically reflected how sustainability practices on campus are increasingly being embraced not just as administrative initiatives, but as shared values within the student community.

Monthly plantation drives using endemic species, the creation of habitat patches, and the careful design of landscape elements reflect an attempt to allow ecological processes, such as soil regeneration, species interactions, and seasonal cycles, to re-establish themselves within a rapidly transforming institutional landscape.


Team of Green Office at IITH

Waste, Responsibility, and Institutional Care
Second, sustainability is conceptualised as the creation of responsible waste and resource flows, where attention is paid not only to infrastructure and technology but also to everyday practices and behavioural change.

At IITH, waste management is integral to promoting a clean, healthy, and sustainable campus environment. In guidance of Dr. Debraj Bhattacharyya, our efforts focus on reducing waste, promoting recycling, and generating renewable energy. Daily garbage collection is handled by Hand in Hand Management, where waste is carefully segregated, with reusable materials sent for recycling and inert waste incinerated at 1000°C, with the resulting ash repurposed as soil fertilizer. Organic waste is processed through composting and vermi-composting to produce nutrient-rich fertilizers used across campus gardens. Additionally, food waste from the mess is converted into renewable biogas to fuel campus kitchens, reducing reliance on conventional fuels.

Waste management initiatives on campus foreground segregation at source, recycling, and reduced disposal, while also drawing attention to the often-invisible labour of housekeeping staff and the institutional arrangements that enable or constrain such practices. These practices on a day-to-day basis are supervised by Golla Vamsi with thoughtful planning, coordination, and execution on the ground. To help manage the plastic bottle waste in an effective manner, IITH also signed a bond with Bisleri International Pvt Ltd, with their 'Bottle for change' Program, which ensures adequate training of the housekeeping staff, and assures that all used plastic gets collected by Bisleri approved recycling partners for recycling. Waste is treated not merely as an end-product to be managed, but as a social and organisational challenge that requires continuous learning, coordination, and participation.

Living with Biodiversity: Shared Habitats on Campus
Third, sustainability is framed as biodiversity coexistence, recognising the campus as a shared space for humans and non-human life, and an opportunity to help thrive the great diversity of flora and fauna, creating an oasis for biodiversity to thrive.

On an ordinary day, the campus is animated by a quiet symphony of birdsong.

Trees and pathways echo with the calls and movements of a remarkable diversity of avian life, purple sunbirds flitting between flowering branches, magpie robins calling from shaded perches, koels announcing the season, and bee-eaters rolling and hopping from tree to tree.
The wagging tails of wagtails animate open spaces, while kingfishers glide swiftly across the landscape, their calls cutting through the air. During certain seasons, migratory birds join the resident species, gathering around small water bodies alongside permanent inhabitants such as the magnificent painted storks.


A sunbird pausing to sip nectar from sunlit blossoms

Beyond its rich birdlife, the campus also supports a diverse assemblage of non-avian species, including snakes, frogs, and reptiles such as chameleons, as well as occasional sightings of mongooses and Indian hares. Recognising the presence of these non-human residents, sustained efforts have been made to gradually create a healthier and more resilient ecosystem. Central to this has been the preservation and restoration of natural grasslands, habitats that are essential for many bird species, reptiles, and amphibians, along with the careful creation of new ecological niches that support conservation within the campus landscape.

These efforts are closely linked to teaching and learning. As part of my academic engagement, I take students on birdwatching walks and invite specialists to help cultivate curiosity and attentiveness toward the living world around them. IIT Hyderabad also actively participated in the global Campus Bird Count 2025, during which over 80 bird species were documented on campus over two days with student participation. Among the more recent initiatives is the development of a butterfly garden, designed through the careful selection of host plants, shrubs, herbs, and nectar species that support different stages of the butterfly life cycle. This space not only contributes to conservation efforts but also encourages students to pause, observe, and learn through sustained engagement with nature.

Together, these initiatives have enabled the campus to function as a mosaic of smaller ecosystems - interwoven grasslands, tree cover, water bodies, and open gardens, supporting biodiversity while also meeting the everyday needs of the campus community. In doing so, IIT Hyderabad demonstrates how institutional landscapes can nurture coexistence between human activity and diverse forms of life. This perspective aligns with broader sustainability debates that stress coexistence, care, and the protection of everyday biodiversity beyond formally protected areas.

Finally, sustainability at IITH is understood as an everyday institutional practice, embedded in routine decision-making around plantations, waste management, maintenance work, teaching, and student engagement. Rather than being confined to policy documents or flagship projects, sustainability unfolds through mundane yet critical actions, how waste is segregated, how landscapes are maintained, how students are involved in observation and documentation, and how environmental responsibility is cultivated as part of campus culture. Seen this way, the IITH campus emerges not merely as a site of sustainability outcomes, but as a living laboratory where sustainability is continuously negotiated, practiced, and redefined beyond carbon credits metrics, to learning from nature, living closely with it, and nurturing a culture of conservation and coexistence.


IIT Hyderabad: An Emerging Oasis of Biodiversity and Sustainability

> *"Trees and pathways echo with the calls and movements of a remarkable diversity of avian life, purple sunbirds flitting between flowering branches, magpie robins calling from shaded perches, koels announcing the season, and bee-eaters rolling and hopping from tree to tree."*


A Mosaic of Ecosystems: Planted Trails, Built Environments, and Natural Grasslands (PC: Ajay Gonji)

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Pipit in the natural grasslands of IIT Hyderabad

Engineering High-Entropy Materials (HEMs) on Various Substrates for High-Performance Electrocatalytic and Photo-electrocatalytic generation of Hydrogen

KID: 20250405 | Ms. Neha Mishra, Mr. Ankur Srivastava, Dr. Chokkakula L. P. Pavithra, Dr. Debaprasad Shee,Dr. Suhash Ranjan Dey

The global energy demand towards sustainable energy seeks hydrogen's attention in the near future as a green, efficient, and versatile fuel. The promising ways to generate green hydrogen are through electrochemical (EC) and photoelectrochemical (PEC) splitting of water. The former technique relies only on the usage of electricity to split water, whereas the latter one harnesses the sunlight along with an external bias to split water into hydrogen and oxygen.

Recent advances in materials science are progressing in this field, particularly with the usage of various high-entropy materials (HEMs) along the effective substrate chosen to support it. The design and development of high-entropy alloys (HEAs) and high-entropy oxides (HEOs) containing transition metal elements with suitable composition results in enhanced catalytic performance comparable to conventional noble catalyst such as Pt group.

In EC studies, our research focuses on tailoring catalyst's composition, electronic structure and morphology to minimize the overpotential and charge transfer resistance.

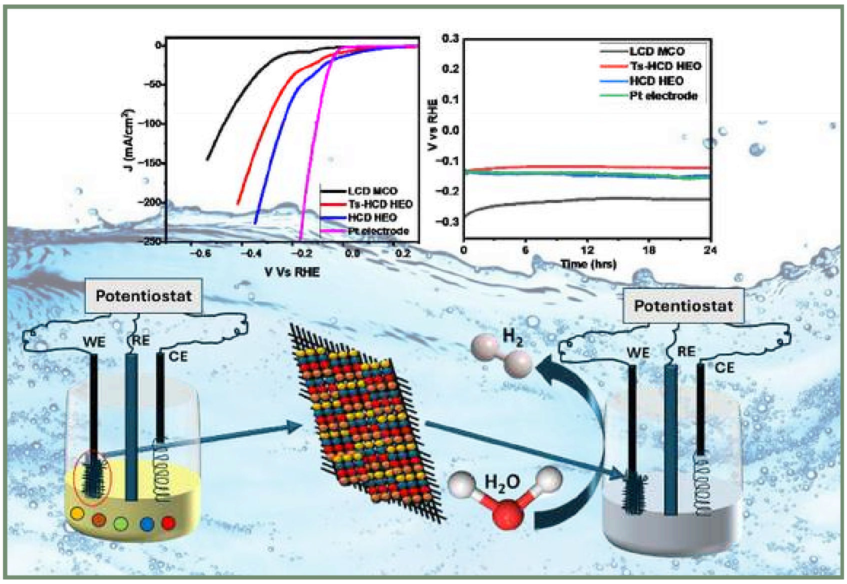

Figure 1. Graphical Representation of HEA electrocatalyst and its HER performance in alkaline media

Additionally, long-term stability is also carried out alkaline media for overall efficacy of electrocatalyst. In parallel, PEC work integrates these materials as co-catalysts with light-absorbing semiconductors such as silicon.

> *The global energy demand towards sustainable energy seeks hydrogen's attention in the near future as a green, efficient, and versatile fuel.*

These semiconductors are used to construct photoelectrodes capable of harnessing sunlight along with external bias to generate hydrogen at more positive onset potential w.r.t RHE. The design includes band alignment for efficient charge separation, surface passivation to suppress recombination and photo-corrosion prevention for long term stability.

In summary, the integrated EC–PEC framework leveraging high-entropy material catalysts on diverse substrates not only bridge fundamental insights with practical development. Rather, they also provide a clear path toward scalable hydrogen technologies that power a sustainable energy future.

As we move toward carbon-neutral energy solutions, advanced innovations towards EC and PEC catalyst plays a critical role in aligning with India's mission towards hydrogen economy. In our laboratory, we have successfully established a robust EC HER system utilizing high-entropy oxide electrocatalysts on diverse substrates, delivering performance comparable to state-of-the-art benchmarks for alkaline water electrolysis.

Additionally, we are working parallelly on developing Si supported HEA cocatalyst as photocathodic materials towards PEC generation of hydrogen.

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Engineering the Urban Breath: An IIT Hyderabad Assessment of the Smart Cities Mission's Impact on Local Air Quality

KID: 20250406 | Dr Ambika Selvaraj, Dr Priya Priyadarshini

1. The Urban Imperative: Why Air Quality Demands a Smart Solution

India's journey towards becoming a leading global economy is inextricably linked to the rapid development and expansion of its urban centers. While this growth signals prosperity, it has concurrently generated significant environmental challenges, including unplanned migration, land-use changes, and, crucially, a considerable degradation of ambient air quality. Air pollution levels in Indian cities have been a major concern, with the rise in particulate pollution being identified as a big risk factor contributing towards the country's disease burden and impacting health, with exposure increasing the risk of illnesses such as bronchitis and lung cancer. Beyond local health crises, rising air pollution levels also contribute towards global climate change.

In response to this mounting challenge, the national administration, supported by the Central Pollution Control Board (CPCB) and State Boards, has launched several programs for source identification, monitoring, and action plan development. Amidst this, the Smart Cities Mission (SCM), a Central Sector Scheme under the Ministry of Housing and Urban Affairs (MoHUA), was hypothesized to have major positive implications on the improvement of local air quality (LAQ) through the integration of smart technologies and infrastructure.

This Sustainability Impact Assessment Study, conducted by the Indian Institute of Technology Hyderabad (IITH) under the SAAR-Sameeksha Series, aimed to meticulously examine the direct and indirect effects of SCM projects on enhancing local air quality practices across 100 Smart Cities. The specific objectives were to assess the present efforts for Air Quality Improvement at the National Stratum, undertake a Primary Impact Assessment through field visits, and propose appropriate recommendations for overcoming the identified gap areas.

2. Methodology: Bridging Policy and Field Reality

The study employed a robust, two-tiered methodology to ascertain the impact of SCM on LAQ improvement.

- **National-Level Theme-based Impact Assessment**: This involved the circulation of a comprehensive questionnaire to all 100 Smart Cities through MoHUA, which sought to quantify the status of LAQ within these cities.

City Visits and Detailed Primary Assessment: A total of five cities—Indore (Madhya Pradesh), Lucknow (Uttar Pradesh), Pune (Maharashtra), Surat (Gujarat), and Kochi (Kerala)—were strategically selected for in-depth field visits. Selection criteria included alignment of the city's projects with the LAQ theme and geographical representation of the Indian landscape.

These field visits allowed for a detailed assessment of the technical, social, environmental, and economic impacts of SCM projects.

It is important to note the study's observed limitation: since 'Air Quality Improvement' does not form one of the explicit thematic focus areas of SCM, projects directly associated with it are limited. Therefore, the assessment considered projects likely to improve urban air quality indirectly, such as the development of green spaces, renewable energy, and public transportation improvements.

3.National Inferences: The Green and Digital Pivot

The analysis of responses from all Smart Cities at the national level revealed that project implementation and data availability related to LAQ Improvement were still limited. Nevertheless, a clear trend emerged regarding the implementation of indirect LAQ-enhancing projects:

- **Green Infrastructure Focus:** The most common focus area through which SCM was contributing was the enhancement of urban green spaces. Projects related to the development of parks and open green spaces, along with roadside tree plantations, were implemented by almost all cities.
- **Source Understanding:** 'Urban Greening and Development of Open Public Spaces' as well as 'Source Apportionment to understand local sources of Air Pollution' were the key focus areas where several smart cities had implemented projects.
- **Clean Energy and Mobility:** Projects enhancing non-motorised means of transportation (such as public bike sharing systems) and popularization of renewable energy sources (solar photovoltaics) have been implemented by all cities, having a positive impact on local air quality.

Crucially, Integrated Command and Control Centres (ICCCs) in cities like Lucknow, Pune, and Surat are implementing smart solutions for traffic management through the Adaptive Traffic/Transit Management System (ATMS). This system is designed to reduce journey times and traffic congestions, and improve speed efficiency and access to public transportation. All these interventions ultimately result in the reduction of vehicular emissions, contributing significantly towards air quality improvement.

4.Field Visits: Case Studies in Urban Innovation

The primary assessment, based on field visits, provided granular details on how selected cities are leveraging SCM funds and infrastructure:

4.1. Lucknow: Collaboration and Smart Monitoring

Lucknow's approach is marked by an innovative, multi-stakeholder collaboration for LAQ improvement.

- **Integrated Traffic Management:** The ICCC's Integrated Traffic Management System (ITMS), which comprises the Adaptive Traffic Control System (ATCS), Traffic Surveillance System (TSS), and Traffic Enforcement System (TES), is fully functional. This system is leveraged by the Air Pollution Action Group (A-PAG), with which the Lucknow administration has signed an MoU (Figure 1).
- **Targeted Source Identification:** SCM-Lucknow provided A-PAG with 32 PTZ Cameras for the identification and monitoring of recurring/chronic issues leading to air pollution, primarily focusing on chronic garbage dumping sites. This strongly suggests that effective Solid Waste Management (SWM) through improved collection and segregation efficiency would lead to long-term reduction in open dumping, thereby having a net positive impact on LAQ.
- **Environmental Sensor Network:** Smart City Lucknow is monitoring data generated by a total of 35 environmental sensors installed across the city, including five installed by SCM-Lucknow, six by UPPCB and CPCB, and the remaining by a private vendor (LMC). This network monitors both air pollution parameters and hydro-meteorological parameters, allowing for the generation of alerts.

4.2 Indore: Citizen Awareness for Cleaner Transit

While Indore's reputation is largely built on SWM excellence (from the parallel SWM assessment study), its LAQ efforts through SCM are focused on citizen engagement as shown in Figure 2. Specifically, the city has undertaken citizen awareness campaigns for traffic awareness, which directly feeds into the reduction of vehicular congestion and, consequently, tailpipe emissions.

4.3 Surat: Promoting Clean Commute

Surat has actively promoted clean and non-motorised transportation under the SCM.

- **Public Transport and Bike Sharing**: The city has invested in a public bike sharing system, which provides a clean mode of transportation, improves last-mile connectivity, and has a potential positive impact on the health of residents. Data provided by the Smart City indicates that approximately 2.5 lakh commuters are daily using the public transport services.
- **Digital Traffic Management**: The city's ICCC also utilizes smart solutions for traffic management through ATMS.

4.4 Pune: Digital Management and Quantification Need

Pune's ICCC is instrumental in implementing smart traffic management solutions through the ATMS to reduce vehicular emissions. However, a key conclusion from the primary assessment, covering all cities including Pune, was that while projects contribute towards 'air quality improvement,' their specific impact needs to be better quantified through empirical evidences.

4.5 Kochi: Leveraging Renewable Energy

Kochi's projects are contributing to LAQ improvement by popularizing renewable energy (solar photovoltaics) sources. The installation of solar energy systems helps mitigate emissions associated with conventional energy generation, thus having a positive impact on ambient air quality. Also, the Public Bike Sharing System launched in 2019 in a PPP model with CSML and KMRL being the major stakeholders. Around 1000 cycles were procured as part of the project. Presently citizens can access around 900 cycles from 46 docking stations including 21 metro stations around the city as shown in Figure 3 benefit the local air quality.

5.Recommendations and Policy Directives

The study concludes that several SCM-medicated projects are contributing towards the cause of local air quality improvement. However, to truly harness the mission's potential for urban air pollution mitigation, future projects need to be significantly streamlined Based on the National Assessment and Field Visits, the IITH team proposes the following policy directives and future directions:

- **Direct Thematic Inclusion:** The most crucial requirement is an amendment to the SCM guidelines for the formal recognition of 'Local/Urban Air Quality Improvement' as a direct thematic focus area or vertical of the mission. Since SCM projects for LAQ are currently limited and indirect, this inclusion would significantly influence Smart City Special Purpose Vehicles (SPVs) to propose projects directly related to the abatement of air pollution.
- **Focus on Pan-City Initiatives:** Air quality improvement, like solid waste management, is inherently a pan-city initiative. Since most SPVs limit their civil and developmental works to Area-Based Development (ABD) areas, it is suggested that greater weightage be given to future proposals that incorporate pan-city developmental projects focused on LAQ improvement.
- **Boosting Academic-Industrial-Governance Collaboration:** The success of the Lucknow SPV's MoU with A-PAG is a valuable model. Boosting Public Private Partnerships (PPP) projects that target academic-industrial-governance collaborations is suggested for better source identification, data analysis, and timely mitigation of air pollution.
- **The Behavioral Change Imperative:** Citizens often perceive air as a "free resource," leading to a lack of demand for clean air standards in new developments. Smart Cities SPVs must plan and implement extensive awareness campaigns for a behavioral change among city residents, making them aware of their right to clean air. Once citizens demand the presence of clean air, upcoming projects would be bound to monitor and report emissions more robustly.

The findings of this sustainability impact assessment offer an insightful overview of city-specific challenges, gap areas, and strategies. By prioritizing the formal inclusion of Local Air Quality in the SCM mandate and leveraging the digital backbone of the ICCCs, India's Smart Cities can strategically transition from indirect contributors to direct mitigators of urban air pollution, securing a healthier, more sustainable future for its citizens.

Acknowledgement:
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To read the full report:
https://www.iith.ac.in/projects/sustainability_impact_assessment_local_air_quality/

Figure 1: Before/After Images depicting various types of issues (A: pothole; B: Unpaved Road; C: Bricks and concrete on public land; D: Garbage dumped on public land) impacting local air quality identified under the DSP initiative of A-PAG and their resolution (Source: A-PAG) in Lucknow

Figure 2: Pictures from the campaign (Red Light-On Engine-Off) organized to combat air pollution as provided by the Indore Smart city as well as from the visit to one of the several Ahilya Vans established across city to enhance urban green cover.

Figure 3: Map showing the location of the 46 docking stations developed under the PBS system and bicycles parked in some of the docking stations in Cochin (data provided by CSML)

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From Catalysis to Circular Materials: Sustainability-Driven Research

KID: 20250407 | Prof Tarun K. Panda

Motivation

Sustainable chemical production requires high efficiency, minimal byproducts, and the avoidance of hazardous contamination. At IIT Hyderabad, we aim to design catalysts based on earth-abundant metals to enable environmentally benign processes. Our research work bridges the intersection of chemical innovation and sustainability, focusing on how fundamental inorganic/organometallic chemistry can align with sustainability aspirations. Rather than being limited to traditional "applied environmental science," we embed sustainability at the molecular level by innovating cleaner, safer, more efficient chemical routes. Our work spans catalyst design, polymer chemistry, and organic synthesis — all with an eye on minimizing environmental impact and maximizing atom economy, resource efficiency, and safety.

Challenges and solutions

The main areas that we are working on focus on Earth-abundant metal catalysis for "green chemistry. Instead of relying on expensive or toxic metals, our work focuses on earth-abundant, non-toxic, and cost-effective metal complexes based on alkali metals, alkaline earth metals, titanium, zirconium, aluminium, and zinc, which shine as sustainable and affordable alternatives to precious metal catalysts, providing a crucial solution to our environment and resources, particularly in large-scale organic transformations. Second, in line with the principles of green chemistry, atom-economical and selective transformations, such as the research on hydroboration of unsaturated bonds (alkenes/alkynes), strive for high selectivity and low waste. Although the area has been dominated by transition metal complex catalysts, main-group element complexes have been making a steady but essential influence. Notably, the idea of substituting costly transition metals with inexpensive, non-toxic, and earth-abundant main-group elements has emerged as a promising new direction in organometallic chemistry. Recent developments in ring-opening polymerization (ROP) and the copolymerization of cyclic esters, epoxides, and anhydrides have utilized benign metal catalysts. Homogeneous alkali and alkaline-earth metal complexes (Li, Na, K, Cs, Mg, Ca, Sr, Ba) have proven effective for polymerizing cyclic esters. When designed carefully, these polymers offer a sustainable option, as they can be produced in biodegradable forms. We are also exploring metal-free and green-solvent approaches, which offer a cleaner and more sustainable alternative to conventional, often hazardous, reaction conditions.

Differentiating factor

Many organic scaffolds vital to catalysis also serve as essential motifs in pharmaceuticals, agrochemicals, and pesticides, with their metabolic stability supporting broad applications in chemical biology. Therefore, a significant challenge lies in developing efficient and sustainable routes for synthesizing bioactive organic scaffolds such as N-methylated amines, which are key building blocks in numerous pharmaceuticals and also function as important amine-protecting groups. We have developed a new methodology where amidophosphine boranes serve as valuable reducing agents, distinguished by their air and moisture stability, as well as their cost-effectiveness. Employing these compounds, we established an environmentally benign and sustainable method for converting carbamates into N-methyl amines under mild, catalyst-free conditions. We are also actively engaged in developing new eco-friendly solvents, which have become a vital component of modern green catalysis. Deep eutectic solvents (DESs)—mixtures of two or three components primarily associated through hydrogen bonding—offer an economical, recyclable, and environmentally friendly reaction medium.

Recently, we developed a DES composed of a quaternary diammonium salt (QDAS) and urea (1:2), which has proven to be a promising and straightforward catalytic medium for the atom-economic synthesis of oxazolidinone compounds from epoxides and isocyanates. In this protocol, no additional catalyst or organic solvent is required, as the DES itself functions both as the solvent and as the catalytic system. Using this method, a diverse range of oxazolidinone derivatives has been obtained in good to excellent yields.

In the area of polymerization, the use of non-toxic metals as ROP initiators provides notable benefits over other metal catalysts. In our work, we demonstrated the fast and efficient ring-opening homo- and copolymerization of cyclohexene oxide and glutaric anhydride employing a titanium promoter in solvent-free conditions. Titanium is an excellent choice for the ring-opening polymerisation (ROP) of cyclic ethers, thanks to its strong catalytic activity, affordability, and non-toxic properties. This makes titanium-based catalysts ideal for producing biodegradable polymers for applications such as drug delivery and medical implants. With rising environmental awareness, scientists are now focusing more than ever on creating biodegradable materials to replace harmful non-biodegradable ones.

Next phase of the work:

Our current focus lies in designing new ligand systems suitable for a variety of catalytic transformations, including the hydroboration of nitriles, alkynes, and carboxylic acids; ketone cyanosilylation; cross-dehydrocoupling of amines and silanes; and the synthesis of urea, biuret, isourea, isothiourea, phosphorylguanidine, and quinazolinone frameworks.

We also plan to focus on modifying DESs by adjusting the hydrogen bond donor (HBD) and acceptor (HBA) components, as well as their ratios. Doing so will allow us to adjust properties such as viscosity, density, melting point, and polarity to match the specific needs of various reactions. This tailored design will help us create more efficient and sustainable DES-based systems for a wide range of organic catalytic reactions. Depolymerization is a promising strategy for recycling waste plastic into constituent monomers. Polyurethane, primarily produced through the polyaddition of polyols and polyisocyanates, ranks as the sixth most manufactured polymer and is utilized in a wide array of products, including clothing, furniture, adhesives, insulation, and automobiles. The rising demand for PU products heightens concerns about the disposal of PU waste. In our lab, we are developing a method to depolymerize various types of PU waste, such as PU foams (both rigid and flexible) and elastomers, to recover polyol products. These can be reused in the production of PU products or other valuable items, leading to a circular economy.


Best poster award to Ms Shweta Sagar


Best poster award to Ms Priyanku Nath

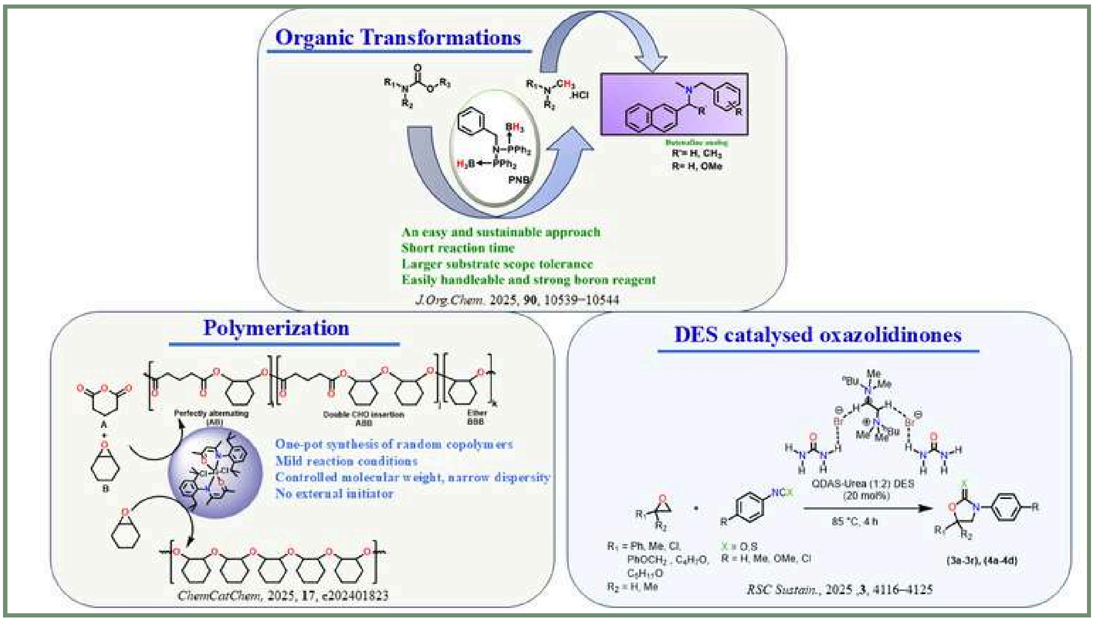

Figure 1. Schematic Diagram of Catalysis by Synthetic Organometallic Chemistry and Catalysis Lab (SOMCC Lab)

 

"SOMCC Lab" at the Department of Chemistry @IITH

Prof Tarun K Panda
Professor, Department of Chemistry

From Filtration to Degradation: A Way Forward in Designing Sustainable Hybrid Membranes for Tertiary Treatment of POPs

KID: 20250408 | Mr Venkateshwaran Gopal and Dr Ambika Selvaraj


[1]


[2]

1. Introduction

Persistent organic pollutants (POPs) are complex organic chemicals that persist in the environment for a long period of time due to their intricate physicochemical bonds. In general, POPs include pollutants such as pesticides, pharmaceuticals, organic dyes and personal care products, etc. These POPs are bioaccumulative in nature, and hence exposure for a long duration can lead to several illnesses, including reproductive, genetic, and neurological disorders. Therefore, it is crucial to eliminate the POPs from the discharge of water to lower the possibility of negative impacts on living species. Most existing treatment systems are not designed to effectively remove POPs, thereby necessitating the need for advanced or tertiary treatment processes.

Membrane filtration has emerged as a promising solution due to its efficiency in removing trace contaminants and easy scalability. However, this technology has some drawbacks, such as low selectivity, highly concentrated reject water, membrane fouling, and low flux. Various research and studies have been carried out worldwide to overcome these challenges. Among the investigations presented, the combination of membrane filtration and advanced oxidation processes (AOPs) has emerged as a potential treatment option.

Generally, AOPs such as photocatalysis and electrocatalysis use radical species with high oxidizing capacity to degrade a wide range of organic contaminants. Although AOPs have shown superior performance on the lab scale, the efficiency for the field scale was limited due to the low concentrated pollutant streams in real-case scenarios. Thus, the integration of AOPs with the membrane helps to alleviate the problem by concentrating the stream. On the other hand, AOPs degrade the contaminants on the membrane surface while subsequently reducing the membrane fouling. Thus, a hybrid membrane addresses the operational constraints of discrete treatment units while maximizing the advantages.

In this context, we work towards designing and developing a next-generation flow-through hybrid membrane integrated with advanced functional materials that endow photo- and electrocatalytic properties. This integration is expected to significantly enhance the selectivity, permeability, and structural stability of the membrane, while enabling simultaneous adsorption and degradation of toxic POPs. The outcome of this study will contribute to sustainable and efficient water purification technologies tailored for real-world applications.

2.Sustainability indicators in a hybrid membrane

The hybrid membranes used for POPs treatment in our study address sustainability by contributing to environmental protection, resource efficiency and long-term stability. The key aspects are discussed in detail as follows:

2.1 Usage of waste materials as precursors

The utilization of waste materials as precursors for the fabrication of functional materials represents a sustainable approach for water treatment applications. In general, household and industrial waste products often possess reuse potential and thus can be valorized into membranes, adsorbents or catalytic components. Such a strategy reduces the reliance on virgin raw materials and aligns with the circular economy aspects of SDGs. In this context, our study focuses on valorization of waste aluminium foils and spent graphite for the synthesis of functional materials, as shown in Figure. 1. This approach not only reduces material costs but also mitigates waste disposal and associated environmental impacts.

2.2 Energy-efficient operation

In this study, a sunlight-active photocatalyst was synthesized and integrated into the membrane to enable operation under natural solar irradiation. The resulting hybrid membrane harnesses solar energy for photocatalytic activation and subsequent generation of reactive radical species at the membrane interface, enabling simultaneous separation and degradation of POPs. As a result, the solar-driven hybrid membranes significantly reduce dependence on external energy inputs and represent a sustainable and energy-efficient alternative for decentralized water treatment facilities.

2.3 Availability of clean water

The integration of membrane with photo- and electrocatalytic materials often in the degradation of POPs into simpler compounds such as CO_2 and H_2O. This facilitates the significant removal of contaminants from water bodies and allows for its reuse in various operations, depending on the quality of the obtained permeate. Such an operation reduces freshwater extraction and directly supports UN SDG 6 (Clean water and sanitation) by ensuring access to safe drinking water.

2.4 Long-term stability: Conventional membranes are often limited by membrane fouling, which increases operational costs due to frequent cleaning or replacement. In contrast, hybrid membranes enable the in-situ degradation of POPs at the membrane surface, thereby preventing membrane fouling. As a result, the hybrid membranes exhibit extended operational lifetimes, allowing for repeated use. This extended durability reduces material consumption and minimizes the overall environmental impact.

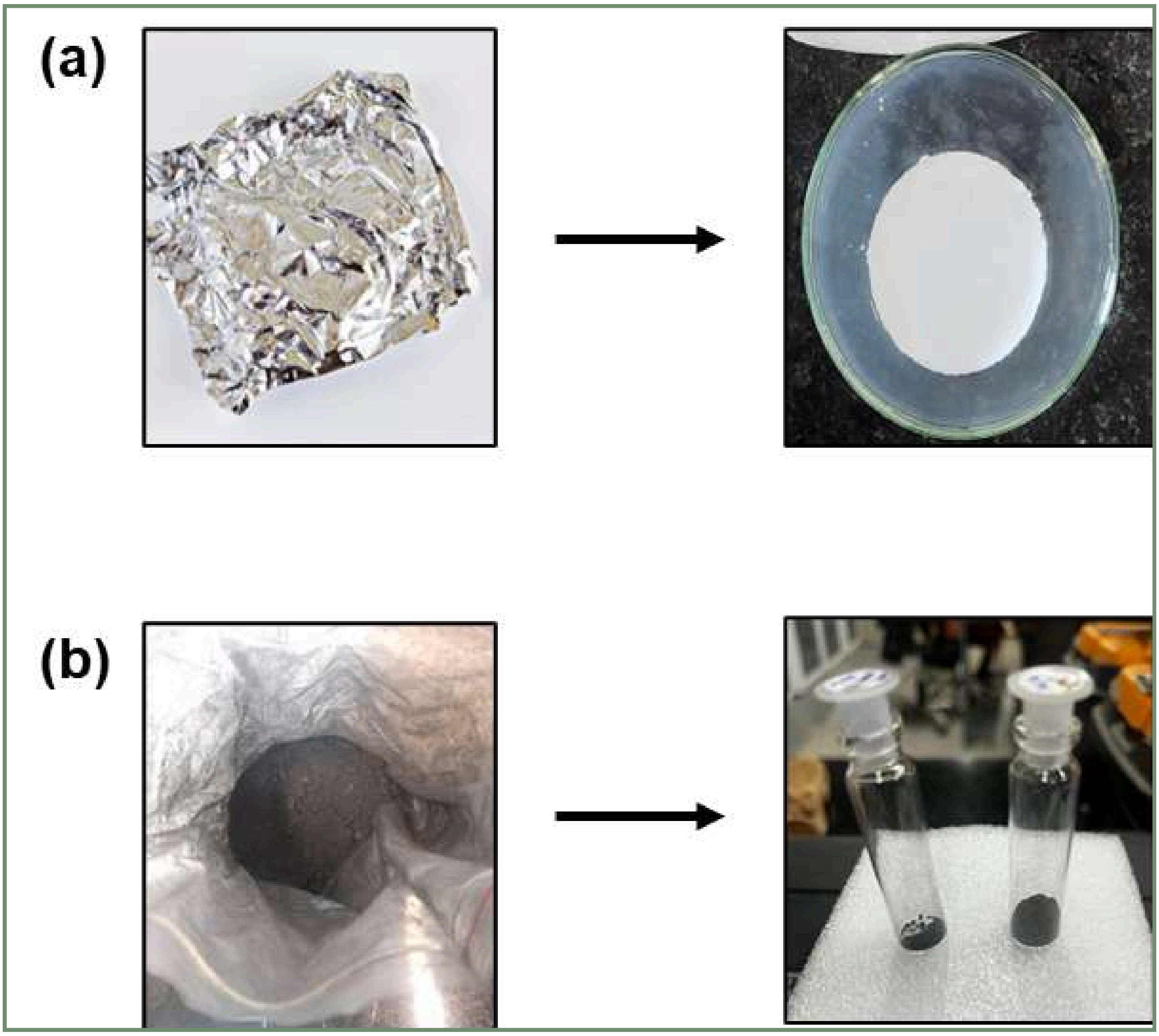

Figure 1 (a) Waste aluminium foil to Al_2O_3 membrane, (b) spent graphite to rGO

> *Overall, sustainable hybrid membranes represent a transformative approach to achieving efficient and resilient water treatment systems that align with global clean water and environmental sustainability goals.*

3. Summary

Hybrid membranes have demonstrated significant potential for the treatment of POPs through a combined operation of separation and degradation. In addition, beyond pollutant removal, the developed membranes also address sustainability by enabling the reuse of waste-derived materials, incorporating sunlight-active components, and exhibiting long-term operational stability. Collectively, these attributes make hybrid membranes environmentally benign and cost-effective solutions for decentralized water treatment applications. However, further research on multiple pollutant removal, techno-economic assessment, and real-water validation is required for lab-scale to practical implementation. Overall, sustainable hybrid membranes represent a transformative approach to achieving efficient and resilient water treatment systems that align with global clean water and environmental sustainability goals.

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Geopolymer Pavements with Recycled Aggregates: A Sustainable Solution

KID: 20250409 | Mr Cheerla Prabhu Teja, Prof Sireesh Saride

Introduction

Across India, pavements shape how cities grow, how people move, and how economies thrive. Yet, as infrastructure expands, the pressure on natural aggregates continues to rise, pushing the search for materials that can support the next generation of pavement construction. With natural resources being finite, the need for credible, sustainable alternatives has become increasingly apparent. At the same time, according to the Building Material Promotion Council, India estimates that the generation of massive volumes of construction and demolition waste (CDW) is around 150 million tonnes annually, while formal recycling accounts for barely one percent of this amount. A similar challenge exists with fly ash, which thermal power plants generate in excess of 300 million tonnes each year, much of it remaining unused. Together, CDW and fly ash represent an underutilised resource stream with significant potential. Our research explores how these secondary materials can be combined and transformed through geopolymer stabilisation to create robust, sustainable pavement base layers that reduce reliance on natural aggregates and pave the way for greener infrastructure.

From Debris to Design: Strengthening Recycled Aggregates with Geopolymers

Natural aggregates have high environmental and economic costs. At the same time, materials like fly ash continue to accumulate as by-products of power generation, and CDW continues to build up due to increasing urbanization. Geopolymer stabilization offers a way to address these challenges simultaneously. Instead of relying on traditional cement, which contributed roughly 1.7 billion metric tonnes of CO_2 emissions globally in 2021, fly ash can be chemically activated to form a strong, low-carbon binder. When this binder is used to stabilize recycled aggregates, such as CDW, it transforms them into reliable pavement base materials, reducing reliance on natural aggregates. Put simply, industrial by-products, rich in silica and alumina, when chemically activated, form geopolymers that improve the performance of recycled aggregates, making them suitable for pavement construction. In our laboratory studies, varying proportions of CDW and natural aggregates are blended and stabilised using fly ash–based geopolymers.

Figure 1. Illustrative of the process for geopolymer stabilisation of recycled aggregates

This binder significantly improves the mechanical performance of these materials, making them suitable as a stabilized base material for road construction. By turning underutilized industrial and construction residues into engineering-grade pavement layers, this approach reduces pressure on natural aggregates while advancing a more sustainable and resource-efficient future for pavement infrastructure.\

Why It Matters

Conventional pavement construction relies heavily on natural aggregates and cement, both of which are associated with significant environmental and economic costs. The findings of this study indicate that geopolymer-stabilized base layers can save approximately 60–100% of natural aggregates by incorporating recycled materials such as construction and demolition waste, consistent with trends reported in previous studies. In addition, previous studies [1] indicate that the use of fly ash–based geopolymers instead of cement results in carbon dioxide emissions of only about 20–30% of those from cement-treated mixes, while also reducing construction costs by approximately 17–25%. At scale, this approach conserves natural resources, lowers embodied carbon, and promotes circular, cost-effective pavement infrastructure.

Summary:

Geopolymer-stabilised recycled aggregates offer a practical and environmentally responsible pathway for constructing durable pavements. This research highlights how new approaches in pavement construction can contribute to greener and more sustainable infrastructure, providing solutions that are locally adapted, resource-efficient, and low-carbon. As India continues to expand its road networks, approaches like this could redefine how infrastructure is conceived and built.

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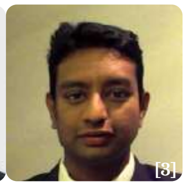
IIT Hyderabad's Journey Toward a Net-Zero Emission Campus

KID: 20250410 | Mr B Koti Reddy, Mr V K Nagal, Dr Pradeep Yemula



Sustainability at IIT Hyderabad (IITH) is evolving from an abstract ideal into an everyday campus practice. With growing concerns around climate change, energy security, and responsible resource use, academic institutions must demonstrate leadership not only through research but also through implementation. At IITH, this has taken the form of a structured commitment to become a Net-Zero Emission Campus by 2030. This journey did not begin with technology alone. It began with understanding.

Knowing Where We Stand

A comprehensive campus-wide carbon footprint assessment was undertaken using globally accepted greenhouse gas accounting principles. Emissions were mapped across electricity consumption, fuel usage, mobility, waste, and water systems. The exercise revealed that electricity demand dominates the campus emission profile - unsurprising for a modern residential academic campus operating laboratory, hostels, data infrastructure, and utilities around the clock. This quantified baseline shifted sustainability discussions from intent to action. Emissions became measurable, comparable, and manageable - allowing interventions to be prioritized based on impact rather than perception.

Clean Energy as a Foundation

Renewable energy integration emerged as a central pillar of the Net-Zero roadmap. IITH has expanded on-campus solar photovoltaic installations through rooftop and ground-mounted systems, while exploring innovative formats that integrate solar generation into daily campus spaces. Equally important is the effort to improve reliability. The campus is planning battery energy storage solutions to support solar generation, reduce dependence on diesel generators, and enhance resilience during grid disturbances.

Efficiency Before Expansion

Alongside renewable energy, IITH has emphasised demand reduction through efficiency. Large-scale replacement of conventional lighting with LEDs, adoption of high-efficiency HVAC systems, and deployment of energy-efficient motors and fans have significantly lowered baseline consumption. These measures are reinforced by digital energy monitoring systems that provide real-time visibility into consumption patterns. Treating energy as data enables continuous improvement, early fault detection, and informed operational decisions.

Looking Beyond Electricity

Sustainability efforts at IITH extend beyond power systems. Campus mobility is gradually transitioning toward electric and shared transport. Waste management practices emphasize segregation, recycling, and composting. Water sustainability is addressed through sewage treatment, reuse of treated water for landscaping, and reduced freshwater withdrawal. Together, these measures reflect a systems approach where energy, water, and waste are managed as interconnected resources rather than isolated utilities.

A Living Laboratory

One of IITH's distinguishing strengths is the integration of sustainability into education and research. The campus itself serves as a living laboratory where students and researchers work with real operational data, develop digital twins, and test innovative solutions. Sustainability initiatives are embedded into coursework, student projects, and interdisciplinary research.

Culture and Governance

Achieving Net-Zero emissions requires more than infrastructure. It demands participation, awareness, and long-term institutional commitment. Faculty, students, staff, and service partners are active stakeholders in the transition.

Moving Forward

The journey toward Net-Zero at IIT Hyderabad is ongoing. Carbon emissions reduction trajectory (2024-2030) is shown in Figure 1. What distinguishes it is a methodical, data-driven approach that integrates operations, research, and education. At IITH, sustainability is no longer a future objective—it is becoming part of everyday campus life.

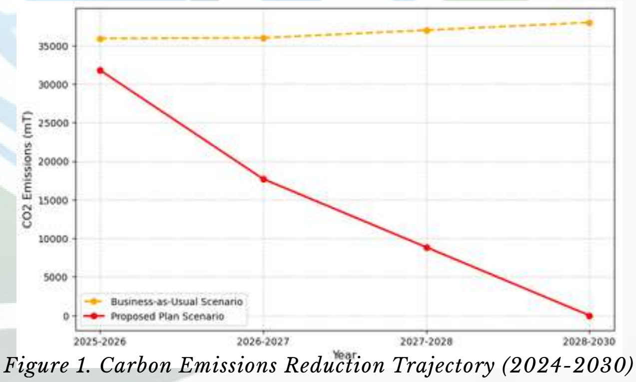


Figure 1. Carbon Emissions Reduction Trajectory (2024-2030)

Highlights

- Campus-wide carbon footprint assessment
- Baseline total GHG emissions: 37,684 tCO_2e per year (Base year: 2024
- Emissions reduction pathway: Phased mitigation across energy, efficiency, mobility, and resource systems
- Large-scale energy-efficiency retrofits
- Estimated capital investment (CAPEX): ₹77 crore for achieving Net-Zero status.

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IITH's Campus-Scale Practices Shaping the Future of Sustainable Academic Campuses

KID: 20250411 | Mr Vinay Kumar

Institutions of higher education today are increasingly called upon to demonstrate how academic excellence can be aligned with environmental responsibility at scale. At Indian Institute of Technology Hyderabad, this challenge is being addressed by treating the campus itself as a living laboratory for sustainability, where planning, infrastructure, governance and everyday practices function as an integrated system. With an ambitious yet carefully structured goal of becoming a Net Zero campus by 2030, IIT Hyderabad is embedding sustainability into the design and daily life of the campus through campus-scale interventions spanning clean energy generation, energy-efficient design, water-sensitive planning and biodiversity stewardship—offering a replicable model for future-ready academic institutions.

A Campus Designed with Sustainability at Its Core

From its master planning stage, IIT Hyderabad has approached development with long-term environmental responsibility in mind. Infrastructure growth has been carefully aligned with natural systems, ensuring that built spaces coexist with ecological processes. This integrated approach allows the campus to function not just as an academic institution, but as a self-sustaining ecosystem that responds to regional climate, geology and biodiversity.

Turning Parking Spaces into Power Stations

At the core of IIT Hyderabad's Net Zero journey lies a decisive transition towards renewable energy. The Institute has reimagined conventional infrastructure—particularly parking areas and rooftops—as productive clean energy assets. By installing solar panels over parking sheds and buildings, the campus has avoided land-use trade-offs while maximising renewable energy generation.

Currently, IIT Hyderabad operates a 0.95 megawatt (MW) solar power plant, and an additional 3.5 MW solar project is nearing completion. Once fully commissioned, the total installed solar capacity will reach 4.45 MW, supported by over 9,400 solar panels across the campus. This solar expansion is expected to meet a substantial share of the Institute's electricity requirements, significantly reducing dependence on grid power and lowering carbon emissions—an essential step towards achieving Net Zero by 2030.

Efficiency Before Expansion

While renewable generation is critical, IIT Hyderabad has placed equal emphasis on reducing energy demand. Guided by recommendations from Energy Efficiency Services Limited (EESL), the campus is replacing conventional ceiling fans with high-efficiency models across academic, residential and administrative buildings.

Student hostels showcase another forward-looking intervention: an advanced radiant cooling system based on Japanese design principles. Using chilled water pipes embedded in ceilings and floors, the system maintains indoor comfort at around 25°C with significantly lower energy consumption compared to conventional air-conditioning.

Architectural design elements, including window placements that minimise direct heat gain, further enhance thermal efficiency.

Reinforcing these efforts, several academic and residential buildings on campus have received GRIHA certification, underscoring IIT Hyderabad's commitment to nationally recognised green building standards.

Water Security Through Nature-Led Engineering

Located in a region characterised by hard rock geology, IIT Hyderabad has adopted a science-driven, nature-integrated approach to water management. The campus seamlessly blends natural contours with engineered infrastructure to capture monsoon runoff, recharge groundwater and support non-potable reuse. A network of lakes, bio-swales and artificial ponds anchors this system. The International Guest House Lake functions as both a stormwater storage and groundwater recharge structure, while an extensive bio-swale network spanning nearly 14.84 km slows runoff, filters sediments and enhances percolation. Together, these systems provide a combined water storage capacity of over 4.79 crore litres, significantly reducing reliance on external water sources.

Beyond functionality, these water bodies have evolved into ecological assets—supporting aquatic life, attracting birds and regulating the campus microclimate.

Building a Biodiversity Oasis

IIT Hyderabad's sustainability vision extends well beyond infrastructure into ecological stewardship. Over the past six years, sustained tree plantation drives, encouraged by successive Directors, have transformed the campus landscape. Thousands of trees planted through monthly and monsoon plantation initiatives have strengthened carbon sequestration and ecological resilience.

The results are visible. The campus today hosts a rich diversity of flora and fauna, with over 60 species of birds documented, including a growing presence of peacocks. This biodiversity has been formally captured in a dedicated publication on the birds of IIT Hyderabad. More recently, a butterfly garden has been established as a micro-habitat to support pollinators.

Landscaped spaces such as fruit gardens, Ficus Island and the Neem Trail further reflect a deliberate effort to create interconnected ecological zones, ensuring that development enhances, rather than displaces, nature.

Governance, Education and Leadership in Sustainability

Sustainability at IIT Hyderabad is not incidental—it is institutionalised. A dedicated Sustainability Committee oversees planning, coordination and monitoring of initiatives across energy, water, biodiversity and waste management, ensuring continuity and accountability.

Strengthening this foundation is the Greenko School of Sustainability, which plays a central role in advancing sustainability education, interdisciplinary research and policy engagement. The School focuses on critical areas such as energy transition, climate action, circular economy and sustainable development, preparing future leaders to address complex environmental challenges at scale.

Living Sustainability Every Day

The Institute's Net Zero vision is reflected in daily campus life. IIT Hyderabad actively promotes non-motorised transport, financially supporting students to purchase bicycles at the time of admission. E-vehicles cater to internal mobility needs, reducing emissions from conventional transport.

Waste management follows a circular economy approach. Solid waste is segregated at source, recyclables are recovered, organic waste is converted into compost and vermi-compost for campus gardens, and food waste from mess facilities is processed into biogas to fuel kitchens—closing the loop between consumption and resource recovery.

A Living Laboratory for a Sustainable Future

Together, these interventions—solar-powered infrastructure, energy-efficient buildings, water-sensitive design, biodiversity conservation, institutional governance and sustainable lifestyles—position IIT Hyderabad as a living laboratory for sustainability. The campus demonstrates how technology, policy and nature can work in tandem to address climate challenges in real-world settings.

Articulating this long-term vision, Prof. B. S. Murty, Director of IIT Hyderabad, notes, “Our Net Zero goal is not a standalone target. Sustainability and biodiversity are part of the soul of IIT Hyderabad. From how we design our buildings and energy systems to how we conserve water and nurture ecosystems, the campus is envisioned as a living laboratory where technology and nature coexist to create solutions for a sustainable future.”

As solar panels rise over parking spaces, water flows through green corridors, and biodiversity thrives alongside academic pursuits, IIT Hyderabad is demonstrating how higher education institutions can lead India's transition to a low-carbon, climate-resilient future—one campus at a time.

Mr Vinay Kumar
Public Relations Officer, IITH

Innovative Pathways for Converting Biomass and Sewage Sludge into Valuable Resources – Integrated Multidisciplinary Research Excellence

KID: 20250412 | Prof Debraj Bhattacharyya, Prof Tarun K Panda

Green Solvent-Assisted Valorisation of Biomass for a Sustainable Bioeconomy

As the world moves toward cleaner and more dependable alternatives to fossil fuels, biomass has emerged as a central focus of sustainable research. This renewable feedstock, derived from agricultural residues, forestry byproducts, and other non-food plant materials, offers a practical pathway to reduce human reliance on limited petroleum resources. Transforming such biomass into fuels, chemicals, and materials not only supports a greener industrial landscape but also strengthens the foundations of a circular bioeconomy, where waste is reintegrated as a usable resource rather than discarded. The overall process of biomass valorisation and its contribution to a sustainable bioeconomy is illustrated in Figure 1.

A major step toward this transition lies in developing gentler, more efficient pretreatment methods that break down the complex structure of biomass. Conventional approaches often rely on strong acids or alkalis, which demand high energy input, are not environmentally friendly, and create waste streams. In contrast, green solvents such as ionic liquids (ILs) and deep eutectic solvents (DESs) provide a cleaner and more adaptable route. Well-studied ILs, including 1-ethyl-3-methylimidazolium acetate and 1-butyl-3-methylimidazolium chloride, have demonstrated the ability to disrupt lignin–carbohydrate linkages and enhance the conversion of cellulose to fermentable sugars. Similarly, DESs formed from combinations like choline chloride with glycerol or urea offer low toxicity, biodegradability, and straightforward preparation, making them suitable for sustainable processing.

In parallel, the study also investigates advanced DES systems, including the di-ionic ammonium-based DBTMEDABr/TFA and TMDPEDABr/LA, which provide an environmentally friendly and cost-efficient alternative for biomass pretreatment. These tunable DESs interact strongly with the carbohydrate matrix in biomass, supporting selective removal of lignin and enhancing the accessibility of cellulose for subsequent hydrolysis. Their application to diverse feedstocks, such as sugarcane bagasse, rice straw, and Napier grass, demonstrates the versatility of green solvent systems across varied biomass sources.

Beyond pretreatment, these solvents assist in generating valuable platform chemicals like 5-hydroxymethylfurfural (5-HMF) and furfural, compounds central to the development of bio-based polymers, fuels, and specialty chemicals. By enabling such transformations under moderate conditions, IL- and DES-based systems reduce energy consumption and minimise the formation of unwanted byproducts that commonly hinder downstream processing.

The broader impact of our research lies in its contribution to establishing sustainable biorefineries that align with principles of green chemistry. Through selective fractionation of lignin, cellulose, and hemicellulose, these solvent systems create opportunities for producing a wide spectrum of renewable products, from fermentable sugars and biofuels to high-value chemicals and advanced materials. The continued refinement of solvent design, process optimisation, and feedstock selection is essential to scaling these technologies and embedding them within a functional circular bioeconomy.

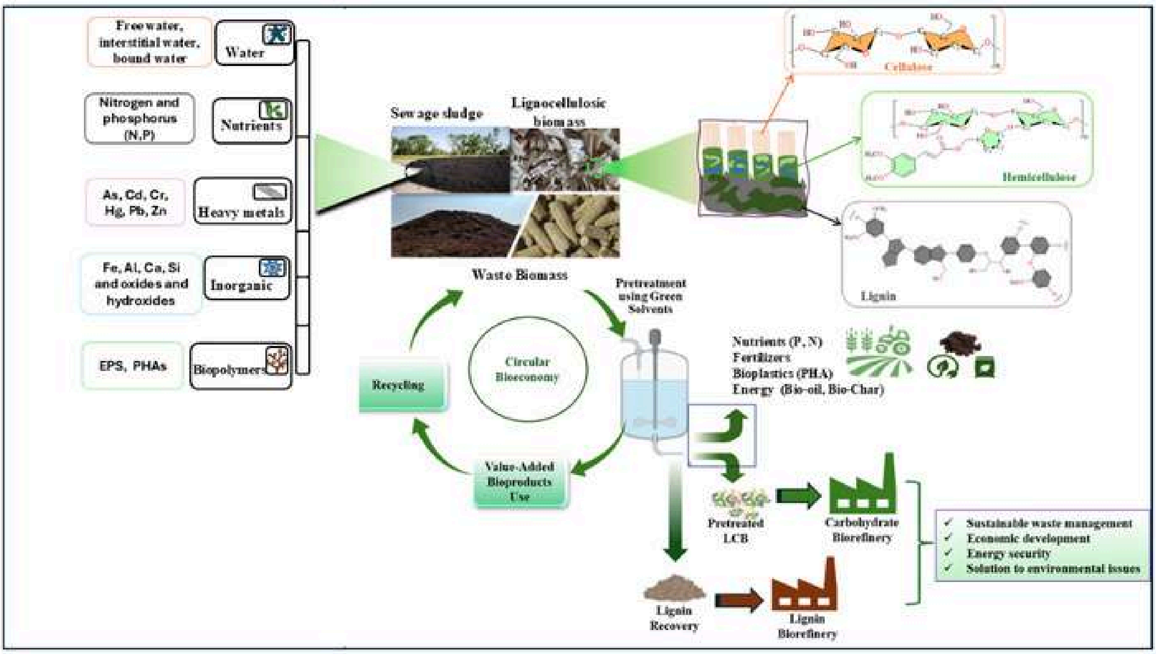

Figure 1. Waste biomass valorisation via a sustainable approach.

Advancing the valorisation of lignocellulosic biomass is inherently interdisciplinary, bringing together expertise in chemistry, biotechnology, materials science, and engineering. This work reinforces the value of such collaboration by demonstrating how innovative solvent development can unlock new efficiencies, lower environmental impact, and accelerate the shift toward resource-responsible industrial practices. With greener pretreatment pathways and more accessible conversion routes, the vision of transforming agricultural and industrial residues into valuable products becomes increasingly achievable, contributing to a sustainable and economically resilient future.

Sustainable Valorisation of Sewage Sludge: A Complementary Pathway

While biomass valorisation progresses toward greener methodologies, sustainable management of sewage sludge (SS) represents another critical challenge in waste-to-resource research. SS, generated as an unavoidable byproduct of wastewater treatment, is often produced in huge quantities and poses environmental, economic, and regulatory concerns. Turning this semi-solid waste into valuable products is therefore essential for closing resource loops and advancing sustainable waste-management practices.

At IITH, ongoing research work at the sewage treatment plant spans multiple research areas, including wastewater treatment, water reuse, and the valorisation of generated residues. One of the main areas of focus is the transformation of sewage sludge, an unavoidable byproduct of wastewater treatment, into value-added materials. Such efforts contribute to closing the loop within a circular economy and reflect the broader goals of sustainable resource recovery and management. SS contains organic matter, nutrients, and mineral components that can be harnessed to produce low-cost adsorbents, bioplastics, nutrient fertilisers (N and P), proteins, nanocomposite materials, and biofuels. For instance, adsorbents derived from SS can be further modified with metal oxides to enhance their capacity for removing contaminants, particularly micropollutants in water.

Despite the long-standing use of conventional SS management methods, such as land application, composting, incineration, and anaerobic digestion (AD), these approaches have limitations. Land application risks heavy-metal build-up and nutrient leaching; incineration leads to energy loss, air pollutants such as nitrogen and sulfur oxides (NO_x and SO_x), and the permanent loss of recoverable phosphorus; and while AD is cost-effective, its efficiency is limited by the slow biodegradability of certain sludge components. Additionally, sludge disposal represents more than half of the total operating cost of many wastewater treatment plants and contributes significantly to greenhouse gas emissions.

These limitations have intensified interest in non-conventional, sustainable conversion techniques. Thermochemical processes, hydrothermal carbonisation, hydrothermal liquefaction, pyrolysis, and gasification, offer multiple pathways to convert SS into solid, liquid, and gaseous fuels, carbon-rich materials, and precursor chemicals. Similarly, biochemical routes enable nutrient recovery and biopolymer extraction under environmentally benign conditions. Integrating these processes allows sequential recovery of diverse products, maximising resource utilisation while minimising waste. Figure 1 illustrates the sustainable valorisation pathways of sewage sludge and the range of recovered products.

The best oral presentation award

Students at work

Our research focuses on the large-scale utilisation of SS as a raw material for value-added transformations. By adopting low-toxicity solvents, energy-efficient processing routes, and modular conversion strategies, the work aligns closely with the principles of sustainable biomass and waste management. We also explored amino-acid-based DESs as green solvents for the hydrothermal carbonisation of SS to generate a carbon-rich hydrochar. Ultimately, these efforts aim to develop economically feasible and environmentally responsible technologies that can reduce sludge burdens while generating useful products for industrial and agricultural applications.

> *“By adopting low-toxicity solvents, energy-efficient processing routes, and modular conversion strategies, the work aligns closely with the principles of sustainable biomass and waste management.”*

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Department of Chemistry

Integration of Waste Valorization with Energy Generation through Bioelectrochemical Systems (BES): A Sustainable Solution

KID: 20250413 | Prof Suhash Ranjan Dey, Mr ArunKumar J S

Climate mitigation is a critical factor in preventing catastrophic global warming in the future. Improper treatment of waste generated by various industries has led to extensive land, water, and soil pollution. Industrial wastes can be classified as recyclable, biodegradable, and non-biodegradable, among others. In parallel, urban wastewater generation has increased significantly due to rapid urbanization. According to the NITI Aayog report titled "Urban Wastewater Scenario in India" (2022), approximately 72,368 million litres per day (MLD) of wastewater were generated in the preceding year. The report further revealed that only about 44% of this wastewater is treated, along with the associated sewage sludge.

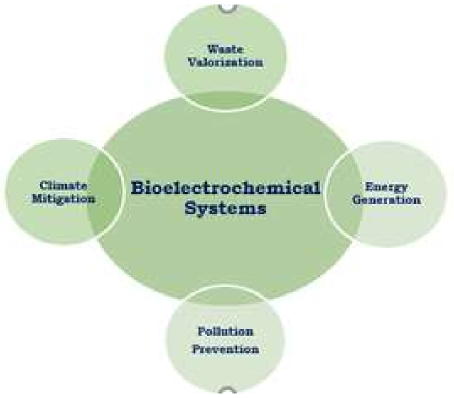

Figure 1. Importance of Bioelectrochemical Systems

Wastewater, sewage sludge, and municipal solid waste are rich resources for the production of bioenergy and platform chemicals. In countries such as India, a large fraction of these wastes is disposed of in landfills, leading to severe environmental contamination and the direct release of greenhouse gases (GHGs) into the atmosphere. Existing conventional wastewater treatment plants and biogas production facilities are inadequate to manage the rapidly increasing volumes of liquid and solid wastes. Bioelectrochemical systems (BES) integrate traditional biological reactors with electrode-based setups, enabling multifunctional applications within a single system. However, despite their significant potential, BES technologies are still at a nascent stage of commercial development.

Bioelectrochemical systems consist of anodic and cathodic electrodes housed within a reactor chamber, with or without a membrane separator, depending on the intended application.

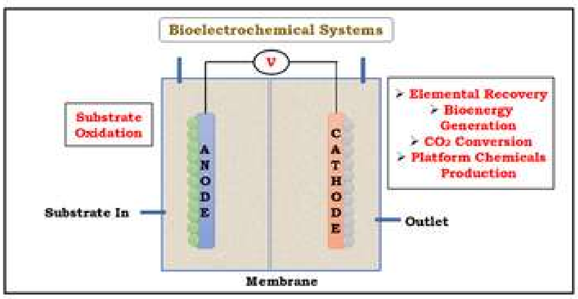

Figure 2. The Multifunctional BES

Advanced bioelectrochemical systems are employed in:

- Advanced wastewater treatment, including the removal of heavy metals, nutrients, toxic elements, and the treatment of industrial leachates.
- Energy generation, such as biomethane and biohydrogen production from municipal solid waste and sewage sludge.
- Platform chemical production for applications in fuels, solvents, and pharmaceutical industries.

Figure 3. Lab scale Upflow Bioelectrochimical System Reactor (BES)

The above bench scale BES reactor (present in the Combinatorial Lab, MSME department) is used for waste valorization with simultaneous biohydrogen production.

> *"Wastewater, sewage sludge, and municipal solid waste are rich resources for the production of bioenergy and platform chemicals. In countries such as India, a large fraction of these wastes is disposed of in landfills, leading to severe environmental contamination and the direct release of greenhouse gases (GHGs) into the atmosphere."*

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Learning from Nature's Survivors: Microbes as the First Step in Sustainable Metal Recovery

KID: 20250414 | Prof Suhash Ranjan Dey, Prof Debraj Bhattacharyya, Nehal Patel

The First Step toward Sustainable Metal Recovery

The rapid growth of electronics, renewable energy systems, and electric mobility has quietly created a new kind of resource crisis. Technologies such as lithium-ion batteries, solar panels, and electronic devices rely heavily on metals like copper, cobalt, nickel, manganese, and lithium. While these materials enable modern life, their end-of-life waste poses a serious environmental challenge if not handled responsibly.

Instead of treating this waste as a problem, our research looks at it as an opportunity by asking a simple question: Can nature help us recover these metals sustainably?

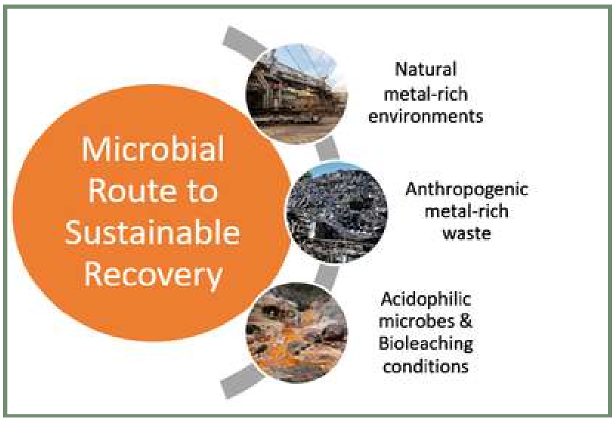

Figure 2. An overall snapshot illustrating the shift from primary metal extraction from the Earth's crust to surface-accumulated anthropogenic metal waste, and how nature-inspired microbial processes such as bioleaching can be applied as a sustainable alternative.

From Solid Waste to Liquid Resource

Traditional metal recovery methods often involve high temperatures, strong acids, and significant energy inputs. While effective, these processes are environmentally intensive and challenging to scale sustainably. In contrast, my work focuses on bioleaching, a process where microorganisms perform the chemistry for us.

Certain bacteria and fungi naturally interact with metals in their environment. When introduced to metal-rich wastes, these microbes secrete organic acids, enzymes, and redox-active compounds that slowly dissolve metals from solid materials. As a result, metals that were once locked inside solid waste become mobilized into a liquid phase.

This liquid, often referred to as a metal-rich leachate, is the most critical outcome of the first step. Once metals are available in solution, they can be separated, purified, and reused using much milder downstream techniques. In simple terms, microbes act as biological miners, converting waste into a form that is far easier to process.

Why Use Microbes at All?

The advantages of this approach are hard to ignore:

- It works at room temperature and normal pressure
- It requires fewer harsh chemicals
- It generates minimal secondary pollution
- It is naturally selective, depending on microbial behaviour

Most importantly, bioleaching aligns perfectly with the principles of sustainability and the circular economy, recovering value while minimizing environmental harm.

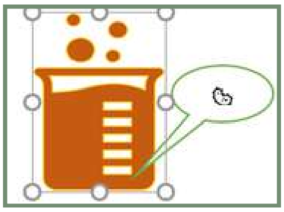

Figure 1. Conceptual representation of microbial bioleaching conditions, a leachate containing metals and microbes.

From Detoxification to Recovery

This biological step also serves a dual purpose. As microbes dissolve metals into liquid form, they reduce the toxicity of solid waste, making it safer for handling and further processing. This idea of detoxification followed by recovery was central to our work, where we are exploring how biological systems and omics tools can guide circular economy strategies in metal recovery.

Here, the focus is not on extracting metals immediately, but on preparing the waste intelligently, letting biology do what it does best before applying engineering solutions.

How This Leads to Metal Recovery

Once metals are available in solution, conventional recovery methods such as precipitation, electrochemical separation, or adsorption become far more efficient and controlled. Instead of forcing metals out of solids, we collect what microbes have already made accessible.

Thus, bioleaching becomes the gateway step, transforming complex waste into a manageable resource stream.

A Nature-Inspired Way Forward

As the demand for critical metals continues to rise, sustainable recovery routes are no longer optional. By allowing microorganisms to perform the first and most energy-intensive step, we move closer to cleaner, greener, and more resilient material cycles.

Sometimes, the most innovative technology is not new machinery, but learning how to work in harmony with nature.

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Pioneering Sustainable Cathodes and Anodes for Next-Generation Electric Vehicles

KID: 20250415 | Ms Jyotirekha Dutta, Prof Surendra K Martha

Imagine powering your phone or car with a lightweight powerhouse that recharges hundreds of times without fading quickly; that's the lithium-ion battery (LIB) revolutionising our daily life. These batteries pack more energy into smaller spaces than ever before, fueling everything from laptops to EVs with minimal self-discharge. No memory effect means you can top them up at any time, making them ideal for our on-the-go world. However, there's a downside: extracting rare metals from the earth can devastate nature and risk supply disruptions. [1,2] However, game-changing recycling that reclaims nearly all those valuables, innovative material designs paired with greener technology, unlocks a circular, eco-friendly energy revolution.

The rapid proliferation of LIBs in electronics and electric vehicles has generated vast amounts of hazardous e-waste, with only 3% of spent batteries currently being recycled. This highlights the urgent need for robust closed-loop protocols to mitigate environmental impacts and promote resource sustainability through circular economy principles (Figure 1). [1] Enhancing pretreatment stages, such as cell discharge, mechanical dismantling, and black mass recovery, integrated with AI-driven automated segregation and policy-driven collection incentives, offers a pathway to profitable, eco-friendly mechanochemical separation of high-grade materials, dramatically boosting recycling efficiency and curbing future energy demands. [4]

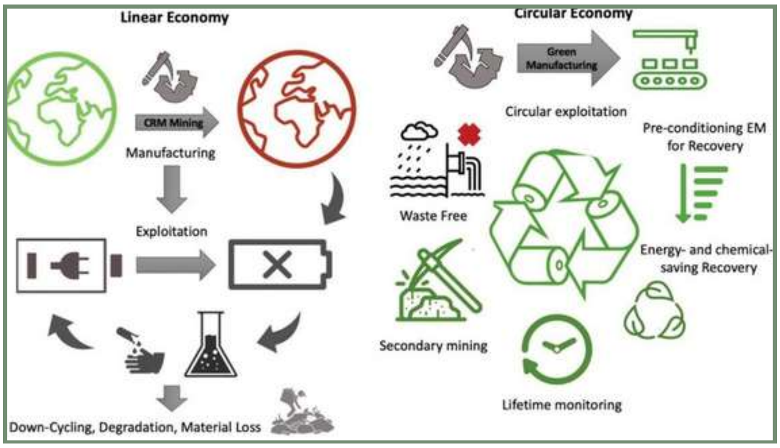

Figure 1: Comparison of recycling in the linear economy and the circular economy. [1]

The rapid proliferation of LIBs in electronics and electric vehicles has generated vast amounts of hazardous e-waste, with only 3% of spent batteries currently being recycled. This highlights the urgent need for robust closed-loop protocols to mitigate environmental impacts and promote resource sustainability through circular economy principles (Figure 1). [1] Enhancing pretreatment stages, such as cell discharge, mechanical dismantling, and black mass recovery, integrated with AI-driven automated segregation and policy-driven collection incentives, offers a pathway to profitable, eco-friendly mechanochemical separation of high-grade materials, dramatically boosting recycling efficiency and curbing future energy demands. [4]

Sustainable battery research envisions electrochemical technologies that not only store energy but also protect the ecological and social systems on which they rely. It emphasises that the design, production, use, and disposal of batteries must respect environmental and social boundaries. The goal is to ensure long-term resource security and social equity throughout the battery lifecycle. [1] It demands innovation in cathode and anode materials to power electric vehicles while minimizing environmental impact and enabling circular economies. Efforts in developing low-cobalt Ni-rich layered oxides, high-entropy cathodes, and silicon-graphite anodes focus on enhancing energy density, cycle life, and recyclability to support scalable EV adoption without resource depletion. [3] In this view, sustainability becomes a unifying thread that weaves together environmental conservation (mitigating life-cycle emissions, toxicity, and resource depletion), social responsibility (safeguarding workers and communities), and economic resilience (delivering scalable, affordable technologies), all coordinated through circular strategies such as eco-design, enhanced durability, thoughtfully engineered second-life pathways, and efficient, high-recovery recycling.

In our laboratory, comprehensive efforts focus on reutilising all LIB components, from graphite anodes and $LiNi_xMn_yCo_yO_2$ (NMC xyz, x + y + z = 1) / $LiFePO_4$ / $LiCoO_2$ cathodes to separators and current collectors (Figure 2). Significant effort has been devoted to regenerating spent LIB graphite to restore electrochemical performance and upcycle carbon components, emphasising graphite recovery as a critical material due to its high environmental and economic production costs. [5] We are also working on freestanding alloy and conversion-type anodes to achieve high cycle life and power through simplified designs, minimising inactive mass and additives. [6] These integrated strategies link superior battery metrics with resource efficiency, curbing raw material demands and diverting waste. Our laboratory advances sustainable battery research by developing efficient extraction methods for valuable elements, such as Li, Ni, and Co, from spent LIB cathodes, prioritising closed-loop recovery. Concurrently, we target Co alternatives through Co-less and Co-zero cathodes, achieving key milestones in high-performance with resource-efficient elements such as Mn and Fe. [7,8]

We are developing a cobalt-free $LiNi_{0.5}Mn_{1.5}O_4$ cathode through a greener and more sustainable synthesis route and investigating its compatibility with silicon-based anodes. Pioneering among leaders, our extensive work on dual-carbon batteries eliminates the use of transition metals entirely, delivering the most sustainable and environmentally friendly energy storage solutions. [9]

Through our lab's closed-loop recycling of all LIB parts, from graphite anodes and key metals like Li, Ni, and Co to Co-free cathodes and dual-carbon batteries, we are on our way to deliver high-performance EV power while cutting waste and raw material needs. These efforts turn battery challenges into green solutions that protect the planet and ensure long-term resource security. In short, we are developing sustainable energy storage solutions for a greener future.

Figure 2: An overview of our ongoing research on sustainable battery chemistry.

> *Sustainable battery research envisions electrochemical technologies that not only store energy but also protect the ecological and social systems on which they rely. It emphasises that the design, production, use, and disposal of batteries must respect environmental and social boundaries*

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Sustainable Urban Water Management: Case of Hyderabad City

KID: 20250416 | Mr Abhishek Raisinghani, Dr Maheswaran R

Introduction

Urban India is at a critical juncture when it comes to water security. Rapid urbanisation, climate variability, and growing demand have placed unprecedented pressure on existing water systems. Per-capita water availability has declined sharply, from 5.18 ML in 1951 to about 1.49 ML in 2021, and is projected to further reduce to 1.19 ML by 2050 [1], [2], [3], [4].

Hyderabad, the city historically shaped by the Musi River and its intricate network of lakes and tanks, has lost nearly 61% of its lake area since 1979 [5], reducing its natural storage, and increasing dependence on long-distance water imports. Municipal supply has remained capped at 2GL/day for a decade, even as demand crosses 2.4–2.5GL/day and is projected to exceed 3.1GL/day by 2030 [6].

Research Objectives

The question that emerges is urgent and fundamental: How can Hyderabad restore the resilience of its natural water systems while meeting the rapidly expanding demand?

The study aims to develop an integrated, city-scale water balance for GHMC by assessing current water availability and use, identifying key stress drivers, analysing future demand–supply gaps through scenarios, and proposing targeted, scalable recommendations for sustainable urban water management.

Progress and Way Forward

The natural water balance for the study integrates multiple datasets: IMD rainfall grids, land cover from ESRI, soil from FAO, groundwater recharge data from INGRES, ET and soil moisture from India-WRIS, with runoff estimated using the SCS Curve Number method. Ultimately, all data was calculated for each ward at seasonal time frame.

GHMC (~650sqkm) receives an average annual rainfall of about 970 mm, translating to roughly 678 GL of water. Most amount of which is lost naturally in the form of evapotranspiration (44%). Having more than 80% of land as built-up, 41% is converted to runoff.

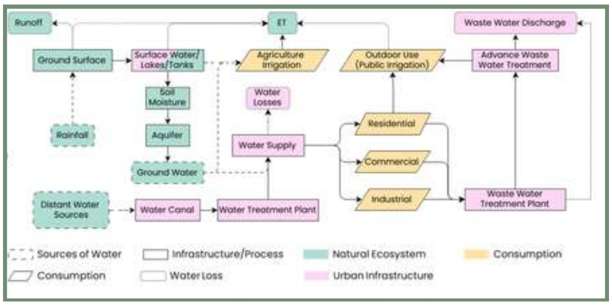

Figure 1. Schematic representation of Urban Water Balance

Around 9% is converted into soil moisture, and remaining 6% is recharged to ground water. Seasonally, most water is lost as ET during dry month, and as ET and runoff both, during wet period.

The next steps include expanding the model from natural hydrology to the full urban water cycle—integrating imports, groundwater use, sectoral consumption, wastewater flows, and reuse. This will be followed by diagnosing system inefficiencies and conducting scenario analyses to understand future demand–supply gaps under varying growth and management strategies, ultimately informing actionable interventions.

Expected outcomes

The project is expected to produce deliver a data-driven water balance model identifying current and future supply gaps, and a scenario-based restoration strategy combining hydrological reconnection, stormwater capture, and demand-management measures. Ultimately, it aims to create a replicable model for other Indian cities facing similar challenges and reposition water bodies as an active component of a resilient, climate-adaptive urban water system.

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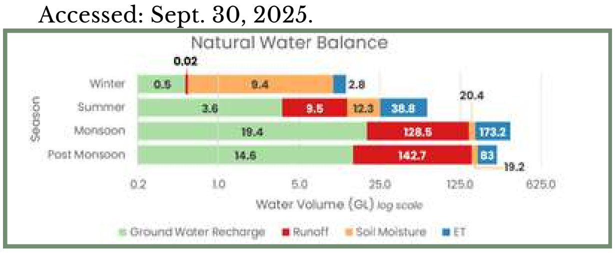

Figure 2. Seasonal Natural Water Balance - GHMC

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Sustainable Urban Watersheds for Climate-Resilient Cities

KID: 20250417 | Mr Sudarshan Saravanan, Dr Shiva Ji

In the 1960s, an island nation now regarded as a global leader in urban design, planning, and water management faced conditions remarkably similar to those confronting India's metropolitan regions today. This young nation grappled with water scarcity, recurring epidemics, and frequent flooding driven by rapid urban development. Its first prime minister famously remarked that "every other policy had to bend at the knees for water survival." In response, agencies and ministries were reorganized to reflect the inherently interdisciplinary nature of water-related governance. In the early years, when the government expanded state-funded residential housing, urban flooding intensified year-by-year. In 1966 the Bukit Timah Flood Alleviation Scheme was initiated, under which several canals and drains were constructed to flush out water from the neighbourhood of Bukit Timah to the sea. Despite this, the year 1969 was the most devastating, masking 3,000 citizens homeless. This again demonstrates that good results take time and require consistent effort. Without getting demotivated, in 1972 a drainage masterplan was conceptualized in collaboration with several development agencies. The plan mandated demarcated land alongside waterways for future expansions and was the first coordinated effort. The plan was also initiated in a combined effort to ensure efficient slime development and riverfront revival, in many ways very similar to what Ahmedabad did in the past two decades. Until the 1980s the strategies for flood management were largely functional and utilitarian, concrete canals and drains aimed at rapid flood water drainage. The city nation we are talking about is Singapore. After the 1980s Singapore achieved its critical challenges of housing and employment. So the Singaporean leadership started contemplating 'How can we improve quality of life beyond meeting the basic needs?".

In 1989, the Waterbodies Design Panel (WDP) was established to integrate water bodies into the urban landscape, enhancing their aesthetic value, strengthening the city's image, and helping attract high-quality talent. This came at a time when many state-funded housing projects required an upgrade. In 2001 the Gov of Singapore merged the drainage and sewage department to create one unified agency, called the Public Utilities Board (PUB) dealing with the entire loop of the transport of water, supply, drainage, treatment and distribution. In the following year Singapore started its ambitious NEWater programme to recycle treated sewage water with membrane filtration and purify it into drinking water. In 2004 the four national taps strategy came into light, a plan to diversify water supply sources.

1. Local Catchment Water
2. Imported Water
3. NEWater Reclaimed Water
4. Desalinated Water

Singapore then sealed its position as a global leader in urban planning, management, and design with the launch of the Active, Beautiful, Clean Water (ABC Waters) Programme by PUB in 2006. The programme aimed to transform utilitarian canals and stormwater drains into multifunctional urban assets, enabling the entire city to function as an integrated rainwater catchment while closely intertwining water management with urban public life. Indian cities such as Surat, Ahmedabad, Thiruvananthapuram, and Indore have made significant strides in meeting citizens' basic needs and are now well-positioned to elevate their urban systems to a higher level in a decade or two. Urban planning must combine deep inter-agency collaboration, the consideration of socio-cultural benefits and biodiversity preservation, coupled with the sustenance of natural ecosystems habitat.

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Figure 1: Conceptual Urban Vision Viksit Bharat by 2047 (Generated with Google Gemini AI)

The Digital Mandate: How Smart Cities in India are Redefining Solid Waste Management

KID: 20250418 | Dr Ambika Selvaraj, Dr Priya Priyadarshini

1. The Urban Imperative for Sustainable Waste

With the advent of India's growing economy and thus an increase in per capita GDP, urbanization has accelerated in a manner that has completely Changed the face of Indian cities. A major direct impact of such accelerated growth, together with enhanced consumerism and linear commodity supply chain systems, is the emergence of increased waste generation in these cities. Traditionally, for many years, the foremost mode of managing waste in most Indian cities used to be mere dumping. However, mounting scientific evidence regarding the negative environmental consequences of these outdated strategies—such as the formation of leachate and resulting emissions—has necessitated a paradigm shift in urban governance.

In response, waste management in India has seen a complete overhaul from a purely civic function to a "value chain spanning collection, transport, processing including treatment, recycling, and upcycling, to final disposal. The launch of the Clean India Mission (Swachh Bharat) provided the initial impetus, but it is the Smart Cities Mission (SCM), a Central Sector Scheme under the Ministry of Housing and Urban Affairs (MoHUA), that has truly integrated sanitation and efficient Solid Waste Management (SWM) as a core element of holistic urban development.

This study, undertaken by Dr. Ambika's group in Indian Institute of Technology Hyderabad, attempted to gauge the direct and indirect effects of SCM in the SWM sector in India. Our hypothesis was that information technology and 'smart solutions' can prove to be an important means of dealing with intense challenges being faced by Indian cities. The research methodology adopted a two-fold approach. One, a nation-wide theme-based sustainability impact assessment through a thorough questionnaire. Two, a primary sustainability assessment through field research in five purposively chosen cities.

Case Study: The National Impact - Digitalizing the Waste Chain

The national assessment, with responses from all 100 Smart Cities, proved to prove that SCM funds are being used actively towards strengthening the SWM sector, sometimes in a complimenting role to Urban Local Bodies (Municipal Corporations). The statistics show a definitive trend towards a digitally tracked and efficient waste environment:

- **Fleet and Infrastructure Development**: A large portion of the budget for SCM went towards basic infrastructure. A total of thirty-six cities acquired new transport vehicles for waste collection, and another twenty-two cities built waste transfer stations and processing units.
- Intelligent Monitoring: Perhaps the most revolutionary step is the integration of SWM modules into the Integrated Command and Control Centre, which is a project initiated by twenty-six cities. Such integration is very essential for enhancing the level of monitoring concerning waste management and efficiency.
- **Handling Legacy Waste:** Twenty-one cities used SCM funding for dealing with legacy waste sites, which is a major step towards achieving 'Zero Waste City' status.
- **Policy and Vision:** To further prove their commitment over a period of time, cities including Indore, Surat, Gwalior, Chandigarh, Thanjavur, and Belagavi have developed vision documents and policies to become circular and carbon neutral in the SWM sector.

On a broad level, it can be seen from this national assessment that there is a momentum towards enhancing all aspects of SWM, but it is equally evident that a more integrated focus with a desire to improve data management and reporting is indicated.

Field Studies and Insights - A Deep Dive into Smart Cities Mission on SWM

To truly comprehend the practical efficacy and four-dimensional sustainability impact—technical, social, environmental, and economic—of SCM projects, Dr. Ambika's team undertook primary field assessments in five cities: Indore, Surat, Pune, Lucknow, and Cochin as illustrated in Figure 1. The selection was based on the alignment of their projects with the SWM theme, initial project information shared, and geographical representation of the Indian landscape.

3.1 Indore: The Zero-Waste Blueprint

Indore, consistently recognized for its SWM excellence, stood out as the undisputed leader. The city has implemented a best-in-class model where household segregation is enforced into a remarkable six waste streams as shown in Figure 2. This strict adherence to source segregation has enabled the considerable up-scaling of centralized processing facilities.

3.1.1 Key Achievements:

- **Zero to Landfill:** The city government has achieved a total reduction in the waste disposed of in landfill sites by making proper use of all kinds of waste.
- **100% Coverage:** Indore shows a 100% door-to-door waste collection and a 100% level of waste segregation at source.
- **Environmental Benefits:** As a direct consequence of not landfilling, not only have the lifespans of existing landfill sites in this city been extended, but more importantly, serious environmental harm from landfill emissions, groundwater pollution, and soil pollution from leachate have been prevented.

- **Aesthetics and Health**: The technical success has translated into social and environmental benefits; during the field visit, it was observed that there are no community dust bins and transport is done using totally covered vehicles, which prevents spillage and prevents foul odor, thus improving aesthetics and health within the community.

3.2 Surat and Pune: Monitoring Excellence Meets Segregation Challenges

Surat and Pune are examples of Smart Cities where digital technology is playing an intensely active role in ensuring efficiency. In both cities, their respective ICCCs are playing a vital role in ensuring efficient monitoring of waste collection routes and movement. They have developed both centralized and decentralized systems in handling both wet and dry waste.

Despite such technical complexity, both cities face serious challenges which can undermine the sustainability of the model adopted by them. The principal challenge is a lack of awareness among citizens in both cities with respect to waste segregation. In response, mixed waste is being generated in varying proportions, making it difficult for the performance levels of processing plants. Moreover, both cities are facing serious capacity issues due to an increasing boundary and a "floating population," especially in Pune.

3.3 Pune Specific Points and Challenges:

Implementation of Integrated Solid Waste Management essentially falls under the administrative jurisdiction of the PMC with the Pune Smart City Development Corporation Limited (PSCDCL) lending its expertise and technology to improve monitoring, efficiency and data collection related to Solid Waste all along the value chain. This support is being enabled through the ICCC (a smart city project completed in March, 2020 and built at a total cost of 155.10 crore) as given in Figure 3. The assessment in Pune emphasized an additional challenge of compounding, wherein a major share of construction work and vehicular traffic adds a substantial amount of construction and demolition waste and dust to the existing waste generation. Additionally, awareness programs may be conducted to emphasize in-situ models of composting, including home, community, and institutional systems, which would significantly alleviate the transport challenge associated with taking waste to processing sites and thereby work towards a reduction in fuel consumption and emissions.

3.4 Lucknow and Cochin: Leveraging Technology for Tomorrow

Lucknow and Cochin show how SCM can utilize technology to establish a basis for an enhanced SWM.

- **Lucknow:** The ICCC has spearheaded a number of projects to enhance logistics, including smart fleet management with live tracking and fuel sensors to reduce wastage. It has also ensured regular household waste collection through the installation of bin-level sensors and Near Field Communication (NFC) tags for collection point monitoring.
- **Cochin**: Cochin's efforts are currently focused on a suite of upcoming infrastructural projects under the Cochin Smart Mission Limited (CSML), including the procurement of waste compactors, mechanized street sweeping machines, and the installation of CCTV at dumpsites. However, the city's Integrated Command and Control Centre (IC4) has yet to realize its full potential due to a technical gap: limited availability of standardized datasets from concerned municipal departments required for full system integration. This underscores the broader point that digital infrastructure is only as effective as the data feeding it, requiring enhanced cooperation and skill development within administrative departments.

4. The Human Element and The Road Ahead

The Smart Cities Mission is contributing considerably to the improvement of SWM efficiency and monitoring across India. It is enabling cities to procure smart vehicles, develop crucial infrastructure, invest in digital monitoring systems, and remediate environmental hazards like legacy waste sites. Cities like Indore have demonstrated a replicable best practice model, proving that achieving a 'zero-landfill' status is possible through aggressive source segregation and processing capacity. However, a fundamental gap persists - the limited citizen awareness and sensitization towards waste segregation. This social and behavioral challenge remains the single largest barrier preventing smart cities from maximizing the efficiency of their new civil and digital infrastructure. Future SCM projects must strategically focus on overcoming this challenge through enhanced information dissemination, citizen sensitization, and community-level capacity-building programs, operating in tandem with the development of physical and digital assets. Furthermore, for SCM projects to achieve maximum success, there is a clear need for enhanced cooperation, collaboration, and clear delegation of responsibilities between the City Municipal Corporations (ULBs) and the Smart Cities Special Purpose Vehicles (SPVs).

Ultimately, the findings of this sustainability impact assessment offer a valuable resource for policymakers, city administrators, and technical engineers. By prioritizing the human element of source segregation and leveraging smart technologies for monitoring and processing, Indian Smart Cities can effectively mitigate the challenge of urban waste, paving the way for a truly sustainable and circular urban future.

To read the full report:

https://iith.ac.in/projects/sustainability_impact_assessment_study_on_solid_waste_management/

Acknowledgement:

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Figure 2: Field visit photos from Indore depicting the smart SWM

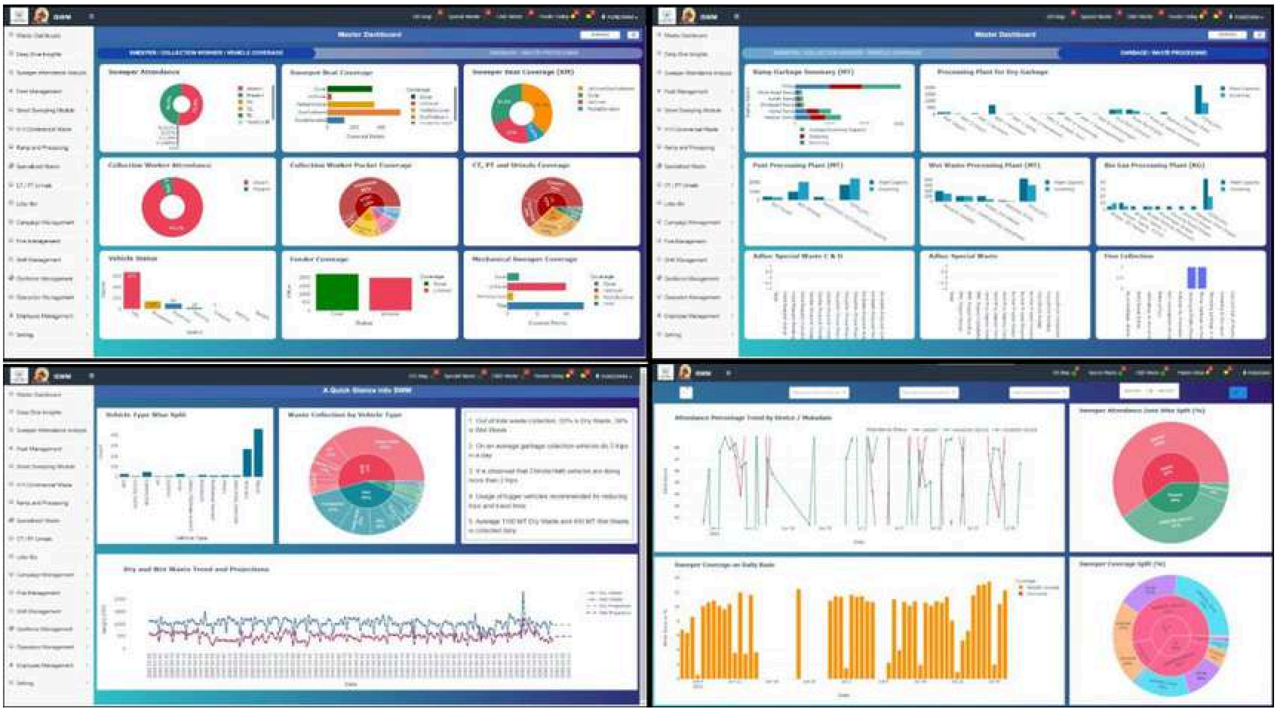

Figure 3: Pune Smart City-ICCC dashboards depicting various parameters related to Solid Waste Management

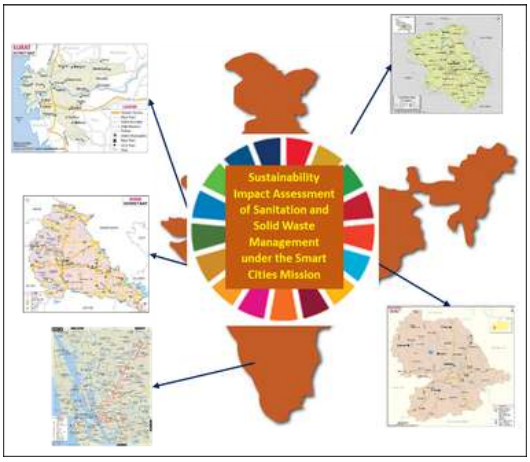

Figure 1: The five cities covered in this study's field visit

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Zebrafish as a Sustainable Animal Model in Biomedical Research

KID: 20250419

Mr Atanu Pramanik, Ms Ghazala Rahman, Prof Anamika Bhargava

The global scientific community faces a constant challenge: advancing biomedical research responsibly, affordably, and sustainably, while reducing costs and environmental impact. While traditional mammalian models have driven major discoveries, they also come with ethical constraints, high maintenance costs, long generation times, and substantial environmental demands involving space, water, energy, and feed. In contrast, the zebrafish (Danio rerio) has emerged as an excellent, low-cost, high-throughput research model that unites accessibility, versatility, and sustainability.

Why Zebrafish Are a Sustainable Model in Biomedical Research?

Affordability: Zebrafish require compact aquatic systems, low-volume water usage, and minimal feed, significantly reducing the environmental footprint compared to mammalian facilities.

High Fecundity and rapid development: A single pair of zebrafish can lay up to 200-300 eggs per week. Zebrafish embryos develop rapidly, with major organ systems forming within 24-48 hours post-fertilization, allowing for rapid experimental turnaround.

High Genetic Homology: Zebrafish share 70% of human genes, and 84% of disease-associated genes have zebrafish orthologs. Zebrafish possess a remarkable regenerative capacity and share major organs with humans, including the heart, liver, and kidneys.

Transparency Advantage: Zebrafish larvae are nearly transparent, enabling non-invasive, real-time microscopy of organ development, blood flow, and drug effects.

Transgenic Lines: Fluorescent transgenic lines like Tg(fli1:EGFP) for vessels, Tg(myl7:EGFP) for heart cells, and Tg(GATA1:dsRed) for erythrocytes, leveraged with transparency, enable high-resolution, non-invasive in vivo imaging of tissue dynamics and gene activity.

Zebrafish and the 3Rs for Ethical and Sustainable Approach: The zebrafish model organism aligns with the 3Rs principle (Reduce, Refine, Replace) and contributes to more ethical and sustainable research practices.

Reduction: Zebrafish larvae up to 5 days post-fertilization are exempted from ethical regulation for vertebrate models. This exemption reduces reliance on mammalian systems, lowers resource demands, and supports more sustainable research practices.

Refinement: Zebrafish offer high-throughput data collection, reducing the number of animals required per study.

Replacement: Zebrafish can substitute mammalian models in early-phase screenings, minimizing ecological and ethical impact.

Zebrafish Animal Model in Biomedical Research

At IIT Hyderabad, our lab employs zebrafish as a sustainable vertebrate model for research spanning mental health, cancer, toxicology, and drug efficacy. Our work integrates innovative in-house tools and techniques, further improving affordability and accessibility.

Mental Health Disorders

Despite their evolutionary distance, zebrafish possess conserved neuroanatomical and neurochemical pathways (including serotonin, dopamine, and GABA systems) relevant to human neuropsychiatric conditions. At IIT Hyderabad, our lab utilizes the in-house developed (in collaboration) open-source low-cost ZebraTrack [1] method to assess anxiety behaviour in zebrafish. This aligns strongly with sustainability goals by reducing reliance on expensive tracking systems.

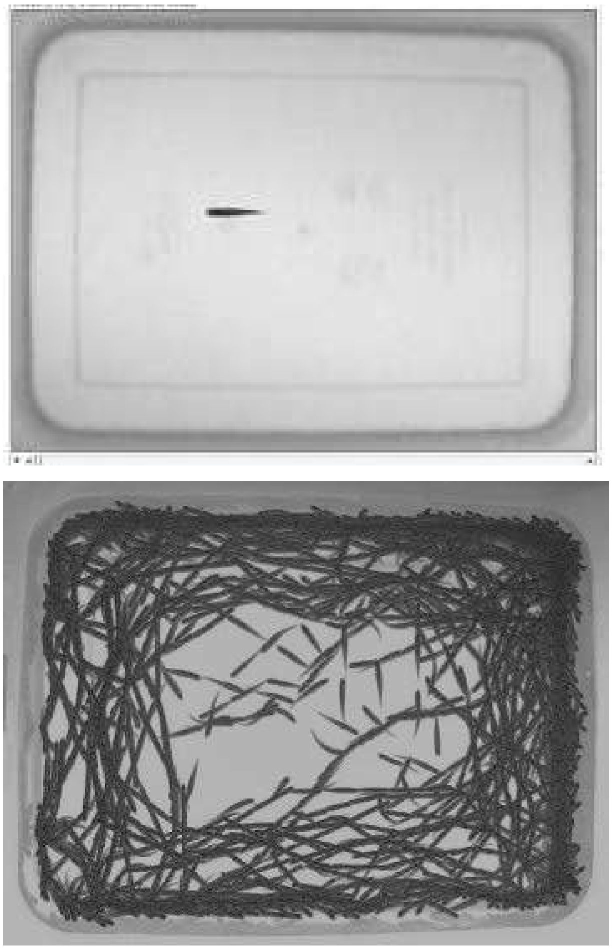

Fig 1: Swimming trajectory of zebrafish in the open-field test tank, analyzed using the ZebraTrack method [1]. The trajectory (path followed by zebrafish overtime) illustrates locomotor behaviour used to assess neurotoxicity

Cancer Xenografts

Zebrafish larvae lack a fully developed adaptive immune system, allowing non-rejected transplantation of human cancer cells. This creates a rapid and visually accessible system for studying tumor growth, angiogenesis, metastasis, and therapeutic response.

Our group has successfully established a zebrafish breast cancer xenograft model, enabling real-time visualization of tumor progression and screening of anti-cancer compounds [2].

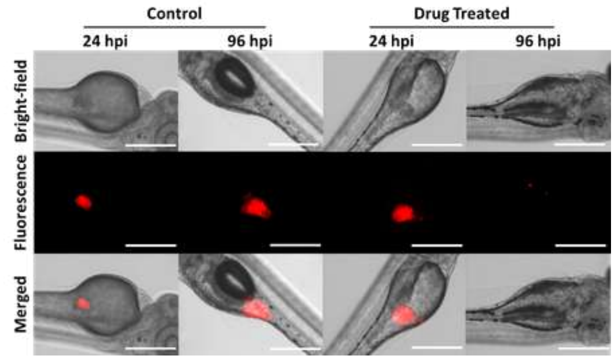

Fig 2: Zebrafish breast cancer xenograft model for tumor growth, metastasis and drug efficacy research. Red colour represents fluorescently labelled breast cancer cells injected into the zebrafish larvae. Drug treatment could eliminate cancer in vivo. hpi= hours post injection. Figure reproduced from [2].

Toxicology and Drug Efficacy Screening

Zebrafish enable multi-well plate-based drug screening, with embryos absorbing test compounds directly from water. This bridges the gap between cell culture and mammalian models while dramatically reducing material requirements. We use zebrafish larvae to evaluate cardiotoxicity, neurotoxicity, and systemic toxicity of drugs, herbicides, and environmental contaminants [3].

Our lab has developed ZebraPace in collaboration, an open-source method for accurate quantification of cardiac rhythm in untethered zebrafish larvae [4].

Conclusion

Zebrafish have become a cornerstone of modern biomedical research due to their genetic relevance, rapid growth, transparency, and experimental versatility. Their low environmental footprint, compatibility with the 3Rs, and high-throughput capabilities make them a sustainable alternative to traditional mammalian models. At IIT Hyderabad, the integration of zebrafish models across disciplines, from toxicology and neuroscience to cancer research, demonstrates our commitment to ethical, affordable, and environmentally responsible scientific advancement.

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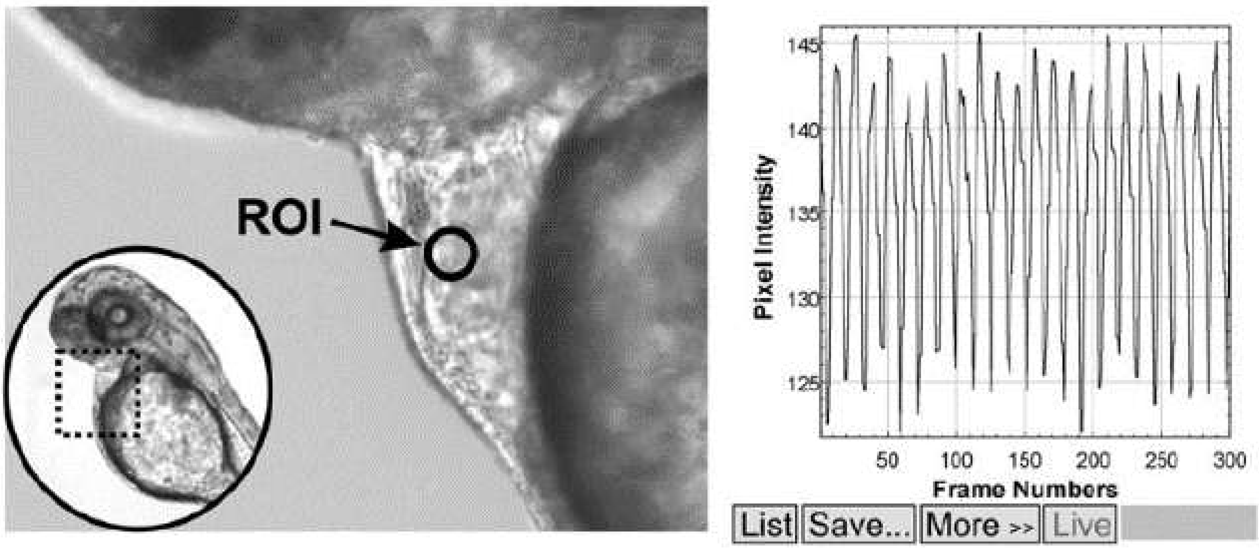

Fig 3: Heartbeat analysis in zebrafish larvae using the ZebraPace method for cardiotoxicity assessment. Figure reproduced from [4].

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THURSDAY 25 DECEMBER 2025 | THE HANS INDIA | HYDERABAD

Young Hans

30th inter IIT staff sports meet begins at IIT Hyderabad

HYDERABAD

Following the successful hosting of the 58th Inter IIT Students' Sports Meet, the Indian Institute of Technology Hyderabad (IITH) inaugurated the 30th Inter IIT Staff Sports Meet 2025 with a ceremonial opening at its Athletics Track within the Sports and Cultural Complex. The six-day event will be held till December 29 and has drawn close to 2,000 staff participants from all 23 Indian Institutes of Technology across the country.

The Staff Sports Meet marks three decades of promoting fitness, camaraderie and lifelong engagement with sport among non-student members of the IIT system. Hosted by IIT Hyderabad, the event reinforces the idea that sporting spirit and teamwork extend beyond age, designation and professional roles.

The opening ceremony featured a coordinated march past by staff contingents representing all participating IITs, symbolising unity and institutional pride. Formal proceedings included the hoisting of the Inter IIT flag, the lighting of the ceremonial mashal, oath-taking by participants and officials, and cultural performances that reflected India's diverse artistic traditions.

The meet was formally declared open by Chief Guest Aditya Mehta, a renowned para-athlete and sports advocate. Addressing the gathering, he highlighted the importance of consistent training and teamwork, stating that sport had played a transformative role in his life. He encouraged participants to remain active and committed to physical fitness.

Guest of Honour Arshad Shaik, an international para-cyclist, spoke about the empowering role of sports in building resilience and inner strength.

He urged participants to continue engaging in sports as a way to overcome personal and professional challenges.

Chairman of the Board of Governors at IIT Hyderabad, B. V. R. Mohan Reddy, also addressed the gathering and emphasised the role of sports in fostering discipline, teamwork and resilience among professionals. He encouraged staff members to actively participate in sporting activities to maintain physical well-being and a sense of collective spirit within institutions.

Prof. B. S. Murty, Director of IIT Hyderabad, described the Inter IIT Staff Sports Meet as an integral part of institutional culture. He noted that the values nurtured through sport—such as perseverance, ethical conduct and teamwork—remain relevant throughout professional life. Prof. Murty expressed pride in IIT Hyderabad hosting both the students' and staff sports meets in the same year, highlighting the institute's commitment to holistic development.

Paritosh Pankaj, Superintendent of Police, Sangareddy, was also present at the ceremony and motivated participants by noting that while individuals may come from diverse backgrounds, sport serves as a unifying force.

The Staff Sports Meet will feature competitions across multiple disciplines, including athletics, cricket, football, volleyball, badminton and table tennis. Events will be conducted throughout the week in a spirit of friendly competition and mutual respect, with the campus expected to remain vibrant with sporting activity.

కంది ఐఐటీలో ఆటల జోరు..!

కొనసాగుతున్న ఇంటర్ స్పోర్ట్స్ మీట్

ఇక్కడి వసతులు చూసి ఆశ్చర్యాన్ని వ్యక్తం చేసిన ఇతర ఐఐటీయన్లు

Fri, 19 December 2025
https://epaper.dishadaily.com/c/78759571

Inter-IIT sports meet begins in Hyderabad with 2,500 students from 23 campuses

The Hindu Bureau
HYDERABAD

The 58th edition of the inter-IIT sports meet kicked off at IIT-Hyderabad at Kandi, Sangareddy, on Sunday. The weeklong event is witnessing the participation of about 2,500 students from the 23 IITs in various sporting disciplines.

Following it up will be the inter-IIT sports meet for the staff, scheduled to take place from December 24 to 29, with over 2,000 participants in various categories.

Olympian and badminton star Saina Nehwal, inaugurating the sports meet, said the country's pride can be built not only through world-class research and innovation but also through fitness, a passion for sports and healthy lifestyles.

"Sport is not just about competitions that last a week; it is about the habits we form every day. Regular workout and staying active instil discipline, resilience and focus – qualities that are as important as academics and research," she said.

Also present at the ceremony, India's chief badminton coach Pullela Gopichand advocated for making sports an integral part of campus life.

"I strongly believe that sports add immense value to a student's life by building character, discipline and confidence. When sports become a way of life on campus, they enrich education and help shape well-rounded individuals," he said.

Chairman of the Board of Governors at IIT-Hyderabad, B.V.R. Mohan Reddy and director B.S. Murty were among those present at the event.

Badminton icon Saina Nehwal addressing participants at the 58th Inter IIT sports meet, which kicked off at the IIT-Hyderabad campus at Kandi in Sangareddy district on Sunday. MOHD. ARIF

ఐఐటీలో స్టాఫ్ ఇంటర్ స్పోర్ట్స్ మీట్

ప్రారంభించిన పారా అథ్లెటిక్ గోల్డ్ మెడలిస్ట్ ఆదిత్య మెహతా

స్టాఫ్ ఇంటర్ స్పోర్ట్స్ మీట్ వేడుకలను ప్రారంభిస్తున్న ఆదిత్య మెహతా

దిశ, సంగారెడ్డి : ప్రతిష్టాత్మకమైన ఐఐటీ హైదరాబాద్ వేదికగా దేశంలోని 23 ఐఐటీల నుంచి వచ్చిన విద్యార్థులకు ఇంటర్ స్పోర్ట్స్ మీట్ వేడుకలు జరుగుతున్న సంగ తి తెలిసిందే. ఈ వేడుకలు మంగళవారంతో ముగిసాయి. బుధవారం స్టాఫ్ ఇంటర్ స్పోర్ట్స్ మీట్ వేడుకలను ప్రారంభించారు. ఈ నెల 24 నుంచి 29 వరకు ఈ స్పోర్ట్స్ మీట్ నిర్వహిస్తారు. ఈ కార్యక్రమానికి ప్రముఖ పారా అథ్లెటిక్ గోల్డ్ మెడలిస్ట్ ఆదిత్య మెహతా వేడుకలను ప్రారంభించారు. క్రీడలతో ఎన్నో రకాల ప్రయోజనాలు కలుగుతాయని, మానసిక, శారీరక శాంతికి కూడా క్రీడలు ఎంతో దోహదం చేస్తాయని ఆయన తెలిపారు. ఈ స్పోర్ట్స్ మీట్లో 2వేల అధ్యాపక బృందం సభ్యులు పాల్గొననున్నారు.

దిశ Thu, 25 December 2025
https://epaper.dishadaily.com/c/78802408

INBRIEF

IIT-H, Rajasthan govt. ink MoU for AI-mineral exploration

The government of Rajasthan has signed an MoU with IIT Hyderabad to use Artificial Intelligence and Machine Learning for critical mineral mapping in its 39 districts. The MoU was signed during the Pravasi Rajasthani Divas 2025, on December 10, held at the Jaipur Exhibition and Convention Centre, the IITH release on Saturday stated. Under this, IIT-H will build a prediction model that integrates geological, geochemical, geophysical and multispectral satellite datasets from all districts to generate AI-based mineral prospectivity maps. This system will help identify potential zones for minerals such as lithium, copper, graphite, zinc, nickel, cobalt, rare earth elements, and other critical resources.

తంగేడు, పులాయి ఆకులతో 'ఇనుము'

రుద్ర

ఐఐటీ హైదరాబాద్ ఇంటర్నేషనల్ సర్టిఫికేట్ ప్రోగ్రామ్ ఇన్ ఇంటిగ్రేటెడ్ ప్రొడక్ట్‌సర్వీస్ సిస్టమ్ డిజైన్ ప్రారంభం

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ఈనాడు

కీలక ఖనిజాల అన్వేషణ, తయారీ..

ఆత్మనిర్భర్ భారత్‌కు అత్యవసరం

ఐఐటీహెచ్ డైరెక్టర్ ఆచార్య బీఎస్ మూర్తి

Date : 09/12/2025 EditionName : TELANGANA(SANGAREDDY) PageNo : 02

ఈనాడు

ఐఐటీ.. సంపద సృష్టిలో మేటి

సహజ వనరుల వినియోగానికి అడుగులు

సౌర విద్యుత్తు: 8.5 మెగావాట్లు

జల సంరక్షణ: 5 కోట్ల లీటర్లు

పర్యావరణ పరిరక్షణ..

ఎరువుగా మార్చి..

వ్యర్థజలాలు.. శుద్ధి చేసి..

అదర్శంగా తీర్చిదిద్దాలి: బీఎస్ మూర్తి, డైరెక్టర్, ఐఐటీ

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సాక్షి

ఆవిష్కరణలు... అదరహో

ఐఐటీహెచ్‌తో ఇటలీ సాంకేతిక భాగస్వామ్యం

- స్థిరమైన డిజైన్లు, ఆవిష్కరణల నైపుణ్యాలే లక్ష్యం
- జనవరి 15 నుంచి సంయుక్త ఆన్‌లైన్ సర్టిఫికేషన్ ప్రోగ్రాం

ఒప్పంద పత్రాలను చూపుతున్న ఐఐటీహెచ్, ఇటలీ మిలన్ సంస్థ ప్రతినిధులు

11/12/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 7
Source : https://epaper.andhrajyothy.com

ఈనాడు
epaper.eenadu.net

ఐఐటీహెచ్‌లో జల అంకురం..

ప్రతి విద్యాలయమూ పట్టాలి గునపం

ఆలయానికో కోనేరు.. గ్రామానికో చెరువు.. వీధికో బావి.. అనాదిగా మన సంస్కృతిలో భాగమైన ఆచారాలు. జలసంరక్షణకు ఆవాసాలు. కాలక్రమంలో బోరుబావులు వచ్చాక.. నేల బావులు, మెట్ల బావులు అరుదైనవిగా మారిపోయాయి. నగరాలు, పట్టణాలు విస్తరిస్తున్నచోట చెరువులు వెంచర్లవుతున్నాయి. అయితే జలసంరక్షణ విలువ తెలిసిన ఐఐటీ హైదరాబాద్ తన వంతుగా.. ప్రాంగణంలో 105 మీటర్ల పొడవు, 85.5 మీటర్ల వెడల్పు, 2.55 మీటర్ల లోతుతో చెరువును ఏర్పాటు చేసింది. 654 ఎకరాల ప్రాంగణంలోని లోతట్టు ప్రాంతంలో దీనిని అభివృద్ధి చేశారు. ఆవరణలో కురిసిన వర్షం నీరు మొత్తం అందులోకి చేరుతోంది. దీంతో ఇక్కడ 2,28,92,600 లీటర్ల వర్షపు నీరు నిల్వ ఉంటోంది. ప్రాంగణంలోని వేల మొక్కలకు ఈ నీటినే అందిస్తున్నారు. అన్ని విద్యాలయాలు తమ ప్రాంగణాల్లో ఈ ఏర్పాటు చేస్తే భవిష్యత్తు తరాలకు జలాధారం అబ్బకుండా ఉంటుందా?

– ఈనాడు, సంగారెడ్డి

Date : 03/12/2025 EditionName : TELANGANA PageNo :

Metallurgists meet to be held at IIT-H

DC CORRESPONDENT
HYDERABAD, NOV. 28

Hyderabad is getting ready to host one of India's biggest gatherings of metallurgists and materials scientists at IIT Hyderabad from December 4 to 6. IIT-H director Prof. B.S. Murty will be the president of Indian Institute of Metals, one of India's oldest metallurgical and materials engineering associations, that will host the event.

The conference will deepen industry-academia ties through presentations by leading experts and researchers, Prof. Murty said. The three-day event combines the 79th annual technical meeting of the Indian Institute of Metals (IIM) and an international conference on advanced materials and critical minerals for energy transition.

Organisers are expecting more than 1,600 participants, including a large number of students presenting their work. Prof. Subhash R. Dey of IIT-H called the event "a Kumbh Mela for metallurgists and materials scientists," pointing out that the edition had received over 1,400 abstracts across 14 themes.

Technical committees reviewed the submissions and recommended 409 oral presentations across 14 parallel sessions and about 750 posters, with around 70 invited speakers spread over the sessions.

Dr S.V.S. Narayana Murty, vice-president of the IIM and CMD of Midhani (Mishra Dhatu Nigam), said, the events would set the stage for meaningful discussions among stakeholders to advance self-sustainability." During on December 5 and 6, IIM will host two sessions on advances in steel in cooperation with the Japan Institute of Metals and Materials (JIMM), along with two sessions on high-entropy alloys and Integrated Computational Materials Engineering (ICME).

Indian Institute of Metals president Prof. B.S. Murty releases a poster on conference of metallurgists and materials scientists to be hosted at IIT Hyderabad from December 4 to 6. — BY ARRANGEMENT

నవజ్యోతి

డిసెంబర్ 4-6 వరకు ఐఐటీ హైదరాబాద్ లో ఇంటర్నేషనల్ కాన్ఫరెన్స్ ఆన్ మెటీరియల్స్ ఫర్ ఎనర్జీ ట్రాన్సిషన్

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సమ్మిళిత వృద్ధికి అవకాశాలు అందించడమే లక్ష్యం

సుజుకీ మోటార్ కార్పొరేషన్ గ్లోబల్ మార్కెటింగ్ కౌన్సెలర్ కెంజి సైటో

04/11/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 7
Source : https://epaper.andhrajyothy.com

ఈనాడు

ఐఐటీ.. సంపద సృష్టిలో మేటి

సహజ వనరుల వినియోగానికి అడుగులు

సౌర విద్యుత్తు: 8.5 మెగావాట్లు

జల సంరక్షణ: 5 కోట్ల లీటర్లు

పర్యావరణ పరిరక్షణ..

ఎరువుగా మార్చి..

వ్యర్థజలాలు.. శుద్ధి చేసి..

అదర్శంగా తీర్చిదిద్దాలి: బీఎస్ మూర్తి, డైరెక్టర్, ఐఐటీ

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ఉత్సాహంగా హాఫ్ మారథాన్

ఐఐటీ హైదరాబాద్ ప్రాంగణంలో పందెం
2,200 మంది రన్నర్లు హాజరు
ప్రారంభించిన వరల్డ్ ఎబిలిటీ స్పోర్ట్స్ కాంస్య పతక విజేత బాబోతు పావని

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Source : https://epaper.andhrajyothy.com

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ఐఐటీహెచ్‌లో రెండో ఎడిషన్ హాఫ్ మారథాన్

- రిజిస్ట్రేషన్‌కు ఈ నెల 10 వరకు గడువు
- 30న రన్నింగ్ పోటీలు

Hans India

IITH launches NBV Skilling Centre to empower rural and semi-urban youth

HANS NEWS SERVICE
HYDERABAD

IN a major initiative towards inclusive education and rural empowerment, the Indian Institute of Technology Hyderabad (IITH) inaugurated the 'Skill Development Centre' under its Rural Development Centre (RDC) on Monday. Named the NBV Skilling Centre, this endeavour is a collaborative effort between IITH, Next Bharat Ventures (an initiative of Suzuki Motor Corporation), and the Deshpande Foundation.

The Centre's core mission is to equip rural and semi-urban youth with industry-ready technical skills, entrepreneurial capabilities, and enhanced educational opportunities. It is set to serve as a hub for holistic development, offering comprehensive programmes that combine soft skills, communication training, and hands-on exposure to innovation-driven technologies.

Speaking at the inauguration, IITH Director Professor B S Murty stated, "IITH started the Rural Development Centre in 2020 with the vision to support rural development through innovative technologies. The new Skill Development Centre takes this vision forward empowering India's youth through education, innovation, and real-world skill building."

Dr Satish Regonda, Chairperson of the RDC, emphasised that the Centre strengthens RDC's core themes of Education, Environment, and Entrepreneurship, transforming rural regions into spaces of opportunity and innovation.

The initiative is anchored by the Next Bharat Skilling Foundation (NBSF), a Section 8 not-for-profit entity. Its flagship programmes — SkillPlus (for rural graduates), Skill in Village (SiV) (for school students), and Technical Skilling for MSMEs — aim to train over 50,000 youth and impact more than 50,000 school students by 2035.

Dr Gururaj "Desh" Deshpande, Founder of the Deshpande Foundation, remarked that collaborative initiatives like this bridge the gap between talent and opportunity, enabling youth from every corner of the country to participate in India's growth story. Kenji Saito, Director of Next Bharat Ventures and Councillor at Suzuki Motor Corporation, added that the partnership reflects Suzuki's commitment to empowering India's youth through practical skills and inclusive growth.

The event was attended by various dignitaries, including Ranga Rao Nutakki, Chairman of Sai Deepa Rock Drills Pvt Ltd, who pledged support to the mission, along with senior officials from Suzuki, the Deshpande Foundation and IITH.

సిరి

సోలార్ ప్యానెల్ రీసైక్లింగ్ కోసం జీరోకార్బన్ సిలికాన్ శుద్ధీకరణలో అంతర్జాతీయ భాగస్వామ్యానికి ఐఐటీ హైదరాబాద్

30 Oct 2025 - Page 12
epaper.siridaily.com

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ట్రైజియో టెక్నాలజీస్ ప్రతినిధులు అశోక్ వేములపల్లి కుటుంబసభ్యులతో ఐఐటీహెచ్ డైరెక్టర్ బీఎస్ మూర్తి, ప్రొఫెసర్లు

ఐఐటీహెచ్‌కు ట్రైజియో టెక్నాలజీస్ సహకారం

కంది, అక్టోబరు 15 (ఆంధ్రజ్యోతి): సంగారెడ్డి జిల్లా కంది పరిధిలోని ఐఐటీహెచ్‌లో అధునాతన సాంకేతికతతో కంప్యూటర్ ల్యాబ్ ఏర్పాటు చేసేందుకు ట్రైజియో టెక్నాలజీస్ సంస్థ సహకారం అందించింది. ఈ మేరకు ఐఐటీహెచ్‌లోని డిపార్ట్‌మెంట్ ఆఫ్ కంప్యూటర్ సైన్స్ అండ్ ఇంజనీరింగ్ విభాగంలోని ఒక ఫ్లోర్‌కు బుధవారం ఆ సంస్థ ప్రతినిధులు దాత అశోక్ వేములపల్లి పేరు పెట్టారు. ఐఐటీ హైదరాబాద్‌లో ఆవిష్కరణలకు స్ఫూర్తినిస్తూ చేసిన ఈ పరివర్తనాత్మక సహకారం.. భవిష్యత్తు కోసం ఆవిష్కరణ పర్యావరణ వ్యవస్థలను పెంపొందించడానికి విద్య, పరిశ్రమల మధ్య ఉమ్మడి దృక్పథాన్ని సూచిస్తుందని ఐఐటీహెచ్ డైరెక్టర్ బీఎస్ మూర్తి అన్నారు. ఈ చర్య ద్వారా ఐఐటీహెచ్‌లో సాంకేతిక నైపుణ్యం, పరిశోధనలు అభివృద్ధి చెందుతాయని బీఎస్ మూర్తి తెలిపారు.

16/10/2025 | Sangareddy-Medak(Sangareddy Medak District) | Page : 9
Source : https://epaper.andhrajyothy.com

Over 2,500 participate in 58th Inter IIT Sports Meet in city

TIMES NEWS NETWORK

The meet features over 2,500 student-athletes competing across multiple disciplines from Dec 14-21. It will be followed by the 30th inter-IIT staff sports meet from Dec 24-29

Hyderabad: The 58th Inter IIT Sports Meet 2025, India's largest intercollegiate sporting event, kicked off at the Indian Institute of Technology Hyderabad, bringing together athletes from all 23 IITs across the country.

The meet features over 2,500 student-athletes competing across multiple disciplines from Dec 14-21. It will be followed by the 30th inter-IIT staff sports meet from Dec 24-29, involving nearly 2,000 staff participants.

The opening ceremony featured a march-past by IIT contingents with military bands, cultural performances and addresses by dignitaries.

Addressing the gathering, badminton player Saina Nehwal said, "Sport is not just about competitions that last a week; it is about the habits we build every day. Working out daily and staying active helps shape discipline, resilience, and focus — qualities that are equally important in academics and research. Let us make India proud not only through world-class research and innovation, but also through our fitness, passion for sports, and healthy lifestyles."

నవజ్యోతి

గ్రామీణ సమాజాల సాధికారత కోసం ఐఐటీ హైదరాబాద్ నైపుణ్యాభివృద్ధి కేంద్రం ప్రారంభం

Govt plans more skywalks to address safety issues, snarls

IIT-Hyderabad To Pinpoint Key Facility Areas

Sunny.Baski
@timesofindia.com

EASING URBAN CONGESTION

- Focus areas: Ameerpet, Dilsukhnagar, LB Nagar & Hitec City
- New skywalks planned at Secunderabad railway station & JNTU LuLu Mall
- Tenders floated by HUMTA; more projects to follow after IIT-H report
- IIT-Hyderabad to identify priority locations through a detailed study

Hyderabad: To enhance pedestrian safety and ease traffic congestion, the state govt is planning to build more skywalks at major junctions. To identify the most suitable locations, the govt has roped in IIT-Hyderabad to conduct a comprehensive study to determine where these facilities are most needed.

Key areas under consideration include Ameerpet, Dilsukhnagar, LB Nagar, and Hitec City — zones known for heavy foot traffic and frequent congestion. Officials hope that building skywalks at these points will not only provide safer crossings for pedestrians but also streamline traffic flow, reducing bottlenecks at major junctions.

Meanwhile, Hyderabad Unified Metropolitan Transport Authority (HUMTA) is rolling out two new skywalk projects near Secunderabad Railway Station and JNTU-H. Currently, the skywalk built by L&T Metro Rail links Secunderabad East Metro Station to Rathifile bus station, but it does not extend up to the railway station, leaving a crucial gap in pedestrian access.

To address this, a multi-purpose skywalk is planned to offer seamless connectivity for commuters moving between different modes of transport. The proposed structure will link Secunderabad Railway Station, Secunderabad East Metro Station, Secunderabad West Metro Station, and Rathifile Bus Station. It will be around 800 meters long and 4 meters wide. Similarly, at the JNTU junction, a new skywalk is proposed to connect JNTU Metro Station directly with LuLu Mall.

"We have floated tenders for two new skywalks, one in Secunderabad and another near JNTU-Hyderabad. This initiative is expected to not only enhance urban mobility but also transform the city's infrastructure, making Hyderabad more pedestrian-friendly and efficient. Once IIT-H submits the feasibility report, we will plan more skywalks across the city," said a senior official in HUMTA.

నవజ్యోతి

ఐఐటి హైదరాబాద్‌లో గ్లోబల్ మెటలర్జీ లీడర్ల సమావేశం

ABN ఆంధ్రజ్యోతి

లోహ శాస్త్రవేత్తల కుంభమేళా!

- ఐఐటీహెచ్‌లో ఐఐఎం 79వ అంతర్జాతీయ సదస్సు
- 1,200మంది ప్రతినిధుల రాక

05/12/2025 | HYDERABAD MAIN II(Hyderabad Main_II) | Page : 12
Source : https://epaper.andhrajyothy.com

సిరి

ఐఐటీ హైదరాబాద్ లో అశోక్ వేములపల్లి ఫ్లోర్ ప్రారంభం

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ఆంధ్రజ్యోతి

డ్రైవర్ లెస్ ఎయిర్ ట్యాక్సీ
ఇంటి మూలమూలల్లోకి సూర్యకాంతి
సైన్యం కోసం కార్బన్ ఫైబర్ 'షీల్డ్' బ్లోక్
ఐఐటీహెచ్‌లో అద్భుత ఆవిష్కరణలు
'ఇన్వెంటివ్ 2026' ఎక్స్‌పోలో స్టార్టప్‌ల ప్రదర్శనలు

అబ్బురపరిచే ఆవిష్కరణలు

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Source : https://epaper.andhrajyothy.com

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క్యూఎస్ వరల్డ్ వర్సిటీ ర్యాంకుల్లో ఐఐటీహెచ్ సత్తా

- ఆసియాలోనే 270వ స్థానం

13/11/2025 | HYDERABAD MAIN II(Hyderabad Main_II) | Page : 12
Source : https://epaper.andhrajyothy.com

ఇకపై కృత్రిమ ఊపిరితిత్తులు

- ఐఐటీ హైదరాబాద్ పరిశోధన
- ఐఐటీ హైదరాబాద్ పరిశోధన సంస్థ అభివృద్ధి
- ఐఐటీ బయోమెడికల్ ఇంజనీరింగ్ విభాగం

శాశ్వత పరిష్కారం దిశగా పరిశోధనలు

Thu, 08 January 2026
https://epaper.dishadaily.com/c/78893313

Saina Nehwal Inaugurated the 58th Inter IIT Sports Meet at IITH

58th
Inter IIT Sports
@IITHyderabad

IITH hosted the 30th Inter IIT Staff Sports Meet 2025, inaugurated by renowned Paralympians Shri Aditya Mehta, an Asian Para-Cycling Silver Medalist, & Shri Arshad Shaik, a world-class Para-Cyclist

30th
Inter IIT Staff
Sports
@IITHyderabad

Inauguration of the “Ashok Vemulapalli Floor” an occassion to celebrate the Legacy and Innovation

Inauguration of the Vacuum Chamber Test Stand supported by Applied Materials to enhance hands-on learning in semiconductor technology

The Department of Chemical Engineering proudly inaugurated its IIChE Student Chapter

Inauguration of 'Skill Development Centre' to Empower and Upskill Rural Communities

IITH Nexus 2025 brought together corporates and innovators to explore breakthroughs in AI, 6G, healthcare, sustainability, and more

IITH hosted the first Expert Committee Meeting of the ANRF PM Professorship Scheme, followed by a campus tour highlighting the institute's research and innovation ecosystem

Japan Ambassador's Visit to IITH

IITH hosted 3rd Japan Academic Day to deepen India–Japan academic and research collaboration

Inauguration of the JEOL–IITH Microscopy Training Centre, marking a new milestone in advanced research and innovation

India's Critical Minerals Push and Global Materials Innovation Define 79th IIM Annual Technical Meeting (ATM) Finale held at IITH

IITH proudly hosted iNaCoMM 2025 — the 7th International and 22nd National Conference on Machines and Mechanisms

IITH successfully hosted the 9th edition of ServDes, Asia's first, bringing together 250+ delegates from 25 countries for a global exchange on service design and innovation

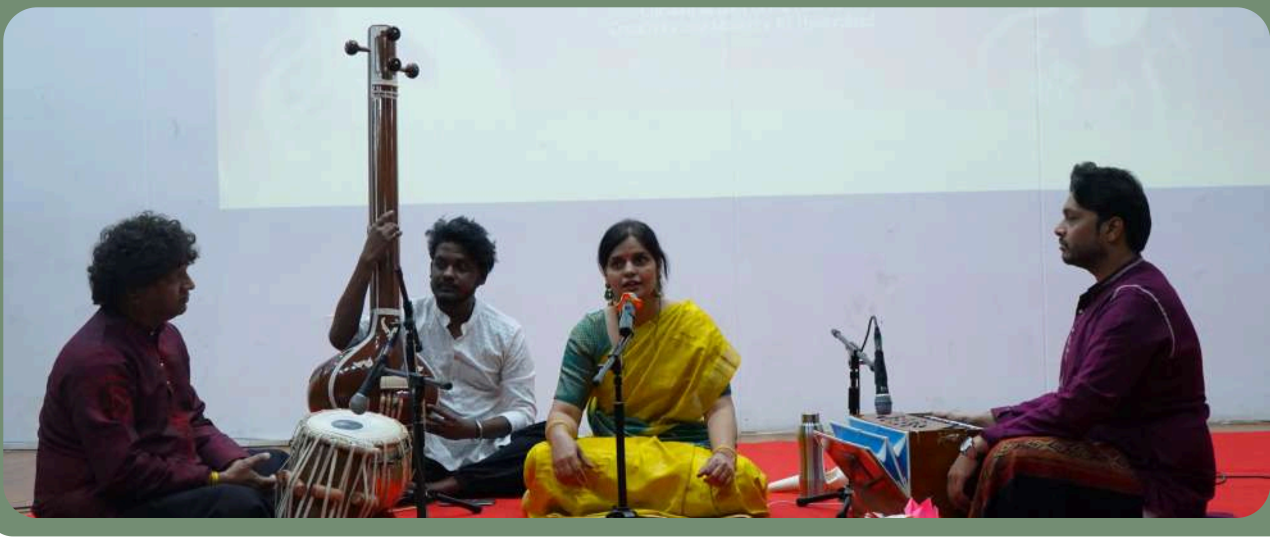
Department of Biomedical Engineering celebrated BMilaap 5.0

The Department of Biotechnology celebrated "Foundation Day 2025" under the theme "From Foundations to Frontiers

IITH hosted a soulful "Classical Evening" organized by SPIC MACAY, celebrating the rich heritage of Indian classical rhythm

The stage play "Aanand" was an another mesmerizing event by the team Spicmacay

The Department of Liberal Arts, IITH, organized Cadence, a soulful evening celebrating the richness of Hindustani classical music



IITH Commemorated 150 years of Vande Mataram

Collective reading of the "Preamble of the Constitution of India."

Hamamatsu Day Celebrations, highlighting Indo-Japanese collaboration

The Astro Rakugo Theatre at IITH captivated the audience with a unique blend of storytelling, astronomy, and cultural performance

IITH's RDC–Prayas hosted 'Prerna 2025' to inspire rural students and strengthen community engagement

IITH celebrated Ekta Diwas 2025 with a Run for Unity and Unity Pledge, honoring the spirit of unity and nation-building

IITH set 3 new records and won the Runner-up Trophy at the 39th Inter-IIT Aquatics Meet 2025

Ms Purva Kherkar, Lady Physical Training Instructor at IITH won 3 medals in the 23rd Asia Masters Athletics Championship

IITH's NCC Contingent shines at Combined Annual Training Camp (CATC) VII – 2025, Karimnagar

Fit India spirit echoes at the IITH Half Marathon 2025 as 2,200 runners take over the campus

IITH observed Vigilance Awareness Week 2025 with an Integrity Pledge & a session promoting integrity and transparency


IITH observed Vigilance Awareness Week 2025 with a talk by Shri Bolewar Babu, IOFS, ODF, emphasizing integrity, transparency, and accountability for a corruption-free society

As part of Vigilance Awareness Week 2025, Quiz and Debate Competitions were organized at IITH to promote integrity, ethics, and vigilance








3,000 saplings were planted by the Green Office using the Miyawaki plantation technique to strengthen green cover and biodiversity on campus

A beautiful new addition to the campus, IITH has inaugurated the Butterfly Garden on its Campus

IITH Successfully conducted Plantation Drives


Plantation Drive for the month of October


Plantation Drive for the month of November


Plantation Drive for the month of December

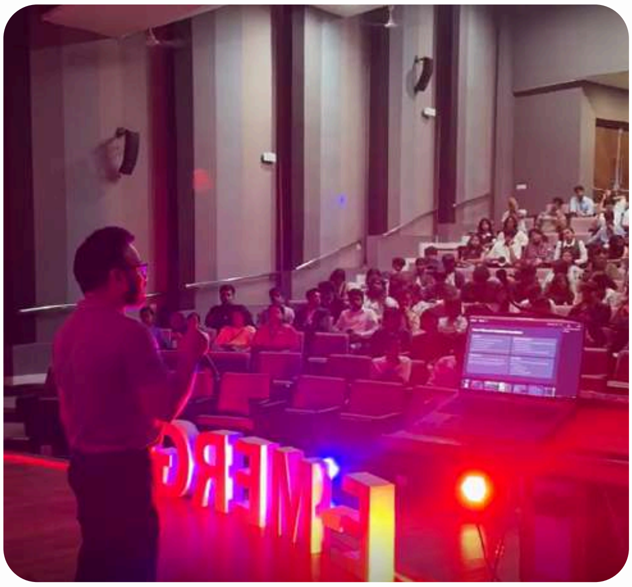
Grant Proposal Writing Workshop organized by the IITH under the ANRF PAIR Program in collaboration with the American Chemical Society

Science Communication Workshop organized by the IITH under ANRF PAIR Program in collaboration with America Chemical Society

IITH hosted the Rashtriya Karmayogi Master Trainer's Training Programme to empower large-scale capacity building in public service

IITH hosted the Rashtriya Karmayogi Master Trainer's Training Programme to empower large-scale capacity building in public service

E-Cell, IITH conducted Emerge 3.0, featuring inspiring talks by industry leaders and vibrant participation from students across 15+ colleges



The Milan Opening Ceremony at IITH marked a vibrant and memorable start, celebrating unity, talent, and the spirit of togetherness

Session on "Code. Build. Deploy." organized by Tinkerers' Lab, IITH (Student-led Makerspace)

Session on "From Circuits to Robots – Introduction to Mechatronics" organized by Tinkerers' Lab at IITH (Student-led Makerspace)

Session on "Machines that Learn – AI for Everyone" organized by Tinkerers' Lab, IIT Hyderabad (Student-led Makerspace)

Talk on "The Digital layering of social life: gender dynamics in today's world" by Prof Usha Raman Professor at the Dept of Communication, UoH

Dr. Sreetama Das delivered an insightful talk on quantum reservoir computing using Jaynes–Cummings models.

Department of Liberal Arts, organized a two-day Kaamera – A Gender and Work Film Festival

Session on "Technology /AI Leverage in Day-to-Day Life as an Entrepreneur"by Mr. Narasimha Rao Vadde CEO & Managing Director at BILVANTIS TECHNOLOGIES

IITH enthusiastically conducted the faculty orientation program 2025

Session on "From Circuits to Robots – Introduction to Mechatronics" organized by Tinkerers' Lab at IIT Hyderabad (Student-led Makerspace)

IITH hosted an inspiring Extra Mural Lecture by Acharya Prashant

Session on "Sustainability and Management Education: Reflections from Practices the World Over"by Prof. Amlan Bhusan, Chairperson at MBI Global, Oxford University

IIMATM2025, the Technical Exhibition at IIT Hyderabad showcased impactful industry–academia collaboration, bringing together leading exhibitors, researchers, and innovators to highlight advancements in materials and technology.

The Visual Voices of Kerala's Politics, a design-research project by Neetha Joseph Kalappurakkal, MDes and PhD scholar at the Department of Design, IITH, has been selected for exhibition at the Students' Biennale 2025, part of the Kochi-Muziris Biennale—India's largest contemporary art exhibition

IIT Hyderabad Signs MoU with Indian Railways to Advance Railway Innovation and Research

Collaboration with Bisleri International Pvt Ltd to implement the 'Bottles for Change' sustainability initiative on campus

Rajasthan Govt. engages IITH to build an AI-driven mineral exploration system, signing an MoU to use AI and Machine Learning for mapping critical minerals

TiHAN–IITH & Delhi Metro Rail Corporation (DMRC) signed MoU to Advance Autonomous Mobility and Strengthen Last-Mile Connectivity

IITH launched International Certificate Programme in Integrated Product–Service System (IPSS) Design, jointly developed by Department of Design, IITH, and POLI.design, in partnership with IICCI

An MoU with Phase Change Solutions to foster collaboration in advanced thermal and phase-change technologies

Prof. B. S. Murty,
Director, IIT Hyderabad

was conferred with the prestigious "Honorary Doctor of Engineering" by the Swinburne University of Technology, Australia

Prof. Deepak John Mathew
Department of Design

Received Lifetime Achievement Award in the field of Design Research by Design Research Council of India

Dr. Nithyanandan Kanagaraj
Department of Physics

Appointed as Associate Editor of the prestigious Journal IEEE Photonics Technology Letters, published by the Institute of Electrical and Electronics Engineers (IEEE)

Dr. Gaurav Sharma
Department of Biotechnology

for the open-science tool – GScholarLens, being featured in Nature, one of the world's most prestigious scientific journals

Dr. Sandipan Ray,
Department of BioTechnology

Received the Young Scientist Award at the 11th World Congress of Chronomedicine (WCC 2025)

Prof. Sushmee Badhulika
Department of Electrical Engineering

Received Clarivate "India Research Excellence – Citation Award 2025" in the category of Individual Researchers — Women in Research

Prof. C Malla Reddy
Department of Chemistry

conferred the prestigious"OPPI Scientist Award 2025" by the Organisation of Pharmaceutical Producers of India (OPPI)

Prof. Prem Pal, Dean (Administration)
Department of Physics

& Mr. Naveen Srivastava, Junior Hindi Translator

Received the Second Prize for Institute's Hindi E-Magazine Pravaat

Prof. Prem Pal, Dean (Administration)
Department of Physics

Received Third prize for Official language implementation in our institute

Dr. Chandrashekhar Lakavath
PhD scholar, Department Civil Engineering Engineering

Appointed as an Assistant Professor, Department of Civil Engineering, IIT (ISM) Dhanbad

Dr Neeraja Sinha
PhD Scholar, Department of Chemistry

honored with the Young Scientist Award in the Chemical Sciences by the Telangana Academy of Sciences

Mr. Lijin Lohithakshan
MDes student, Department of Design

Received the Best Documentary Film Award in his documentary film 'SWARAM' at the 5th Culture Cinema Film Festival

Dr. Ramunaidu Randhi

PhD Scholar, Department of Mathematics

Received the Best Faculty Award 2025 from the Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam,in recognition of his outstanding contributions to academics, research, and outreach

Mr Siddharth Shrivastava

PhD scholar
Department of Artificial Intelligence

Received the 2025 Global Google PhD Fellowship in Human-Computer Interaction

Mr Sunny Ladkat

PhD Scholar in Development Studies, Department of Liberal Arts

Received the Best Paper Award at the 3rd Doctoral Colloquium organised by the Madras Institute of Development Studies (MIDS), Chennai

Ms. Sadia Basri

PhD Scholar, Centre for Interdisciplinary Program

Received, the Best Oral Presentation Award,a Gift card worth 5000 JPY, and a Book voucher worth € 150 from Springer Natureat the 19th International Water Association, IWA Conference on Sludge Management, held in Kyoto, Japan

Mr. Yashwanth KB

PhD Scholar, Department of Biotechnology

Received the 2nd Prize in the Quiz Competition in the "Harnessing Artificial Intelligence for Multi-Omics Data Integration and Analysis"

Mr Siddharth Shrivastava

PhD Scholar, Department of Mechanical and Aerospace Engineering

Received the Taylor and Francis Best Oral Presentation Award at the International Conference on Micro-Nano Fluidics 2025

Mr. Sandeep Kumawat

Research scholar, Department of Chemistry

Received, the Best Poster Presentation Award & cash prize at the International Symposium on Frontiers in Sustainable Organic Synthesis and Chemical Biology

Mr Chinmay Barman

PhD scholar, Department of Physics

Received the Best Poster Awards in The XXIII International Workshop on the Physics of Semiconductor Devices 2025 (IWPSD 2025)

Mr Aakash Singh

PhD Scholar, Department of Physics

Received the Best Poster Awards in The XXIII International Workshop on the Physics of Semiconductor Devices 2025 (IWPSD 2025)

Mr. Aashish Sahu

PhD scholar, Department of Mechanical and Aerospace Engineering

Received the Best Poster Awards in The XXIII International Workshop on the Physics of Semiconductor Devices 2025 (IWPSD 2025)

Mr. N Shyam Sridhar

MTech Student, Department of Mechanical and Aerospace Engineering

Received the Best Poster Awards in The XXIII International Workshop on the Physics of Semiconductor Devices 2025 (IWPSD 2025)

Mr. S Rami Reddy

MTech, Mechanical and Aerospace Engineering

Received the Best Poster Awards in The XXIII International Workshop on the Physics of Semiconductor Devices 2025 (IWPSD 2025)

Faculty

Dr Puram Praveen has been appointed as an Assistant Professor in the Department of Entrepreneurship and Management, IIT Hyderabad. He has done a Ph.D. in Management from the Indian Institute of Management Kozhikode (IIMK) in 2024, with his thesis exploring the Sharing Economy in the Food-sector. He also works in the domains of Sports Analytics and Lean Thinking. Prior to joining here, he worked in the Institute of Management Technology (IMT), Hyderabad. He completed a B. Tech (Mech) in 2014 from Visvesvaraya National Institute of Technology (NIT), Nagpur, followed by 3 years in L&T Construction.

Dr Puram Praveen
Assistant Professor
Department of Entrepreneurship and Management

Dr Anupam Sanghi has been appointed as an Assistant Professor in the Department of Computer Science and Engineering, IIT Hyderabad. Before joining IITH, he was a Postdoctoral Researcher at TU Darmstadt, Germany. He also brings valuable industry research experience from his roles at IBM Research and Huawei Technologies, Bengaluru. He obtained his B.Tech. from JIIT, Noida, and his M.E. and Ph.D. from IISc, Bengaluru. His research interests include database systems, AI for databases, and database testing and benchmarking.

Dr Anupam Sanghi
Assistant Professor
Department of Computer Science and Engineering

Dr Abhijit Das has been appointed as an Assistant Professor in the Department of Computer Science and Engineering, IIT Hyderabad. Prior to joining IITH, Dr. Das was a Director of Research at UPC BarcelonaTech. Before that role, he was a Post-Doctoral Researcher with the TARAN team at INRIA. Earlier in his career, he briefly worked as a Senior Silicon Design Engineer at AMD. Dr. Das completed his B.Tech. at NERIST, Arunachal Pradesh, M.Tech. at NIT Silchar, and Ph.D. at IIT Guwahati. His research interests include computer architecture, systems for AI/ML, and quantum computing systems.

Dr Abhijit Das
Assistant Professor
Department of Computer Science and Engineering

Dr Rama Srinivas Varanasi has been appointed as an Assistant Professor in the Department of Material Science and Metallurgical Engineering, IITH. Prior to joining IITH in 2025, Rama Srinivas was a JSPS Postdoctoral fellow/Specially Appointed Assistant Professor at the Institute for Materials Research, Tohoku University in Japan during 2021-2025. Dr. Rama Srinivas received his Ph.D. from the Max Planck Institute for Sustainable Materials in 2021. Before his Ph.D., he completed his dual degree from the Department of Metallurgical and Materials Engineering, IIT Madras, in 2017. His research interests include near atomic-scale design of engineering materials enabled by the use of atom probe tomography, with a focus on steels and alloy design strategies to mitigate hydrogen embrittlement.

Dr Rama Srinivas
Assistant Professor
Department of Material Science and Metallurgical Engineering

Dr Gogulapati Sreedurga has been appointed as an Assistant Professor in the Department of Artificial Intelligence, IIT Hyderabad. Prior to joining IITH in 2025, Dr. Sreedurga was a DeepMind Academic fellow at School of Informatics, University of Edinburgh, UK. Dr. Sreedurga did her B.Tech. in Computer Science and Engineering from IIIT Jabalpur obtaining a gold medal. She obtained her Ph.D. degree from IISc Bangalore and received a special commendation award. Her research interests are in the fields of social choice theory, algorithms, game theory, and multi-agent systems.

Dr Gogulapati Sreedurga
Assistant Professor
Department of Artificial Intelligence

Dr Manaswi Paraashar has been appointed as an Assistant Professor in the Department of Computer Science and Engineering, IIT Hyderabad. Prior to joining IITH in 2025, Dr. Paraashar was a postdoctoral fellow at the University of Copenhagen, Denmark from 2023. Before working at the University of Copenhagen, he was a postdoctoral fellow at Aarhus University, Denmark. Manaswi did his B.Tech. from IIT Kharagpur, and obtained his M.Tech. and Ph.D. degrees from ISI Kolkata. His research interests are in the fields of quantum computing and computational complexity theory.

Dr Manaswi Paraashar
Assistant Professor
Department of Computer Science and Engineering

Dr Ashish Kulkarni has been appointed as an Assistant Professor in the Department of Chemistry at IIT Hyderabad. Before joining IIT Hyderabad in December 2025, Ashish Kulkarni was an Assistant Professor at IIT Tirupati starting in March 2025. Prior to working at IIT Tirupati, he was a postdoctoral fellow at the University of Cologne (as a DAAD-PRIME Fellow), and Forschungezentrum Jülich (Research Center Jülich), Germany, visiting postdoctoral researcher at NIMS, Japan, and JSPS Fellow at Toin University of Yokohama, Japan. Dr. Kulkarni did his 5-year Integrated MSChemistry from IIT Roorkee and obtained his Ph.D. degree under the supervision of Prof. Tsutomu Miyasaka (inventor of perovskite solar cells) at Toin University of Yokohama, Japan.

Dr Ashish Kulkarni
Assistant Professor
Department of Chemistry

Non-Teaching Staff

Mr Vikas Kumar Nagal retired as a Lieutenant Colonel with rich experience of serving in the Indian Army, Corps of Engineers for 23 years, having served in all border areas and extreme climatic conditions. During his service, he completed his B.Tech. in Civil Engineering and earned his Master of Technology from the IIT, Kharagpur. Continuing his academic pursuits, he is currently a Research Scholar at the Indian Institute of Management, Shillong, in OB & HR, focusing on leadership challenges in the digital era. He brings experience of working with the Military Engineer Services, where he was involved in the construction and maintenance of G+16 buildings and other associated infrastructure in Bombay, Daman, and Dahanu with the Indian Navy and Indian Coast Guard.

Mr Vikas Kumar Nagal
Superintending Engineer
Construction and maintenance Division

Mr Vinay Kumar holds a Bachelor's and Master's Degree in Mass Communication & Journalism, as well as a Post Graduate Diploma in Advertising & Public Relations from the prestigious Indian Institute of Mass Communication (IIMC), New Delhi. With over 8 years of professional experience, Mr. Vinay has contributed extensively to Public Relations, Media Management, Communication Strategy, and Development Communication. He has worked with leading Government Ministries including the Ministry of Health and Family Welfare, Ministry of Education, Ministry of Youth Affairs and Sports, and organizations such as TATA Trusts. A UNESCO Awardee, Mr. Vinay has also made significant contributions to Disability Empowerment, Inclusion, and Accessibility.

Mr Vinay Kumar
Public Relations Officer
Office of Alumni and Corporate Relations

Mr Muthukumar S has done B.Tech. in Chemical Engineering from Anna University in 2016. He has worked with leading institutes such as CSIR–NEERI, IIT Madras, and CSIR–CECRI on projects related to Air Quality Assessment, Emission Inventory Development, and Environmental Impact Studies. As a Chief Minister's Green Fellow in Tirunelveli District, he coordinated key initiatives focusing on Climate Action, Green Schools, Mangrove Plantation, and Sustainable Development. His areas of interest include Air Pollution Studies, Environmental Monitoring, and Sustainable Infrastructure.

Mr Muthukumar S
Junior Technician
Chemical Engineering

Mr Battula Venkata Naga Avinash has done BTech in Electrical & Electronics Engineering from R.V.R & J.C.C.E, Guntur. After completion of his education, he joined as Junior Telecom Officer in Bharat Sanchar Nigam Limited.

He has more than 7 years and 9 Months of experience in the field of Maintenance of Batteries, Power plants, exchanges, and Handling Public complaints.

Mr Battula Venkata Naga Avinash

Junior Engineer (Electrical)
Construction and Maintenence Division

Mr Shaiyyam Sakib Sabba has done Diploma in Tool and Die Making from Govt. Tool Room and Training Centre, Dumka (Jharkhand). After completion of his education, he joined Jharkhand Govt. Tool Room, Dumka as a Technician and was later selected as Junior Technician in Central Workshop at IITH.

He has more than 9 years of experience in the field of CNC Lathe and CNC Milling Programming and Operation, conventional lathe, Milling, Grinding, Design in Autocad.

Mr Shaiyyam Sakib Sabba

Junior Technician
Central Workshop

Mr Kammari Habibulla holds a BTech in Electrical and Electronics Engineering from Nimra College Of Engineering and Technology. He began his career as an Electrical Testing Engineer at M/s Yathva Energy Solutions Pvt Ltd and left the Organization in the capacity of Senior Testing Engineer. Subsequently, He worked as an Electrical Signal Maintainer in the Signal & Telecom department of the South Central Railway, Guntakal division, from March 18, 2020, to October 14, 2025. In total,HeI have accumulated more than eight years of extensive experience spanning both the electrical and telecom fields.

Mr Kammari Habibulla

Junior Engineer (Electrical)
Construction and Maintenence Division

Mr Palthyavath Vijay Kumar completed his B.Tech in Electronics and Instrumentation Engineering (EIE) from VNR VJIET (Autonomous) in 2017.
He have 5 years of experience as a Service Engineer with Samtec Healthcare. Where he has worked on CT scan and Digital Imaging (DI) equipment.
He joined IIT Hyderabad, where he support laboratory operations, equipment maintenance, instrumentation setups, and technical assistance for academic and research activities.His areas of interest include Electrical Systems, Instrumentation, Sensors, Measurement Systems and Electronic Diagnostics.

Mr Palthyavath Vijay Kumar

Junior Technician
Electrical Engineering

Anecdote of the Cover Page

The picture tells us, IIT Hyderabad is a green campus. It is a place where new technology (solar, energy efficent research) and smart habits (cycling, recycling) work together to create a clean and sustainable future. The student chooses to ride a bicycle instead of a car or scooter. This means zero pollution for traveling around campus. It shows that small, daily choices are important for a healthy planet. The building roofs are energy efficient, with solar panels utilizing the natural resources for clean electricity and windmills showcasing clean energy. The large green and brown bins show that students and the broader campus community sort their waste for recycling. This helps to reuse materials and reduce waste.

Capturing feathered friends@IITH

Purple sunbird, male (Cinnyris asiaticus)

Image: Dr Gopinath Muvvala, Department of Mechanical and Aerospace Engineering

Purple-rumped sunbird, male (Leptocoma zeylonica)

Image: Dr Gopinath Muvvala, Department of Mechanical and Aerospace Engineering

Top right, likely Great Cormorant (Phalacrocorax carbo); Rest, Indian Cormorant (Phalacrocorax fuscicollis)

Image: Dr. Avinash Eranki, Department of Biomedical Engineering

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https://pr.iith.ac.in/newsletter/about.html

భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad