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Implications for Power and Environment

SPECIAL HIGHLIGHTS

India's Energy Crisis Problem is not Isolated—Rather Structural

Sustainability Meets Infrastructure

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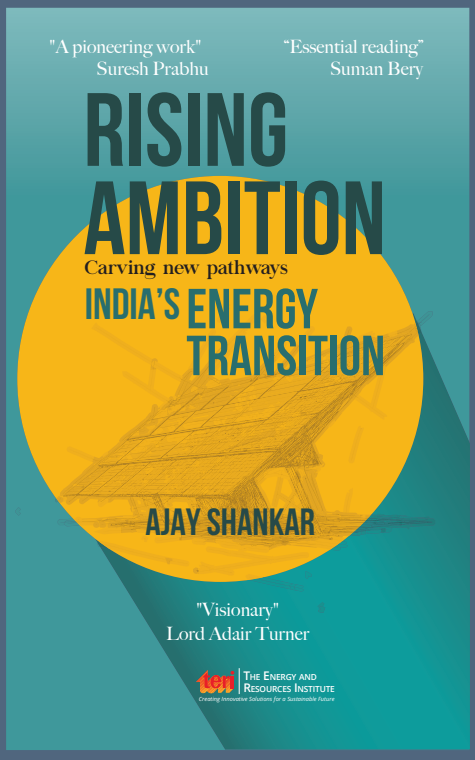
When Sunshine Returned to Our Kitchen

IN CONVERSATION

Harsh Singhal, Founder & CEO of NetZero Labs



teri



Rising Ambition Carving New Pathways India's Energy Transition

Ajay Shankar
Distinguished Fellow
The Energy and Resources Institute (TERI)

India aims to become net zero by 2070. This book sets out the pathways to net zero with key milestones. It suggests policy choices and ways to minimize the cost of this fundamental transition deriving lessons from the remarkable success that has been achieved in renewables. It makes the case that moving away from fossil fuels would also help India become a developed country with a competitive green economy.

Year: 2025
Size: 5 inch x 8 inch
Pages: 244
ISBN: 978-93-94657-19-9
Price: ₹495.00

"A meticulously documented analysis of India's decarbonization possibilities by one of our most thoughtful and experienced administrative scholars."

Suman Bery
Vice Chair, NITI-Aayog

"Becoming net zero while continuing to grow the economy would be one of India's critical challenges in the future. This is a pioneering work which gives an excellent and comprehensive analysis of the challenges and the best way to succeed."

Suresh Prabhu
Former Union Minister, Government of India

"Rising Ambition is analytically robust but also visionary and a critical guide to how India can both become a rich developed nation and make a major contribution to avoiding the potential catastrophe of global warming."

Lord Adair Turner
Chair Energy Transitions Commission

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EDITORIAL



> As nations embrace the benefits of digitalization, sustainability must remain a central consideration in planning future infrastructure.

The digital economy is rapidly becoming one of the defining pillars of contemporary development. From cloud computing and e-commerce to artificial intelligence (AI) and digital governance, data-driven technologies now shape how societies function, businesses operate, and citizens engage with services. As digital transformation accelerates, the physical infrastructure that supports this ecosystem is expanding at an unprecedented pace, bringing both opportunities and challenges.

At the centre of this transformation are data centres—the facilities that store, process, and transmit the enormous volumes of information generated every day. While largely invisible to the public, they have become indispensable to modern life. The growing adoption of AI, in particular, is driving demand for larger and more powerful data centres capable of handling increasingly complex computing requirements.

Yet, the rapid expansion of these facilities raises important sustainability concerns. Data centres require vast amounts of electricity to operate continuously and significant quantities of water to maintain optimal operating temperatures. As their scale increases, so do questions related to energy security, greenhouse gas emissions, resource consumption, and environmental impacts. For developing economies such as India, where digital growth coincides with rising energy demand and resource constraints, these challenges warrant careful consideration.

The cover story in this issue examines the evolving landscape of data centres and their implications for power systems, natural resources, and the environment. It explores how the sector's growth could reshape electricity consumption patterns, necessitate investments in generation, transmission, and energy storage infrastructure, and intensify efforts to secure reliable and sustainable sources of power. The article also draws attention to the often-overlooked issue of water consumption and highlights the importance of developing more efficient cooling technologies and resource-conscious operational practices.

As nations embrace the benefits of digitalization, sustainability must remain a central consideration in planning future infrastructure. Technological progress and environmental responsibility need not be opposing goals; rather, they must advance together. The challenge before policymakers, industry leaders, utilities, and consumers is to ensure that the digital infrastructure of tomorrow is not only efficient and resilient but also values its ecological footprint.

We hope this issue encourages an extensive dialogue on how the foundations of the digital age can be strengthened while remaining aligned with the principles of sustainability, resource efficiency, and long-term environmental stewardship.



Vibha Dhawan
Director-General, TERI



The June 2026 cover story, Homes that Nurture Nature and Togetherness, offers a refreshing perspective on sustainability by reminding readers that environmental stewardship begins at home. Instead of focusing solely on advanced technologies or large-scale policy interventions, the article convincingly demonstrates how thoughtful architectural design and everyday choices can foster ecological balance while strengthening family and community bonds. I was particularly struck by the concept of a "720-degree approach" to design, which recognizes the interconnectedness between the built environment, natural ecosystems, and human values. The suggestions to incorporate indigenous plants, bird-friendly spaces, and well-designed balconies and terraces are practical and inspiring. Equally compelling is the emphasis on reimagining the kitchen as the heart of the home—a space that encourages respect for food, minimizes waste, and promotes shared responsibility across family members. As cities continue to expand vertically, this article serves as a timely reminder that sustainable living is not measured by the size of our homes but by the values they embody. It is an insightful and thought-provoking contribution that deserves to be widely read by homeowners, architects, and urban planners alike.

Ahana N Deshpande
Mumbai, Maharashtra

The feature article Rising Temperatures: Drivers, Implications, and the Way Forward is a timely reminder that extreme heat is no longer an occasional weather event but a defining challenge of our times. I particularly appreciated the article's lucid explanation of how climate change and the urban heat island effect together intensify heat stress in cities. Equally important were the practical solutions it proposed, including green infrastructure, reflective building materials, and improved urban planning. As India experiences increasingly frequent and severe heatwaves, such evidence-based discussions are essential for policymakers as well as citizens. The article effectively highlights that building heat-resilient cities requires collective action, informed planning, and greater public awareness. It is an insightful contribution to the ongoing climate discourse.

Amit Basu
New Delhi

Published by Dr Vibha Dhawan on behalf of The Energy and Resources Institute, Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003. Editor-in-chief Dr Vibha Dhawan

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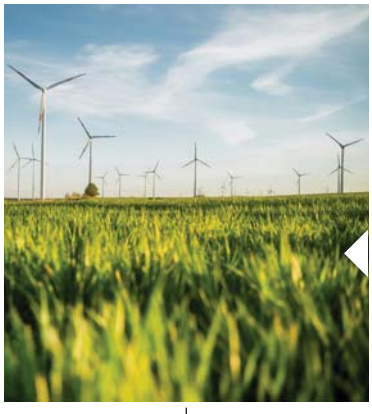
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India Reinforces Green Development through Integrated Conservation

India has reiterated its commitment to sustainable development by integrating biodiversity conservation, ecosystem restoration, pollution control, renewable energy expansion, and climate resilience into national development planning. Recent government assessments highlight improvements in forest cover, mangrove restoration, wetland conservation, river rejuvenation, and wildlife recovery through sustained policy interventions. Officials emphasize that environmental sustainability will remain central to India's economic growth strategy, with continued investments in clean energy, ecosystem restoration, and climate adaptation. The integrated approach seeks to ensure that development objectives are pursued alongside ecological protection and long-term environmental security.

Source: Press Information Bureau

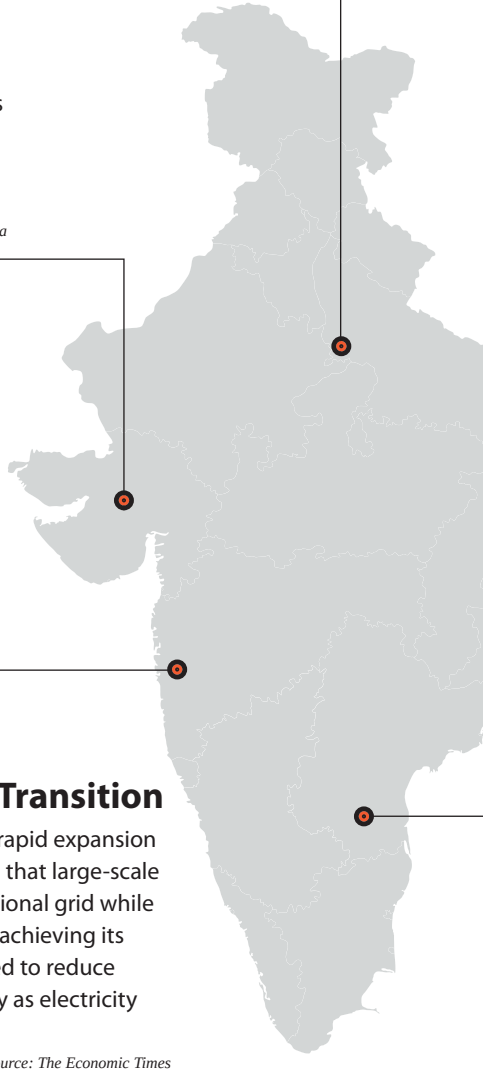
Human–Lion Conflict in Gujarat Prompts Scientific Investigation

Growing instances of human–lion conflict around Gujarat's Gir landscape have prompted the state government to commission the Wildlife Institute of India to undertake a comprehensive scientific study. Researchers will investigate changes in lion behaviour, habitat use, prey availability, and movement corridors to identify factors driving increased encounters between people and wildlife. Conservation experts believe that evidence-based management strategies are essential for safeguarding both local communities and the globally significant Asiatic lion population. The initiative reflects India's evolving approach towards landscape-level wildlife conservation that integrates ecological science with community safety.

Source: The Times of India; Mongabay India



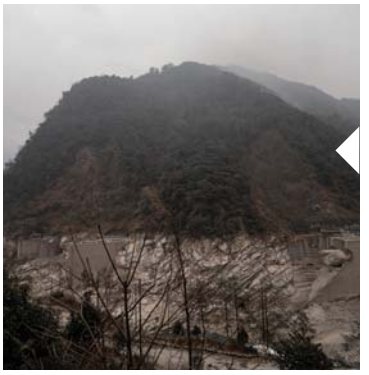




India Accelerates Battery Storage to Power Clean Energy Transition

India is stepping up investments in battery energy storage systems (BESS) to complement the rapid expansion of solar and wind power. Union Minister for New and Renewable Energy Shri Pralhad Joshi said that large-scale storage infrastructure will be crucial for integrating intermittent renewable energy into the national grid while ensuring reliable electricity supply. The government views battery storage as a key enabler for achieving its target of 500 GW of non-fossil fuel capacity by 2030. Enhanced storage capacity is also expected to reduce curtailment of renewable power, improve grid resilience, and strengthen India's energy security as electricity demand continues to grow.

Source: The Economic Times



Sikkim Tunnel Accident Raises Questions on Hydropower Safety

A tragic explosion inside an under-construction tunnel at NHPC's Teesta Stage-VI Hydroelectric Project in South Sikkim claimed several lives and highlighted the occupational risks associated with large infrastructure projects in ecologically sensitive Himalayan regions. Preliminary investigations suggest that methane accumulation may have triggered the blast. Rescue operations involving the NDRF, SDRF, and NHPC teams continued under challenging conditions due to toxic gases inside the tunnel. The incident has renewed calls for stricter geological assessments, enhanced worker safety protocols, and improved disaster preparedness in hydropower projects located in fragile mountain ecosystems.

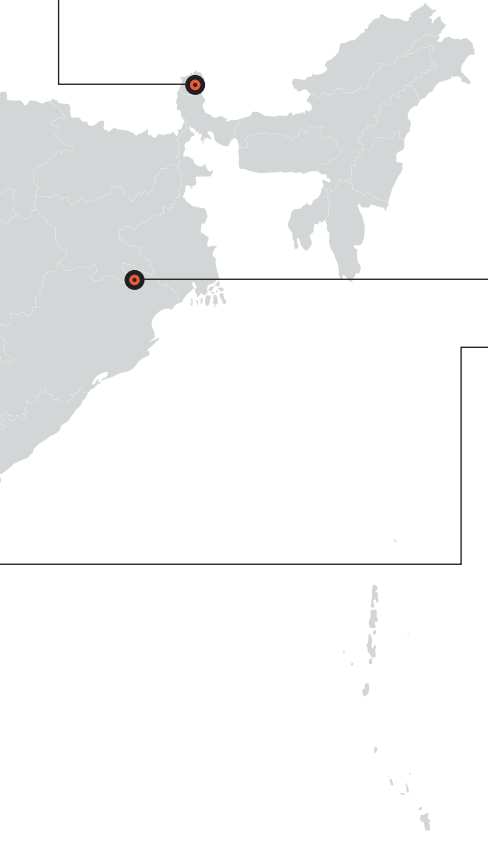
Source: People.com

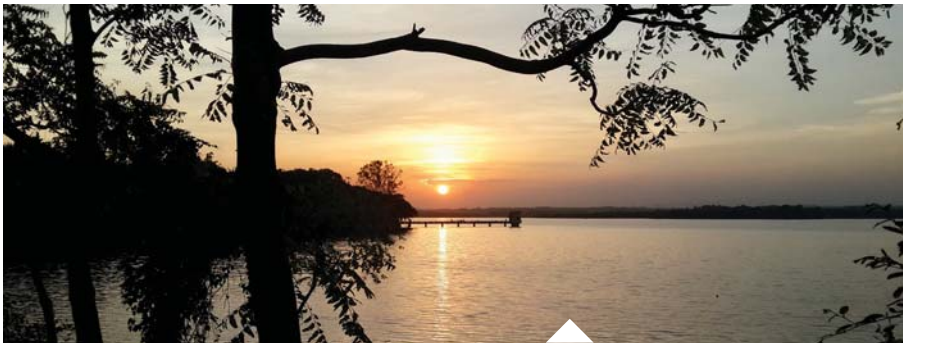
World Snake Day Draws Attention to India's Reptile Diversity

World Snake Day, observed on July 16, highlighted the ecological importance of India's diverse snake fauna. Home to more than 300 snake species, India supports a remarkable range of reptiles that play a vital role in maintaining ecosystem balance through rodent control and food-web regulation. Conservationists used the occasion to raise awareness about habitat loss, illegal wildlife trade, and misconceptions surrounding snakes. Species such as the King Cobra, Indian Rock Python, Russell's Viper, and Common Krait were showcased to promote scientific understanding and encourage coexistence between people and wildlife.

Source: The Times of India







Ecopreneur Awards Showcase India's Green Business Leadership

India's transition towards a greener economy received a boost as the Ecopreneur Awards 2026 recognized entrepreneurs driving sustainable innovation across sectors. The awards celebrated businesses working on renewable energy, waste management, circular economy solutions, sustainable manufacturing, green mobility, and resource-efficient technologies. Organizers noted that environmentally responsible enterprises are becoming increasingly important in supporting India's climate goals while creating jobs and promoting inclusive economic growth. Experts believe that encouraging green entrepreneurship can accelerate sustainable industrial development and strengthen India's leadership in clean technologies and responsible business practices.

Source: The Times of India



Wales Declares Drought after Historic Rainfall Deficit

Authorities in Wales officially declared drought in several regions after prolonged heatwaves and exceptionally low rainfall pushed rivers to record-low levels. July 2026 is projected to become the driest month in nearly two centuries, affecting freshwater ecosystems, agriculture, and water security. Water utilities introduced restrictions, including hosepipe bans, while environmental agencies warned of mounting ecological stress on rivers and wetlands. Climate scientists noted that rising global temperatures are increasing the likelihood of prolonged summer droughts across Europe, highlighting the need for improved water management, climate adaptation, and ecosystem resilience.

Source: The Guardian





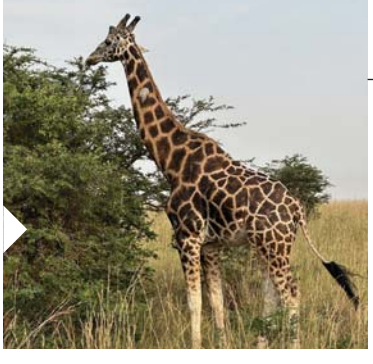
Biodiversity Experts Convene to Advance Global Nature Targets

Scientists, policymakers, and conservation practitioners gathered on July 27 for the twenty-eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-28) under the Convention on Biological Diversity. The meeting is preparing scientific recommendations for CBD COP17, scheduled later this year in Armenia. Discussions focus on accelerating implementation of the Kunming–Montreal Global Biodiversity Framework through ecosystem restoration, species recovery, sustainable resource use, invasive species management, and biodiversity finance. Experts believe that the outcomes of SBSTTA-28 will play a critical role in shaping international biodiversity policy and strengthening global efforts to halt and reverse nature loss by 2030.

Source: Convention on Biological Diversity; Global Landscapes Forum

Uganda Relocates Endangered Giraffes to Safer Habitat

Uganda has begun relocating endangered Nubian giraffes from Murchison Falls National Park to the Ajai Wildlife Reserve as part of an ambitious conservation programme aimed at reducing pressures from expanding oil development and habitat degradation. Wildlife authorities expect the translocation to strengthen giraffe populations while restoring biodiversity in the protected reserve. The initiative also supports broader ecological restoration efforts involving the reintroduction of several native species. Conservationists believe that combining habitat restoration with community participation and eco-tourism can improve long-term wildlife protection while creating sustainable livelihood opportunities for local communities.



Source: Associated Press, 24 July 2026.

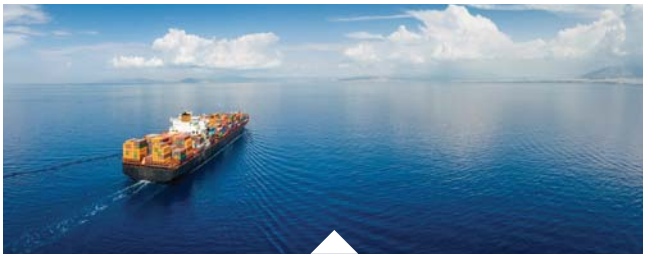


Plastic-Free July Campaign Highlights Need for Systemic Change

The global Plastic Free July campaign gathered momentum across more than 190 countries, encouraging individuals, businesses, and governments to reduce dependence on single-use plastics. Environmental organizations emphasized that while individual behaviour is important, long-term solutions require stronger regulations, reusable packaging systems, producer responsibility, and sustainable product design. Campaigns throughout July highlighted the links between plastic pollution, biodiversity loss, chemical contamination, and climate change. Experts argued that the movement is increasingly evolving from a consumer awareness initiative into a broader call for structural reforms that support circular economy principles and sustainable production systems.

Source: Plastic Free July Foundation; Pacific Environment Newsletter





High Seas Treaty Begins Transforming Global Ocean Governance

The landmark High Seas Treaty, which entered into force earlier this year, continued to shape international discussions on marine biodiversity during July. Governments and conservation experts worked on mechanisms to establish marine protected areas in international waters, strengthen environmental impact assessments, and ensure equitable sharing of marine genetic resources. Covering nearly two-thirds of the world's oceans beyond national jurisdiction, the treaty is expected to become a cornerstone of global ocean conservation. Experts believe its successful implementation could significantly improve protection of marine ecosystems, migratory species, and deep-sea biodiversity while enhancing resilience against climate change and overexploitation.

Source: United Nations; High Seas Treaty Secretariat.

Indonesia Strengthens Sustainable Investment Agenda

Indonesia has intensified efforts to attract sustainable investment through preparations for the Indonesia Sustainability Forum 2026. Government officials have highlighted green industrial development, renewable energy, critical minerals, sustainable infrastructure, and climate-resilient economic growth as priority areas for international collaboration. The initiative seeks to position Indonesia as a regional hub for sustainable investment while balancing industrial development with environmental protection and ecosystem conservation.

Source: Indonesia Sustainability Forum; ANTARA News



Lighting the Last Mile

How TERI's LaBL 2.0 Can Accelerate India's SDG 7 Journey

India has made remarkable progress towards SDG 7 by expanding renewable energy capacity, with non-fossil sources now accounting for over half of its installed electricity capacity. However, ensuring reliable and productive energy access for underserved communities remains a challenge. TERI's Lighting a Billion Lives (LaBL) 2.0 addresses this gap by promoting decentralized renewable energy solutions that support rural livelihoods, entrepreneurship, and traditional industries. By transforming clean energy into a driver of inclusive growth, LaBL 2.0 advances multiple Sustainable Development Goals while accelerating India's energy transition, say **Dr Amit Kumar Thakur** and **Dr Kanika Chowdhary** in this article.

India's clean energy transition has emerged as one of the country's most significant development achievements over the past decade. The 2026 Sustainable Development Report[1] by the UN Sustainable Development Solutions Network (SDSN) reflects this progress, with India improving its overall SDG Index ranking by 18 places, rising to 94th among 169 countries with an overall score of 68.3, representing a 9.6 percentage point increase since 2015.

This momentum is increasingly being reinforced at the local level. For instance, Bhopal's pioneering Voluntary Local Review, developed with UN-Habitat, signals that achieving the SDGs will increasingly depend on locally led solutions that translate national commitments into measurable community outcomes. While the country has made notable strides across several Sustainable Development Goals, SDG 7 (Affordable and Clean Energy) stands out as a cornerstone of India's broader climate and development agenda.

India's progress under SDG 7 has been driven by ambitious policy reforms, technological innovation, and sustained public investment. The country has committed to achieving 500 GW of non-fossil fuel electricity capacity by 2030, supported by competitive renewable energy auctions, large-scale solar parks, and rapidly declining solar photovoltaic costs. As of January 2026, India's installed electricity capacity reached 520.5 GW, with 271.97 GW—more than 52 per cent—coming from non-fossil sources, including 263.19 GW of renewable energy and 8.78 GW of nuclear power. Renewable energy alone now accounts for 51.55 per cent of the country's installed electricity capacity, representing a historic structural shift in India's energy mix.



Yet the challenge before SDG 7 is no longer confined to expanding electricity generation or increasing renewable capacity. The next phase requires ensuring that clean energy is reliable, affordable, productive, and inclusive, particularly for rural, remote, and economically vulnerable communities. Many regions continue to experience unreliable electricity supply, weak distribution infrastructure, and limited opportunities to convert energy access into improved livelihoods. Achieving SDG 7 by 2030 therefore demands solutions that go beyond electrification and create tangible socio-economic benefits at the community level.

1 Details available at <https://dashboards.sdgindex.org/>

This is where TERI's Lighting a Billion Lives (LaBL)[2] 2.0 offers a transformative approach. Building upon TERI's globally acclaimed Lighting a Billion Lives initiative, LaBL 2.0 moves beyond providing basic lighting to enabling productive use of clean energy. It represents a shift from energy for consumption to energy for production, recognizing that sustainable energy access should directly support livelihoods, enterprise development, local resilience, and economic empowerment. Rather than treating electricity merely as an essential service, the initiative positions clean energy as a catalyst for rural prosperity.

LaBL 2.0 promotes decentralized renewable energy solutions that power micro-enterprises, agricultural activities, and traditional occupations, particularly in regions where centralized infrastructure alone cannot adequately meet local needs. Such decentralized systems complement national grid expansion while improving energy reliability, reducing dependence on fossil fuels, and strengthening climate resilience.

2 Details available at <https://labl.teriin.org/>



A compelling demonstration of this approach is the Pokhran pottery cluster in Rajasthan, where around 150–180 artisan households are being supported through hybrid solar energy systems. The intervention mechanizes pottery production, reduces energy costs by nearly 70 per cent, increases productivity, and encourages greater participation of younger generations in preserving traditional crafts. By lowering production costs and enhancing competitiveness, clean energy becomes an instrument for both economic development and cultural preservation.

This productive-use model addresses several of the remaining gaps under SDG 7. It improves energy reliability in underserved regions through decentralized renewable systems, reduces operational costs for rural enterprises, creates new income opportunities and strengthens community resilience against climate and economic shocks.

The significance of LaBL 2.0 also extends beyond SDG 7. By enabling entrepreneurship, supporting local industries, and fostering climate-resilient livelihoods, the initiative contributes simultaneously to poverty reduction, decent work, innovation, sustainable communities, and climate action. It demonstrates how affordable and clean energy can serve as an enabling platform for achieving multiple SDGs through integrated local development.

India has built the infrastructure for a clean energy future; the next step is ensuring that energy reaches the last mile to transform lives and livelihoods. If the first phase of India's energy transition focused on lighting homes, the next must focus on lighting livelihoods.

TERI's Lighting a Billion Lives 2.0 embodies this vision by transforming clean energy into an engine of inclusive growth. As India advances towards achieving SDG 7, initiatives such as LaBL 2.0 offer a scalable pathway for bridging the remaining gaps, ensuring that the country's energy transition is measured not merely by gigawatts installed, but by the millions of lives empowered through affordable, reliable, inclusive, and productive clean energy. ■



Dr Amit Kumar Thakur, Associate Director, Social Transformation and CSR, and
Dr Kanika Chowdhary, Associate Fellow, Social Transformation and CSR, TERI. This article was originally published on the TERI website (https://teriin.org/).

Pesticide Puts Bumblebees at Risk

A Hidden Threat

A next-generation pesticide designed to kill crop pests may also be interfering with the reproductive health of bumblebees. Researchers discovered that low-dose exposure to sulfoxaflor changed gene activity, especially in tissues involved in reproduction, raising concerns about long-term impacts on bee populations. Because pollinators are essential for about one-third of the world's food production, finding ways to protect them while controlling pests has become increasingly important.

Bumblebees may be small, measuring only about an inch long, but they play an enormous role in global agriculture. About one-third of the world's food production relies on pollinators such as bees. At the same time, these vital insects face growing pressure from pesticides and other environmental threats. Modern pesticides have helped farmers protect crops and increase yields, but some can also damage the pollinators that make many harvests possible. One such chemical is sulfoxaflor, a next generation pesticide introduced in 2013 to eliminate



sap feeding insects such as aphids on crops including soybeans and corn. While sulfoxaflor is effective against pests, it is also known to be toxic to bees. Scientists are now uncovering how even low levels of exposure may affect bee reproduction at the molecular level.

Common Pesticide Alters Bee Gene Activity

Researchers at the Georgia Institute of Technology found evidence that sulfoxaflor changes both gene activity and reproductive function in bumblebees. In the US Department of Agriculture funded study, worker bumblebees were exposed to low doses of the pesticide before researchers examined changes in their gene expression.

The largest changes appeared in ovarian tissue, suggesting that the pesticide may interfere with reproductive processes. According to the researchers, these genetic changes could reduce the number of offspring produced and, over time, contribute to declining bee populations.

To investigate these effects, the team flash froze bee tissues and analysed their RNA to measure how gene activity changed after pesticide exposure. They also used computational models to identify the biological systems most



affected by the chemical. "What makes this study exciting is that it connects molecular changes in gene expression to real-world consequences for individual bees and their colonies," said Michael Goodisman, a professor in the School of Biological Sciences. "That type of connection is rare and gives us a much clearer picture of how pesticides affect bees."

Balancing Pest Control and Pollinator Protection

The findings underscore an ongoing challenge for modern agriculture: protecting crops from destructive pests without harming the beneficial insects that support food production. "We need pesticides to control crop pests, but they can also harm essential non-target insects like bumblebees," said Sarah Orr, who led the research as a postdoctoral fellow at Georgia Tech and now works as an assistant professor at the University of Tampa. "As a scientist, my goal is to identify practical solutions that support pest management while also protecting beneficial insects and the food systems that depend on them."

Orr emphasized that maintaining healthy bee populations is essential for successful pollination. "We need many bees for successful pollination," Orr said. "If they're not producing enough offspring, pollination will decline."



Bumblebees Face Multiple Threats

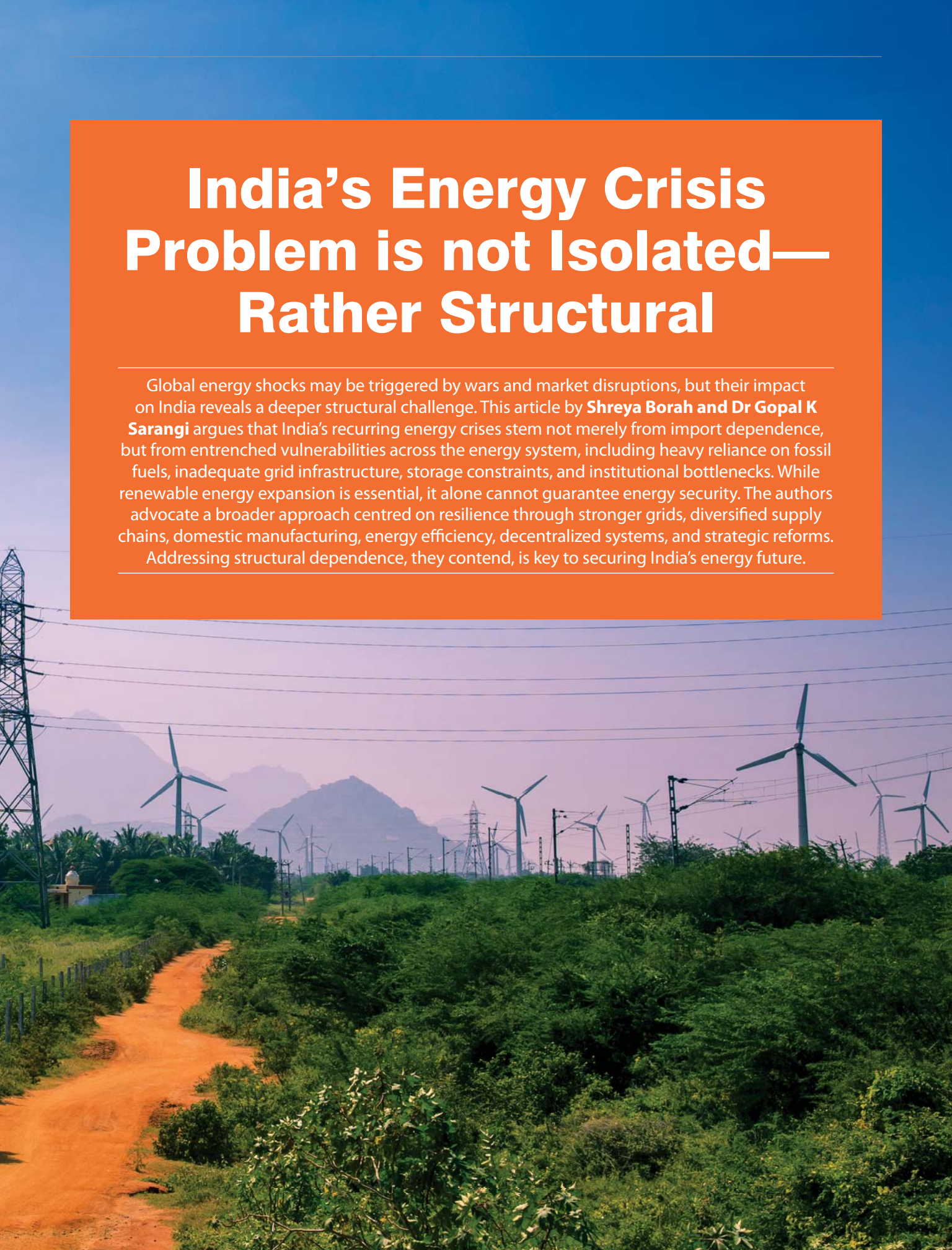
Pesticides are only one of several challenges affecting bumblebees. Rising temperatures and increasingly frequent heatwaves are adding even more stress to pollinator populations. By gaining a better understanding of how chemicals such as sulfoxaflor influence bee biology, researchers hope to develop farming practices that protect crops while also safeguarding the pollinators that many food systems depend on. ■

Source: https://www.sciencedaily.com/news/top/environment/



India's Energy Crisis Problem is not Isolated—Rather Structural

Global energy shocks may be triggered by wars and market disruptions, but their impact on India reveals a deeper structural challenge. This article by **Shreya Borah and Dr Gopal K Sarangi** argues that India's recurring energy crises stem not merely from import dependence, but from entrenched vulnerabilities across the energy system, including heavy reliance on fossil fuels, inadequate grid infrastructure, storage constraints, and institutional bottlenecks. While renewable energy expansion is essential, it alone cannot guarantee energy security. The authors advocate a broader approach centred on resilience through stronger grids, diversified supply chains, domestic manufacturing, energy efficiency, decentralized systems, and strategic reforms. Addressing structural dependence, they contend, is key to securing India's energy future.





Unfolding of the Crisis

War-triggered disruptions have once again unravelled the ugly face of the global energy crisis. The International Energy Agency (IEA) has termed it an "unprecedented disruption" to global fuel markets, urging member countries to release emergency oil stocks and implement demand-side measures to combat supply shortages and curb soaring energy prices. The current crisis appears to be more severe and consequential than historical episodes, such as those in 1973, 1979, and 2022. For heavily energy import-dependent economies like India, such disruptions have both short-term and long-term impacts. In the short term, impacts are reflected in supply scarcity, price rises, fuel tax readjustments, and shifts in cooking options; in the long term, they manifest as macro-economic destabilization, including rising inflation, industrial slowdown, fiscal stress, and the depletion of precious foreign exchange reserves, inter alia.

What distinguishes the present crisis is not just its scale and magnitude, but its systemic reach, spanning energy markets, global supply chains, and macroeconomic structures. Disruptions at critical chokepoints such as the Strait of Hormuz, through which nearly 20 million barrels per day[1] —about 25 per cent of global seaborne oil trade—flows, have contributed to Brent crude rising above $100 per barrel,[2] more than 40 per cent higher than pre-war levels. Cascading supply chain disruptions and force majeure declarations[3] further highlight how tightly interconnected energy systems amplify shocks, while even substantial buffers, such as OECD strategic reserves of over 1.25 billion barrels,[4] remain insufficient in addressing disruptions of uncertain duration.

Crisis Goes Beyond Energy Supply Scarcity in India

For India, the crisis goes beyond the direct impacts of scarcity; it exposes long-standing issues with the country's energy supply system. Yet the defining feature of this crisis is not its scale alone, but its uneven impact, particularly across energy-intensive sectors, transport systems, and vulnerable households. Import-dependent economies like India remain acutely exposed to external shocks. Nearly half of India's crude oil and

[1] Details available at <https://www.iea.org/about/oil-security-and-emergency-response/strait-of-hormuz>

[2] Details available at <https://mecouncil.org/publication/iran-war-grappling-with-an-unprecedented-energy-crisis/>

[3] Details available at <https://www.aljazeera.com/news/2026/3/13/force-majeure-what-is-it-and-why-have-some-gulf-countries-invoked-it>

[4] Details available at <https://www.iea.org/reports/oil-market-report-march-2026>

a majority of its gas imports originate in West Asia, making geopolitical instability a direct economic risk. This dependence is not occasional; rather, it reflects a pattern, wherein demand growth has outpaced domestic supply, fossil fuel infrastructure remains deeply entrenched, and the scaling of alternative energy sources continues to face constraints. Fossil fuels remain central to India's energy system, supplying nearly 79 per cent of domestic energy and underpinning most consumption, with imports covering a significant share of demand, as total final consumption has grown by roughly 30 per cent[5] since FY16. Consequently, global disruptions, whether driven by war, market dynamics, or supply constraints, tend to reverberate through the Indian economy in relatively predictable ways. The Russia–Ukraine war, for instance, triggered surges in global oil prices, translating into rising domestic fuel costs, widening current account deficits, and increased pressure on policymakers to intervene.

Falling Back to Dirty Energy Options

Policy responses to these shocks have largely been reactive and, at best, short-term in nature. Faced with tightening supply, policymakers have rationed natural gas, prioritized households and curtailed industrial use. Coal-based power capacity has also been ramped up to stabilize electricity supply, to around 187 GW,[6] with Section 11 of the Electricity Act invoked to meet peak demand. As a fallback option, authorities have reintroduced kerosene to sustain household energy access, allowing storage of up to 2,500 litres, extendable to 5,000 litres, at fuel stations. This shift



from 'kerosene free' India to its temporary reintroduction highlights underlying vulnerabilities in the energy system.

These measures unveil a broader tension between short-term crisis management and long-term energy transition goals. Coal, often positioned as a fallback, further illustrates this contradiction: in practice, it continues to function as a primary stabilizer rather than a marginal backup, dominating India's electricity generation mix and being repeatedly relied upon during supply shocks. While this ensures short-term stability, it sustains import dependence: India imports roughly 250 million tonnes[7] of coal annually despite rising domestic production, including over 210 million tonnes[8] from captive and commercial mines in FY 2025–26, locking the economy into carbon-intensive infrastructure with long-term economic and environmental implications.



[5] Details available at <https://images.assettype.com/downtoearth/2026-04-01/t3rkidob/Energy_Statistics_India_2026.pdf>

[6] Details available at <https://www.reuters.com/sustainability/boards-policy-regulations/india-boosts-coal-gas-output-power-demand-hits-record-peak-heatwave-2026-04-27/.>

[7] Details available at <https://www.thehindu.com/business/Industry/india-has-bandwidth-to-substitute-about-150-mt-of-imported-coal-with-domestic-production-official/article70838980.ece>

[8] Details available at <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2248300&reg=3&lang=2>



Limits of Renewable Expansion

Expanding renewable energy alone will not resolve these vulnerabilities. Delivering clean energy remains a challenge. India's grid continues to face transmission bottlenecks and losses of around 15–20 per cent,[9] while renewable capacity has, in some instances, outpaced grid expansion, leaving significant capacity underutilized. The intermittency of solar and wind, combined with limited storage, further constrains reliable supply, often necessitating continued reliance on coal and diesel backups.

At the same time, renewable deployment faces its own constraints. Land acquisition challenges, right-of-way issues for transmission lines, grid integration barriers and uncertainties in long-term power purchase agreements with distribution companies continue to affect progress. These bottlenecks highlight that the transition is not only technological, but institutional. Moreover, the scaling of renewable energy systems is increasingly contingent on access to critical minerals such as lithium, cobalt, and rare earth elements, introducing new resource dependencies and geopolitical risks.

In this context, the central question is not whether India can transition to cleaner energy, but whether it can afford not to.

Is There Any Way Out?

Beyond energy generation: strengthening the system

India's energy transition cannot be reduced to expanding renewable generation alone, as the bigger challenge lies in transforming how energy is produced, transmitted, and consumed. Despite rapid growth in renewable capacity, grid bottlenecks, storage limitations and transmission losses continue to constrain reliable delivery. Addressing this requires greater investment in grid infrastructure, battery storage and demand-side management. Targeted viability gap funding for storage technologies, alongside time-of-day tariffs, can better align electricity demand with renewable supply. At the same time, programmes such as the Perform, Achieve and Trade (PAT) scheme and the UJALA initiative highlight how energy efficiency and load management can reduce energy intensity, while easing pressure on supply systems. A resilient transition depends not only on generating cleaner energy, but on building systems capable of delivering it reliably.

Clean energy also creates new dependencies

Yet, a cleaner energy future does not automatically guarantee energy independence. India's dependence may simply shift from imported fossil fuels to imported solar modules creating new supply chain vulnerabilities. Reducing these risks requires stronger domestic manufacturing through production-linked incentives (PLI schemes), battery recycling and domestic cell production,

[9] Details available at <https://timesofindia.indiatimes.com/city/chennai/indias-power-supply-nears-24x7-as-losses-fall-infra-push-pays-off/articleshow/129810852.cms>

alongside diversified supply chains. India's decision to mandate the use of domestically manufactured solar ingots and wafers from June 2028 reflects growing efforts to reduce import dependence. Strategic partnerships will also matter: nearly 70 per cent[10] of India's critical minerals overlap with the European Union's CRM list, creating scope for cooperation through platforms such as the India-EU Trade and Technology Council.[11] As the EU's Carbon Border Adjustment Mechanism (CBAM) reshapes clean supply chains, such partnerships could strengthen more resilient and lower carbon mineral value chains.

Redefining energy security

The present crisis also calls for a broader rethinking of what energy security means. In an era of recurring geopolitical and market disruptions, supply adequacy alone is no longer sufficient. For India, energy security must increasingly be understood as resilience: the ability of the system to absorb shocks without reverting to carbon-intensive and economically costly pathways. This requires accelerating electrification, renewable integration and investing in system resilience. Parallel reforms in electricity distribution companies (DISCOMs), particularly through the expansion of smart metering and loss reduction under the Revamped Distribution Sector Scheme (RDSS),[12] are equally necessary to improve operational efficiency and strengthen financial viability.

Local resilience and decentralization

Long-term change must also be





complemented by short-term resilience mechanisms. Expanding strategic petroleum reserves and further diversifying crude sourcing, building on India's expansion of oil suppliers from around 27 countries to more than 40[13] in recent years, can strengthen resilience against sudden supply disruptions. At the same time, resilience cannot rely exclusively on centralized systems. Given the high upfront costs of decentralized renewable energy systems, targeted public support through capital subsidies, concessional financing and enabling regulatory frameworks can accelerate adoption, particularly in rural and peri-urban areas. If dependence has amplified vulnerability, building resilience may ultimately require moving closer to decentralized and diversified energy systems.

India's repeated exposure to global energy shocks is not an accident. It is the predictable outcome of structural dependence. Unless that dependence is addressed, crises will not remain as exceptions: they will become the norm.■

Shreya Borah and Dr Gopal K Sarangi, TERI School of Advanced Studies, New Delhi. The views expressed are personal.

[10] Details available at https://www.orfonline.org/public/uploads/posts/pdf/20260505110231.pdf

[11] Details available at https://www.europarl.europa.eu/RegData/etudes/ATAG/2024/757587/EPRS_ATA(2024)757587_EN.pdf

[12] Details available at https://energy.economictimes.indiatimes.com/news/power/nearly-5-5-cr-smart-electricity-metres-installed-across-country-under-rdss-shripad-yesso-naik/128747240

[13] Details available at https://economictimes.indiatimes.com/industry/energy/oil-gas/india-importing-crude-from-40-countries-argentina-is-new-supplier-hardeep-puri/articleshow/118120210.cms?from=mdr



Technology Empowering Everyday Climate Action

Harsh Singhal discusses how technology is making climate action accessible

As climate challenges intensify, environmental action cannot remain the responsibility of governments and corporations alone. Technology is creating new pathways for individuals to participate in verified reforestation and ecosystem restoration through everyday transactions, making climate action more accessible, measurable, and scalable. **Harsh Singhal** is the **Founder & CEO of NetZero Labs**, which has developed CarbonCart, a Shopify plugin that enables e-commerce brands to seamlessly embed climate action into the customer journey. By integrating verified tree planting and carbon offsets at checkout, the platform helps transform everyday purchases into measurable environmental impact. Here, he is in an exclusive email conversation with our editorial team for *TerraGreen*.



Climate action is often perceived as the responsibility of governments and businesses. How can technology help make climate action more participatory for individuals?
While governments and businesses play a critical role in reducing emissions at scale, individuals also influence a significant portion of global emissions through daily transportation, energy, and consumption decisions. The challenge is that most people want to contribute but often lack the opportunity to make impact.

Technology has the power to make climate action far more participatory by empowering individuals to reduce their environmental impact. Digital tools, AI-driven recommendations, carbon tracking platforms, and sustainable shopping solutions can help people make informed decisions in their daily lives, from what they buy to how they travel and consume energy. Technology can enable millions of small actions to collectively drive meaningful environmental change.

How is the concept of turning everyday transactions into environmental action changing the way people engage with sustainability?
Turning everyday transactions into environmental action is making sustainability more accessible and integrated into people's daily lives. Traditionally, many consumers viewed climate action as something that required significant lifestyle changes or donations, but technology now allows individuals to contribute simply through routine activities such as shopping, commuting, or making online purchases. By embedding sustainability into existing consumer behaviours, these solutions reduce friction and make climate action effortless. This shift



is helping people move from passive awareness to active participation.

What role can e-commerce platforms play in driving large-scale reforestation and ecosystem restoration efforts?
E-commerce platforms have a unique opportunity to drive large-scale reforestation and ecosystem restoration because they facilitate billions of consumer transactions each year. By integrating sustainability initiatives directly into the checkout experience, retailers can enable customers to support tree planting, carbon removal, and ecosystem restoration projects with minimal effort. Beyond funding, e-commerce platforms can also increase



transparency by showing consumers the environmental impact of their contributions and connecting them to verified restoration projects. When sustainability becomes embedded within the purchasing journey, e-commerce can transform everyday consumer spending into a powerful mechanism for mobilizing resources at scale and accelerating global restoration efforts.

There is growing scrutiny around carbon offsets and greenwashing. How can technology ensure that climate contributions are transparent, verifiable, and impactful?

Trust is the currency of climate action, and technology is critical to earning it. Today, transparency and verifiability can no longer be optional. Advanced technologies such as satellite monitoring, remote sensing, AI-driven analytics and blockchain enable climate projects to be tracked, audited and validated with far greater accuracy than ever before. These tools can provide real-time visibility into project progress, independently verify environmental outcomes and create tamper-resistant records of impact.

Most importantly, technology shifts the conversation from promises to proof. By giving businesses and consumers access to clear, data-backed evidence of where contributions are going and what outcomes they are delivering, it helps ensure climate action is measurable, accountable and capable of creating lasting environmental value.

Why is public participation critical to the success of reforestation initiatives, and what are the challenges in scaling such participation?

Restoring ecosystems at scale cannot be achieved by governments and businesses alone. Lasting environmental impact requires collective action from communities, individuals, and organizations. However, scaling participation remains challenging. Many people are unsure how they can contribute, question whether their efforts make a meaningful difference, or lack visibility into the outcomes of their actions. To overcome these barriers, participation must be made simple, accessible and rewarding. Technology can play a transformative role by embedding climate action into everyday behaviours, reducing friction, and providing transparent, verifiable data on impact. When people can clearly see the tangible results of their contributions, it builds trust, strengthens engagement, and encourages long-term participation.





How can digital tools help make sustainability outcomes more measurable and accessible for both businesses and consumers?

Digital tools make sustainability outcomes more measurable and accessible by providing real-time data, impact tracking, and transparent reporting. They enable businesses and consumers to understand the environmental impact of their actions, track progress towards sustainability goals, and make more informed decisions. By turning complex environmental data into clear and actionable insights, technology helps make sustainability more transparent, engaging, and effective.

Looking ahead, what innovations do you believe will define the future of participatory climate action and nature restoration?

The future of participatory climate action will be shaped by technologies that seamlessly integrate sustainability into everyday life. Real-time impact tracking, satellite-based verification, and embedded climate contributions within digital payments and e-commerce will make it easier for individuals to participate in environmental action. These innovations will increase transparency, build trust, and enable millions of people to contribute to nature restoration and climate solutions through their daily activities. ■

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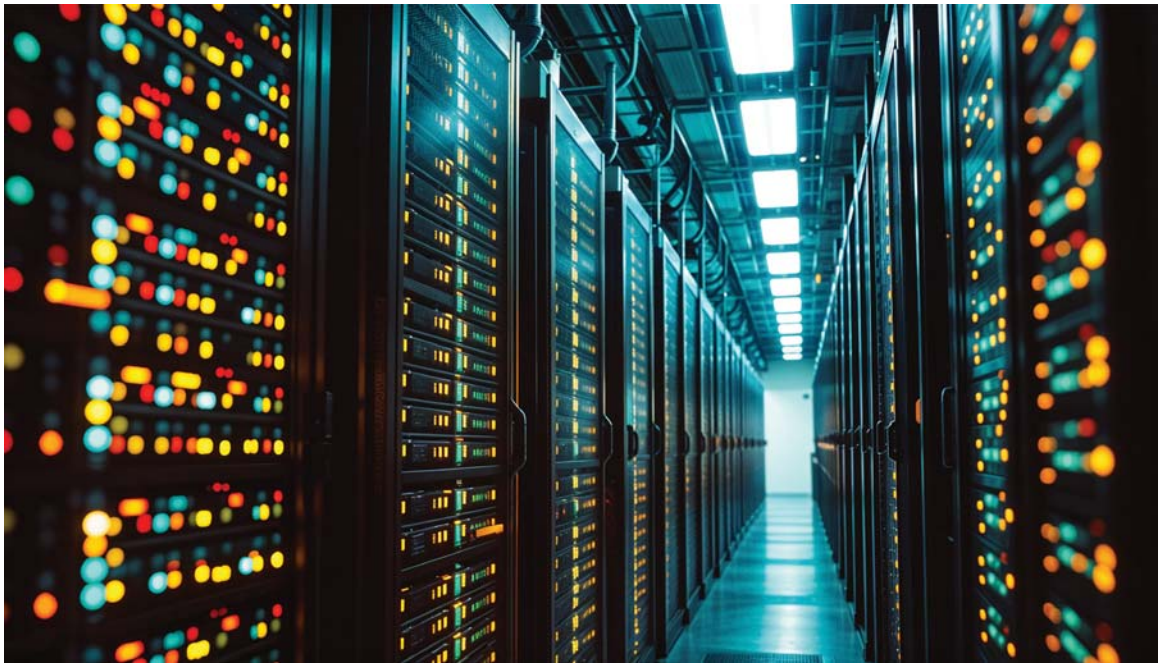


Data Centre Boom

Implications for Power and Environment

Data centres are the backbone for the digital economy, cloud computing, and AI development. They enable round-the-clock access to internet, e-commerce, banking, and government operations. Data centres, characterized by huge demand for power and water, are likely to see phenomenal growth in the coming years, which may pose serious challenges for the utilities and society. In this article, **M R Nouni** and **Abhyudai Nouni** discuss about present status and future growth of data centres and implications thereof on power system, resources needed, and environment.


DATA CENTER



In modern society, digital technology has profoundly transformed almost every aspect of daily life, reshaping how we communicate, work, and access information. Digital technologies refer to generation, storage, and transmission of information in binary form using electronic tools, systems, devices, and resources. They include hardware (computers, smartphones, servers and smart wearable devices), software (apps and operating systems), data (cloud computing and databases), and networks (internet, 5G, wi-fi and Bluetooth) to enable communication, automation, and information management.[1] Digital transformation, which integrates information and communication technologies (ICT) such as artificial intelligence (AI), cloud computing, and internet of things (IoT) is reshaping economies, industries, and social interactions.[2] Emergence of E-commerce, shift in consumer's behaviour to digital platforms and online stores from brick-and-mortar retail outlets have contributed to digital transformation.[3] The rise of ICT especially AI is pushing the demand higher for robust



and scalable infrastructure required for data storage and processing—the roles performed by data centres.[4]

What is a Data Centre?

A data centre is a physical facility that houses critical ICT infrastructure such as (a) servers that provide resources, data, services, or programmes over a network; (b) data storage drives that hold, save, and retrieve data; and (c) network equipment consisting of hardware—primarily switches, routers, firewalls, and cabling—that connect servers and storage devices to enable data transmission, internet access, and security. Data centres provide high-speed connectivity, robust security, and reliable power needed for cloud computing, AI, and daily digital operations. They offer cost-effective and

[1] Details available at <https://www.igi-global.com/dictionary/digital-technology/7723>

[2] Details available at <https://enterprisersproject.com/what-is-digital-transformation#:~:text=Digital%20transformation%20can%20be%20a%20people%20issue.,market%20pressures%20*%20Rapidly%20changing%20customer%20expectations>

[3] Verhoef P C et al (2021), Digital transformation: A multidisciplinary reflection and research agenda, Journal of Business Research, Vol 122, pp 889–901.

[4] PwC, The strategic role of data centres in empowering India's digital revolution.

scalable solutions for organizations/businesses to store and access data rather than maintaining in-house hardware for this purpose. In addition, power sub-systems; uninterruptible power supplies; backup power generators; ventilation and cooling system; and fire suppression systems are essential for reliable operation of data centres.[5,6] A schematic of a typical data centre is shown in Figure1.[7]

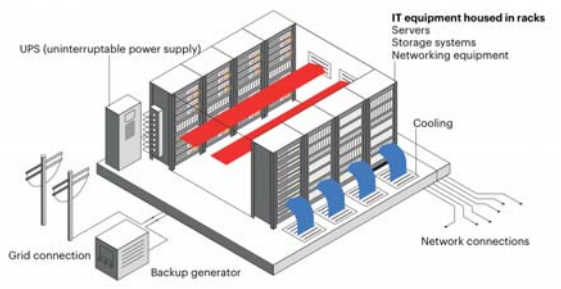


Figure 1: Schematic of a data centre (Source: IEA, Energy and AI, https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai)

Evolution and Growth of Data Centres

The first data centre, commonly referred to as a mainframe room was built in 1945–46 at University of Pennsylvania to house Electronic Numerical Integrator and Computer.[8] Data centres have evolved from room-sized single machines to globally distributed, gigantic (hyperscale) facilities during the last few decades. There were more than 11,000 data centres in operation globally in April, 2026 with the USA alone having 4,184 data centres. Other leading countries with more than 200 data centres each are—UK (515); Germany (514); China (369); France (345); India (296); Canada (287); Australia (272); Japan (257); Italy (219); and Brazil (205).[9] The global growth of data centres is represented as cumulative GigaWatt (GW) of IT capacity installed rather than just the number of facilities established, as this metric better reflects the massive power demand, driven by AI-related computing. While the number of hyperscale facilities are tracked, capacity is the primary indicator of the industry's growth. Global data centre capacity is likely to be 200 GW by 2030, up from about 97 GW at the end of 2024.[10,11]

Scenario in India

Like elsewhere, data centre growth in India is also driven by AI, rising demand for internet and government requirement to host user data locally. Consequently, India's data centre capacity has grown from about 375 MW in 2020 to around 1.5 GW by 2025 and is likely to be more than 10 GW by 2032.7,[12] Availability of inexpensive electricity, data sovereignty mandates and latency are incentivizing setting up of new huge data centres in countries such as India. Reliance Industries (1.5 GW), Google (1 GW), Digital Connexion (1 GW) and Anant Raj Clouds (300 MW) are planning to set up data centres in Vishakhapatnam. Some other companies like Sify technologies, Nxtra by Airtel, Yotta and NTT Global are also expanding their data centre capacities in other cities like Chennai, Delhi-NCR, Hyderabad, and Mumbai.[13] With an aim of positioning Andhra Pradesh as a preferred destination for hyperscale data centre investment, the state has decided to grant deemed distribution licence to the strategic data centres with a minimum connected load of 300 MW. This move will enable data centre developers to independently procure, distribute and manage electricity within the project boundaries and thus ensuring reliability of continuous power supply that may be beyond the scope of the existing system of serving high tension consumers.[14]

Types of Data Centres

Data centres are categorized mainly by ownership, location, and functionality. The primary types include6:

a. Enterprise: owned/operated by one organization;

5 Details available at <https://aws.amazon.com/what-is/data-center/>

6 Details available at <https://www.zscaler.com/zpedia/what-is-data-center#:~:text=Data%20centers%20are%20important%20because%20they%20store,software%20*%20Automation%20tools%20*%20Management%20software>

7 IEA, Energy and AI, https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai

8 Details available at <https://www.datacenterknowledge.com/data-center-construction/8-milestones-in-data-center-history-1946-to-today>

9 Details available at <https://www.statista.com/statistics/1228433/data-centers-worldwide-by-country/>

10 Details available at <https://www.visualcapitalist.com/charted-the-growth-of-global-data-center-capacity-2005-2025/>

11 Details available at <https://www.jll.com/en-us/insights/market-outlook/data-center-outlook>

12 Details available at <https://ddnews.gov.in/en/indias-data-centre-capacity-rises-fourfold-since-2020-power-demand-may-reach-13-56-gw-by-2032>

13 Details available at <https://www.newindianexpress.com/xplore/2026/Apr/30/indias-data-centre-boom-rising-demand-for-power-and-water>

14 Details available at <https://timesofindia.indiatimes.com/city/vijayawada/ap-unveils-deemed-discom-policy-for-large-data-centres/articleshow/130586151.cms>



b. **Colocation**: third-party on-site facility providing shared resources to multiple organizations;
c. **Cloud**: vendor-managed off-site facility offering services through internet;
d. **Hyperscale**: gigantic facility, generally built and operated by digital giants to support needs for cloud applications and AI;
e. **Edge**: smaller facility located closer to end user for faster and efficient access to computing resources; and
f. **Modular type**: containerized portable system, deployed in remote locations for regions having space constraints.

Tiers of Data Centres and their Land and Power Requirements

Uptime Institute has classified data centre tiers from 1 to 4 based on reliability, uptime, and redundancy, ranging from basic infrastructure to fully fault-tolerant systems, as summarized in Table 1.[15,16]

Table 1: Uptime Institute's classification of data centre tiers from 1 to 4 based on reliability, uptime, and redundancy

Tier	Number of paths for power and cooling	Redundant and back-up components	Expected uptime (%)	Total annual downtime (hours)	Footprint (m^2)	Power requirement (MW)
1	Single	Few	99.671	≤ 28.8	< 1000	< 1
2	Single	Some	99.749	≤ 22	> 5000	1–5
3	Multiple	N+1	99.982	≤ 1.6	5,000–10,000	5–20
4	Multiple	2N or 2N+1	99.995	26.3 minutes	> 10,000	> 20

Energy Requirement of Data Centres and GHG Emissions

Data centres are guzzlers of energy and their energy needs make them unique, considering: (a) very high uptime with nearly flat electrical load; (b) very high-power requirement ranging from few MW to GW; and (c) very high energy requirement per m^2 of floor area. A data centre with 1 GW of IT load will typically need 1.1–1.5 GW of continuous electricity supply after considering power requirements for cooling and other loads. Electricity requirement of data centres can be met in three ways—through grid, on-site generation, and through hybrid mode (grid and on-site). Data centres consumed about 415 TWh of electricity in 2024, which was around 1.5% of world's electricity consumption.11 Electricity consumption in the data centres in the USA, China, Europe, Japan and India was about 180 TWh, 100 TWh, 70 TWh, 20 TWh and 9 TWh, respectively in 2024. Considering the rapid expansion of data centres in the coming years, global electricity consumption by them is expected to reach 945 TWh by 2030. Among the different sub-systems of different types of data centres, power consumption by the servers is dominant.

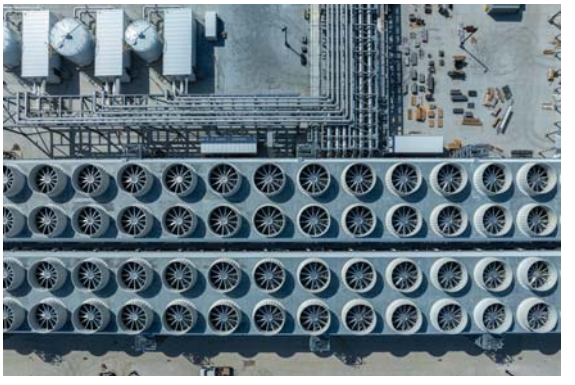
[15] Details available at <https://blog.servermania.com/data-center-tiers>

[16] Details available at <https://www.hpe.com/in/en/what-is/data-center-tiers.html>

New data centres being established are mainly of hyperscale type, the most efficient one, with the bulk of electricity consumption in the servers and other IT equipment.11 Future efforts are directed to make data centres more energy efficient by optimizing power use and enhancing cooling efficiency. In 2023, 56% of electricity consumption of data centres was met by fossil fuels with remaining power coming from renewables and nuclear. The emissions footprint of a data centre depends on its location and the fuel mix and carbon intensity of the local grid. Average carbon intensity of the grid varies from 0.3–0.6 kg CO_2/kWh or higher depending on region and fuel mix employed for power generation.[17] Carbon dioxide emission from the data centres in 2024 was in excess of 160 million tonnes and bound to go up substantially by 2030 with about 945 TWh of electricity consumption.

How can India Address Issue of Reliable Power Supply to Data Centres?

Emergence of data centres as bulk energy consumers in India will call for creating additional power generation capacity and driving investment in energy storage and transmission infrastructure upgrades. Many data centre developers have set ambitious goals for reducing emissions by procuring renewable electricity from solar, wind and hydro sources. Limitations of supplying continuous and reliable electricity on 24x7 basis through renewable sources may force the developers to rely on fossil fuels, along with the use of diesel generators as backup leading to increased GHG emissions and release of harmful pollutants. As an alternative to procuring electricity from utilities or through PPAs, some technology companies are co-





locating data centres with power generation facilities, enabling them to generate some or most of their own electricity directly that will help in faster development and avoid grid congestion. Further, to capitalize on the data centre growth opportunity in India, long-standing issue of grid reliability needs to be addressed, calling for faster augmentation of grid infrastructure and aligning its development with the pace of construction of new data centres.

Water Requirement of the Data Centres

Modern data centres generally use water, especially fresh, for cooling the servers. Water consumption in a data centre is directly related to its energy consumption. With increasing use of energy in AI centric data centres to handle increasing computing loads, their water requirement increases considerably for cooling processor chips, so as to avoid overheating and potential damage. Data centres require huge amounts of water ranging from 1100 m3 to as much as 19,000 m3 daily, depending on their size.[18] Considering annual water consumption of 25 billion litres for a 1 GW data centre, globally data centres consumed about 2,425 billion litres of water in 2024. With 10 GW of data centres in India by 2032, about 250 billion litres of water will be needed annually. Data centres typically lose about 80% of water withdrawn to atmosphere by evaporation during cooling, and the rest is released as wastewater. This discharge often contains minerals, chemicals, and heavy metals, making reuse difficult without intensive treatment, thus ruling out reuse. Water requirement of data centres depends on various factors, including location, climate, water availability, size, and IT rack chip densities. With increasing demand for AI in hyperscale data centres, chip density is growing, which leads to higher room temperatures, necessitating use of more water chillers at the server

[17] Details available at <https://www.orfonline.org/research/the-consumption-of-energy-by-data-centres-implications-for-the-global-south>

[18] Details available at <https://thecityfix.com/blog/from-energy-use-to-air-quality-how-data-centers-affect-us-communities/>



level to maintain temperatures. Therefore, sustainable and resilient growth of data centres demands improving cooling efficiency and developing less fresh water intensive cooling systems.

Data Centres and Noise

Modern data centres operate 24/7 with less than 26.3 minutes of downtime per year, which requires access to a stable and highly reliable electricity in MW/GW scale, depending on its type. Many data centres depend on gas-based power generation for their normal operations along with diesel generators as a backup during emergencies. Construction of data centres, operation of cooling systems and backup power generation systems can cause noise that could be harmful for humans and other living beings.

Land Requirement for Setting up Data Centres

Proliferation of data centres may put huge pressure on land required for constructing them and it may range from about 224 acres for an average data centre to about 1,000 acres for a hyperscale type.[18] Finding such huge parcels of land closer to large cities, especially in India seems difficult.

Thermal Islanding Effect in the vicinity of Data Centres

Scientists have cautioned that modern data centres create "heat islands," a localized phenomenon similar to urban heat islands, where heat dissipated from server cooling may raise surrounding land surface temperatures by 2–8 °C. Impact of heat dissipated by a data centre may extend up to 10 km, potentially affecting local climate and increasing energy demand for cooling in surrounding areas.[19] In regions, serving



as hubs for data centres, the problem can be far more serious.

Conclusions

The proliferation of data centres, driven by digital transformation is creating unprecedented demand for electricity and putting increased strain on the environment. The gravity of these issues will get compounded with further boom in data centres growth as even a small data centre can place an immense, concentrated burden on local electricity infrastructure and natural resources. Electricity demand of data centres, which is essentially of base load type will primarily be met using fossil fuels thereby impacting emissions and air quality adversely. Powering data centres solely on clean energy sources in India looks extremely challenging due to variable nature of renewable resources, insufficient energy storage capacity and slow pace of addition of nuclear power generating capacity. Besides, rapid expansion of data centres threatens freshwater supplies, implying incorporating modifications in their design and operations to make them water sustainable. In India, water stress problem may be more acute as it is home to nearly 18% of the world's population but only 4% of its freshwater resources. Hence, future data centres will need to adopt sustainable practices in terms of consumption of power and other natural resources. ■

Dr M R Nouni has been associated with power and renewable energy sectors for nearly four decades. He worked at the Ministry of New and Renewable Energy (MNRE), Government of India, for about three decades and was involved in policy formulation and implementation of RD&D programmes; and Abhyudai Nouni, who works at Amazon, USA is a software engineer with nearly a decade of experience in large-scale computing systems. He graduated from IIT Roorkee and holds a Master's degree in Computer Science from the UMass, Amherst, USA with specialization in AI.

[19] Details available at <https://futurism.com/artificial-intelligence/data-centers-temperature-spikes>

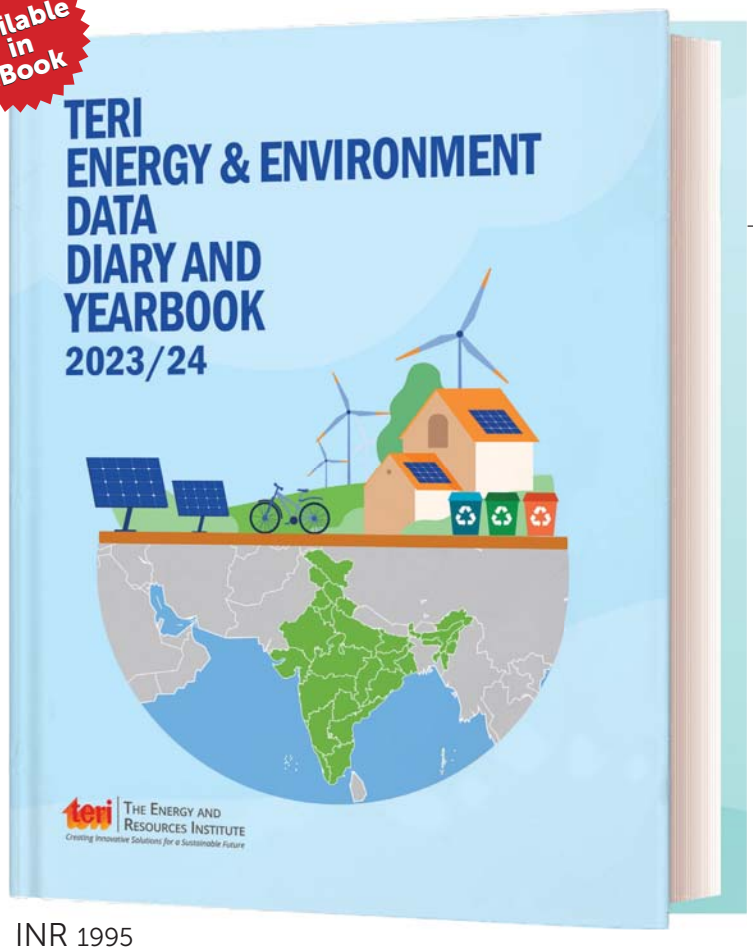
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Sustainability Meets Infrastructure

Why India's Growth Story Must Be Built Differently

As India advances towards Viksit Bharat 2047, it has a unique opportunity to embed sustainability into the vast infrastructure yet to be built. The article argues that infrastructure planning must integrate low-carbon materials, climate resilience, digital technologies, and resource-efficient designs from the outset. It highlights the economic benefits of resilient infrastructure, the need to address embodied carbon and rising cooling demand, and the role of policy, public–private partnerships, and global best practices. Sustainable infrastructure, the authors **(Dr Debajit Palit** and **Mandar Joshi)** contend, is not merely an environmental aspiration but the foundation of India's long-term economic growth and resilience.

India stands at a defining moment in its development journey. As the country advances towards its goal of Viksit Bharat by 2047, new cities, industrial corridors, airports, rapid rails, data centres, and housing complexes will redefine its economic landscape. The challenge, however, is not just to build more infrastructure, but to build it in a way that today's developmental gains do not become tomorrow's economic and environmental liabilities.

Sustainability can therefore no longer be treated as an environmental add-on or a post-construction compliance requirement. Sustainable infrastructure presents a systems challenge—it requires aligning urbanization, energy systems, material choices, technology, and climate resilience into a coherent framework. Economic growth and environmental stewardship are not competing objectives for a developing country like India; they are mutually reinforcing imperatives.

The India Yet to Be Built

India holds a unique advantage that many developed economies never had. According to a recent NITI Aayog building sector report, Scenarios Towards Viksit Bharat and Net Zero – Sectoral Insights: Buildings (Vol. 5),[1] India has yet to construct approximately 80 per cent of the building stock that it will require in 2070. This presents a prime opportunity to integrate sustainability at the design and construction stage itself.



The urgency of this task cannot be overstated. NITI Aayog projects India's urban population to increase from around 500 million to over 800 million by 2047, with more than half the country's population living in cities. Simultaneously, rising incomes

1 Details available at <https://niti.gov.in/sites/default/files/2026-02/Scenarios-Towards-Viksit-Bharat-and-Net-Zero-Sectoral-Insights-Buildings.pdf>



and improving living standards will drive demand for new apartments and higher consumption of energy-intensive services.

The question, therefore, is not whether India will urbanize, but how it must do so.

Building for the Long Term

If urban growth follows business-as-usual patterns of resource-intensive development, India risks locking itself into inefficient systems for decades. Reports by the Royal Institution of Chartered Surveyors (RICS),[2] which is the world's leading professional body for qualifications and standards in land, property, infrastructure, and construction, and NITI Aayog[1] indicate that the building sector contributes nearly one-third of India's greenhouse gas emissions, with almost 48 per cent of these emissions originating from construction materials such as cement and steel. Every infrastructure asset built today will remain operational for 40 to 70 years, making today's decisions critically consequential for decades to come.

This is why we must approach sustainability through a lifecycle lens. It is no longer sufficient to focus solely on operational energy efficiency. We must simultaneously address embodied carbon by promoting low-carbon materials, circular construction practices, and resource-efficient designs. The adoption of low-carbon cement, fly ash bricks, and prefabricated construction techniques can reduce emissions, minimize waste, and shorten construction timelines without significantly increasing costs. Similarly, decentralized sewage treatment systems can recycle water for landscaping and flushing, reducing dependence on municipal water supplies.

Climate-Proofing India

Climate resilience must become equally central to infrastructure planning. India is already witnessing increasingly severe heatwaves, floods, and extreme weather events that impose substantial economic costs. A report by the Coalition for Disaster Resilient Infrastructure[3] indicates that climate-related disasters drain up to two per cent of the nation's GDP annually, eroding government revenues by as much as 12 per cent. These losses are expected to rise significantly unless

2 Details available at <https://www.rics.org/content/dam/ricsglobal/documents/reports/rics-cop28-policy-paper-india.pdf>

3 Details available at <https://dymez6ioe12by.cloudfront.net/media/wp-content/uploads/2026/04/13114551/FRIP-Exec-Summary-hi-res.pdf>



resilience is integrated into infrastructure investments.

Mumbai, the financial capital of India, provides a compelling example of why long-term planning matters. The city already grapples with congestion, urban heat stress, and flooding. Addressing these challenges requires integrated planning that combines resilient drainage systems, energy-efficient buildings, green spaces, and significantly improved and more diversified public transportation. Infrastructure decisions taken today will determine whether India's cities become engines of productivity or centres of vulnerability.

Encouragingly, evidence suggests that investments in resilience generate substantial economic returns. Studies on cost-benefit analysis[4] have shown that incorporating resilience in infrastructure adds 5–15 per cent to upfront costs but can yield returns of up to 12 times the initial investment through avoided losses and enhanced productivity over the asset's lifecycle. Sustainability can thus operate as a cost optimization strategy.

Simple interventions at the design stage can significantly reduce future expenditure. For instance, proper building orientation, reflective roofs, external shading, enhanced daylighting, and natural ventilation can substantially lower energy demand over the life of a building without adding significant costs. Such measures will become indispensable as cooling emerges as one of India's defining infrastructure challenges over the coming decades. Rising temperatures, rapid urbanization, and increasing incomes will drive unprecedented growth in cooling demand, pushing air-conditioner penetration to 65 per cent by 2050 and 80 per cent by 2070, as per NITI Aayog's projections. If cities continue to adopt energy-intensive cooling systems without improving thermal performance, electricity demand will surge sharply, placing enormous pressure on the power sector.

The Green–Digital Nexus

Technology can be a powerful multiplier in this transition.

Digital tools such as Building Information Modelling (BIM), artificial intelligence (AI), smart grids, and Internet of Things (IoT)-enabled systems can optimize infrastructure performance throughout their lifecycle. Analysis by the International Energy Agency shows that AI-driven energy management systems can reduce energy consumption by 10 to 20 per cent while facilitating the integration of renewable energy into power systems.

However, digitalization also presents a new challenge. Global data centre electricity demand is projected to increase considerably over the next decade. In India, as per NITI Aayog, data centres could account for nearly six per cent of electricity demand by 2050, corresponding to approximately 45 GW of additional load. This creates a striking paradox: the very tools that promise to optimize energy efficiency also accelerate grid demand. Planning for this expansion requires integrating digital infrastructure development with clean energy deployment from the outset.

Policy frameworks will remain indispensable in accelerating this transition. Instruments such as the Energy Conservation and Sustainable

4 Details available at <https://dymez6ioe12by.cloudfront.net/media/wp-content/uploads/2026/04/20145441/Finance-Brochure09-4-2026.pdf>

Building Code (ECSBC) 2024[5] and Eco-Niwas Samhita 2024[6] have established important foundations. Yet, their implementation remains uneven. Digital monitoring, independent verification, stronger municipal capacities, and performance-based incentives will be essential to improve compliance.

Public–private partnerships will also play a critical role. India's infrastructure ambitions are far larger than what public finances can support alone. By combining public sector vision with private sector innovation and efficiency, these partnerships can accelerate investments in green buildings, smart infrastructure, and renewable energy systems. Increasingly, performance-linked contracts tied to sustainability indicators such as water recycling, energy savings, and emissions reductions can further strengthen outcomes.

Global Lessons for Building Better

India can draw useful lessons from global urban sustainability models. For instance, Singapore's district cooling system, one of the world's largest, cuts cooling energy demand by about 40 per cent and reduces electricity use by 30–50 per cent through highly efficient centralized cooling and thermal storage.

The Netherlands offers a strong example of integrated water management, with regional water authorities managing resources based on river basins rather than political boundaries. Its long-term Delta Programme combines flood protection, water quality, and land-use planning, making the country a global leader in climate resilience and water governance.

The EU's material passport is a digital document tracking all materials in products and buildings throughout their life cycle for reuse and recycling. This framework succeeds by combining digital tracking, comprehensive life cycle coverage, circular economy data integration, and standardized components covering basic information, sustainability metrics, and environmental impact data for construction materials.





However, successful adoption will depend on tailoring these solutions to India's context, particularly socioeconomic conditions and affordability requirements. Ultimately, sustainable infrastructure is not about slowing development; it is about redefining development itself.

The choices India makes during this decade will determine its trajectory for generations. Every road, every building, and every city we construct today will shape economic competitiveness, environmental resilience, and quality of life for decades.

The future of India's infrastructure will not be measured by the number of projects we build, but by whether those projects remain efficient, resilient, and productive in an increasingly uncertain world. Sustainability cannot remain merely an environmental aspiration; it is an economic imperative. Building sustainably is, quite simply, it is the foundation of a truly developed India. ■

Dr Debajit Palit is the Centre Head at the Centre for Climate Change & Energy Transition and Mandar Joshi is a Research Consultant at Chintan Research Foundation. Views expressed are personal.

5 Details available at <https://www.beeindia.gov.in/WriteReadData/L45218/7534511430467336.pdf>

6 Details available at <https://beeindia.gov.in/WriteReadData/L45218/0405504518282114.pdf>

Europe inside a Thermodynamic Trap

The science behind Europe's intensifying thermodynamic heat trap

In this article, **Shamim Haque Mondal** highlights that Europe is facing an intense heat wave driven by a combination of climate change and atmospheric dynamics. Arctic warming has weakened the polar jet stream, creating persistent omega blocking patterns that trap hot air from the Sahara over the continent. Descending high-pressure systems compress and heat the air, while cloudless skies intensify solar radiation. Dry soils and vegetation reduce evaporative cooling, converting more solar energy into surface heating. Urban heat islands further worsen temperatures, preventing nighttime cooling. Together, these factors have turned much of Europe into a thermodynamic heat trap.

Recently, a video went viral on social media showing hundreds of people jumping into the water near the Eiffel Tower in Paris to escape an intense heat wave. From a distance, the long-neglected water bodies appeared like a massive public swimming pool. And it wasn't just Paris—the same scenes were witnessed across France.

According to official figures, more than 40 people, mostly young people and children, have recently drowned while swimming in these unsafe waters. The national meteorological department issued its highest-level heat alert for 54 regions across the country. The heat wave was so severe that world-famous tourist attractions, including the Eiffel Tower and the Louvre Museum, were closed at 4 p.m. Similar extreme conditions have also affected several other European countries. What is driving this sudden heat wave? Before answering that, it is important to understand what a heat wave is and under what conditions it develops.



The average temperature recorded over the past 30 years is generally considered the normal temperature for a particular location. A heat wave is declared when the temperature remains 3–5°C above this long-term average for three to five consecutive days, depending on the criteria adopted by the meteorological authority. The World Meteorological Organization (WMO) defines heatwave conditions as temperatures above 5°C for five consecutive days (although according to the Indian Meteorological Department, a heatwave is considered to be ongoing if the temperature above 3°C lasts for more than three days).

Heat waves are now affecting many countries around the world, but why are they occurring even in the traditionally cooler countries of Europe? To understand this, let us look about 10 km above France's picturesque landscape, where powerful high-altitude air currents, known as the jet stream, flow. Under normal conditions, the jet stream acts like a highway in the sky, steering depressions and storms from west to east. It also helps aircrafts reach



their destinations more quickly while consuming less fuel. These fast-moving air currents are driven by the sharp temperature contrast between the frigid Arctic and the much warmer equatorial regions.

In fact, this large difference in temperature causes a sharp air pressure difference or pressure gradient in the troposphere; air from warmer regions with higher pressure tends to move faster towards colder polar regions with lower pressure, but the Coriolis force caused by the Earth's rotation causes the northward airflow to curve slightly to the right (east). The difference in air pressure and the Coriolis Effect together cause the air to move sharply along lines of latitude. As the altitude increases, the speed of the wind also increases, which is called the 'polar jet stream.'

In the era of globalization, the temperature of the Arctic region is constantly increasing due to the burning of fossil fuels, as a result of which the temperature difference between the Arctic and equatorial regions is decreasing, and the jet stream is losing its velocity. Because of this slow motion, the jet stream begins to shake and create giant snake-like ripples, which scientists call rosy waves. Today, these waves have a large and muffled shape, resembling the Greek letter Ω (omega), called the omega block; it is surrounded by a wide area of hot air in the middle and relatively cold air on both sides. According to meteorologists, it is drawing warm air from North Africa and the Sahara; that's why the heat wave is getting stronger and stronger.

Underlying this blocking pattern of the European sky is a large wall of high pressure, roughly speaking, an anticyclone layer, in which the wind never rises and forms cold clouds; rather, it descends sharply to the surface, which is popularly called 'dynamic subsidence' in atmospheric science.

The lower the air, the more compressed it becomes. According to the laws of thermodynamics, this is all heated air. This heat-trapping process acts like a giant pump, compressing and heating the entire continent's air mass. The downward movement of air destroys the existence of clouds. As a result, the sky of Europe turned into a massive firework, which concentrated the maximum amount of solar radiation on the earth's surface.

Now the question may arise that heat waves may occur in some places, but how did they spread so fast in the entire continent? The high-pressure system here acted like a giant gear;



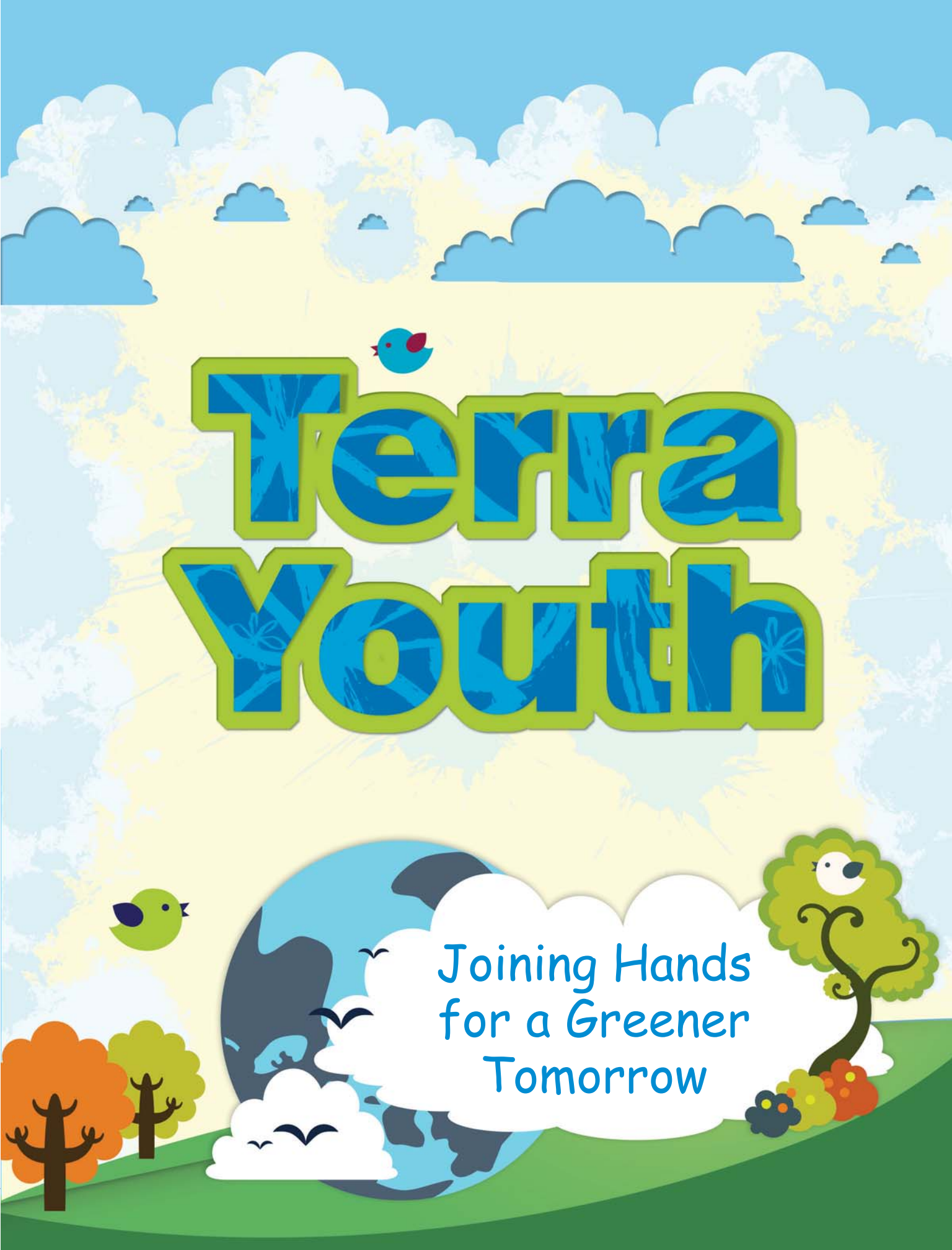
this natural system, rotating clockwise, drew extremely dry and hot air directly from the Sahara Desert and pushed it northward across the Mediterranean Sea. This caused droughts in the climates of Spain, France, and Central Europe. And the centre of this heat wave in Europe is France; the hot and dry air flowing there also affects the atmosphere of neighbouring countries because when the centre of the heat wave burns a region, it also dries the air around it. As a result, the surrounding landscape begins to change over time; it is then caught in the heat wave and becomes its biggest ally.

Normally, when sunlight falls on European plants, a large part of that solar energy is absorbed by soil moisture and plants. "It is mainly used for evaporation and transmission—what scientists call 'latent heat flux'." In fact, it works like a natural air conditioner, which converts solar energy into harmful water vapour instead of directly converting it into heat. When the soil moisture reaches zero, the plants close the pores of their leaves to survive. At that time, with no more water left to evaporate, the 'latent heat flux' completely collapsed. As a result, the entire solar energy is somehow forced into a 'sensible heat flux,' which directly raises the temperature of the air. The dry soil then becomes a huge source of thermal radiation, which heats the air adjacent to the surface.

In a densely populated city like Paris, this is further exacerbated by the urban heat island effect; concrete and pitch absorb this sensible heat flux throughout the day and release it into the air at night, leaving the city without a chance to cool down even at night.

Human-caused climate change has increased the normal temperature of the entire world. In the summer, thanks to the pleasant weather, Paris was so attractive to tourists; today it has become a burning furnace. The streets are hot, the roofs are burning in the sun, and there's no relief at night. To the average person, it may seem like just one scorching week, but to meteorologists, what's happening across Europe is a perfect example of planetary thermodynamics—where the combined effects of stagnant air, drying soil, and climate change have virtually devastated people's lives. ■

Dr Shamim Haque Mondal, Physics Division, State Forensic Science Laboratory, Kolkata, West Bengal.


Terra Youth
Joining Hands for a Greener Tomorrow

When Sunshine Returned to Our Kitchen

The Untapped Potential of Solar Cooking in India

His family, during a period of LPG scarcity, rediscovers a solar cooker purchased in the early 1980s and finds that it can reduce household gas consumption by more than 50 per cent. The experience prompts a broader reflection on the untapped potential of solar cooking in India, particularly in the Central Himalayan hills where sunshine is plentiful but fuel supplies can be uncertain. A lived experience is shared by – **Rajshekhar Pant.**

The recent difficulty in obtaining regular LPG supplies in many parts of the country has brought an unexpected guest back into our kitchen—a solar cooker. Like many families of our generation, we had purchased one sometime in the early 1980s at the subsidized cost of INR 250, if I recall it correctly. It was part of a nationwide enthusiasm for alternative energy that briefly flourished before fading into the background. For decades, the cooker lay forgotten in a corner, gathering dust and memories in equal measure.

Then came the present uncertainty over cooking gas supplies.

One sunny morning, we pulled the old box-type solar cooker out of storage, cleaned it, repaired a few loose fittings, and decided to give it another chance. To our pleasant surprise, it worked almost as efficiently as we remembered. Within a few days it had become a regular feature of our household routine. Rice, pulses, vegetables, potatoes, stew for the pets and even some slow-cooked dishes





began finding their way into the solar cooker.

A few weeks later, we realized that our LPG consumption had fallen by more than half.

What began as a temporary response to a shortage soon revealed itself as a practical lesson in energy resilience.

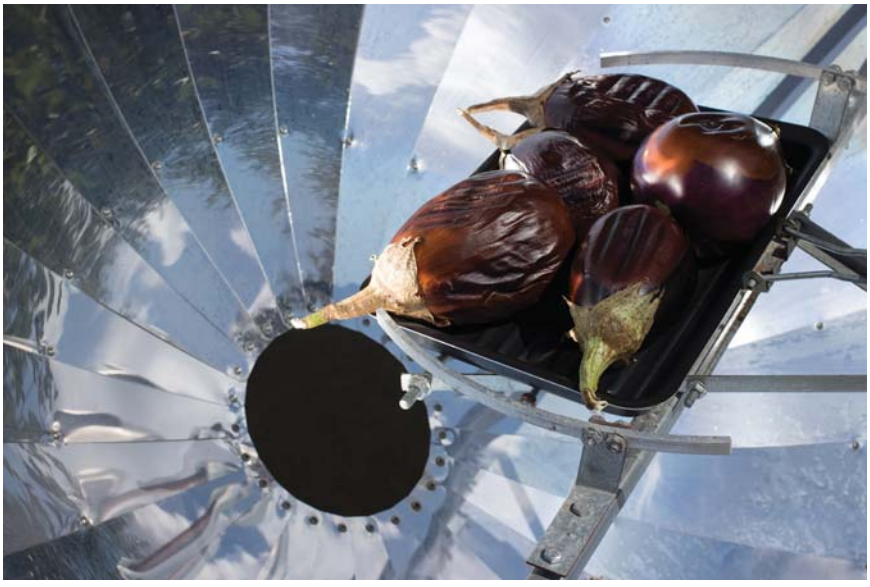
India receives abundant sunshine for most of the year. Yet solar cooking remains a neglected technology. While rooftop solar panels have gained visibility, solar cookers continue to be seen as curiosities rather than serious household appliances.

This is unfortunate because solar cookers are particularly suited to many parts of India, including the Central Himalayan region. Contrary to popular assumptions, hill districts often enjoy bright sunshine for long stretches, especially during the post-monsoon, winter, summer and spring months. At the same time, transporting LPG cylinders to remote villages is costly, logistically challenging, and vulnerable to disruptions caused by landslides, road closures, or supply bottlenecks. At times those from the villages away from the main road have to spend the entire day in carrying the empty cylinder to the gas godown and the refill back home. In such circumstances, every meal cooked by sunlight reduces drudgery besides the dependence on fuel brought from hundreds of kilometres away.

When people hear the term 'solar cooker,' most imagine the traditional box cooker familiar from school science exhibitions. These do remain useful and affordable, but technology has moved ahead. Today, a wide range of solar cookers is available. Box solar cookers are inexpensive, simple to operate, and ideal for slow cooking. Parabolic solar cookers are capable of producing much higher temperatures suitable for frying and faster cooking. Panel cookers are lightweight and relatively inexpensive. Community solar cookers are designed for schools, hostels, temples, and community kitchens. At the higher end solar-electric hybrid systems are there







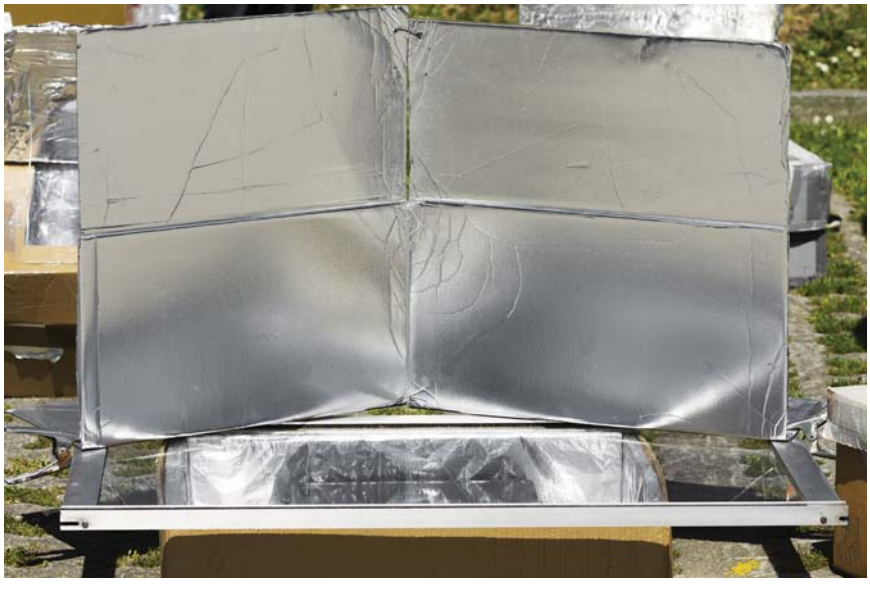
which combine photovoltaic panels with electric cooking devices and can function even when sunlight fluctuates.

Different regions and income groups may require different solutions. There is no single model that fits all households.

For many families, particularly in rural and hill areas, the initial cost remains the biggest obstacle. A solar cooker often pays for itself over time through fuel savings, but the upfront investment can discourage adoption. This is where public policy can play a transformative role. Governments at both the central and state levels could consider subsidizing household solar cookers, much as LPG connections were once promoted. Some other steps could be—supporting local manufacturing units in hill states; making solar cookers available through cooperative societies, self-help groups or even through the LPG gas godowns, frequented quite regularly in hills by the villagers for collecting refills. Offering easy financing through rural banks; demonstrating their use through schools, agricultural extension centres, and village development programmes and including solar cooking within broader renewable-energy missions may also be helpful in due course. Such measures would not merely promote a green technology; they would strengthen household energy security.

Perhaps the greatest challenge is not technological but psychological. Many of us have become accustomed to instant cooking and on-demand energy. Solar cooking requires a little planning. Food is prepared during the sunny part of the day rather than at the press of a button. Yet the rewards are considerable. Food cooks gently, fuel costs decline, and dependence on external energy sources is reduced. In an age increasingly concerned about sustainability, climate change, and energy security, solar cookers definitely deserve another look.

As we watch our old solar cooker quietly doing its work under the Himalayan sun, it is difficult not to wonder whether we abandoned a useful idea too quickly. The cooker that entered our home more than four decades ago as a symbol of an alternative future may still have something valuable to teach us. Sometimes innovation does not arrive in the form of a new invention; it waits patiently in a storeroom, reminding us that solutions to present challenges may already be within our reach. ■



Rajshekhar Pant is an amateur filmmaker, photographer, and writer who has authored more than a thousand articles, reports, and other pieces published in some of the country's leading newspapers and magazines.

Eco Kranti Shubh Labh National Summit

The Eco Kranti Shubh Labh National Summit in Bengaluru brought together entrepreneurs, investors, policymakers, researchers & industry leaders to accelerate sustainable and climate-positive innovations emerging from across the country. The summit focused on climate technology, circular economy, waste management, green manufacturing, sustainable consumer products, and rural innovation. More than 900 entries were received and 250 plus startups, researchers and innovators from across India participated in the first edition of Eco Kranti Shubh Labh 1.0 National Summit, 30 plus startups selected as well a two-day sustainability and social innovation conclave organized by Eco Kranti, an initiative of the Sri Sri Rural Development Programme (SSRDP), in collaboration with Startup India and the Department for Promotion of Industry and Internal Trade (DPIIT).

Held at The Art of Living International Centre in Bengaluru, the summit brought together entrepreneurs, investors, policymakers, researchers and industry leaders to accelerate sustainable and climate-positive innovations emerging from across the country. Speaking on the occasion, Devang Vora, Founder of Eco Kranti & Director of SSRDP, said, "Shubh Labh is the flagship innovation, incubation, and acceleration platform of SSRDP ECOKRANTI, committed to nurturing at least 1,000 high-impact startups by 2030 across sustainability, rural development, climate action, circular economy, agritech, waste management, clean technologies, and social innovation.

Our mission is to discover, incubate, mentor, fund, and scale purpose-driven enterprises emerging from villages, rural India, and semi-urban communities, transforming local challenges into globally scalable solutions while building a prosperous and sustainable future. The summit focused on climate technology, circular economy, waste management, green manufacturing, sustainable consumer products and rural innovation, the summit featured live pitching sessions by the top shortlisted startups, investor interactions, mentorship programmes and panel discussions aimed at strengthening the country's growing impact entrepreneurship ecosystem.



The summit saw participation of leading venture capitalists (VCs) and ecosystem partners, including Utpal Doshi (Ignition Capital), Ravin Bhadja (Find Me Factory), Kedar Pandya (Wadhwani Foundation) and Ravi Ranjan (Velocity 1, Dubai), who served as jury members, mentors and investors for the Shubh Labh cohort. India Accelerator, Institution's Innovation Council, Future Age, Finvolve and MotionGility were among the ecosystem partners supporting the event.

Devang Vora added, with Gurudev Sri Sri Ravishankarji's blessing, "We believe meaningful change begins at the grassroots. Through Shubh Labh, we aim to nurture 1,000 impact startups by 2030 that will contribute to rural development, sustainability, and India's transition towards a circular economy."

The summit also highlighted the growing impact of the Eco Kranti movement. Over the past two years, the movement has reached more than 10,000 households and helped prevent nearly 200 tonnes of single-use plastic waste. It aims to reach 10 lakh households and prevent 1,000 tonnes of single-use plastic waste over the next two years.

Through its Shubh Labh platform, Eco Kranti aims to build a national ecosystem for identifying, mentoring, funding and scaling impact startups with a core focus on sustainability and rural development that are creating sustainable solutions for the nation while delivering measurable social, environmental, and economic impact. ■

Cooler Cities, Greener Future

A Scientist's Search for Climate-Smart Materials

In this article, **Dr Manali A Joshi** highlights the growing impacts of climate change and underscores the urgent need to embrace sustainability as a way of life. The article argues that unchecked urbanization, excessive concrete cover, and environmental degradation have intensified carbon emissions and urban heat island effects. It advocates reviving nature-based solutions, particularly increasing green cover and adopting eco-friendly technologies. A key focus is Soil and Water Bio-engineering, which offers a sustainable alternative to conventional slope protection methods. The article showcases coir-based biodegradable blankets for erosion control, demonstrating how innovative, climate-smart materials can enhance resilience, sequester carbon, and support sustainable development.

An elderly man sits by a window on a sweltering summer afternoon, reminiscing about his youth, when summers were less scorching and the air less humid. Elsewhere, a farmer gazes in despair at his damaged fields after unseasonal rains have devastated his crops at the height of summer. These are not isolated incidents; they are stark reminders of a deepening global crisis that sustainable development seeks to address.

The overexploitation of natural resources, widespread deforestation, and a rapidly growing carbon footprint have compelled us to confront the grave consequences of our relentless pursuit of economic growth, technological advancement, and material comfort. The impacts of climate change and environmental degradation are no longer distant threats—they are unfolding before our eyes. It is imperative that we recognize the extent of the damage inflicted on the environment by human activities and take urgent, collective action to restore ecological balance before it is too late.

Sustainable development, in a literal sense, means the development that takes place by planning and judicious use of resources so that they can be used by future generations. But have we ever paused to think about embracing sustainability as a way of life? This is largely because our understanding of sustainability is often superficial, shaped mainly by what we read in newspapers and magazines about environmental protection and renewable resources.

We need to understand that every activity of ours is in some way or another going to impact nature. Therefore, we must develop a deeper understanding of sustainability and commit ourselves to adopting eco-friendly technologies, even if they entail higher upfront costs. Such investments are not merely expenses; they are essential steps towards securing a sustainable future for ourselves and generations to come.

It is not that we need to do something new, since several policies are already implemented in this regard since long. Our ancestors had used such techniques in the past, which need to be revived now, so that the disrupted balance of nature can be restored. The most imperative issues that need to be addressed immediately are the increasing carbon footprints due to increased concrete cover and unplanned infrastructure development, while taking the environment for a toss. The crux of this issue is the realization that green areas can become effective carbon capture instruments for businesses, households, and city planners by choosing the proper plants, managing land effectively, and implementing sustainable practices. Hence, increasing green cover can lead to the absorption of carbon and a decrease in the heat island effect induced by soaring temperatures.

Conventional slope protection methods often rely on stone pitching and concrete structures, which can adversely affect the environment through stone quarrying and the extensive use of cement. Soil and Water Bio-engineering offers a more sustainable alternative, owing to its lower cost and reduced maintenance requirements. The approach stabilizes slopes by applying suitable protective coverings to prevent erosion and future landslides, followed





by the establishment of vegetation. This vegetation not only reinforces slope stability through its root systems but also acts as a carbon sink, sequestering significant amounts of atmospheric carbon dioxide over time.

One such bioengineering technique, which is a reinvention of old lost methods, has been adopted in many projects all over India. This is the use of eco-friendly material for slope protection and soil erosion control. This product is the outcome of extensive research performed by Mr Vinaay and his team over decades, where they have manufactured a coir blanket for slope protection having 85 to 90 per cent of coir fibres, and only 10 to 15 per cent polymer. These possess excellent properties of being biodegradable and versatile, for erosion control and slope protection of highways, railways, agroforestry, mines and other infrastructure development for lakes, *nala*s, and other artificial water bodies.

It has proved to work successfully in all the areas, from the highest rainfall zones to the driest climatic conditions. It has successfully performed on several slopes that are flatter than 30 degrees and steeper up to 80 degrees. It possesses the exclusive property of providing suitable strength over time as the roots grow further, entangling with each other, thereby increasing its structural stability. In the modern era of construction, "Sustainable Development" is no longer a buzzword; it is a technical requirement. As we expand our urban footprints, we inevitably disturb the natural soil crust, leading to accelerated erosion. Carbon sequestration is becoming a key tactic in lowering atmospheric carbon dioxide (CO_2) levels in light of the growing worries about climate change. Eco-friendly landscaping in the household, business, and municipal sectors has substantial, often overlooked potential for reducing carbon footprints, even if large-scale reforestation and agricultural practices have garnered the most attention. ■

Dr Manali A Joshi, Academician and Environmental Researcher, Assistant Professor, Department of Civil Engineering at Dr Vishwanath Karad, MIT-World Peace University, Pune, India.



Earth's Waters are Quietly Running out of Oxygen, Scientists Warn

A comprehensive review led by researchers at the Scripps Institution of Oceanography, University of California San Diego, has identified aquatic deoxygenation as one of the world's most pressing but under-recognized environmental crises. Dissolved oxygen levels are declining across oceans, lakes, rivers, estuaries, and coastal waters owing to climate change, nutrient pollution, and rising temperatures. Since oxygen is essential for aquatic life, its depletion threatens fisheries, biodiversity, and the ecological processes that regulate Earth's climate. The researchers argue that deoxygenation is closely linked to several planetary boundaries, including climate change, ocean acidification, biodiversity loss, freshwater degradation, and chemical pollution. They recommend that dissolved oxygen be recognized as a separate planetary boundary, emphasizing that the phenomenon is not confined to isolated ecosystems but is becoming a global threat.

Source: https://www.sciencedaily.com/

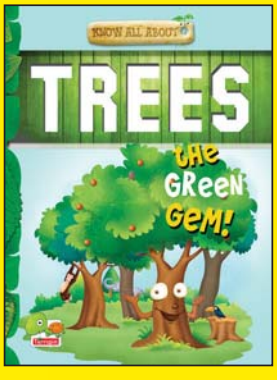
Healthier Diets Could Slash Agricultural Emissions and Restore Nature

A new international study suggests that a global transition towards healthier diets could dramatically reduce greenhouse gas emissions while creating opportunities for ecosystem restoration. Researchers found that reduced demand for livestock products would substantially decrease the land required for grazing and animal feed production, potentially cutting emissions from land-use change by as much as 85 per cent by 2050. The freed-up land could be used for reforestation, biodiversity conservation, or sustainable agriculture. At the same time, production of fruits, vegetables, legumes, and nuts would need to expand to meet changing dietary patterns, improving public health while lowering agriculture's environmental footprint. The findings underscore the interconnectedness of food systems, climate mitigation, and biodiversity conservation, indicating that dietary shifts can complement technological innovations and policy measures in achieving global sustainability goals.

Source: https://www.sciencedaily.com/



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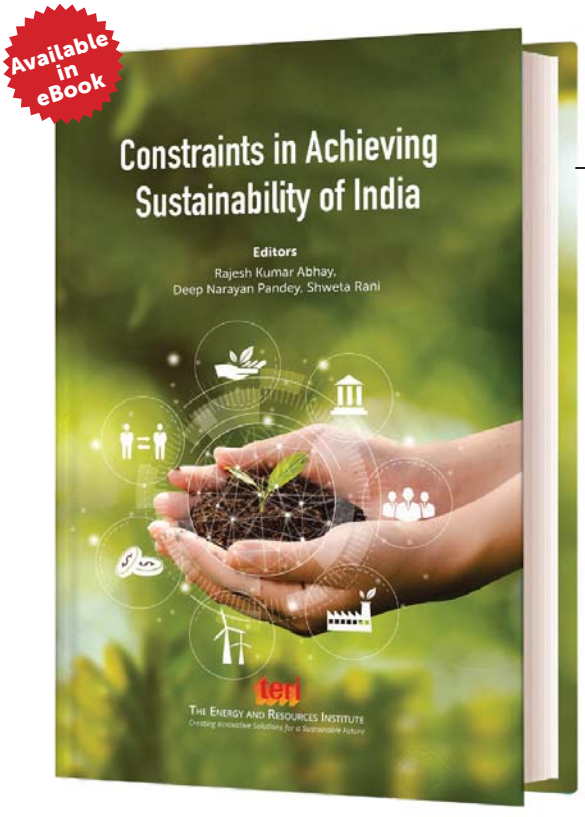
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Purpose of the book is to develop, contribute, and disseminate scientific knowledge pertaining to the issues related to sustainable development. The chapters are developed so that the contents can facilitate comprehension of the major constraints in achieving sustainability including but not limited to environmental, social, economic, and governance-related issues from local, regional, to national level. Resource management, climate change, agriculture, population, education, women, poverty, infrastructure, crime, corruption, governance, are the other relevant topics that have been both identified and suitably discussed. *Constraints in Achieving Sustainability of India* can be utilized as a guiding tool for realizing sustainability in development, especially, in the Indian context.

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Raptors at the City's Edge

Coimbatore's Master Plan Embraces Urban Biodiversity Conservation

A joint report by the Tamil Nadu Forest Department and WWF-India highlights the importance of conserving raptors within Coimbatore's Master Plan 2041. Based on surveys conducted across seven forest ranges, the study recorded 25 raptor species and revealed that most sightings occurred in ecotones, the fragile transition zones between forests and urban areas. As Coimbatore expands, these habitats face increasing pressure from development and infrastructure projects. The report recommends protecting critical habitats, establishing ecological corridors, adopting bird-safe infrastructure, improving waste management, and creating an Urban Biodiversity Monitoring Cell. Integrating these measures can help ensure nature-positive and sustainable urban growth.

The skies of Coimbatore are telling a story—one of resilience, quiet warning, and urgent opportunity. Against the backdrop of expanding city limits and ambitious development, a new assessment is drawing attention to the ecological guardians that often go unnoticed above the urban bustle. Raptors—eagles, kites, owls, and vultures—have long served as sentinels of environmental health. In Coimbatore, they are now shaping the conversation about the city's future.

On February 28, 2026, underscoring a commitment to nature-positive urban planning and biodiversity conservation, the Hon'ble Forest Minister of Tamil Nadu, Shri Thiru R S Rajakannappan, in the presence of Ms Supriya Sahu, IAS, Additional Chief Secretary (Environment, Climate Change & Forests) released — *Elevating Raptors in Coimbatore Master Plan 2041*— a joint report by Tamil Nadu Forest Department and WWF-India. The report was released in Coimbatore in the presence of Shri Srinivas R Reddy, PCCF & HoFF; Shri Rakesh Kumar Dogra, PCCF & CWLW; Shri D Venkatesh, CCF; Shri N Jayaraj, former Coimbatore DFO; and other officials and NGO representatives.



"Elevating Raptors in Coimbatore Master Plan 2041" is a comprehensive study undertaken by the Tamil Nadu Forest Department and WWF-India spanning seven forest ranges across Coimbatore during 2021–2025. The study involved field surveys that were conducted in 2025. A total of 202 sightings of raptors, representing 25 species, were recorded during field surveys. The most commonly observed raptor species were the shikra (*Tachyspiza badia*), Brahminy kite (*Haliastur indus*),



and crested serpent-eagle (*Spilornis cheela*).

A crucial finding of the study was the strong association between raptors and ecotones, which are the transition zones between different habitat types. These are areas where forests meet the city—fragile edges increasingly strained by rapid urbanization. More than 40 raptor species were found to be thriving in these transitional zones and nearly 79 per cent of all raptor sightings occurred in these ecotones, areas most vulnerable to encroachment, habitat fragmentation, and infrastructure expansion.

In Coimbatore's rapidly changing landscape, these insights are critical. The Coimbatore Master Plan 2041 envisions significant urban expansion into peri-urban and forest-adjacent areas, many of which overlap with ecologically important raptor habitats identified in this study. This report seeks to elevate the importance of raptors and integrate their conservation into the core of urban ecological planning in Coimbatore.

The report presents key recommendations supported by a structured action plan. These include measures to safeguard critical habitats; establish ecological corridors; promote bird-safe infrastructure, such as insulated power lines; strengthen solid waste management to reduce the risks of secondary poisoning; and institutionalize an Urban Biodiversity Monitoring Cell to embed ecological considerations within municipal governance systems.

The action plan provides a strategic framework for mainstreaming raptor conservation into Coimbatore's urban and peri-urban development agenda. It identifies priority interventions across land-use planning, infrastructure regulation, urban design, ecological monitoring, and community engagement. The framework calls for inter-departmental convergence and multi-stakeholder coordination, and recommends integrating raptor conservation measures into statutory, city-level planning instruments to ensure accountability and long-term sustainability.

Ms Supriya Sahu, Additional Chief Secretary, Environment, Climate Change and Forests Department, Tamil Nadu, said "Coimbatore stands at a pivotal crossroads with its Master Plan 2041, offering a unique chance to craft a sustainable, nature-positive city. This vital raptor assessment by the Tamil Nadu Forest Department and WWF-India reveals critical insights into a raptor-sighting cluster in fragile edge habitats that may be under urban pressure. Protecting key habitats, ecological corridors, bird-safe



infrastructure, and reformed waste practices must be woven into the Master Plan for biodiversity-rich growth, making Coimbatore a harmony of progress and heritage where raptors soar over green corridors and wetlands."

Shri Rakesh Kumar Dogra, IFS, Principal Chief Conservator of Forests and Chief Wildlife Warden, Tamil Nadu, further added, "India's wildlife conservation has evolved towards landscape-scale strategies and community partnerships beyond protected areas. This report integrates cutting-edge science into Coimbatore's urban framework, with surveys



documenting over 40 species, including threatened raptors in urban-forest ecotones. As Coimbatore's population surges, we advocate precautionary land-use planning, an Urban Biodiversity Monitoring Cell, and alignment with state initiatives like bird-safe powerlines—positioning Coimbatore to pioneer nature-positive urbanism."

Ratul Saha, Director, Raptor Conservation Programme, WWF-India, said, "As apex predators, raptors are indispensable to ecosystem stability, regulating prey populations, maintaining ecological balance, and serving as powerful indicators of landscape and urban health. This report focuses on ecotones—transitional zones acting as biodiversity hotspots and buffers and urges habitat-sensitive zoning, bird-safe infrastructure, and green networks aligned with UN-Habitat principles for compact, resilient cities. By embedding these into the Coimbatore Master Plan 2041, we advance nature-positive urbanization, supporting WWF-India's 2030 goals for ecosystem integrity and threatened species through science-based collaboration."

This initiative is well aligned with Tamil Nadu's broader conservation trajectory and its demonstrated leadership in ecological stewardship, including multiple Green Missions focused on landscape restoration, climate resilience, and biodiversity enhancement; the designation of 20 Ramsar sites; and the notification of India's first Dugong Reserve in the Gulf of Mannar, among others.

As Coimbatore looks towards 2041, the presence of raptors across its margins offers both a measure of hope and a call to responsibility. Their survival hinges on the choices made today—land use, infrastructure design, waste management, and the value placed on ecological knowledge. If Coimbatore succeeds in weaving raptor conservation into the fabric of its future, it will not only protect a vital group of species but also craft a model for cities seeking to grow without severing their connection to the natural world. For now, the raptors continue to circle above, their flight patterns a reminder that the fate of urban biodiversity and the future of human well-being remain deeply intertwined. ■

Source: https://www.wwfindia.org/resources/explore/featured_stories/?28323/Raptors-at-the-citys-edge

Ladakh
A Date with Science and Nature
A journey towards sustainability and decoding India's strong cultural heritage

In this article, **Sarvesh Devraj** shares his long-awaited journey to Ladakh, where he explored the region's remarkable blend of traditional wisdom, scientific innovation, and environmental stewardship. Through visits to SECMOL, HIAL, Hanle Observatory, monasteries, and the Ice Stupa at Tarchit, he highlights sustainable practices that help communities thrive in a harsh cold-desert environment. The article examines passive architecture, natural cooling systems, greenhouse cultivation, waste management, and water conservation innovations rooted in local knowledge. The author also reflects on the warmth and resilience of Ladakh's people and the lessons the region offers for building a more sustainable future.

I have always been fascinated by the stunning landscapes of Ladakh. However, as a cold desert, the region endures harsh climatic conditions, making the optimization of resources a way of life for its people. My journey to this breathtaking part of the country began in 2017, driven by two major aspirations:

- As a climate researcher, I wanted to understand the unique innovations deeply rooted in Ladakhi culture and also visit SECMOL (Students' Educational and Cultural Movement of Ladakh), founded by Sonam Wangchuk, to gain educational insights.
- To pursue my passion for Astronomy at the Chandra Observatory in Hanle.

Despite several attempts over the years, my plans never materialized until this year. My friend Rohit, based in Leh, gave me the encouragement I needed to finally visit Ladakh for the Sun and Earth Festival 2024, organized by the Himalayan Institute of Alternative Ladakh (HIAL). I am truly grateful for his persistence and the immense effort he put into making my stay in Ladakh an unforgettable experience.


HIAL main building in Phey

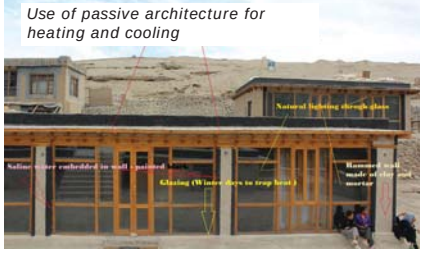
During my maiden visit to Ladakh, I explored several stunning locations, including Tar Village, the remarkable architecture of Alchi Monastery, decoding SECMOL initiatives and the serene Thikshey Monastery, unforgettable landscapes of Hanle and breathtaking Tarchid. I also had the pleasure of meeting many wonderful people from this region, all of whom greeted me with warm smiles despite the challenging terrain.

My journey of learning about sustainability and developing a deeper sense of empathy for this region has shown me how small, meaningful initiatives can collectively create a significant impact in our lives and help Mother Earth to breath. I learnt how to build wall and using natural materials for keeping the temperature low during summers. Throughout this journey, SECMOL has left a profound impression on me. Its unique approach encourages curiosity, nurtures natural talent, and empowers individuals to discover their true potential. It reinforced my belief that education plays a vital role in shaping young minds and guiding future generations towards a more sustainable and responsible way of living. By fostering innovation, self-reliance, and environmental consciousness, institutions like SECMOL demonstrate

how education can become a powerful catalyst for positive change.

Perfect Utilization of Passive Architecture for Temperature Maintenance

Keeping the harsh winter climate of Ladakh in mind, all buildings at SECMOL and HIAL have been designed using passive architectural principles. These include solar heating through glazing and salt-water-based thermal storage to retain heat indoors even when outdoor temperatures drop to –25°C. In addition, overhangs and insulation help reduce heat gain during summer, while natural ventilation is achieved by strategically positioning windows in accordance with prevailing wind flows. Temperature is also continuously monitored to optimize indoor thermal comfort. Through these passive heating and cooling measures, indoor temperatures are maintained at approximately 10–15°C during winter days and 15–25°C during summer days.



Use of passive architecture for heating and cooling

All the walls are oriented towards the south to maximize heat gain during winter. Most of the construction materials are sourced locally, minimizing waste during the building process. In these structures, the window-to-wall ratio has been optimized to ensure ample natural lighting and effective passive heating.

The wood waste generated during the construction and saw dust is stuffed in the ceiling as an insulation to stop heat loss through the roof in winters and the same act as insulator for sun heat during summer time. A jacket wall positioned outside the main structural wall insulates the outer walls. The six-inch gap between these walls is filled with low-cost insulation materials such as sawdust, wood shavings, or occasionally discarded paper and plastic items such as bottles and bags. In some instances, cow dung is used as an insulating plaster. When combined with the right proportions of earth and clay, it creates a durable and thermally efficient plaster.

The columns made through rammed earth technique can accommodate these bottles filled with salt waters for trapping heat, as salt water is a good conductor of heat. The outer surface of wall is painted with black for absorbing more heat. Therefore, by utilizing basic heat-transfer principles, these buildings release stored heat during cold winter nights, helping maintain a comfortable indoor temperature. This is not a new concept in Ladakh; local communities have been using such techniques for generations. However, for me, it was a wonderful opportunity to learn about these sustainable solutions, which are rooted in local knowledge and rely primarily on locally available resources.



Use of passive architecture for heating and cooling

Natural Freezer Based on Evaporative Cooling

At SECMOL, students use a simple yet effective natural evaporative cooling system to keep vegetables fresh at a temperature range of 10–22°C without relying on conventional refrigeration. Water is regularly sprinkled to facilitate the cooling process, while a dedicated team of students monitors and manages the temperature and overall system performance.

The storage room is thoughtfully designed using sustainable materials. Its floor is layered with small stones and mud to enhance cooling efficiency, while the roof is insulated with sawdust and other recycled waste materials to minimize heat gain. This innovative, low-cost solution demonstrates how traditional wisdom and sustainable practices can be combined to create environmentally friendly alternatives for food preservation.

Greenhouse for Vegetation

Ladakh's rugged terrain and harsh winter climate make vegetable cultivation particularly challenging during the colder months. To ensure a consistent supply of fresh produce on campus, maintaining suitable growing conditions is crucial. SECMOL addresses this challenge through the use of a greenhouse that enables students to cultivate vegetables throughout the winter season.

The greenhouse incorporates innovative and sustainable design elements. Reused bottles painted black are strategically placed to absorb solar heat during the day and gradually release it when temperatures drop, helping to maintain a stable environment for plant growth. This simple yet effective solution not only supports year-round cultivation but also demonstrates how resourcefulness and sustainable practices can overcome environmental constraints.


Ice stupa at Tarchit village

Ice Stupa

As the world grapples with the urgent issue of climate change, the disappearance of mountain glaciers has become a significant concern. Estimates indicate that ice loss since 1970 amounts to approximately 26 metres of water

equivalent[1] in 2022–23. This severe problem has led to environmental imbalances and is putting many regions at risk of submersion. The Himalayan range in Ladakh is home to some of the world's notable glaciers. The Siachen Glacier, located in Ladakh, is the second-largest glacier outside the Polar Regions and the largest glacier in the Himalayas. Water availability is particularly significant for Ladakh, which faces harsh winter conditions and, at times, struggles with limited water for irrigation during the summer (April and May) due to less water in streams. This creates huge problems for farmers to meet the water supply demand for their newly planted crops. By mid-June, the rapid melting of snow and glaciers in the mountains causes an excess of water and even flash flooding. By mid-September, farming activities have concluded, but a smaller stream continues to flow throughout the winter, steadily but wastefully, into the Indus River without benefiting anyone. The main crops in Ladakh are barley, wheat, mustard, lentils, pulses, potatoes and vegetables.

The challenge of storing excess water during the winter for use during times of need has become a focus for SECMOL and HIAL researchers. To address this issue, the concept of the Ice Stupa or artificial glaciers has emerged. An Ice Stupa is a glacier grafting technique that creates conical ice heaps to store unused winter water and conceptualized by Mr Sonam Wangchuk. During the summer, when water is scarce, the Ice Stupa melts to provide irrigation water. For this innovative solution, Mr Wangchuk was awarded the Rolex Award for Enterprise.

During the Sun and Earth Festival, I had the opportunity to visit the Ice Stupa at Tarchit and witness first-hand how this remarkable innovation works. I was deeply impressed by its significance and practical value in supporting irrigation and water security for the local community.


Waste management

Tarchit is a picturesque village located about 75 kilometres from Leh in the Rong region of Nyoma Tehsil. The Ice Stupa is strategically positioned on a north-facing slope, allowing it to remain shaded from direct sunlight for most of the day. Built at an elevation of approximately 500 metres above the village, the site provides ideal conditions for the formation and preservation of the stupa. It has the capacity to store nearly 1.5 crore litres of water, including around 8.3 million litres of winter water in frozen form.

The team at HIAL regularly monitors the Ice Stupa, collecting valuable data to improve future designs and enhance their efficiency. The site also serves as a living laboratory for innovation and learning. Each year, Tarchit hosts an Ice Stupa competition on World Water Day, bringing together communities, innovators, and enthusiasts to celebrate sustainable water solutions.

Scaling up this initiative and constructing Ice Stupas near more villages requires identifying suitable valleys at elevations above 4,000 metres. These locations should ideally face north to minimize solar exposure and maintain lower temperatures. Such conditions are ideal for creating artificial glaciers that remain frozen through the winter and release water gradually during the spring growing season. In some instances, Ice Stupas have survived for nearly a year before completely melting, highlighting their potential as an effective and sustainable water-storage solution for high-altitude regions facing water scarcity.

Waste Segregation, Utilizations and Waste Treatments—Nothing Left Out

Waste generated on the campus is carefully collected, segregated, and managed to maximize its reuse and recycling potential. Plastic bottles are creatively repurposed for landscaping and beautification projects, while discarded tires are used as planters for trees and other vegetation.

Students play an active role in the campus waste management system by monitoring the quantity and types of waste generated each day. This hands-on involvement helps them identify opportunities to reduce waste, promote recycling, and encourage more sustainable consumption practices. Through these initiatives, the campus not only minimizes its environmental footprint but also fosters a culture of responsibility and environmental stewardship among students. ■

Sarvesh Devraj is a Climate Researcher. He can be reached at sarveshdevraj@gmail.com. All photographs are courtesy of the author.

1 Details available at <https://www.climate.gov/news-features/understanding-climate/climate-change-mountain-glaciers>

The Next Offshore Wind Challenge Lies Onshore

Building the foundations for India's offshore wind future

In this article, **Mayuri Singh** and **Nishant Saxena** argue that India's offshore wind sector is moving beyond resource assessment towards market creation, supported by new policies, viability gap funding, Contracts for Difference, port investments, and international partnerships. While strong wind resources exist, the key challenge is making projects financially viable and attractive to investors through effective risk allocation. The authors emphasize that offshore wind is also a legitimacy and communication challenge involving communities, ecosystems, industries, and governments. Drawing lessons from Europe, they contend that stakeholder alignment, institutional credibility, and a shared long-term vision will be as important as technology and financing in determining India's offshore wind future.

As the Global Wind Day 2026 conference was organized under the theme *"Wind Energy: From Ambition to Acceleration,"* offshore wind is once again moving to the centre of the country's clean energy agenda. A fresh offshore wind tender is expected along the Tamil Nadu coast after earlier procurement efforts struggled to sustain developer interest. The Government has approved a ₹7,453 crore support package for the country's first 1 GW of offshore wind capacity off Gujarat and Tamil Nadu, including support for port infrastructure. A 500 MW Contracts for Difference (CfD) pilot has been announced. The India-UK Offshore Wind Taskforce has begun work on financing frameworks, market design, supply chains and infrastructure readiness.

These developments are significant individually. But collectively, they suggest that India is no longer discussing offshore wind as a resource opportunity. It is beginning to assemble the architecture of an offshore wind market. And this distinction is important.

For much of the past decade, India's offshore wind narrative revolved around potential. Resource assessments identified promising coastlines, policy frameworks were drafted, and ambitious targets were announced. But commercial momentum remained limited.



The challenge was never the availability of wind. India possesses an estimated wind potential exceeding 1,163 GW at a hub height of 150 metres. Preliminary assessments by the National Institute of Wind Energy indicate capacity utilization factors of 45–50 per cent along parts of the Tamil Nadu coastline. The resource base has been evident for years.

What remained uncertain was the pathway from resource potential to investable opportunity. Earlier offshore procurement efforts encountered muted developer interest amid concerns around project economics, transmission arrangements, infrastructure readiness, construction risk, and long-term revenue visibility. Strong wind resources alone were insufficient to attract the scale of capital required for a new market.

Viewed through that lens, the recent policy push takes on greater significance. Viability Gap Funding improves project economics. Contracts for Difference enhance revenue certainty.



Port investments strengthen execution readiness. International partnerships help build technical and institutional capability. Together these interventions address a common challenge of financeability. The debate is gradually shifting from resource discovery to risk allocation.

The central question is no longer whether offshore wind can be built in India. It is whether risks can be distributed and managed in ways that make long-term investment viable. And that shift marks an important moment for the sector.

Offshore Wind is Also a Legitimacy Challenge

Offshore wind expands the circle of stakeholders far beyond developers and regulators. Ports become part of the energy transition. Marine ecosystems become part of project planning. Fishing communities become stakeholders in infrastructure decisions. Coastal economies become part of industrial strategy. This changes the nature of the challenge. Infrastructure projects are usually discussed as engineering and financing exercises. In practice, they are also exercises in legitimacy. Different stakeholders evaluate the same project through different lenses, and those perceptions can influence outcomes as much as technical considerations.

What makes offshore wind unusual in India is that the sector is entering public consciousness before it has entered commercial scale. That creates a strategic opportunity many infrastructure sectors never receive.

Most large infrastructure programmes inherit perceptions shaped by years of public debate, market experience or political controversy. Offshore wind remains unfamiliar to most stakeholders in India. Opinions are still forming. Expectations remain fluid.

The narratives established during this phase will influence how the sector is understood for years to come.

If offshore wind becomes associated primarily with costs, uncertainty, or disruption, those perceptions may prove difficult to reverse. If it is understood within a broader framework of coastal development, industrial growth, energy security, and long-term economic opportunity, the conversation evolves differently. For offshore wind, legitimacy is built long before the first turbine is installed.

Narrative Risk is Also Project Risk

Infrastructure sectors routinely assess financial, regulatory, and construction risks. Offshore wind introduces another dimension of narrative risk. Misunderstandings around project costs, fisheries, coastal impacts, transmission infrastructure, or local benefits can delay projects even when technical and financial challenges have been addressed. Information gaps are often filled by assumptions, speculation or competing narratives. This is why communication cannot be treated as a post-award activity.

Investors need confidence in policy durability and risk allocation. Communities need clarity on local impacts and opportunities. State governments need visibility into industrial and economic benefits. Each stakeholder group is evaluating the credibility of the sector's long-term promise.

In that sense, communication becomes part of market creation rather



than a supporting activity around it.

Europe Offers a Useful Contrast

A useful comparison emerged this year when North Sea countries advanced plans for approximately 100 GW of coordinated offshore wind development as part of a broader 300 GW vision for 2050. The significance of that initiative lies beyond the scale of deployment. The participating countries are working to align transmission infrastructure, investment frameworks, long-term planning, and cross-border cooperation around a shared offshore energy system. Offshore wind is being treated as strategic infrastructure that supports energy security, industrial competitiveness, supply-chain resilience, and regional economic development.

That evolution offers an important lesson for India. Europe's experience suggests that offshore wind scales most effectively when it is understood as an economic and strategic ecosystem rather than a collection of individual projects. The success of offshore wind depends not only on the quality of the resource or the design of auctions, but also on the ability of institutions, investors, and communities to align around a long-term vision.

India's offshore wind journey remains at a much earlier stage. But the questions now emerging around financeability, infrastructure readiness, stakeholder alignment, and public legitimacy are strikingly similar. The difference is that India still has an opportunity to shape those conversations before the market reaches commercial scale.

The Next Phase Will Be Decided Onshore

India's offshore wind sector is entering its most consequential phase. The technical resource exists. Policy support is becoming more sophisticated. Financial mechanisms are evolving. International partnerships are expanding. The harder challenge lies elsewhere. It lies in building an ecosystem where developers, lenders, manufacturers, ports, governments, and communities arrive at a sufficiently shared understanding of the opportunity and the risks involved in pursuing it.

Every successful offshore wind market has ultimately addressed that challenge in its own way. India's next chapter will depend less on the quality of wind available offshore and more on the quality of institutions, market signals, and stakeholder alignment built onshore. The turbines will eventually become the visible symbols of progress. The foundations of the sector will be established much earlier, through the credibility, coordination, and long-term conviction that persuade stakeholders the opportunity is worth pursuing. ■

Mayuri Singh is an energy sector legal and regulatory communications expert, with deep experience in policy interpretation, statutory frameworks, and execution advisory; and Nishant Saxena is a strategic communications advisor and journalist focused on the energy and environment sector. The authors run and manage Comm'fident, a strategic communications-led management advisory focused on India's energy, infrastructure, and environment sectors.



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https://gss2026.iisdindia.in/

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https://conferencealerts.co.in/event/101272434

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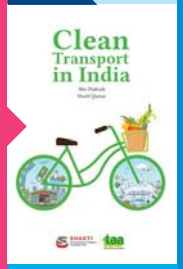
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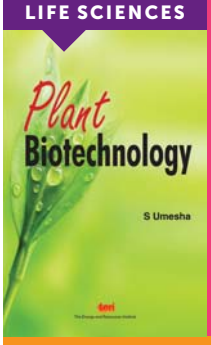
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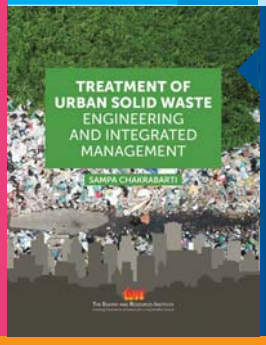


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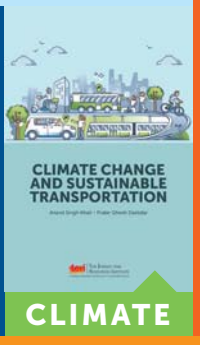


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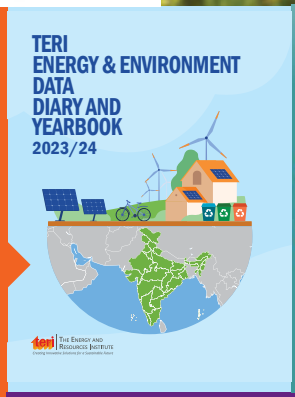


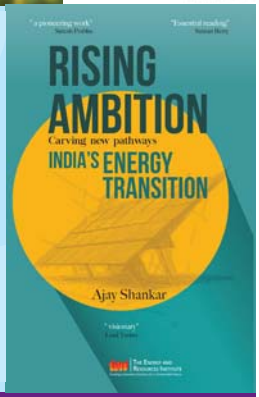
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