



ANNUAL REPORT

2024-25



PRESIDENT'S MESSAGE

"उत्तिष्ठत जाग्रत प्राप्य वरान्निबोधत।"

– Kathopanishad 1.3.14

("Arise, awake and stop not until the goal is reached.")

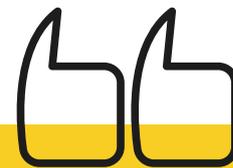
It is with immense gratification and a sense of deep institutional pride that I present the second edition of the National Economic Forum's Annual Report - a compendium that encapsulates not just the chronology of our year, but the intellectual spirit that animates our journey.

The past year has been nothing short of a transformative chapter of growth and evolution for NEF. As India embarks upon an ambitious and transformative economic trajectory toward Viksit Bharat@2047, NEF too has sought to mirror that ambition through rigorous scholarship, critical inquiry and multi-stakeholder engagement. Our work this year has spanned across thematic pillars vital to India's future - from the microcosmic potential of the bamboo economy, to the vast, algorithmic frontier of artificial intelligence. In each of these domains, our researchers continue to work with academic precision and policy foresight, producing knowledge that is both evidence-based and implementation-ready.

We have, in parallel, enhanced our institutional infrastructure. The launch of NEF's newly redesigned website - an intuitive, data-rich and user-oriented interface - has enabled wider dissemination of our ideas to stakeholders across ministries, state governments, media, civil society and the global research community. It is our belief that a think tank must not only think, but also communicate, connect and catalyse. The new digital gateway is a significant leap in that direction.



www.nationaleconomicforum.org



What distinguishes NEF is not merely the diversity of its research interests but the coherence of its purpose: to shape policy frameworks that are attuned to India's socio-economic realities, and yet inspired by its global aspirations.

Devesh Tripathi

President, National Economic Forum (NEF)

What distinguishes NEF is not merely the diversity of its research interests but the coherence of its purpose: to shape policy frameworks that are attuned to India's socio-economic realities, and yet inspired by its global aspirations. Whether it is our ongoing policy work on agri-regulatory reform, frontier technologies or climate-smart development, NEF strives to offer not rhetorical flourishes, but actionable blueprints.

Looking ahead, the National Economic Forum is poised to consolidate its role as a crucible of transformative thought and catalytic policy engagement. Within our intellectual ecosystem, youthful idealism intersects with seasoned wisdom to craft frameworks that are deeply anchored in India's socio-economic realities, yet aspirational in their global outlook. I warmly invite scholars, practitioners, civil servants and citizens alike to delve into our research, critique it with rigour, enrich it with diverse perspectives and - where purpose converges - join us in shaping an economic architecture that is both equitable and future-ready.

In the words of the Upanishadic seers: "*Uttishthata, Jagrata*" - let us rise, let us awaken, and let us continue to walk the arduous but essential path of knowledge-driven nation-building.

Jai Hind,

Devesh Tripathi

Dr. Devesh Tripathi



EXECUTIVE DIRECTOR'S MESSAGE

It gives me immense pleasure to present NEF's Annual Report, a document that reflects not only the breadth of our research endeavours but also the depth of our institutional conviction that evidence, ethics and excellence must lie at the heart of public policy.

The past year has been transformative for NEF. As India advances toward its long-term vision of Viksit Bharat@2047, our Forum has sought to contribute meaningfully to the national discourse through rigorous scholarship, multi-sectoral engagement and a spirit of constructive inquiry.

Whether our work has delved into the frontiers of artificial intelligence and digital public infrastructure, examined governance reforms and institutional strengthening, analysed geostrategic shifts around the world, or explored the complex interplay between sustainability, law and economic growth, the guiding philosophy has remained constant, that of, to generate knowledge that is actionable, credible and deeply rooted in India's developmental realities.

A major milestone this year was the constitution of the NEF Advisory Board, a distinguished group of leaders whose guidance strengthens not only our -

institutional vision but also enhances credibility as well as provides strategic direction for our future work. We have also prioritised institutional growth. This year's expansion of NEF's digital interface, partnerships ecosystem and internal research capacity marks a significant stride in our journey to becoming a leading voice in India's policy landscape. This report highlights our commitment to staying ahead of emerging challenges while anchoring our work in long-term national priorities.

What gives NEF its unique identity is the convergence of youthful intellectual energy and seasoned policy experience within our team. This intersection has enabled us to produce research that is analytically robust yet accessible, designed to empower policymakers, industry leaders, civil society actors and citizens alike.

As we look ahead, NEF remains steadfast in its mission to serve as a bridge between ideas and implementation. We will continue to champion forward-thinking, data-driven and people-centric policy frameworks that strengthen India's economic resilience and global leadership.

I extend my heartfelt appreciation to our President, mentors, collaborators, researchers and partners whose support makes this journey possible. May our shared pursuit of knowledge-driven nation-building continue with renewed purpose and unwavering resolve.



Jai Hind.

A handwritten signature in black ink, appearing to read 'Jag' with a flourish underneath.

Jagdip Rana

Executive Director , NEF

OUR COLLABORATORS



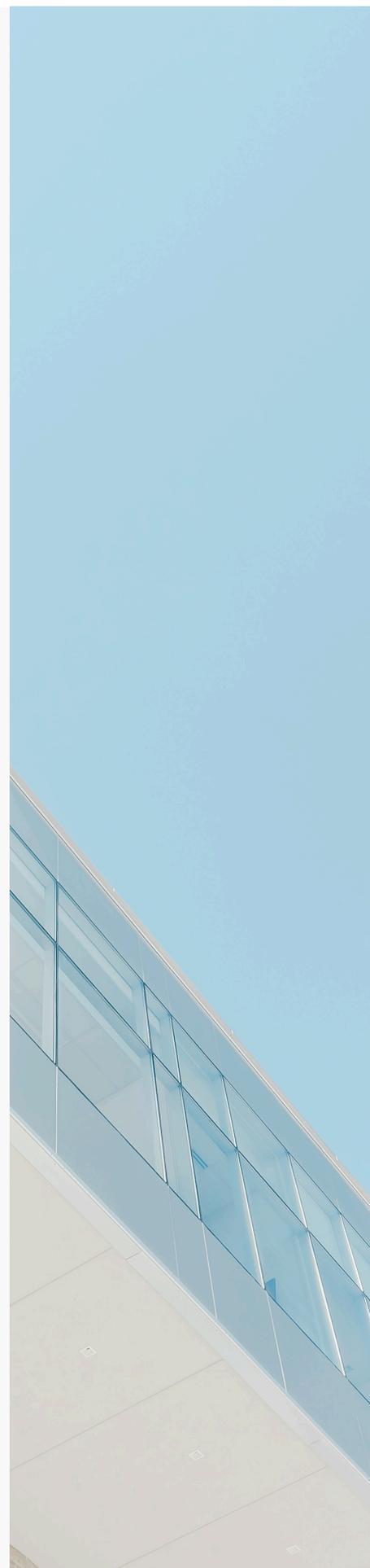
OUR VISION

A Viksit Bharat that is prosperous, inclusive, innovative and sustainable, and that plays a defining role in shaping a multipolar and equitable global economy.

OUR MISSION

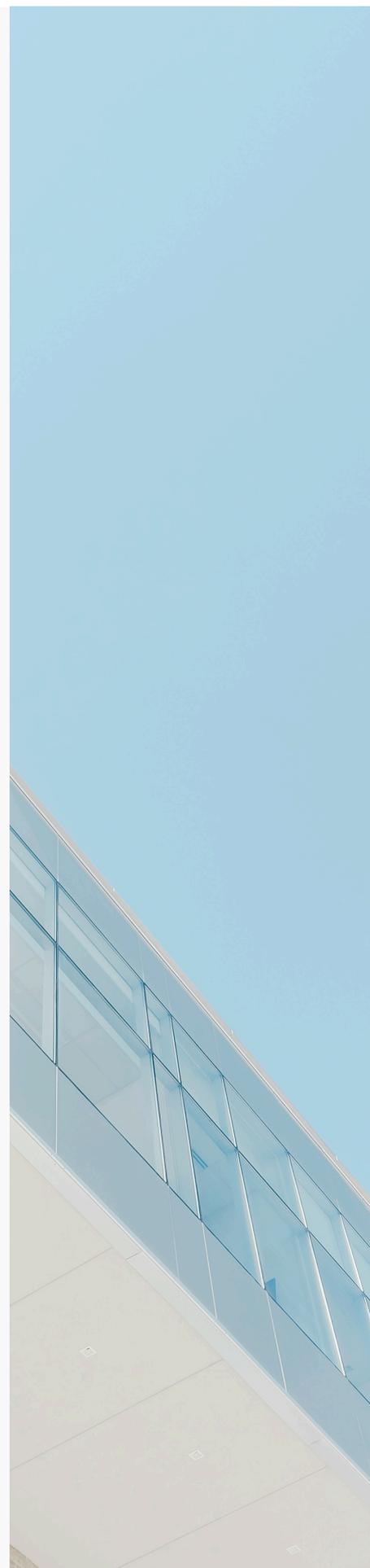
The National Economic Forum (NEF) is India's independent not-for-profit forum for public-private-civil society cooperation. Headquartered in New Delhi, NEF convene the country's most impactful leaders from government, business, start-ups, academia, and civil society to shape national, regional and industry agendas that accelerate inclusive and sustainable growth for India and, by extension, contribute to global progress.

In an era of polycrises, rapid technological disruption and widening inequality, NEF provides a trusted and impartial space where diverse stakeholders can build mutual understanding, forge partnerships and convert insight into action. NEF believes India's greatest strength lies in its democratic energy, entrepreneurial spirit, demographic dividend and civilisational capacity for dialogue. Our mission is to harness these forces to help India achieve developed-nation status by 2047 while serving as a responsible and respected voice in the global economic order.



OUR OBJECTIVES

- Actively discover, curate and produce high-quality research and policy briefs in the domain of economic governance, sustainable frontiers, law and economy and international trade and relations.
- Catalyse public-private collaborations that deliver large-scale economic and social impact.
- Produce frontier-thinking, data-driven insights on India's growth priority areas (infrastructure, manufacturing, sustainable economy, green transition, skills, urbanisation, rural prosperity and global integration).
- Strengthen India's role in global economic governance (G20, WTO, IMF, climate finance, data governance, AI regulation, green energy) while attracting the best global capital, technology and practices to India.
- Provide a platform for various regional and upcoming Indian think tanks, universities and policy labs to present their research on topics of economic significance to national decision-makers, corporates and global leaders.
- Nurture the next generation of Indian leaders and researchers through discussion, policy dialogue and cross-sector exposure.
- Promote competitive and cooperative federalism by convening central government, state governments and industry on a common platform.
- Build trust-based ecosystems around critical national missions.



FOCUS AREAS

TECHONOMICS



GOVERNANCE FOR GROWTH

KNOWLEDGE ECONOMY



LAW AND ECONOMY

SUSTAINABLE HORIZONS



GEOSTRATEGIC FRONTIERS

ADVISORY BOARD



Smt. Charu Malhotra

A leading educationist and learning & development professional with over 25 years of experience in public education, digital transformation and policy. She has worked with over 15 State Governments and Central Ministries on projects in education, technology, and gender-based development programmes. Formerly with KPMG and IL&FS Education, she is the Co-Founder and Managing Director at Primus Partners where she leads the Education, Employability and Entrepreneurship Practice, and advises government bodies and private sector on large scale transformational reform and CSR strategies.

Former Additional Chief Secretary, Government of Gujarat, Former Joint Secretary (Textile), Government of India. A senior civil servant with over 35 years of experience in administration and public policy, Shri Gulati has led critical reforms in the power and energy sector, industry promotion, and infrastructure development. He brings a deep understanding of institutional reform, public finance, and sustainability-driven growth strategies.



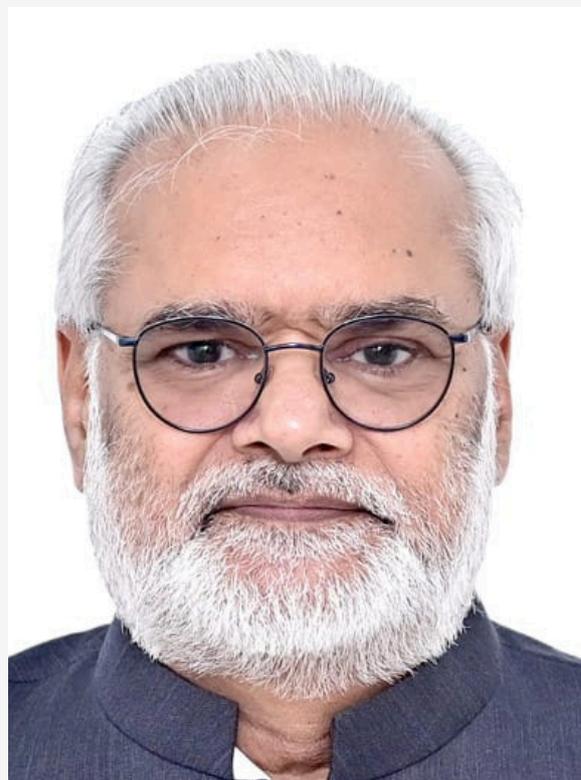
Mr. Sujit Gulati, IAS (Retd.)



Smt. Shveta Kalyanwala

Gender Parity and Social Development Specialist · Independent Consultant. An advocate for gender inclusion and women's economic empowerment, Smt Kalyanwala has worked extensively in the areas of gender policy, social equity, and inclusive governance. Her experience spans research projects and policy advisory roles with national and international development organisations. She brings a strong interdisciplinary perspective to the Board on gender mainstreaming and equitable growth.

Mr. Anand Mohan Tiwari, IAS (Retd.), is a senior public policy leader with 34 years of experience across rural development, tribal empowerment, education, and CSR. He has led major state enterprises, pioneered high-impact livelihood programmes, and continues to guide several academic and development institutions.



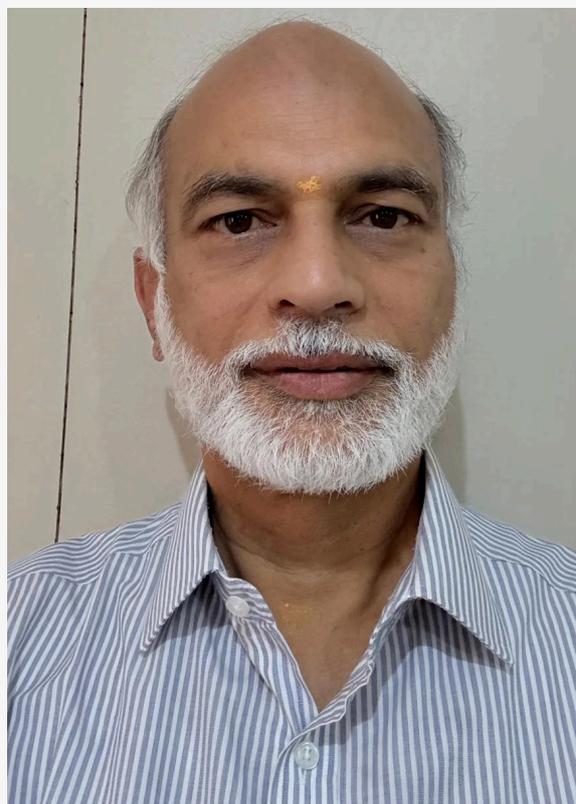
**Mr. Anand Mohan Tiwari, IAS
(Retd.)**



Dr. Sonal Mansingh

Dr. Sonal Mansingh is one of India's most celebrated cultural icons and internationally acclaimed dancer, scholar, author, and artistic visionary. For over six decades, she has brought Indian mythology, philosophy, and social themes to life through her pioneering choreographies and her revival of the Natya-Katha tradition. As Founder-President of the Centre for Indian Classical Dances, she has mentored generations of artists and represented India in over 90 countries. She has served as Chairperson of the Sangeet Natak Akademi and is currently Trustee at IGNC and Visiting Professor at IIT Kharagpur. The first classical dancer nominated to the Rajya Sabha, she is a Padma Vibhushan awardee whose work continues to shape India's cultural identity and inspire social transformation.

Prof. Dr. N. Sridharan is a noted scholar in urban governance, land markets, and spatial planning, with publications in leading global journals. Formerly Director of all three SPAs, he currently advises national ministries, NITI Aayog, and international agencies on sustainable and equitable urban development.



Prof. Dr. N. Sridharan



Dr. D.S. Shukla

Dr. D.S. Shukla is a former Joint Director of the Central Bureau of Investigation (CBI), having a distinguished career spanning over three decades in India's premier investigative agency. He has served across nearly all investigative verticals of the CBI, including Economic Offences, Special Crimes and Anti-Corruption, with supervisory jurisdiction over several key zones across the country. He has also represented India internationally through multiple United Nations policing assignments in Europe and Africa, and at global forums such as UNCAC and Interpol. He combines deep operational experience with strong academic grounding, including a Ph.D. in White Collar Crimes, and continues to contribute to institutional governance and financial oversight through senior advisory roles.

TECHONOMICS

At NEF, Techonomics embodies the intersection of technology and economics, two forces that are reshaping governance, markets and societies in unprecedented ways. For NEF this focus area holds profound relevance. As India beelines towards a \$1 trillion digital economy, the imperatives of data governance, artificial intelligence (AI), cybersecurity, fintech innovation and digital public infrastructure demand informed policy intervention grounded in both economic rationale and technological foresight.

NEF's Techonomics vertical seeks to bridge the gap between innovation and inclusion. From analysing the socio-economic impact of India Stack and the Unified Payments Interface (UPI) to studying the potential of frontier technologies such as blockchain, quantum computing and generative AI, the Forum aims to inform evidence-based policymaking that ensures technology serves as an equaliser rather than a divider.

This entails examining how emerging technologies can boost productivity, formalise the informal sector, enhance transparency in governance and support the Sustainable Development Goals (SDGs).

NEF is uniquely positioned to convene policymakers, technologists and industry leaders to co-create pragmatic solutions. Through policy briefs, roundtables and collaborative research with ministries, academia and the private sector, the Techonomics initiative strives to foster a policy environment that nurtures innovation while safeguarding citizens' rights and economic stability.

In an era where the algorithm increasingly influences the economy, Techonomics ensures that India's technological revolution is underpinned by ethical, equitable and forward-looking policy frameworks, anchoring NEF's mission to align technological advancement with national development priorities.

In FY25, India's journey toward becoming a \$1 trillion digital economy is not just about scale, it is about embedding economic logic into technological change. NEF's Techonomics focus area which is at the intersection of technology and economics, is increasingly central to how India governs, budgets and regulates digital transformation. The latest advancements highlight a maturing ecosystem of digital public infrastructure, AI governance, financial inclusion, data sovereignty and frontier experimentation.

A foundational fact is that India's digital economy is on track to grow sharply. It is estimated that India's digital economy contributed 11.74% of national income in 2022-23, and is only likely to rise in the subsequent years (Mishra et al, 2025). India is ranked as the third-largest country in terms of economy-wide digitalisation (ICRIER, 2025). The government projects that by 2029-30, the digital economy will account for nearly one-fifth of national income (PIB, 2025).

This growth is enabled by massive scale; as of mid-2024, India had over 650 million smartphone users and more than 950 million internet subscribers (India - Digital Economy, 2024). Internet penetration continues to expand in rural and semi-urban regions, bridging the digital divide with each passing day.



One implication of Techonomics is not just measuring how large the digital economy is, but how its benefits diffuse across regions, social groups, sectors and governance layers.

One of India's most mature 'digital public goods' is the Unified Payments Interface (UPI) and the broader India Stack ecosystem (Aadhaar, e-KYC, eSign, etc). In his address at the 5th Influential Leaders of India 2025, Ajay Kumar Chaudhary, Non-Executive Chairman and Independent Director, National Payments Corporation of India (NPCI), noted that UPI has simplified payments for consumers and empowered small merchants to access digital finance.

In terms of market scale, estimates suggest that India's UPI payments market reached the \$2.5 trillion mark well within the first quarter of 2024 (Cornelli et al, 2024).

Between April and September this year, India's UPI payments market expanded steadily, with a nearly 10% increase in transaction volume and a 4% rise in transaction value (NPCI-Statistics, 2025).

This reflects both deepening digital penetration and sustained user engagement in the UPI ecosystem, thereby, indicative of how the payments infrastructure is becoming a cornerstone of the digital economy, not just a utility.

More recently, India has begun to connect the dots between UPI and AI. It is increasingly being argued that India is transitioning from infrastructure-centric digital public infrastructure (DPI) to intelligent financial governance, where AI and analytics are layered over payments flows to detect fraud, tailor credit as well as optimise policy (Madan, CAJS & Kumar, M., 2025.)

On the public infrastructure front, the India AI portal (INDIAai) was formally launched half a decade ago in May 2020, jointly by the Ministry of Electronics and IT (MeitY), the National e-Governance Division (NeGD), and the National Association of Software and Service Companies (NASSCOM), as a national AI platform intended to centralise research, policy, datasets and governance updates.

AI, Governance and Trust

India is working to include governance, ethics and accountability into its regulatory frameworks as AI gains traction. Earlier this year in January 2025, a MeitY Subcommittee's report on AI Governance & Guidelines Development was published for public consultation.

The guidelines emphasise accountability, transparency, bias mitigation, privacy and redress mechanisms (Ministry of Electronics and Information Technology, 2025). At a meta-level, various researchers continue to examine India's evolving AI strategy in the context of global norms, highlighting both opportunities and regulatory challenges.

On the ground, Indian fintech is among the early adopters of AI for risk, compliance and credit underwriting. This has been highlighted in Moody's Investor Service study as well (Virk, S., 2024).

Yet the rapid rise of AI also raises new risks such as, operational failures, algorithmic bias, opacity, emergent behaviour, etc.

For NEF's Techonomics focus area, this stresses the need for policy instruments that can keep up with evolving AI systems, not just after the fact, but in design (so-called 'safety by design') and real-time oversight.

Cybersecurity, Data Sovereignty and Fraud Risks

A rising tide of digital transactions has brought with it sharp increases in cyber risks. In FY 2024, Indian authorities reported a more than fourfold jump in high-value cyber fraud cases, amounting to losses of over \$20 million (Mukherjee, 2025).

This calls attention to the need for robust cybersecurity, digital forensics, capacity building and regulatory frameworks. In Lucknow, for instance, the National Institute of Electronics and Information Technology (NIELIT), under MeitY, has inked an MoU with the Future Crime Research Foundation (FCRF), an IIT Kanpur's AIIDE CoE incubated non-profit specializing in cybercrime research and policy, to strengthen cybercrime training, labs, policy and coordination.

Data sovereignty is another central thread in India's techonomics. India's regulatory environment increasingly emphasises data localisation, controls over cross-border flows, and protection of personal data. This is both an economic and governance lever, i.e, controlling where data resides, ensuring it supports analytics, monetisation, accountability and sovereignty.

Furthermore, the DPI stack is being extended. For example, the digital rupee (CBDC) pilot continues to be explored in India as programmable money, though adoption is nascent.

Inclusion, Informality and Productivity

Another core ambition of NEF's Techonomics is to ensure that emerging technologies uplift rather than exclude. India's informal sector, which accounts for a vast share of employment, remains a frontier for tech inclusion.

Recently, NITI Aayog has proposed a mission called Digital ShramSetu aimed at digitally empowering India's approximately 490 million informal workers, leveraging AI, blockchain and immersive learning to build a 'trust bridge' into the formal economy (NITI Aayog, 2025).

On the SME side, Mastercard's Strive program Digital Saksham reportedly reached over 300,000 SMEs, enabling many to adopt digital tools and business online (ET, 2025).

From the aspect of behavioral policy, studies of UPI find that around 75 % of participants report increased spending post-adoption of UPI, indicating behavioral change in consumption and liquidity via digital infrastructure (Dev et al, 2024).

Meanwhile, policy discourse is exploring micro-entrepreneurship models, such as the MAST enterprises - Micro-enterprises focused on AI, Software and Technology (MAST) - that pair technology with local demand, enabling digital economic participation at hyperlocal scale (Kumar, M, 2024).

The promise is that frontier tech, mainly AI, blockchain and generative models, can increase productivity, reduce frictions, compress transaction costs and connect informal agents to formal services provided the access, incentives and governance architecture are aligned.



Frontier Experimentation & Road Ahead

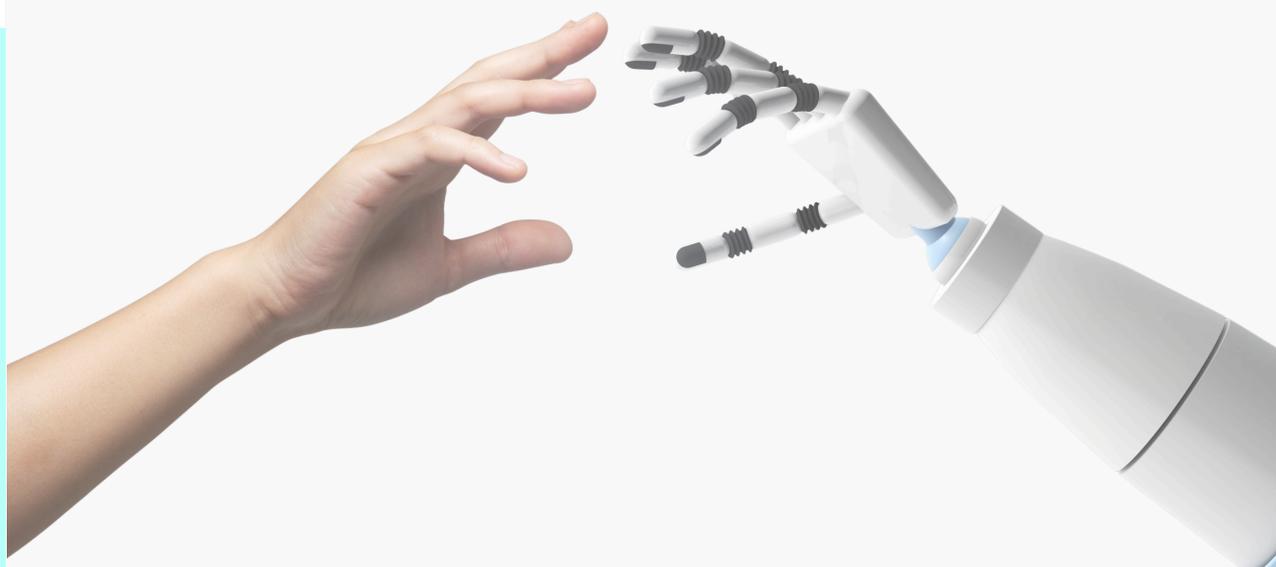
In the past year, India has not just consolidated what works; it has experimented and continues to remain committed to experimenting. Quantum computing, blockchain, generative AI, federated learning and AI-driven regulation are areas under exploration in research labs and policy circles. While many such efforts are nascent and not yet large scale, they reflect India's ambition to be more than a user of foreign technology but a contributor to global innovation.

A key challenge ahead is policy agility wherein India cultivates the ability to respond to emergent risks (e.g. AI failures), update regulatory guardrails, monitor markets and correct distortions. NEF's Techonomics will need to lean not just on ex post regulation, but horizon scanning, ethics audits, public experimentation and participatory governance.

Moreover, infrastructure gaps such as the lack of digital access in remote regions, lack of affordability of devices and absence of last-mile connectivity, must be addressed so that the benefits do not get concentrated in urban or privileged pockets.

Ergo, India's techonomics story, particularly in the last one year, is one of maturing digital public goods, rising AI ambitions, expanding financial inclusion and evolving governance frameworks. The numbers show scale - a significant percentage of national income, hundreds of millions of users, trillions in payments. But the deeper metric is inclusion; how fully the informal sector, women, lagging regions and vulnerable populations can participate, and how policy environments can channel disruption toward equitable growth.

For NEF's Techonomics focus area, the task is to convert these trajectories into coherent policy interventions, particularly, to bridge innovation and inclusion, to align incentives, to design regulation that is anticipatory, to convene stakeholders and to anchor technology in developmental goals. In an era where algorithms increasingly mediate public life, India's technological transformation demands an equally sophisticated economic and governance lens.



GOVERNANCE FOR GROWTH

This focus area embodies our conviction that sound governance is the bedrock of sustained economic progress. India's growth story is as much about institutional integrity and administrative efficiency as it is about market dynamism. Through this focus area, NEF examines the intricate linkages between governance quality, regulatory reform and economic performance. The Forum's research and policy dialogues explore how transparency, accountability and digital transformation in governance can enhance the efficiency of public expenditure, strengthen investor confidence and catalyse entrepreneurship.

Being headquartered in the national capital offers NEF an unparalleled vantage point. New Delhi is not only the seat of policymaking but also the crucible where ideas translate into national programmes.

From engaging with policymakers on administrative reforms and ease-of-doing-business strategies to assessing decentralisation and local governance frameworks, NEF's Governance for Growth initiatives contribute empirically grounded insights to ongoing policy conversations.

The Forum's work in this domain also emphasises participatory governance - where citizen feedback, data-driven evaluation, and

institutional capacity-building converge to make development more responsive and resilient. By fostering partnerships with ministries, state governments and civil society actors, NEF seeks to reimagine governance as a catalyst for growth, not a constraint upon it.

Governance for Growth, thus, reflects NEF's commitment to shaping a governance paradigm that is efficient, transparent and innovation-led, anchoring India's transformation into a \$5 trillion economy that leaves no citizen behind.

In India's evolving development narrative, the idea that governance is not merely a cost but a foundation for growth has gained renewed salience. Institutional integrity, administrative efficiency as well as technological modernisation are now viewed as essential complements to market dynamism. Over the years, India has registered a number of measurable progressions in governance reform.

A central pillar of governance reform has been India's expanding DPI, which underpins more transparent, trackable and low-leakage public delivery systems. Internet connections in India rose from 25.15 crore in 2014 to 96.96 crore in 2024, and 5G towers have been deployed in large numbers, enabling coverage in 99.6% of districts.

By the end of the first quarter of this year, UPI recorded 1,867.7 crore transactions worth ₹24.77 lakh crore, signifying how digital payments have become routine in citizen-government and peer transactions. Platforms such as DigiLocker with 53.92 crore users and the UMANG app ecosystem offering around 2,300 services in 23 languages, have steadily matured as well (PIB, 2025).

Such digital advances reduce administrative friction, shrink opportunities for rent extraction and allow more real-time monitoring of government processes. At NEF, we understand that the linkage is clear - stronger DPI enables more accountable public expenditure.

Stronger governance often shows up in lower regulatory burden, clearer rules, faster permitting and accountability in approvals. The last one year was witness to several reform trajectories that are noteworthy. The Department for Promotion of Industry and Internal Trade's (DPIIT) Business Reforms Action Plan Plus (BRAP+) 2024 deepened earlier efforts to streamline regulatory processes, eliminate redundant compliance burdens and embed digital mechanisms across approvals. In November 2024, the Confederation of Indian Industry (CII) in collaboration with the Ministry of Commerce and Industry, launched a joint Ease of Doing Business & Regulatory Affairs Portal to receive citizen and enterprise feedback, track submissions in order to drive reform through transparency. The Ministry of Corporate Affairs proposed amendments in April earlier this year (with public comments invited on the draft notification in Sept, 2025), to further simplify corporate restructuring norms, fast-track mergers (FTM), and rationalise forex rules.

At the capital markets level, SEBI introduced a suite of reforms in FY25 aimed at enhancing transparency, tightening disclosure, deepening Environment, Social, Governance (ESG) reporting, enhancing independent director scrutiny and integrating compliance across submissions. States remain competitive actors too. The Uttar Pradesh (UP) government reports having undertaken

4,675 reforms including digitisation of around 524 services (TOI, 2025). These reforms collectively nudge the incentive environment. Businesses face fewer opaque delays, states compete to improve governance scores and the burden of red tape is slowly receding.

Beyond systems, governance reform must address the political and institutional architecture that ensures accountability. Some landmark developments in the last one year do merit emphasis. Last year, the apex court in *Association for Democratic Reforms v. Union of India* struck down the Electoral Bonds Scheme 2018, declaring it unconstitutional for violating voters' right to information. This was hailed by many as a momentous judgment that provided a fillip to strengthening electoral transparency.

On public perception, the Corruption Perceptions Index 2024 (by Transparency International) assigns India a score of 38, ranking India 96th out of 180 countries. This is a one-point drop relative to the previous year, suggesting persistent headwinds in public trust.

The BTI Transformation Index 2024 notes that while India has longstanding democratic credentials, critics point to concerns about institutional weakening, democratic backsliding and pressures on independent oversight bodies under the Modi government.

Albeit, this analysis may stem from certain Western biases against India. Civil society and anti-corruption advocates continue to push reform, recommending digitising procurement, widening oversight and strengthening enforcement mechanisms to reduce corruption.

These developments reiterate that in the domain of governance, institutional design and legal safeguards remain areas where further research, dialogue and policy interventions are critical.

Centre's Mission Karmayogi has been highlighted as advancing digital training, transparency and performance orientation in the state apparatus. States have adopted digitised financial management reforms, one of the major ones being SNA-SPARSH, a 'just-in-time' mechanism for digitally tracking fund flows and improving audit management

The corporate sector is also reforming. In the last year, India has renewed push for the implementation of Business Responsibility and Sustainability Reporting (BRSR) norms under SEBI, tightened promoter/related party transaction rules and enforced more frequent governance disclosures.

At the frontier of experimentation, NITI Aayog and MeitY are exploring blockchain-based transparency systems in registries, contracts and trust architectures. This has taken centrality in those interested in the tracking of how the state reframes blockchain as both decentralising and re-centralising governance control (Sarkar, D. & Arora, C., 2024).

In higher education, India's National Academic Depository (NAD) is being expanded to digitise transcripts and credentials, simplifying verification and reducing fraud in degrees.

These innovations reflect how the ideal of participatory governance - merging citizen feedback, data evaluation, and institutional capacity - is being approached across domains.

While the recent advances are promising, India's governance transformation is far from complete. Key challenges include:

- **Enforcement vs Rules:** Many new norms (e.g. in SEBI, corporate law) depend on enforcement culture, capacity and deterring misuse. Weak enforcement is still a bottleneck.
- **State variation & inequality:** Governance outcomes vary sharply across states; laggard states may lack the institutional bandwidth or political will to adopt reforms.

- **Digital divides & exclusion:** While DPI is expanding, marginalised populations may be left behind, especially in low-connectivity areas or among vulnerable communities.
- **Institutional erosion risk:** There are concerns that concentrated executive control or weakening of independent institutions could undercut long-term checks and balances.
- **Capacity constraints:** Bureaucratic capacity, training, accountability structures, data literacy and systems integration remain uneven across departments and tiers of government.

Given India's ambition to become a \$5 trillion economy before the end of this decade, and the World Bank's projection that India must grow at 7.8 % per year to attain high-income status by 2047, the margin for governance inefficiency is narrow (World Bank, 2025).

India's advances in governance over the last year align well with NEF's philosophy - governance is not merely a public good but a growth catalyst. Digital architecture, regulatory reform, state competition and legal safeguards are converging more closely each day to make public systems more transparent, accountable and responsive.





KNOWLEDGE ECONOMY

In an era defined by digital transformation and intellectual capital, the Knowledge Economy stands at the heart of India's journey towards becoming a \$5 trillion economy and subsequently \$10 trillion. This focus area represents both a national imperative and an institutional ethos.

At NEF, the Knowledge Economy focus area seeks to explore how education, research, technology and human capital can collectively enhance India's competitiveness in the global landscape.

The Forum undertakes analytical studies on issues such as digital skilling, intellectual property frameworks, R&D investment, higher education reforms and the diffusion of innovation across sectors. In doing so, it aims to provide actionable policy insights that bridge the gap between academic research, government priorities and industry needs.

NEF continuously strives to play a catalytic role in policy dialogues that shape India's digital and cognitive future. By convening experts across economics, technology and governance, NEF positions itself as a thought leader in designing strategies that empower India's knowledge workers, nurture innovation-driven entrepreneurship as well as align public policy with the demands of the fourth industrial revolution.

Ultimately, NEF views the Knowledge Economy not merely as an economic construct but as a vision of inclusive and sustainable development -

one where ideas, not just industries, become the engines of national progress. Through research, advocacy and collaboration, the Forum contributes to transforming India into a true knowledge powerhouse of the twenty-first century.

In an era dominated by digital disruption, intellectual capital is becoming the fulcrum of national competitiveness. For India, striving toward a \$10 trillion economy, the term 'Knowledge Economy' is not merely a rhetorical aspiration but a strategic necessity. In 2024-25, the contours of India's knowledge-driven transformation energised in multiple domains, ranging from education and skilling to research, innovation diffusion and institutional reforms.

A key enabler of any knowledge economy is sustained R&D investment. While India's Gross Expenditure on Research & Development (GERD) has more than doubled over the past decade (from ₹60,196.75 crore in 2010-11 to ₹127,380.96 crore in 2020-21), the ratio of GERD to GDP has lingered around 0.6-0.67 %, which is significantly below global averages and far from aspirational benchmarks in advanced economies (PIB, 2025).

This paints a persistent challenge of scaling both public and, critically, private R&D investment.

The 2024-25 Union Budget reinforced India's focus on the knowledge sphere; ₹1.48 lakh crore was allocated for education, skilling and employment, with enhanced funding for schemes in digital education, teaching capacity building, etc (PIB, 2024). The same budget also provided detailed allocations under science & technology portfolios. For instance, in 2024-25, the budget for 'Science and Technology Institutional & Human Capacity Building' stood at ₹543.91 crore, and the 'National Mission on Interdisciplinary Cyber Physical System' saw an allocation of ₹815 crore (Notes on Demands for Grants, 2025-2026).

Meanwhile, institutional dynamism has accompanied policy intent. The National Quantum Mission (with a ₹6,003.65 crore envelope) seeks to build India's capacities in quantum communication, computing, sensing and more; by late 2024 it had selected Thematic Hubs (T-Hubs) and Technical Groups to advance hub-based R&D efforts across institutions (National Quantum Mission (NQM) | Department of Science & Technology, n.d.). The proliferation of private and non-traditional players in research also shows up in a paper titled 'Institutional Shifts in Contribution to Indian Research Output' wherein new universities and private institutions are increasingly contributing to India's scholarly output (Singh, V.K., 2024).

That said, the private sector's R&D share remains modest. In 2020-21, only about 36 % of GERD came from industry, whereas leading innovation economies often see private share reaching nearly 70% (PIB, 2025). Albeit, macroeconomic tailwinds are aligning for industry to up its investments, but the scale is still emerging (Kaur et al., 2024).

A knowledge economy is only as strong as its human capital. In the past year, India made noticeable strides on the education and skilling front. At the school level, technology access has expanded. According to UDISE+ data, the share of schools with computers climbed from 38.5% in 2019-20 to 57.2% in 2023-24; internet ava-

-ilability went from 22.3 % to 53.9 % over the same period (Ministry of Education, 2025). Dropout rates are gradually declining, currently around 1.9 % at primary, 5.2 % at upper primary, and 14.1% at secondary levels (PIB, 2025).

In higher education and skill training, the Indian edtech/digital learning sector is surging. The digital education market in India was valued at \$4.20 billion in 2024 and is projected to grow rapidly at a CAGR of around 25 % during 2025-33 (India Digital Education Market Size, Share and Trends Report 2033, 2025). This indicates accelerating uptake of online, hybrid and adaptive learning systems.

From a government-led intervention perspective, new initiatives like the Prime Minister Internship Scheme (PMIS), which was launched in 2024, seek to directly link youth with industry.

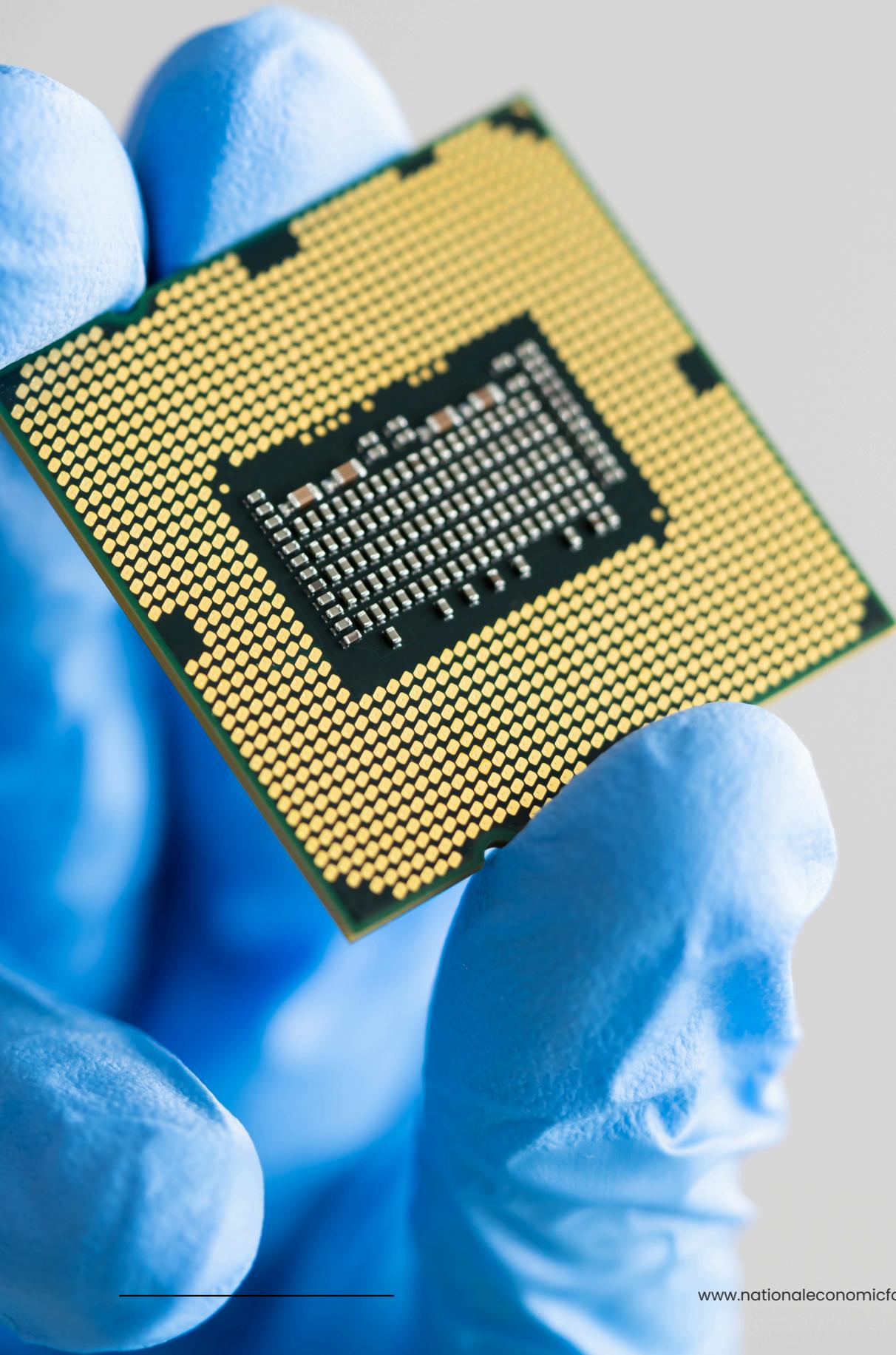
The scheme shall provide internships to the youth over five years across companies galore. This helps reduce friction between academic skills and workplace readiness.

Even then, employability remains a challenge. The India Skills Report 2025 notes that despite improvements, only 54.8 % of youth are considered employable in terms of relevant skills.

The mismatch between what academia offers and what industry demands continues to be a drag on knowledge economy outcomes.

Curricular reform is also in motion. Efforts are underway to weave AI, data science and emerging technologies into engineering, BBA, BCA syllabi via AICTE directives.

The National Academic Depository (NAD) scheme is another innovation that is digitising academic awards and making verification seamless, thus reducing friction in credentialing and transitions.



Technology diffusion across sectors is a key growth vector. India's startup ecosystem continues to be a pillar of its knowledge economy. As of 2025, India is home to over 1.59 lakh DPIIT-recognized startups, ranking among the largest globally (PIB, 2025). Deep-tech and frontier technology startups (quantum, AI, advanced materials) are growing in stature, aided by government missions and thematic funding calls.

In the semiconductor domain, the Semicon India programme is catalysing capacity-building. In 2024, the government approved four semiconductor manufacturing units and nine projects under its SPECS scheme; these are expected to create over 15,500 jobs (PIB, 2024). The electronics and R&D product development market is projected to grow at 12 % CAGR to reach \$63 billion by the end of 2025 from \$31 billion in 2019 (Discover India's Achievements in Science and Technology, 2025).

India is also making significant strides in frontier domains such as AI. In 2024, as part of the IndiaAI Mission, the government initiated three Centres of Excellence in AI (for agriculture, healthcare, sustainable cities) with a ₹990 crore budget (IndiaAI, 2024). Open-source AI capacities are being promoted via the 'YuvAI' initiative, in collaboration with AICTE (PIB, 2024).

The narrative of diffusion also extends to academia-industry linkages. The State of Industry R&D, 2024 report highlights emerging trends in collaboration, co-funding and corporate labs partnering with academia to accelerate translational research.

India's knowledge economy, though advancing, confronts structural constraints. First, R&D intensity is still low: a GERD-to-GDP ratio below 0.7% is well short of global peer benchmarks (PIB, 2025).

Second, private sector R&D remains underrepresented relative to global norms. Third, the geography of access is uneven, despite rising school ICT penetration, rural and remote areas still lag behind in digital inclusion and high-speed internet access. Fourth, employability mismatches and skills gaps persist, especially in soft skills or domain-aligned capabilities.

To tilt the needle further in favour of India's knowledge transformation, a few policy imperatives emerge:

- Boost private R&D incentives: Fiscal credit, co-funding, regulatory push and sectoral R&D mandates could draw more research capital from industry.
- Strengthen translational research ecosystems: More incubators, innovation clusters, university-enterprise consortia and technology transfer offices can help turn ideas into impact.
- Scale quality digital learning infrastructure: Continued investment in broadband access, affordable devices, and capacity-building for teachers remains crucial, especially in under-served regions.
- Curriculum modernisation & modular skilling: Embedding AI, data literacy and interdisciplinary orientation across higher education and vocational pathways can reduce the gap between supply and demand.
- Monitoring & evaluation ecosystem: A data-driven feedback loop - via digital credentialing (such as NAD), metrics on skills uptake and policy impact evaluation - will ensure continuous adaptation.

In toto, India in this past year has registered credible advances in its journey to a knowledge-driven economy. The strengthening of research institutions, expanded funding, digital skilling, diffusion into high-tech sectors and evolving policy frameworks reflect a maturing maturity in approach.

However the path remains steep, especially in harnessing private capital, bridging regional divides and aligning skill supply with future jobs. For an organisation like NEF, this phase offers a rich agenda - from deep diagnostics of institutional bottlenecks to catalytic policy design that

bridges academia, government and industry. The vision of a knowledge economy is more than just about economic arithmetic, it is about transforming ideas, capabilities and inclusion as pillars of India's rise.



SUSTAINABLE HORIZONS

Sustainable Horizons embodies the NEF's commitment to advancing a future where economic growth and environmental stewardship are not mutually exclusive but mutually reinforcing.

India today stands at a critical juncture: rapid industrial expansion, urbanisation and agricultural transitions are reshaping the economic landscape, even as climate stress, resource scarcity and ecological degradation pose existential challenges. Within this context, Sustainable Horizons seeks to frame sustainability not merely as an environmental ideal but as a foundational principle for inclusive growth, green innovation and long-term national resilience.

Through this focus area, NEF undertakes interdisciplinary research on themes such as renewable energy transitions, circular economy pathways, sustainable agriculture, climate finance and biodiversity conservation. By bridging scientific insight with economic rationale, the Forum provides actionable policy recommendations that can guide India's ministries, state governments and development institutions towards low-carbon and equitable growth trajectories.

NEF relentlessly works to translate sustainability from a global discourse into a grounded Indian policy agenda.

Ultimately, Sustainable Horizons reflects NEF's belief that sustainable development is not a

peripheral concern but the core of India's economic future. By aligning ecological balance with economic ambition, NEF strives to ensure that India's progress in the twenty-first century is not only prosperous but also enduring and just.

India today finds itself at a pivotal crossroads. On one hand, the country is pushing ahead with rapid industrialisation, urbanisation and agricultural transformation; on the other, it faces intensifying climate stress, resource scarcity and ecological degradation. In such a charged milieu, the notion of sustainability must become more than a rhetorical ideal, it must anchor national growth. NEF's Sustainable Horizons aspires to blend economic ambition with ecological balance, thereby becoming especially meaningful for India's trajectory.

In recent years, India has accelerated in several sustainability frontiers, namely, renewable energy scale-up, circular economy pilots, climate finance mobilisation, ecosystem restoration and green innovation.

Perhaps the most visible manifestation of India's sustainability push is in power sector transformation. In FY 2024-25, India achieved a record addition of 29.52 GW of new renewable energy capacity, bringing installed non-fossil capacity to 223.6 GW as of June 2025 (from 198.75 GW in 2023-24). This is a striking acceleration in the country's journey toward its 500 GW non-fossil target by 2030 (PIB, 2025).

Solar energy remains the locomotive. India's solar installed base climbed to 107.9 GW as of Jun, 2025. Since 2014, solar tariffs have plunged from about ₹6.17/kWh to ₹2.15/kWh, solidifying India's competitiveness in utility-scale solar (PIB, 2025).

Wind power also sustained momentum, with capacity rising to 51.05 GW as of June 2025 (PIB, 2025). To supplement this, India is ramping investments in grid modernisation, ultra-high voltage (UHV) transmission lines, renewable purchase obligations (RPO) enforcement and hybridisation strategies (solar + storage, wind-solar hybrids).

A flagship project emblematic of scale is the Gujarat Hybrid Renewable Energy Park in Khavda, Kutch. This park is slated to generate up to 30 GW combining solar and wind over a vast 72,600 ha site. The project holds promise not just for power scale but for demonstrating infrastructure integrations, storage, grid balancing models and spatial planning in semi-arid zones.

Complementing wind and solar, India's bioenergy sector is drawing fresh attention. Modern bioenergy currently accounts for 13 % of India's total final energy consumption with projections suggesting growth of up to 45 % by 2030 in this domain (IEA, 2025). This opens pathways to sustainable biomass, biogas, waste-to-energy and agricultural residue valorisation, linking rural livelihoods with low-carbon solutions.

The combined impact is evident. India crossed the milestone of 50 % non-fossil installed electricity capacity ahead of its 2030 target, signaling tangible progress in the energy transition (Reuters, 2025).

A core challenge in sustainable transitions is mobilising finance at scale. India's tracked green finance, while rising in recent years, still falls short of what is required to meet climate and adaptation goals. In the year 2021-22, India recorded its highest levels of tracked green finance, though much more capital will be needed (Chakravarty et al, 2024).

As part of enabling policy frameworks, India has explored novel instruments. One emerging idea is a pan-India parametric climate-linked insurance scheme. Under such schemes, predetermined payouts trigger automatically when specific weather thresholds (heatwaves, heavy rainfall) are breached, thus streamlining claims and lowering administrative friction (Reuters, Manikandan, A., 2025). This concept is currently under discussion with the National Disaster Management Authority (NDMA), Ministry of Finance and insurance sector.

Parallel to that, central and state agencies are embedding climate risk assessments and environmental safeguards in budgetary processes, project appraisals as well as public infrastructure planning. At COP29, 2024 in Baku, India advocated adaptation financing, blended instruments and capacity building as part of its global climate diplomacy.

Sustainability is not only about decarbonising energy, it also demands safeguarding living systems. India's Ek Ped Maa Ke Naam (Plant4Mother) campaign is a major initiative with a target of planting 140 crore trees. Simultaneously, the EcoMark rules (for eco-labelling) were notified in September 2024 to encourage green products.



In terms of forest and tree cover, the India State of Forest Report 2023 (released in 2024) showed forest and tree cover at 8,27,357 sq km or 25.17 % of India's geographical area. These efforts strengthen carbon sinks, improve habitat corridors and provide resilience against erosion, floods and biodiversity loss.

Beyond planting, India has stepped up scientific conservation: for example, the first-ever Ganges River dolphin tagging was undertaken during 2024 under project initiatives to track aquatic biodiversity in vulnerable riverine ecosystems.

Agriculture remains the backbone of India's socio-economic fabric. It is an undoubtable fact that sustainable transitions here are critical for equitable growth. Several states and central agencies throughout the course of the year have pushed with renewed vigour climate-smart farming, crop diversification, micro-irrigation, integrated nutrient management and digital agro-advisory systems.

Uttar Pradesh is pursuing its 'global food basket' ambition through climate-resilient seeds, remote sensing, and farm mechanisation support (TOI, Dikshit, R., 2025).

On circular economy, some pilot efforts in waste-to-resource cycles, plastic recycling, industrial symbiosis and biomaterial innovation have gained traction, especially in some states and metropolitan clusters. These remain in their fledgling state but hold promise as scaling mechanisms.

Despite these gains, multiple structural constraints remain:

- **Financing gap:** India's current green finance flows remain significantly below needed levels to meet NDCs and resilience demand.

- **Grid & integration stress:** Renewables require stronger grid flexibility, storage, demand response and transmission expansions, especially to integrate variable generation.
- **Land & ecological tradeoffs:** Large-scale renewable parks and afforestation must guard against land conflicts, biodiversity fragmentation and community displacement risks.
- **Institutional coordination:** State, central and local authorities often operate in silos; bridging them, particularly for multi-sectoral initiatives (water, agriculture, energy), is an ongoing challenge.
- **Capacity & innovation scaling:** Pilots and innovation experiments must translate into full-scale deployment, requiring incubation, technology adaptation, regulatory backing and human capital.

For NEF's Sustainable Horizons agenda, these gaps offer opportunity spaces. Translating science and economic insight into forward-looking policy blueprints, scenario modeling, capacity-building and strategy roadmaps can help governments and institutions avoid 'islands of success' and aim for systemic transformation.

In FY25, India has made palpable strides on the sustainable frontier such as record renewable energy additions, innovative climate finance explorations, mass tree-planting campaigns and emergent models in sustainable agriculture. These are not mere symbolic wins as they reflect structural choices in favour of low-carbon, resilient and inclusive growth. Despite all this, the path from achievements to era-defining transition remains steep. For a country of India's scale, Sustainable Horizons cannot remain an aspirational vision; it must become the organising logic of national ambition.



LAW AND ECONOMY

At the intersection of jurisprudence and economics lies the focus area of Law & Economy, a pillar of NEF's work in advancing evidence-based public policy.

Such focus is particularly germane in contemporary times as India's economic growth story is inextricably tied to the evolution of its legal and regulatory architecture. As the nation aspires to become a \$10 trillion economy by the end of this decade or early on in the next decade, the interplay between law, markets and governance assumes unprecedented significance.

The Law & Economy vertical at NEF examines how legal frameworks shape economic incentives, influence business behaviour and determine the efficiency of markets.

From analysing the impact of fiscal legislation, insolvency codes and competition laws to studying contract enforcement, property rights and ease of doing business, this focus area bridges the divide between courtroom doctrines and boardroom realities.

It also explores the dynamic interface between constitutional principles and economic policymaking, ensuring that development remains inclusive, equitable and legally sound.

Through rigorous research, policy briefs and stakeholder consultations, the Law & Economy focus area seeks to inform debates on reforms in taxation, corporate governance, digital regulation and public finance.

It also monitors landmark judicial pronouncements and their broader economic implications. In a rapidly transforming India, where legal certainty underpins investor confidence and regulatory coherence determines competitiveness, the Law & Economy vertical serves as a crucial bridge between the legal apparatus and economic aspirations.

By promoting transparency, predictability and justice within the policy ecosystem, NEF's work in this domain reinforces the foundational belief that sound laws are the scaffolding of a robust economy.

The synergy between legal institutions and economic performance becomes ever more important as India pursues its goal of growing its economy exponentially.

Over FY25, several changes in statutory regimes, judicial practice and regulatory design have sought to recalibrate how law structures incentives, shapes markets, and enforces discipline.

One of the most visible advances has been the push to overhaul India's direct tax regime. In February 2025, the government introduced the Income-Tax Bill, 2025 in Parliament, aiming to replace the Income Tax Act, 1961. The new bill is designed with simpler structure, plain-language drafting and reduced opportunities for litigation and ambiguity. It is slated to become effective from April 1, 2026.

The rationale behind this reform addresses one of the longest-standing pain points - tax disputes. As of March 2024, tax litigation across various fora was estimated at ₹13.4 trillion (Ohri, N. & Singh, S.C., 2025). By creating more transparent rules and harmonised assessment timelines, the reform aims to lower compliance costs and reduce economic inefficiencies born of uncertainty.

The reforms are not just cosmetic. In the Economic Survey 2024-25, the government stresses that tax disputes impose high shadow costs, tying up capital and slowing investment. Moreover, the introduction of this Bill is part of a broader narrative of regulatory simplification and digital modernisation in tax administration.

From the Law & Economy prism, this shift helps align the legal architecture with long-term growth incentives - lower friction, greater certainty and reduced rent-seeking through tax litigation.

Insolvency reform remains a critical frontier, given its central role in disciplining inefficient firms, recycling capital and protecting creditor rights. Yet a persistent paradox has been the large divergence between statutory timelines and reality.

To address this, multiple regulatory interventions have been undertaken:

- Earlier in May this year, the Insolvency and Bankruptcy Board of India (IBBI) issued new guidelines amending the Corporate Insolvency Resolution Process (CIRP). A salient rule change stipulated that dissenting financial creditors must be paid proportionally before consenting creditors thereby strengthening the fairness of distribution.
- Looking ahead, a proposed Insolvency and Bankruptcy Code (Amendment) Bill, 2025 promises a more far-reaching overhaul, that of, introducing out-of-court, creditor-initiated resolution routes, enterprise group insolvency provisions and clearing ambiguities in inter-creditor ranking (Ravi et al, 2025).

These reforms are especially critical given judicial pushback in high-stakes cases, such as a recent Supreme Court reversal of a ₹2.3 billion acquisition deal in part due to procedural lapses in creditor dealing (Chaturvedi, A., 2025).

From a Law & Economy vantage point, these adjustments aim to reduce time, lower uncertainty and improve the recovery rates in bankruptcies, thereby restoring the credibility of exit mechanisms and encouraging more prudent risk-taking and credit flows.

India's law-economy agenda has also witnessed reform in business regulation, procedural compliance and state-level deregulation:

- Many states, including Uttar Pradesh, have accelerated deregulation and streamlined licensing via platforms like Nivesh Mitra 3.0. The aim is to shrink timelines, reduce documentation burdens, and remove penal provisions in state/local laws.
- On the competition and marketplace side, regulators have become more attuned to the challenges of digital regulation and antitrust enforcement. While any sweeping national law has not been passed in the last year, new guidelines and consultations have been initiated to deal with platform monopolies, data access and algorithmic pricing.
- Another strand is land and property law. Some state governments have amended land revenue laws to strengthen industrial land administration, in the process attempting to resolve legacy title issues and improve legal certainty for industrial investment.
- Corporate governance tweaks have been introduced to increase disclosure, strengthen minority protections, and tighten board responsibilities.

Legal reform is not only about statutes but also about procedural and institutional innovation in courts, criminal laws and contract enforcement.

- In mid-2024, India replaced colonial-era criminal statutes with a unified Bharatiya Nyaya Sanhita, along with companion acts covering criminal procedure and evidence. These are intended to modernise procedural norms, strengthen rights, and integrate digital methods.
- The government has recently pledged that for crimes registered from 2026 onward, cases must be disposed of within three years. This projects faster adjudication and more predictability.
- In commercial dispute resolution, incremental steps toward faster adjudication are underway. There is renewed pressure to establish specialised commercial courts, reduce pendency, streamline pleadings and promote arbitration.
- Also, the Economic Survey 2024-25 signals renewed attention to procedural reforms in civil courts, digitisation of case filing and better court infrastructure to lower enforcement lag.

These shifts aim to bridge the gap between judicial theory and business practice.

These legal and regulatory changes coincide with a resilient macroeconomic backdrop. Last fiscal year, India grew 6.5% despite global headwinds, with Q4 growth at 7.4% year-on-year (India Economic Outlook, 2025).

The Economic Survey 2024-25 stresses that legal and institutional reforms remain key enablers of productivity, capital efficiency and structural transformation.

But challenges persist. Judicial delays remain entrenched. The gap between law and practice in insolvency is still wide, as seen in 849-day average resolution. Enforcement of new rules depends heavily on administrative capacity and institutional coordination across states.

The new tax law, though promising, still awaits final passage and implementation. The success of digital, platform, and competition regulation frameworks will hinge on sustained policy attention and nimble rule-making.

In 2024-25, India has taken meaningful strides in aligning its legal frameworks with its growth aspirations. From a new direct tax regime, incremental but concrete insolvency reforms, deregulation at the state level, to procedural modernisation in criminal and commercial justice, the trajectory is toward reducing friction, improving predictability and strengthening market discipline.



REGULATIO

LAW

CONSTITUTION

STATUTE

POLICY

RIGHTS

COGNITION



GEOSTRATEGIC FRONTIERS

In an era defined by shifting power balances, regional conflicts and the emergence of new economic alliances, the study of Geostrategic Frontiers has become indispensable to public policy thinking. This focus area holds particular significance, given India's position at the crossroads of the Indo-Pacific, its growing influence in the Global South and its central role in shaping multipolar world dynamics.

The Geostrategic Frontiers vertical at NEF explores how India's foreign policy, trade strategy and security interests intersect with evolving geopolitical realities. From the Indo-Pacific maritime architecture and the recalibration of QUAD and BRICS frameworks to the economic implications of border tensions and energy dependencies, this area of research enables the Forum to analyse how global currents shape domestic policymaking. It also provides an evidence-based understanding of how India can leverage diplomacy, development partnerships and strategic investments to secure its long-term national interests.

NEF's work on Geostrategic Frontiers nurtures a deeper appreciation of India's external engagements, ranging from its neighbourhood-first approach and participation in global supply chain realignments to its leadership in climate diplomacy and South-South cooperation. By integrating perspectives from international relations, economics and

security studies, this focus area positions NEF as a thought leader in crafting actionable insights for policymakers navigating a complex global environment.

Ultimately, Geostrategic Frontiers encapsulates NEF's commitment to advancing India's strategic autonomy and global leadership through informed policy analysis, bridging the domains of geopolitics and governance to ensure that India's ascent on the world stage is both secure and sustainable.

In an era of evolving strategic flux, India's geostrategic frontiers - maritime, land and technological - have seen notable advances in the past year.

The Quad framework continues to evolve as a 'shared strategic vision' for a free and open Indo-Pacific, with India playing an increasingly proactive role (The Quad in 2024: A Combined Strategic Vision for the Indo-Pacific, 2024). In the last quarter of 2024, the Sixth Quad Leaders' Summit reinvigorated India's commitments to maritime cooperation, technology security and resilience in supply chains.

India has sought to translate these principles into tangible initiatives. Under its Security and Growth for All in the Region (SAGAR) vision, India positions itself as a net security provider across its maritime neighbourhood. India introduced the Mutual and Holistic Advancement for Security and Growth Across Regions (MAHASAGAR) doctrine, launched



from Mauritius, to expand the SAGAR paradigm to broader Global South and Indo-African maritime engagements. Further, India has invested in incremental naval capabilities and joint exercises. For instance, the Indo-French naval exercise Varuna 2025, held this year in the Arabian Sea, emphasised anti-submarine warfare and interoperability, reflecting depth in maritime cooperation.

India also has been active in port diplomacy. Proposals for cooperation with Quad partners in port infrastructure development in the Bay of Bengal have been floated, linking maritime architecture with regional connectivity strategies.

India's naval modernisation pushed ahead in recent months. The latest ship commissions and capability enhancements are aligning with the broader strategic goal of safeguarding sea lanes and deterrence. The Indian Navy has been inducting increasingly indigenous vessels and developing underwater warfare assets.

In parallel, the design and development of four Landing Platform Docks (LPDs) under an indigenous shipbuilding regime has gained traction, with cooperation on electric propulsion systems being mooted with the UK.

Border Management, Regional Stability & China Reset

In October 2024, India and China signed a Border Patrol Agreement aimed at de-escalation and restoring patrol rights in zones such as Depsang and Demchok to their pre

This has been interpreted not as a full resolution of structural friction, but as a pragmatic step toward managing tensions while preserving India's strategic posture.

Strategically vital land frontiers, particularly the Siliguri Corridor (the 'chicken's neck' connecting Northeast India to the mainland), have drawn renewed attention. As of 2024, projects such as expanded border roads, advanced landing grounds (ALGs) in places like Nyoma, and alternative rail/road corridors via Bangladesh and Nepal are under serious consideration to reduce over reliance on the Siliguri axis.

Strategic Partnerships & South-South Diplomacy

Greater cooperation is evident across India's growing strategic partnerships. For instance:

- India-Australia: Defense ties have deepened, with agreements on information sharing, submarine search-and-rescue, and joint staff talks.
- India-Philippines: Announced strategic partnership enhancements in trade, maritime security, defence and even space; joint naval engagements in contested sea zones were part of the agenda.
- India, more broadly, continues leveraging FTAs, diaspora diplomacy and development assistance to expand its footprint across the Indo-Pacific.

This illustrates that India is not just reacting to change, but actively shaping alliance and partnership architectures.



Technology, Strategic Autonomy and Economic Security

India is pushing for greater indigenous capability in defence systems, electronic warfare and aerospace. In parallel to involvement in defence manufacturing, India's semiconductor and electronics manufacturing strategy aims to de-risk reliance on China and diversify supply networks, including via the Supply Chain Resilience Initiative with Japan and Australia.

One illustrative capability-upgrade is the Super Sukhoi project, a modernization drive for the Indian Air Force's Su-30MKI fleet. Proposed upgrades include AESA radars, upgraded EW suites, and SEAD (Suppression of Enemy Air Defenses) roles, expanding operational flexibility and lifespan.

With the increasingly contested high ground in space, India is formalising capacities to protect its satellite and orbital infrastructure. Although many details remain classified or in nascent stages, a Satellite Protection Project concept has surfaced, intended to safeguard key assets and build resilience to orbital threats.

Alongside these hardware advances, India is conscious of cyber and information-domain vulnerabilities. Studies have emphasised gaps in real-time cyber threat detection and defence architectures. Strengthening cyber resilience remains a foundational pillar for sustaining strategic autonomy in the digital age.

While advances have been real and multi-dimensional, structural constraints persist:

- Resource and institutional bottlenecks: High-end defence R&D, dual-use controls and budgetary prioritisation often slow translation from policy to deployment.

- Great-power balancing tightropes: India continues to manage nuanced relationships with the U.S., Russia, and China. Its calibration is delicate as it pursues alignment with democratic partners while preserving maneuver space with others.
- Regional backlash and capacity limits: In the Indian Ocean, some states remain cautious of India's expanding footprint. India must balance influence with sensitivities of sovereignty in partner states.
- Technology and supply chain dependencies: Despite efforts, certain critical domains (like advanced microelectronics, high-end semiconductors, exotic materials) still depend on foreign sources.

Nevertheless, geopolitical momentum is favourable. India's growing defence expenditures, expanding strategic partnerships, and normative confidence in the Global South combine to offer a distinct geostrategic posture. India became the sixth largest military spender in 2024, reflecting this shift (Mohan, C.R., 2025).

Ergo, the last year has witnessed India make substantive inroads in its geostrategic frontiers. From maritime diplomacy and naval modernisation, to border recalibrations and technology uplift, India is actively reconfiguring its position not as a passive actor but as a principled power with capacity

. As India looks ahead, success will depend not only on accruing capabilities, but on operational integration, supply-chain independence and the political discipline to sustain long-range visions across shifting global winds. The foundation has been laid. The test now is perseverance and strategic coherence.



IMAGE INDICATIVE OF GEOSTRATEGIC FRONTIERS



EVENTS

PANEL DISCUSSION



About the Event

NEF, in collaboration with TDP Global, organised a panel discussion titled "Green Finance: The Key to Unlocking a Net-Zero Future" at the India International Centre (IIC), New Delhi in Nov, 2024, coinciding with the conclusion of COP29 in Baku.

The session featured distinguished policymakers, industry leaders and domain experts who deliberated on India's pathway to mobilising climate finance for achieving its net-zero goals. The keynote address was delivered by Shri Subhash Chandra Garg, former Finance and Economic Affairs Secretary, Government of India, who underscored the twin challenges of climate injustice and technological adaptation. He urged a transition towards digital and environmental technologies such as AI to address both industrial efficiency and environmental sustainability.

The discussion, moderated by Dr. S.K. Gupta, CEO, ICMAI Social Auditors Organization, included insights from Dr. Suhas Deshmukh, Director, National Council for Vocational Education and Training, Ministry of Skill Development and Entrepreneurship, Dr. Bhavna Chhabra, Associate Dean, IBS Gurgaon, and Mr. Anket Kapoor CEO, SolarFix. The panel emphasised the role of technological innovation, personal and corporate responsibility and viable green finance mechanisms in advancing India's sustainability agenda.



Key highlights included the importance of innovations like artificial photosynthesis, renewable energy adoption and decentralised power generation. Speakers stressed that climate action must align with financial incentives to drive widespread adoption.

Action Points:

- **Technological Innovation:** Prioritise the development of affordable green technologies.
- **Personal Responsibility:** Encourage reduced plastic usage, digital solutions to paper consumption, and energy-efficient practices across industries.
- **Green Finance Instruments:** Promote financial instruments such as green bonds to fund climate projects.
- **Sustainability in Industry:** Foster initiatives like energy audits, waste management, and a shift towards electric vehicles.
- **Global Cooperation:** Push for stronger global commitments to climate finance and equitable distribution of green investments.

The discussion concluded on an optimistic note, reaffirming that India, through policy innovation and collective responsibility, can lead the global transition to a sustainable and net-zero future.



BOOK DISCUSSION



About the Event

In August 2025, NEF, in collaboration with the Valmiki Study Circle (JNU), hosted an engaging book discussion on "No, Minister" with its author, Shri Subhash Chandra Garg, former Finance and Economic Affairs Secretary, Government of India.

In a candid and thought-provoking conversation, Mr. Garg reflected on his decades of service in the Indian bureaucracy, offering deep insights into the complex interplay of policy, politics, and governance.

He spoke about managing economic reforms, tackling institutional challenges, and the realities that shape decision-making at the highest levels of government.

The session concluded with a lively Q&A, where participants engaged Mr. Garg with incisive questions, making it an enriching exchange of ideas and experiences.





PUBLICATIONS

ZERO EMISSIONS TRUCKING: THE FUTURE OF ELECTRIC FREIGHT [Sustainable Horizons]

India's trucking industry is projected to grow over fourfold by 2050, driving economic growth but also significantly increasing transportation emissions.

As the world's fifth-largest economy with a GDP nearing USD 4 trillion, India transports 4.6 billion tonnes of freight annually, amounting to 2.2 trillion tonne-kilometres and costing ₹9.5 lakh crore, as per a 2022 report by NITI Aayog.

With rapid urbanisation, e-commerce growth, and rising income levels, freight demand is expected to expand to 9.6 trillion tonne-kilometres by 2050.

The bulk of this movement—70%—is carried by road transport, predominantly by heavy- and medium-duty trucks (HDTs and MDTs).

In response to this growth, Zero Emission Trucks (ZETs), such as battery electric trucks (BETs) and fuel cell electric trucks (FCETs), offer a crucial solution. ZETs eliminate tailpipe emissions and have lower operating costs, providing an opportunity for India to simultaneously reduce air pollution and improve economic efficiency.

By embracing ZETs, India can enhance public health, reduce its environmental footprint, and position itself as a leader in sustainable transportation.

Many global markets are transitioning from diesel trucks to ZETs, driven by the economic and environmental benefits.

The European Union aims to deploy 80,000 ZETs by 2030, while the United Kingdom has committed to zero-emission heavy-duty trucks by 2040.

Similarly, California's Advanced Clean Trucks regulation mandates the increasing sale of ZETs, contributing to global discourse on the importance of zero-emission freight.

India has a strategic opportunity to become a global hub for ZET manufacturing. With supply chains increasingly globalised and significant growth in freight demand, India's leadership in ZET adoption can differentiate its position in the export market.

This will require coordinated actions from both public and private sectors to build ZET supply chains and deploy necessary infrastructure. Ambitious policies, such as financial incentives and regulatory support, will be key to scaling ZET adoption.



SUNNY SIDE UP: TAPPING LADAKH'S SOLAR GOLDMINE [Sustainable Horizons]

Ladakh, with its high solar irradiance, vast barren land, and strategic location, presents immense potential for solar energy development. However, despite its favourable geographical conditions, the adoption of solar technology in the region remains limited due to technical, financial, regulatory, and social barriers. This research examines the key obstacles hindering large-scale solar adoption in Ladakh and proposes targeted strategies to address them.

The study identifies limited technical knowledge, high initial investment costs, inadequate financial incentives, and complex regulatory frameworks as the primary challenges to solar energy deployment. A statistical analysis was conducted to assess the relationship between these factors and the willingness to adopt solar technology. Findings indicate that while familiarity with solar energy has a weak correlation with perceived viability (correlation coefficient: 0.261, p-value: 0.104), financial constraints play a more significant role in influencing adoption. The chi-square test on affordability and adoption intention (Chi-square statistic: 7.271, p-value: 0.064) suggests that financial incentives could serve as a crucial enabler of solar uptake. Additionally, workshop participation and community influence were found to have limited impact increasing awareness or adoption rates.

To overcome these challenges, their search recommends a multi-stakeholder approach

involving government bodies, private sector players, local communities, and research institutions. The government should enhance financial support mechanisms, including higher subsidies under schemes such as PM-KUSUM, streamline regulatory approvals, and improve awareness regarding policy incentives. The private sector should develop innovative financing models, such as micro loans and pay-as-you-go solar solutions, while investing in high-durability solar technology suited to Ladakh's harsh climate. Local communities must be engaged through hands-on training programmes, capacity building initiatives, and pilot solar projects to strengthen technical expertise and public confidence in solar adoption. Furthermore, research institutions should collaborate with policymakers and industry experts to advance high-altitude solar technology, enhance energy storage solutions, and assess the socioeconomic impacts of solar energy adoption in Ladakh.

In conclusion, while Ladakh has the potential to become a model for sustainable solar energy development, realising this vision requires strategic policy interventions, improved financial accessibility, and enhanced technical capacity. Addressing these barriers through a coordinated, evidence-based approach will enable Ladakh to emerge as a key contributor to India's renewable energy transition and global efforts towards decarbonisation.

THE WATER-ENERGY NEXUS [Sustainable Horizons]

This research brief investigates the critical water-energy nexus in India, a country navigating the dual challenges of water scarcity and increasing energy demands. The interplay between water and energy - where water is integral to energy production and energy underpins water management - highlights the need for integrated solutions to support India's sustainable development trajectory. India, home to 18% of the global population but possessing only 4% of the world's water supply, faces acute water stress. The country's rapid economic growth, coupled with climate variability, urbanisation, and industrialisation, has intensified the interdependence between these resources. Key findings and challenges explored in this brief include:

1. Water in Energy Production

- Thermal power plants, responsible for 70% of India's electricity, account for 80% of water withdrawals in the energy sector. Cooling technologies significantly impact water consumption. Regulatory efforts to reduce water usage in thermal plants show mixed compliance, highlighting gaps in enforcement and technology adoption.
- Hydropower generation alters river ecosystems, with existing Environmental Flow (E-Flow) standards needing enhancement to balance energy goals with ecological health.
- Solar power, though water-efficient, presents challenges in arid regions -

where water scarcity hampers operational efficiency, particularly for Concentrated Solar Power (CSP) plants.

2. Energy in Water Management Energy-intensive urban solutions, such as desalination and wastewater treatment, underscore the critical interdependency between these sectors.

3. Policy and Research Gaps

- Fragmented policies addressing water and energy separately fail to leverage synergies.
- Advancing technologies like dry cooling, air-cooled condensers, and internet of things (IoT) enabled monitoring can optimise resource use, but their scalability and implementation need assessment.
- International benchmarking and stakeholder collaboration are pivotal to enhancing policy frameworks.

This research aims to identify actionable strategies to address the water-energy nexus, including adopting innovative technologies, enforcing integrated policy frameworks, and conducting ecological and economic impact assessments. By focusing on sustainable practices and resource optimisation, India can strengthen its energy and water security while aligning with its climate and developmental goals.

Future efforts must prioritise cohesive governance, stakeholder engagement, and a commitment to balancing energy demands with environmental stewardship.

THE INDO-SINO FERTILIZER STORY

THE GEOPOLITICAL, LOGISTICAL, & ECONOMIC RISKS OF INDIA'S DEPENDENCY ON CHINESE FERTILIZER IMPORTS

[Governance for Growth, Geostrategic Frontiers]

Fertilizers are essential to sustaining global agricultural productivity and ensuring food security, particularly for agrarian economies like India. This brief provides an analysis of the global fertilizer supply chain with a specific focus on India's dependence on imports from China, which is a major global supplier.

The Indian fertilizer industry has a rich history dating back to 1906, when the first fertilizer plant was established in Ranipet, Tamil Nadu. Over the years, the industry has witnessed significant advancements in the production volume, variety of fertilizers, technological innovations, and feedstock utilisation. Recognised as a core sector, the fertilizer industry ranks second only to steel in terms of investment, with its market size reaching INR 942.1 billion in 2023.

Before 1960-61, India primarily produced straight nitrogenous fertilizers such as ammonium sulfate (AS), urea, calcium ammonium nitrate (CAN), ammonium chloride, and single superphosphate (SSP).

The production of NP complex fertilizers began in 1960-61, marking a turning point in the diversification of fertilizer types. Currently, India produces a large number of grades of nitrogen, phosphorus, and potassium (NPK) complex fertilizer. When it comes to import, India imports mainly urea, diammonium phosphate (DAP) and potassium chloride (MOP).



There has been an increase in import of DAP and NP/NPK complex fertilizers and decline in urea and MOP during 2022-23 over 2021-22.

The brief highlights the key trends and dynamics in the China-India fertilizer trade, including trade volumes, supply routes, and bilateral policies. It also examines the risks associated with this dependency, such as geopolitical tensions, export restrictions by China, price volatility, and logistical challenges. Recent events, including global supply chain disruptions due to the Israel-Palestine issue and China's export curbs to safeguard its

domestic supply, have exposed the vulnerabilities of India's reliance on a single dominant supplier. In response to these challenges, this brief identifies opportunities for India to diversify its fertilizer import sources, enhance domestic production capacity, and invest in sustainable alternatives like biofertilizers.

As the world's largest producer of urea, China accounts for about a third of global supplies of the nitrogen - based fertiliser , which is critical to growing crops. As mentioned in the media, India imports about 30% of around 35 million metric tons needed each year for its vast agriculture sector and China was its second largest supplier in 2023. Supplies from Oman, Saudi Arabia, Egypt, and Russia could fill the gap. China is the biggest fertilizer producer and consumer in the world. The country is self-sufficient in N and P and exports a significant share of production, but the country imports potash.



When it comes to Indian states' consumption, the data, shared by Union Agriculture and Farmers Welfare Minister Shivraj Chouhan, highlights that Punjab's wheat and paddy growing districts are the primary consumers of these inputs. In 2022-23, 15 districts in the state reported an average fertiliser consumption of 254.39 kg per hectare. The state's average consumption of around 223 kg per hectare is significantly higher than the national average of 90 kg per hectare. Therefore, the findings in this research brief underscore the importance of addressing India's fertilizer supply vulnerabilities to safeguard its agricultural productivity and food security. Strategic measures, including trade diversification, policy reforms, and technological advancements, are crucial for building a more sustainable and self-reliant fertilizer ecosystem in India.

EXPLORING THE POSSIBILITIES OF SOLAR CARPETING OF INDIAN RAILWAY TRACKS: THE PROS AND THE CONS [Sustainable Horizons]

The Indian Railways (IR), an institution often hailed as the lifeline of the nation, today commands not merely a socioeconomic centrality but also assumes an increasingly critical role in the country's environmental ambitions. As of last year, the Indian Railways operates the fourth-largest railway network globally, spanning over 68,400 route kilometres, employing approximately 1.2 million personnel, and ferrying millions of passengers daily. Beyond the quotidian exigencies of mobility and logistics, the Railways have become a potent instrument for achieving India's broader developmental and environmental milestones. In the crucible of India's energy transition and carbon neutrality aspirations, notably its Net Zero target by 2070 declared at COP26, Glasgow, the Railways have been vested with the herculean mandate of becoming a Net Zero Carbon Emitter by 2030, thereby positioning themselves as a pioneering green transporter on a global stage.

Against this formidable backdrop, the imperative to innovate in the renewable energy (RE) domain has gained unprecedented urgency. The IR has already embarked upon an ambitious renewable energy trajectory, with approximately 487 MW of solar plants (both rooftop and ground-mounted) and about 103 MW of wind power plants commissioned as of November 2024. These strides, while commendable, remain insufficient when juxtaposed against the gargantuan energy demands of an electrifying railway ecosystem, i.e., projected to touch over 8200 MW by 2030. More importantly, to attain the ambitious net zero emissions objective, it is

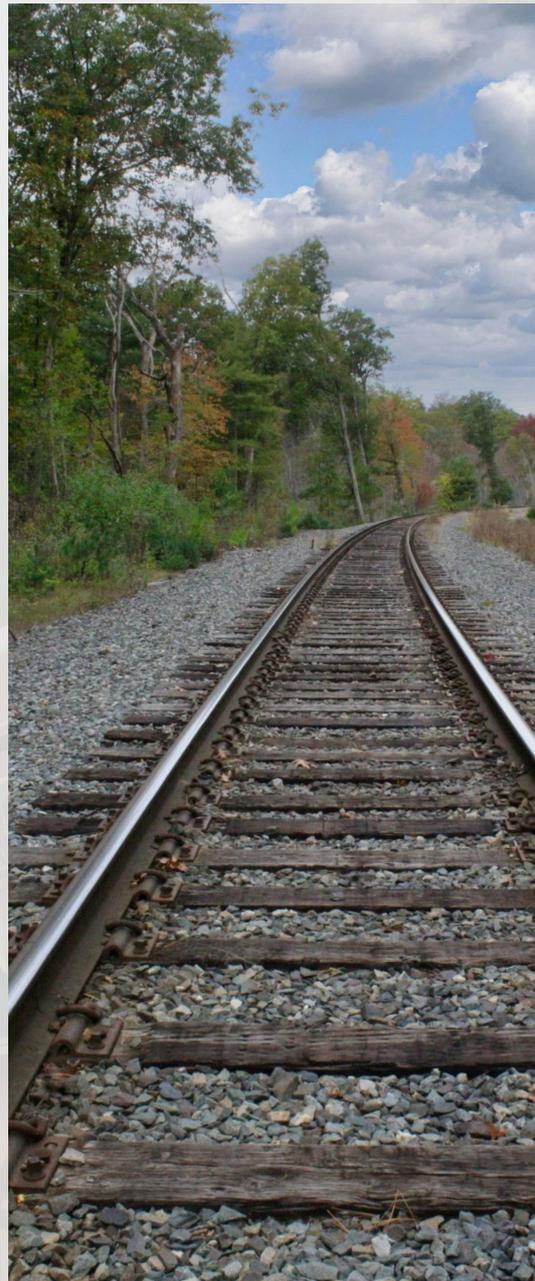
projected that the requisite RE capacity by FY30 will approximate a formidable 30,000 MW. Furthermore, spatial constraints, particularly in densely populated urban agglomerations, circumscribe the scalability of conventional solar farms. It is within this context that there emerges an intriguing proposition, that of 'solar carpeting' of railway tracks. It is an avant-garde endeavour wherein photovoltaic (PV) panels are embedded directly onto or between railway lines, thereby transforming otherwise underutilised land into corridors of clean energy generation.

The conceptual underpinnings of solar carpeting, though embryonic in practice, are not entirely uncharted. Early trials by Belgian rail management company Infrabel, the Netherlands' solar road experiments, and most recently by Switzerland's Sun-Ways have begun to elucidate both the promises and the pitfalls of this audacious vision.

The Swiss innovation by Sun-Ways, launched in 2024, is particularly instructive: employing a mechanical system to deploy modular, removable solar panels between active tracks.

If scalable, this could revolutionise the energy calculus of railway operators; in India's case, the Indian Railways. Yet, these pilot projects also lay bare the formidable challenges; from dust accumulation and mechanical vibrations to safety compliance and high capital costs, that must be surmounted before solar carpeting can metamorphose from an intriguing prototype into a mainstream solution.

This research brief thus undertakes a rigorous exploration of the multifaceted prospects of solar carpeting within the Indian context. Specifically, it seeks to dissect the technical feasibility, economic viability, environmental benefits, and operational ramifications of such an enterprise. It will critically appraise the advantages and limitations intrinsic to solar carpeting, drawing upon empirical evidence and comparative international experiences. Crucially, the brief does not aspire merely to replicate global models in a mechanical fashion; rather, it seeks to adapt and interrogate them through the prism of India's unique infrastructural complexities, diverse climatic conditions, and socio-economic dynamics.



In so doing, this brief situates itself at the vibrant intersection of technological innovation, sustainable development imperatives, and pragmatic policymaking. It envisages a future wherein the Indian Railways, by embracing such pioneering technologies, may once again reaffirm its status, not merely as the backbone of national connectivity but as a harbinger of a greener, more resilient India.

MERGERS IN MOTION

ANALYSING MODERN M&A AND STRATEGIC COMBINATIONS BEYOND BORDERS

[Law & Economy]

This study critically examines the dynamic relationship between corporate law and crossborder mergers and acquisitions (CBMAs) in the context of a rapidly globalizing economy. As multinational corporations (MNCs) increasingly shape the contours of global commerce, the complexity and strategic significance of international M&A transactions have grown substantially. These transactions now often involve navigating a patchwork of legal systems, regulatory obligations, and governance expectations across jurisdictions.

At the foundation of this inquiry lies an analysis of the core elements of corporate law—such as separate legal personality, limited liability, the free transfer of shares, centralized management, and shareholder ownership. These legal features enable companies to raise capital, manage risk, and engage in sophisticated transactions, including mergers and acquisitions. However, the corporate form also presents challenges, particularly concerning accountability, managerial discretion, and shareholder protection. Addressing these issues through effective legal mechanisms is essential to maintaining trust and fairness within the corporate structure. The study also explores how the rise of MNCs has transformed the legal landscape of M&A activity.

With their expansive operations and transnational reach, MNCs operate across multiple regulatory frameworks, compelling a more harmonized and responsive legal environment. The increasing frequency and value of CBMAs necessitate that companies remain vigilant in ensuring legal compliance, transparency, and ethical standards across all operational geographies.

India's role as a growing center for cross-border mergers has further highlighted the need for structural reforms that align with global practices. The current legal and institutional architecture must evolve to support this momentum. This includes updating labour laws, enhancing employee safeguards, streamlining regulatory processes, and fostering legal certainty for international investors. As India integrates more deeply into global value chains, a forward-thinking M&A regime is essential for sustaining competitiveness and investor trust. The research concludes that in today's fast-moving global environment, the success of cross-border M&A is increasingly tied not just to a firm's scale, but to its capacity to respond quickly to regulatory shifts, implement transparent governance, and uphold high standards of compliance. Strengthening India's legal ecosystem for M&A will not only attract responsible investment but will also position the country as a reliable and ethical partner in global business strategy.

LEVERAGING AI TECHNOLOGY FOR CLIMATE-RESPONSIVE TRANSPORT INFRASTRUCTURE IN MUMBAI

ADDRESSING CLIMATE CHANGE AND MONSOON CHALLENGES [Techonomics, Sustainable Horizons]

Mumbai, India's financial hub with 20.7 million residents, faces acute climate challenges that strain its transport infrastructure, including a 53% congestion level costing commuters 121 hours annually (TomTom Traffic Index, 2023), recurrent monsoon flooding disrupting mobility in areas like Dadar and Kurla, and transport-related greenhouse gas (GHG) emissions contributing 20% of the city's total emissions (Mumbai Climate Action Plan, 2022). As of 05:22 PM IST, Monday, June 23, 2025, this research brief, led by the National Economic Forum (NEF), a Mumbai-based research organisation, explores the transformative potential of artificial intelligence (AI) to build a climate-responsive transport system, aligning with India's National Action Plan on Climate Change (NAPCC, 2008) and Mumbai's target of a 30% emission reduction by 2030.

The study conducts a content analysis of 40 studies from 2021–2025 and assesses six AI use cases - intelligent traffic signal systems, demand management, non-motorised transport (NMT) infrastructure, electric vehicle (EV) charging infrastructure, public transport optimisation, and shared transport—to achieve objectives of mitigating emissions, enhancing monsoon resilience, improving efficiency, promoting sustainable mobility, and informing policy. Key findings reveal that AI-driven solutions,

such as intelligent traffic signals using machine learning (ML) and deep learning (DL), can reduce emissions by 15–25% (375,000–625,000 tCO₂e annually) and congestion by 25%, as demonstrated by global precedents like Pittsburgh's Surtrac (CSTEP, 2022). Flood risk prediction models, integrating IoT and IMD's 50 rain gauges, mitigate disruptions by 20–30%, while demand forecasting for BEST buses and suburban railways enhances reliability for 88 million daily trips (KPMG, 2017). NMT planning in Bandra could increase cycling by 10–15%, saving USD 3–5 million in healthcare costs. Collectively, these use cases yield USD 26–44 million in economic savings, supporting equity by improving access for low-income commuters and women. The content analysis identifies themes of traffic optimisation, resilience, sustainable mobility, and emerging technologies like reinforcement learning (RL), but highlights gaps in Mumbai-specific research, EV/shared mobility applications, equity considerations, long-term climate modeling, and AI's energy footprint (e.g. 460 terawatts globally in 2022).

By bridging research gaps and fostering collaborations with IIT Bombay and international partners, this study provides a roadmap for policymakers and stakeholders to enhance Mumbai's transport infrastructure, improving quality of life and setting a replicable framework for coastal cities facing similar climate challenges.

UNDERSTANDING POWER CRISIS PUNJAB BY NUMBERS [Governance for Growth, Sustainable Horizons]

Punjab's power sector faces multifaceted challenges rooted in its agrarian economy, rising demand, and subsidy regimes. Agriculture dominates Punjab's economy driving power usage via hundreds of thousands of irrigation pumps. Successive governments have provided virtually free electricity to farmers (initially for small holdings, later universal), leading to an enormous subsidy burden. Cumulatively, Punjab State Power Corporation Ltd. PSPCL has paid over ₹1.23 lakh crore in farm power subsidies from 1997 to 2024. Annual farm subsidies have soared from ₹604 crore (FY1997-98) to ₹10,000 crore (FY2022-23).

The power sector cannot be kept aloof from the water stress in Punjab that is severe. Punjab's groundwater is falling over as free power promotes deep pumping of waterintensive paddy, 3,500- 4,000 litres of water per kg. Irrigation of about 32 lakh hectares that is happening 73% via tubewells and a 2025 heatwave pushed demand to record 16,711MW. The 14lakh and more tubewells running at full tilt strain the grid daily. Punjab farmers rely on powerful tube wells for irrigation. Free agricultural electricity has vastly expanded pumping, accelerating groundwater decline. financially iSPCL is

deep in the red. Two decades of under-recovery led to unsustainable debt and losses. The state budget carries 10% on account of power subsidies and unpaid dues by the government ₹7,000-₹8,000crore pending in FY2024-25 have created severe cash crunches.

Outstanding arrears (state depts owe ₹2,324Cr as of Jan 2025) force PSPCL to borrow. ₹800 Crore loan was taken in late 2024. Overall state debt has soared; analysts project ₹5lakh crore by 2027. Despite PSERC-allowed tariff hikes FY2023-24 saw only a ₹0.56/kWh increase, cost increases (fuel, coal freight, O&M) continue to outpace revenue, leading to operational losses.

Punjab's generation mix is also under strain. The state's own plants and hydro 4.8GW total are insufficient for growing needs. In FY2018-19, PSPCL's share of generation totaled ~57,800MU, but this came largely from Independent Power Producers (45.8%) and imports/Central sector (22.1%). Renewable energy is growing, Punjab's share 2.1GW by 2024, but still small relative to demand. Punjab's renewable purchase obligation (RPO) is now 27% for FY2023-24; achieving it has been difficult due to limited in-state renewables (mostly hydro used up). Biomass, 97.5MW from paddy straw and rooftop solar remain underutilized.

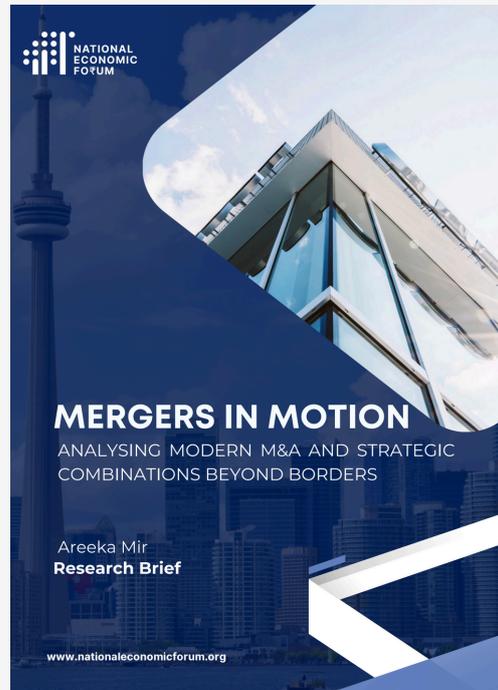
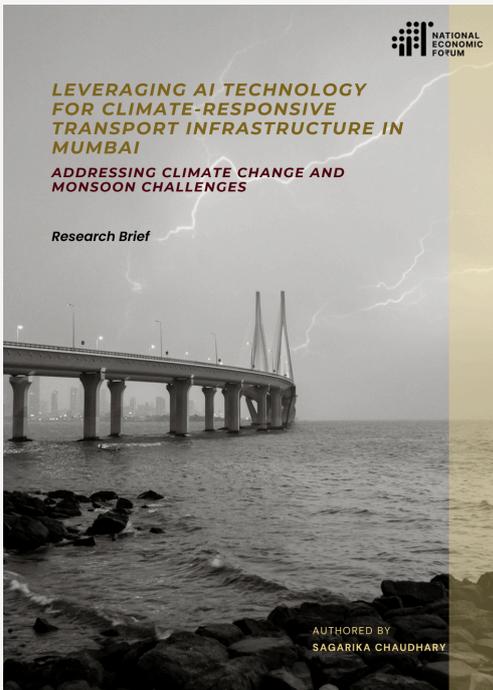
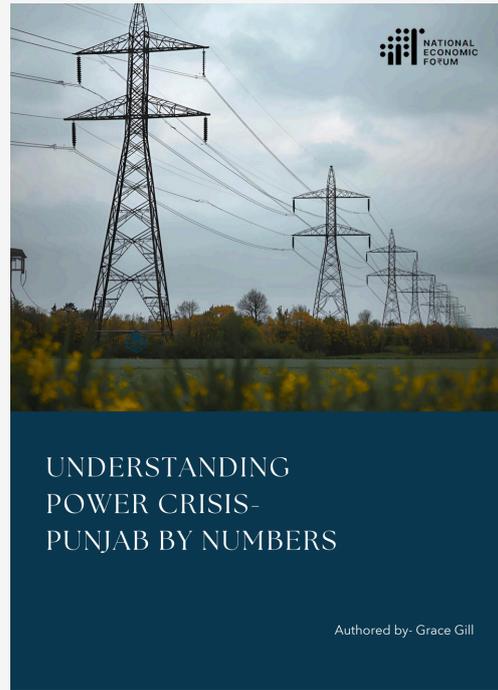


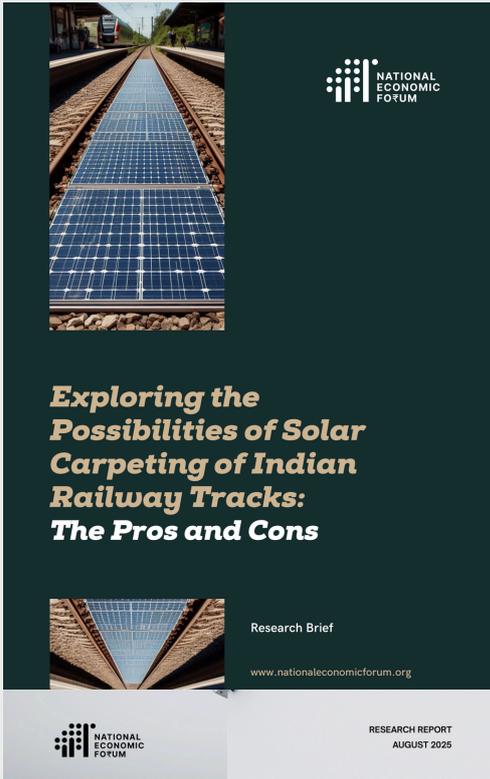
Artificial Intelligence and the Future of Employment in India Opportunities, Challenges, and Sectoral Shifts [Techonomics, Knowledge Economy]

The research paper investigates the impact on employment patterns that AI brings in the case of India. Keeping in view the three major sectors that constitute the economy, namely, agriculture, manufacturing and services, the paper also attempts to make an analysis concerning the urban-rural divide. Content analysis of prior studies - complemented by expert interviews across industries such as healthcare, IT, education, agriculture and manufacturing - has been used. Findings display that AI has both prospects and problems. AI raises productivity, enhances decision-making and augments efficiency; it further creates jobs in data science, running artificial intelligence and digital content.

On the other hand, it threatens low-value repetitive jobs, creates an upskilling requirement and potentially increases inequalities between urban and rural workers. Case studies such as APAIMS 2.0 in Andhra Pradesh, BMW Tech Works India and Infosys AI Centre in Hubballi reveal how AI is presently transforming the workforce in India. This study concludes that AI would never take full control of human labour; however, the actual implications would greatly depend on how efficient India is at implementing training, reskilling and development of infrastructure in its institutions.







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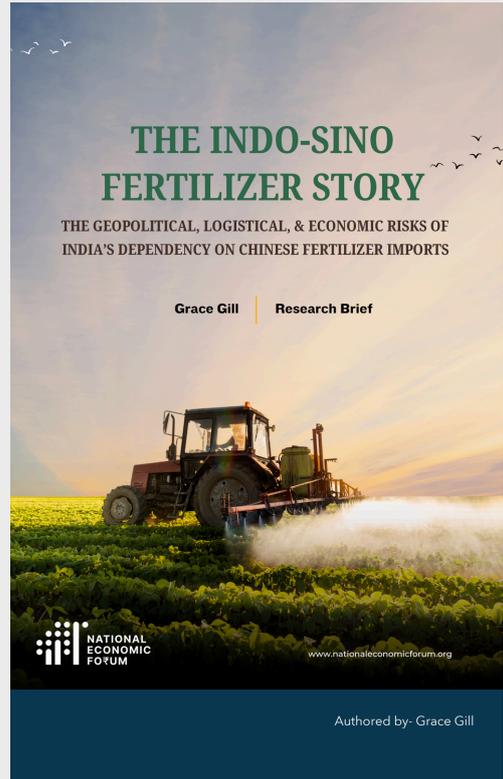
Exploring the Possibilities of Solar Carpeting of Indian Railway Tracks: The Pros and Cons

Research Brief

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RESEARCH REPORT
AUGUST 2025



THE INDO-SINO FERTILIZER STORY

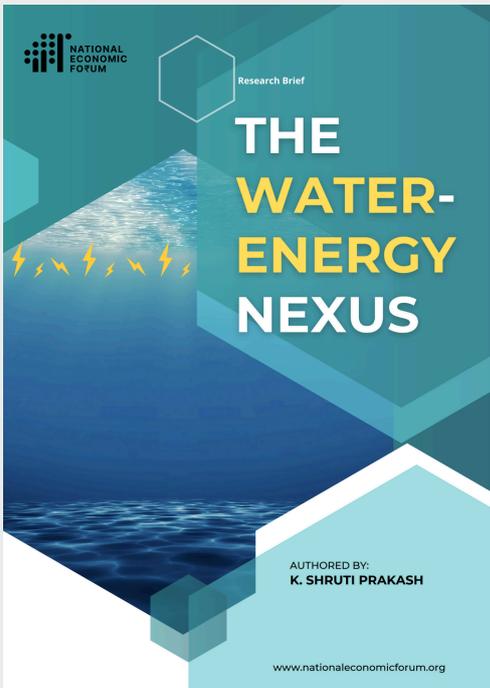
THE GEOPOLITICAL, LOGISTICAL, & ECONOMIC RISKS OF INDIA'S DEPENDENCY ON CHINESE FERTILIZER IMPORTS

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Research Brief

THE WATER-ENERGY NEXUS

AUTHORED BY:
K. SHRUTI PRAKASH

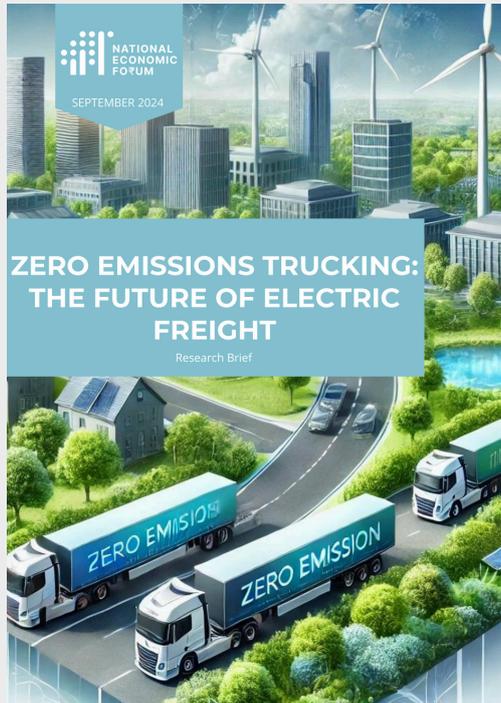
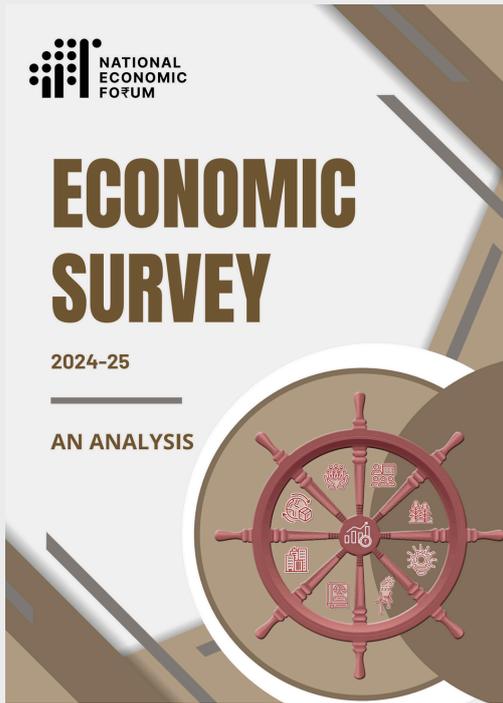
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SUNNY SIDE UP: TAPPING LADAKH'S SOLAR GOLDMINE

Authored By:
Sagarika Chaudhary



YOUR INSIGHT FOR ALL THINGS LATEST

Over the past year, the team has worked with dedication to provide readers with incisive insights into the most pertinent developments shaping India, both domestically and internationally. We have curated over a dozen data-driven representations, distilling complex numbers into accessible knowledge for our readership.

More than forty analytical articles have illuminated a diverse range of subjects spanning our six core focus areas, such as ELV to EV: Why Clean Mobility Policy Needs More Than Just a Gear Shift, Reconstructing Article 5 of the EU AI Act: A Legal and Behavioural Critique in Support of Expanded Regulatory Interpretation, Preventing the Dragon's Roar: An Analysis of Conflict Prevention Interventions in the Indo-China Context (1960-2025) and many more. In addition, over fifty hot-off-the-dais commentaries

offered timely reflections on eminent personalities and facets of their lives often overlooked by mainstream media, to name a few A Life Beyond Loss: The Enduring Legacy of Lord Swraj Paul, The Hyatt UAE Ruling and the Expanding Contours of Permanent Establishment in India, Lord Desai: The Economist Diplomat, India's Fission-to-Fortune Journey Led by Dr. M.R. Srinivasan, among others. These pieces also captured topical events that engaged and informed our audience.

Throughout the year, Director, NEF, contributed critical analyses on matters of national importance under the Director's Desk segment, enriching public discourse with informed and thought-provoking perspectives. His insights on key documents such as the Union Budget and Economic Survey, among many others, received much appreciation from the readership.

DIRECTOR'S DESK



Tax Reimagined



A Pause of Prudence

DIRECTOR'S DESK



Strategic Tradesmanship



A War's Widespread Economic Reverberations



An Outlook: India's Prospective FTAs



The Trump Shock



Budget 2025: A Precarious Balancing Act in a Volatile Ecosystem

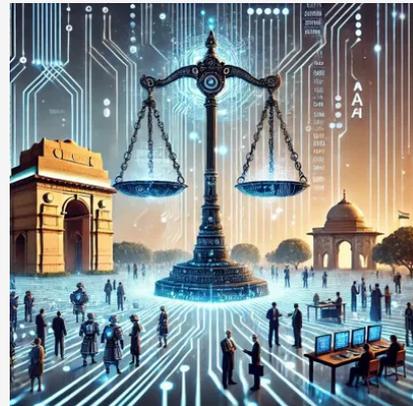


Economic Survey 2024- 25

DIRECTOR'S DESK



The Economic Fallout of the Israel-Palestine War on India



Why India Needs an AI Regulatory Framework?



Trump's Re-election: Ramifications for India



Global Lessons for India's AI Regulation



Knotty Affair: Sustainability of the Big Fat Indian Wedding



Jaishankar Makes It Clear: Pakistan Is Now Just A Sideshow For India

HOT OFF THE DIAS

- Modi at 75: A Journey Through India's Economic Reforms
- India's Semicon Sovereignty
- Tax Tonic 2025: GST Reforms Ignite Affordable Living and Atmanirbhar Bharat's Ascent
- Modi in Tianjin
- ANALYSING QUARTERLY ESTIMATES OF GDP- Q1 20
- A Life Beyond Loss: The Enduring Legacy of Lord Swraj Paul
- The Hyatt UAE Ruling and the Expanding Contours of Permanent Establishment in India
- Trump-Putin Pageantry Leaves India's Tariffs Unchanged
- Economic Takeaways from Prime Minister Modi's Independence Day Address, 2025
- The Tariff Domino Effect: One Levy Leads to Another
- Lord Desai: The Economist Diplomat
- JRD Tata@121: Pilot of the Indian Industry
- Understanding the UK – India Trade Deal
- Urgent Need to Reduce Crude Oil Import Dependency
- Population to Power
- Sanghonomics Rising
- India's Fission-to-Fortune Journey Led by Dr. M.R. Srinivasan
- K. Kasturirangan: Architect of India's Scientific and Educational Transformation
- Between the Lines: What 'Abeyance' Really Means for Indus Waters and Simla Accord
- Prudence with Purpose
- Stability Amid Shocks
- The Economic Inflection
- Earth Day 2025: Our Power, Our Planet
- Ambedkarnomics
- RBI Cuts Repo Rate to 6% Amid Global Headwinds



- Tariff & Tact
- The Waqf Bill 2024: A Comprehensive Overview of Its Passage, Purpose, and Controversies.
- Sunita Williams' Space Odyssey: A Triumph for NASA, a Lesson for India
- Hydrocarbons: The Ligature in Indo-US Ties
- From Sadhus to Servers: Kumbh 2025 Goes High-Tech
- Pravasi Bharatiya Diwas – Celebrating Indian Diaspora's Role
- Dr. Manmohan Singh: Architect of Modern India's Economic Transformation
- The Statesman
- Faith Restored: Notre-Dame, Ayodhya, and the Divide Within
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- RBI Governor Das' Tenure Ends
- The Lobito Corridor
- Retirement Reimagined
- Green Bonds: "System hurdles and the adoption crisis"
- Inflation Face-off: The Battle between Headline and Core
- Thalonomics: The Disproportionate Rise in Meal Prices Compared to Wages
- Trump 2.0: What a Trump Win Could Mean for the Global Economy
- India-Jamaica Ties: A New Chapter in Global South Solidarity
- In Remembrance of Bibek Debroy
- Jamshedpur: The "Ratan's" Perdurable Legacy
- Swachh Bharat Diwas: Swachh Bharat Mission at 10
- A Decade of 'Make in India'
- JRD Tata@121: Pilot of the Indian Industry
- Cash, Codes, and the Unfolding Currency Conundrum: India's 8-Year Demonetisation Journey

NEF CHARCHA PODCAST



NEF
Charcha
WITH
NISHANT KR. HOTA
EP-1 WITH FRANK RAUSAN PEREIRA
INDIA-U.S. RELATIONS AND TRADE TARIFFS



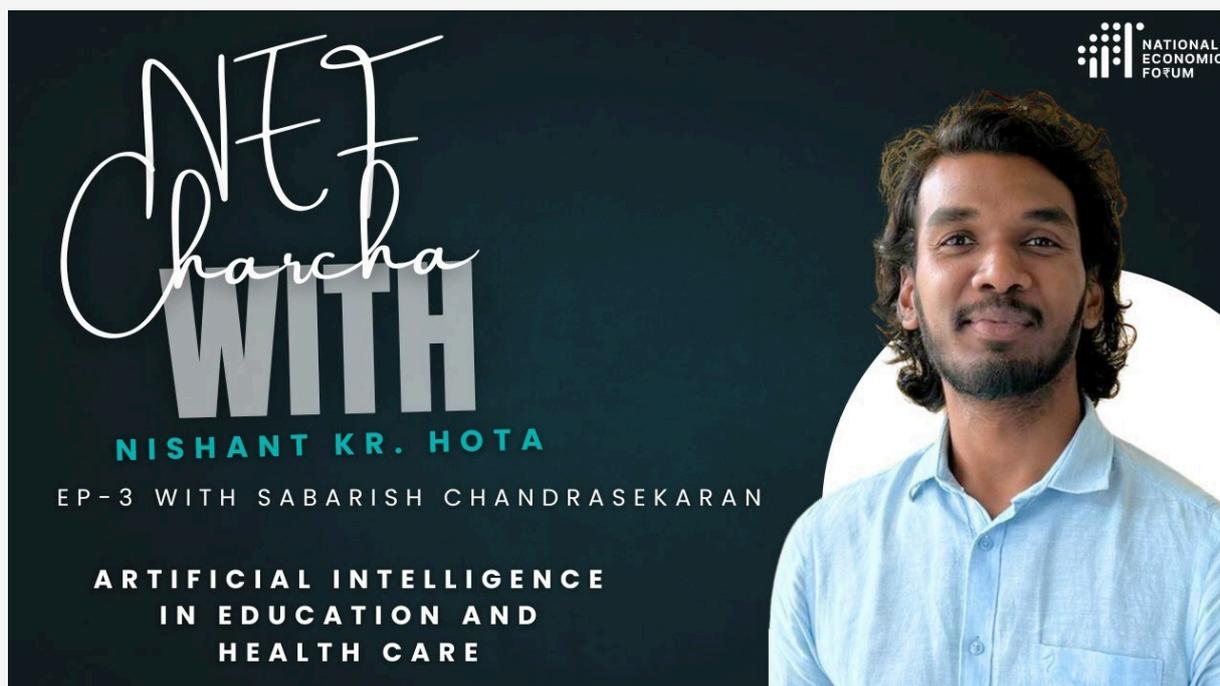
NATIONAL ECONOMIC FORUM



NEF
Charcha
WITH
NISHANT KR. HOTA
EP-2 WITH SUMIT KAUSHIK
POLICY COMMUNICATIONS IN CHANGING TIMES



NATIONAL ECONOMIC FORUM



NIEF
Charcha
WITH
NISHANT KR. HOTA
EP-3 WITH SABARISH CHANDRASEKARAN
**ARTIFICIAL INTELLIGENCE
IN EDUCATION AND
HEALTH CARE**



NATIONAL ECONOMIC FORUM



NIEF
Charcha
WITH
NISHANT KR. HOTA
EP-4 WITH ARUNANSH B.GOSWAMI
**INDIA-ARMENIA
RELATIONS**



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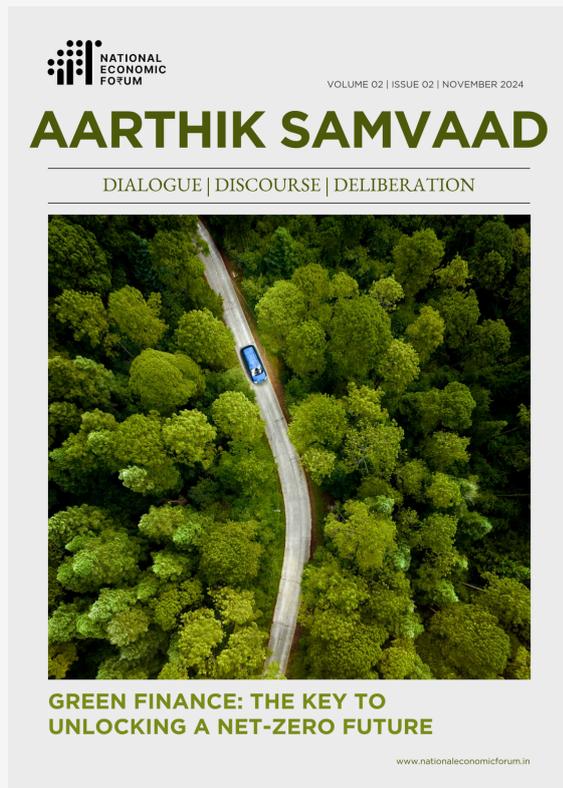
NEF
Charcha
WITH
NISHANT KR. HOTA
EP-4 WITH NAGENDER PARASHAR
**MAKE IN INDIA TO MADE
FOR THE WORLD :MSME
TRANSFORMATION**



NEF
Charcha
WITH
NISHANT KR. HOTA
EP-5 WITH PILOT NEERAJ SEHRAWAT
**FROM POLICY TO PLOUGH
INDIA'S AGRICULTURAL
SHIFT**



NEWSLETTER



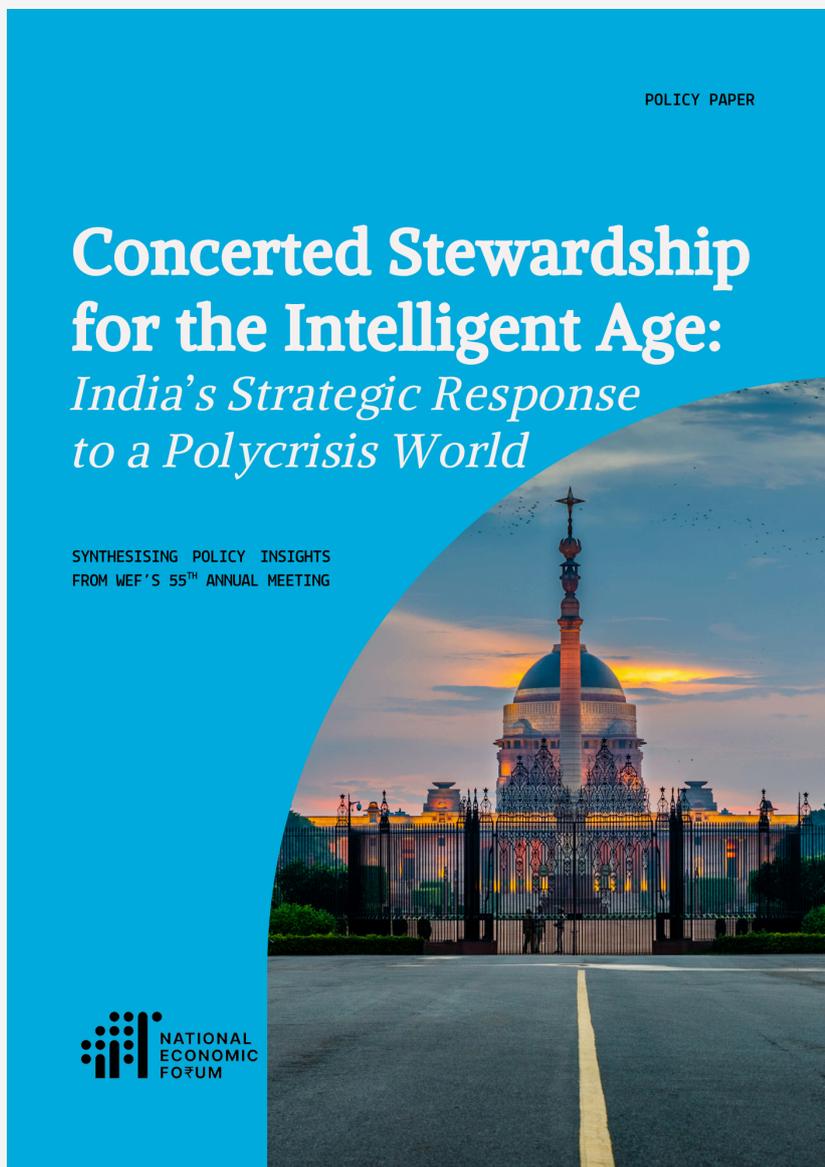
The world convened in Baku for COP29, indicating that the urgency to address climate change has never been more palpable. At the crux of these deliberations lies an indispensable catalyst for action - green finance. It is both the enabler and the accelerant for achieving a net zero future, a shared aspiration that unites nations, economies and individuals in an unparalleled global endeavour.

In this second edition of Aarthik Samvaad, we delved into the pivotal role of green finance in India's metamorphosis into a low-carbon economy. The stakes are monumental. India, with its burgeoning energy demands, expanding urban landscapes and ambitious targets for carbon neutrality, stands at the confluence of challenge and opportunity. How we

marshal financial resources to decarbonise our energy systems, revolutionise our transportation networks and create climate-resilient agriculture will define not just our economic trajectory but also our legacy as stewards of the planet. This edition sought to illuminate the pathways through which innovative funding mechanisms can bridge the chasm between ambition and implementation. We explored the potential of green bonds, blended finance and carbon markets, which promise not only to fund projects but to transform them into sustainable benchmarks. From the thriving micro, small, and medium enterprises (MSMEs) that form the backbone of our economy to the ever-expanding eMobility sector, green finance emerges as the cornerstone upon which sustainable growth pivots.

Moreover, we laid the spotlight on the intersection of circular economy initiatives and sustainable land use, two arenas where the convergence of finance, policy and technology can yield transformative outcomes. The ethos of this newsletter was to highlight how environmental stewardship need not be at odds with economic development. On the contrary, the two can - and must - be harmonised to ensure prosperity for generations to come. As we navigate the corridors of climate action, let Aarthik Samvaad serve as a repository of insights, a catalyst for dialogue, and a clarion call for collective action. For it is through robust and collaborative frameworks that we can aspire to unlock the immense potential of green finance and transform aspirations of a net-zero future into an attainable reality.

WEF COVERAGE 2.0



Based on the observation and analysis of the 2025 World Economic Forum's 55th Annual Meeting at Davos, the NEF team synthesised and collated policy recommendations from various panel discussions and reports. The purpose of the policy paper, a first of its kind comprehensive coverage of WEF, was to provide succinct recommendations for dedicated policy reforms to the public stakeholders in India.

OUTREACH



The Director of the National Economic Forum (NEF) held a fruitful discussion with Hon'ble Lok Sabha MP from Balasore, Odisha, Shri Pratap Chandra Sarangi, at the latter's residence. During the meeting, the Director apprised the Hon'ble MP of NEF's ongoing research initiatives, which were warmly appreciated. The conversation also touched upon the wide array of opportunities that Balasore offers, including tourism, inland waterways, handicrafts, natural resources, and renewable energy prospects such as wind and solar power. The Hon'ble MP graciously invited NEF to his constituency to further strengthen their research efforts, with the shared objective of advancing the welfare and development of the people of Balasore.

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OUTREACH



In a landmark development, the NEF formalised a Memorandum of Understanding (MoU) with the Hydrocarbon Sector Skill Council (HSSC) - a body established under the aegis of the Ministry of Petroleum and Natural Gas and recognised as an Awarding Body by the National Council for Vocational Education and Training (NCVET) under the Ministry of Skill Development and Entrepreneurship. The MoU was signed and exchanged by Mr. Amitabh Banerjee, Former Director, NEF, and Mr. S.K. Bose, CEO, HSSC. This collaboration will pave the way for joint research efforts across the entire hydrocarbon energy spectrum, with an immediate focus on the much-heralded Green Hydrogen.

The National Economic Forum (NEF) formalised a Memorandum of Understanding (MoU) with the School of Management of Financial Institutions (SoMFI), Management Development Institute, Gurgaon.

Mr. Amitabh Banerjee, Former Director, NEF, and Prof. Ajay Kumar Jain, Dean, SoMFI, MDI, signed and exchanged the MoU.

This partnership heralds a significant collaboration, with NEF's Good Governance and Economic Growth vertical joining forces with SoMFI to spearhead initiatives aimed at fostering financial innovation and catalysing sustainable economic growth.



OUTREACH



Yash Kapur, Research Associate had the opportunity to attend an engaging book discussion on Indian Parliament: Shaping Foreign Policy by KV Prasad (Senior Journalist - The Tribune, The Hindu and PTI) at the ICWA. The event featured illuminating remarks by the Hon'ble Deputy Chairman of the Rajya Sabha, Shri Harivansh Narayan Singh; Shri Sujeet Kumar (MP, Rajya Sabha; Member, Consultative Committee on External Affairs); and Amb. TCA Raghavan (former DG, ICWA & former High Commissioner to Pakistan), who offered valuable insights into the dynamic interplay between the Executive and the Legislature in crafting India's foreign policy.

Areeka Mir, Research Associate, participated in an insightful event hosted by the Vidhi Centre for Legal Policy in collaboration with the Competition Commission of India titled, "India's Digital Economy: Competition, Innovation, Regulation and Policy". The event delved into the evolving dynamics of India's digital economy, projected to reach \$1 trillion by 2028. The discussions explored regulatory challenges, the role of fair competition, and the importance of addressing market dominance, recognising that dominance itself isn't problematic, but its abuse is. The dialogue emphasised crafting investor-friendly policies that curb exploitative digital market practices without stifling innovation. Distinguished speakers included Smt. Ravneet Kaur, Chairperson, CCI, and Shri Abhishek Singh, DG, NIC & Addl. Secretary, MeitY.



OUTREACH



Sagarika Chaudhary, Senior Research Associate, delivered a lecture at the Birla Institute of Management Technology (BIMTECH) on the pertinent subject of Sustainability Reporting.

She expressed her deep appreciation for the engagement and intellectual curiosity demonstrated by the PGDM student cohort.

The National Economic Forum extends its profound gratitude to BIMTECH for evincing a strong interest in advancing institutional collaboration, a gesture that #NEF wholeheartedly reciprocates.



OUTREACH



Nishant Kumar Hota, Research and Outreach Associate had the privilege of participating in the inaugural event of the Indic Knowledge System at HRIT University.

It was an enriching experience for him as he engaged with bright students, dedicated faculty members.

He extended heartfelt gratitude to HRIT University and Dr. Anil Agrawal for considering him worthy of contributing as a speaker at this landmark event. NEF looks forward to witnessing the growth of this initiative and the many meaningful conversations it will continue to inspire around India's rich Indic traditions.



OUTREACH



Devesh Tripathi, President, National Economic Forum (NEF) met with R Thyagarajan, Founder, Shriram Group of Finance in Chennai. President NEF briefed him about the NEF. Mr. Thyagarajan liked it very much and agreed to guide NEF in their endeavours.

OUTREACH



The National Economic Forum (NEF) President, Shri Devesh Tripathi, met with the Hon'ble Chief Minister of Maharashtra, Shri Devendra Fadnavis.

During the meeting, the NEF President apprised the Hon'ble Chief Minister of the Forum's visionary mandate and the wide-ranging research initiatives currently being undertaken by the organisation.

The Hon'ble Chief Minister appreciated NEF's significant contributions to informed public discourse and commended its efforts in advancing knowledge dissemination. He also conveyed his steadfast support for NEF's continued expansion and growing impact.

VISION FOR THE UPCOMING YEAR

With India entering a decisive decade on its journey toward Viksit Bharat@2047, the National Economic Forum envisions 2025-26 as a year of intellectual consolidation, digital transformation and policy impact. NEF's mission in the coming year is to strengthen its role as a catalyst of transformative thought and evidence-driven policymaking, anchored in India's realities yet inspired by global best practices.

NEF will continue to operate at the confluence of scholarship, strategy and statecraft, deepening its research across its six thematic pillars - Technomics, Governance for Growth, Knowledge Economy, Sustainable Horizons, Law & Economy and Geostrategic Frontiers. These domains together reflect NEF's belief that technology, governance, knowledge, sustainability and legal coherence are not isolated spheres but interlocking engines of national progress.

In this forthcoming year, NEF will expand its engagement with central and state governments through data-rich policy briefs, capacity-building workshops and collaborative dialogues aimed at translating research into reform.

The Forum will strengthen its partnerships with universities, research councils and international institutions to position India as both a beneficiary and a contributor in the global knowledge ecosystem. Digital modernisation will be a central institutional goal. Building on its redesigned web infrastructure, NEF will leverage data visualisation, interactive dashboards and open-access publications to democratise policy knowledge. The Forum also seeks to cultivate youth participation through research fellowships and leadership labs designed to nurture India's next generation of policy thinkers.

Above all, NEF's vision for 2025-26 is to embed ethical foresight in the heart of economic governance - to ensure that the growth India pursues is inclusive, sustainable and humane. Guided by the ethos of "Uttishthata, Jagrata" (Arise, Awake), NEF shall continue to be a bridge between ideas and implementation, shaping an India that is resilient in structure, equitable in spirit and visionary in purpose.





NATIONAL ECONOMIC FORUM Think Tank & Policy
Research Institute



28, Firozeshah Road, New Delhi- 110001



email@nef.org.in



www.nationaleconomicforum.in



+91 11-35639392