Pre-Consultation Workshop on "Deep Science vs Deep Tech: A Paradigm Shift" (17th December 2025)

The workshop was organised by Indian National Science Academy, American Chemical Society, CSIR–NIScPR, and INSA-Centre for Science, Technology & Innovation Policy. The workshop featured three panel discussions on Demystifying Deep Science and Deep Tech, Building India's Deep Science Ecosystem – Labs, Talent, Capital, and Markets, and Strategies for India's Deep Science Pathways, highlighting the non-linear journey from scientific discovery to market adoption and the need for balanced policy support, patient capital, and strong technology transfer mechanisms.

National Science Day (28th February 2026)

An engaging panel discussion on “Science–Policy Interface for Catalysing Viksit Bharat” was organised by INSA during the second half of the National Science Day programme. The session was chaired by Prof. Shekhar C. Mande, President, INSA, and moderated by Prof. Indranil Manna, Vice President, INSA. The panel featured distinguished experts from NITI Aayog, CSIR, CSTEP, and IGSTC, who deliberated on strengthening India's science, technology, and innovation ecosystem. The discussion highlighted the need to foster scientific temper, engineering excellence, indigenous innovation, translational research, and stronger academia-industry linkages, while emphasising inclusive and people-centric development through gender-sensitive policies, rural women's empowerment, equitable access to education and healthcare, and enhanced support for entrepreneurship and commercialisation of research.

Article launch: “From Deep Science to Deep Tech” (9th March 2026)

The latest piece published in Deccan Herald explores a critical distinction: deep science vs deep tech. Deep science generates knowledge, discovery, and possibility. Deep tech translates those discoveries into products, industries, and national capabilities. For countries like India, this distinction matters immensely. Global technological leadership will be defined not by apps alone, but by breakthroughs in advanced materials, AI infrastructure, biotech, and clean energy- domains rooted in deep science and realised through deep tech. If we want to build the technologies of the future, we must first strengthen the science that makes them possible.
The full article can be accessed here: https://lnkd.in/dX4eYP9N

From deep science to deep tech

KRISHNA RAGHAV CHATURVEDI, FAMIDA KHAN AND KASTURI MANDAL

As countries race to secure technological leadership in a rapidly transforming global economy, two terms dominate policy speeches, funding calls and startup pitches: 'deep science' and 'deep tech'. From India's Rs 1 lakh crore RDI fund to DPIIT's deep tech startup recognition, both phrases signal ambition. Yet they are often used interchangeably and rarely defined with precision.

For India, this is not a semantic issue but a strategic one. The country has a strong publicly funded research base, but translation into globally competitive technologies remains limited. Without conceptual clarity, funding priorities blur, incentives misalign, and expectations collide.

'Deep science' refers to fundamental, curiosity-driven research that advances knowledge frontiers in fields such as physics, chemistry, biology, materials science, and mathematics. It is marked by long time horizons, high uncertainty, and no immediate commerciality.

Historically, transformative technologies have sprung from such work. Thermodynamics enabled the steam engine. Semiconductor physics led to modern computing. Molecular biology underpins biotechnology. What is "deep" today may become standard tomorrow.

Deep science produces potential, not products. Its outcomes are unpredictable and often realised decades later. Applying short-term performance metrics or forcing early commercialisation risks distorting incentives and discouraging risk-taking.

Deep tech represents the commercialisation of scientifically deep breakthroughs into disruptive technologies. It is typically IP-intensive, R&D-heavy, and protected by high technical barriers. Examples include advanced diagnostics, clean energy systems, autonomous platforms, quantum computing, and next-generation manufacturing.

Recently, the INSA Policy Centre (CSTIP), CSIR-NISCPR, and the American Chemical Society brought together scientists, startup founders, policymakers, investors, and international stakeholders for a workshop to address confusion between deep science and deep tech. Clear definitions, participants argued, allow policymakers to fund curiosity-driven research without premature market pressure.

Led by Prof Ashutosh Sharma (INSA president), Geetha Vani Rayasam (CSIR-NISCPR director), Akhilesh Gupta (senior consultant, INSA), Brajesh Pandey (INSA, ED), and Deeksha Gupta (ACS director), discussions converged on a blunt assessment: India does not lack scientific capability.

It lacks a robust system to convert deep scientific knowledge into scalable, market-validated technologies. At the core of this gap lies a need to distinguish clearly between deep science and deep tech.

Participants cautioned against a "translate or perish" culture. While translation is vital, rushing foundational science can compromise quality and long-term impact.

A key insight from the workshop was asymmetry: deep tech often emerges from deep science but not always.

However, deep science does not originate from deep tech. And not all technology qualifies as deep tech. Incremental improvements, cost optimisations, or simple digitisation, however valuable, are not disruptive in the same sense. Recognising this distinction helps prevent the dilution of the term "deep" and ensures that truly transformative innovations receive appropriate support.

Even when strong science exists, translation often falters. Many promising ideas stall in the so-called "valley of death", not because the research is weak but because the ecosystem for lab-to-market transition is underdeveloped. Beyond technology readiness levels (TRLs), participants highlighted three critical dimensions:

- Communication readiness: the ability to explain value to investors, regulators, and customers.
- Manufacturing readiness: scalable production with quality and cost control.
- Market readiness: validated demand, regulatory acceptance, and adoption pathways.

Despite years of dialogue, academia–industry integration remains limited. Public research institutions often operate separately from market realities. Embedded technology transfer officers are scarce, incentives for researchers to commercialise are weak, and IP frameworks can create uncertainty for private partners.

Global innovation leaders have built deliberate systems. In the United States, universities and national laboratories anchor deep tech ecosystems and support spinouts. Europe aligns deep science with societal missions. Australia has streamlined industry collaboration and IP governance. For India, the path forward requires a clear classification framework. Not all science must become deep tech. Nor should every new technology be labelled "deep". The real challenge is identifying which scientific advances are ready for translation and building systems that enable that journey.

(Krishna is with the American Chemical Society; Famida works at the INSA, and Kasturi with CSIR-NISCPR)

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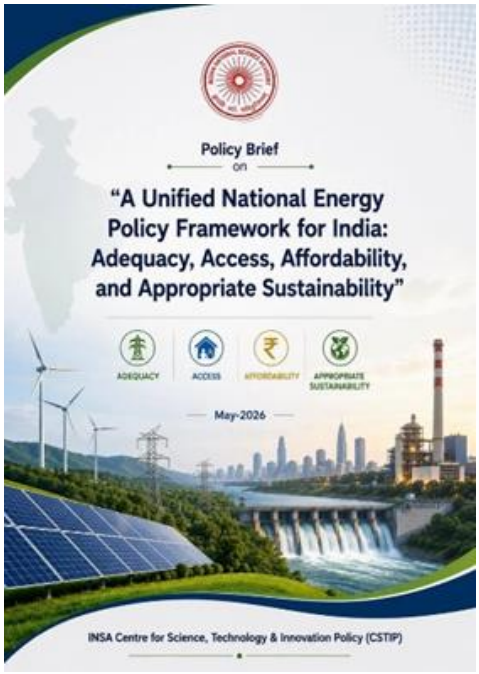
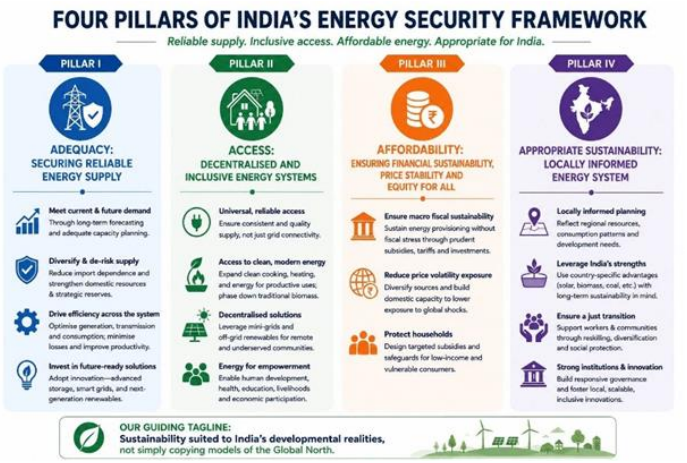
Report Launch: "Survey Report on Ease of Doing R&D in India" (9th April 2026)

The INSA- INSA-CSTIP initiated activities in July 2025 related to NITI Aayog's Ease of Doing Research and Development in India initiative. The CSTIP team drafted a survey questionnaire in consultation with domain experts and NITI Aayog. A pilot survey was conducted, following which the questionnaire was circulated among participants from Indian National Science Academy (INSA), National Academy of Sciences India (NASI), and regional consultative meetings. Approximately 870 responses were received. The data were analysed, and a comprehensive survey report was prepared, which was subsequently launched by the Hon'ble Minister of Science & Technology on 9 April.

Policy brief launch: "A Unified National Energy Policy Framework for India: Adequacy, Access, Affordability, and Appropriate Sustainability" (11th May 2026)

On the occasion of National Technology Day, INSA released a policy brief titled "A Unified National Energy Policy Framework for India: Adequacy, Access, Affordability, and Appropriate Sustainability". The policy brief was unveiled in the august presence of Prof. M. M. Sharma, Padma Vibhushan & Head of Competition Law & Policy; Prof. Raghunath Anant Mashelkar, FNA, FRS & Former Director General, CSIR; Prof. Shekhar Mande, (President, INSA), Professor Ganapati D. Yadav (VP, INSA), Prof. Anurag Agrawal (VP-INSA), Dr. Anjan Ray (Sr Consultant, INSA) and Dr Brajesh Pandey (Executive Director, INSA). Developed through a rigorous consultative process, the brief reflects insights from domain experts and INSA Fellows, gathered through multiple offline and online engagements. In view of the current energy crisis and growing infrastructure challenges, this initiative underscores the urgency of rethinking India's energy governance architecture. The document can be accessed here: https://lnkd.in/gQpvcXs2

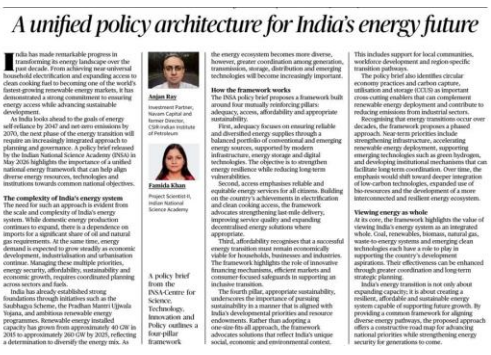




Article launch: "A Unified Policy Architecture for India's Energy Future" (2nd July 2026)

INSA Centre for Science, Technology & Innovation Policy, published an opinion piece titled "A Unified Policy Architecture for India's Energy Future," in The Hindu.

The article argues that India's energy transition is no longer solely a technological or sectoral challenge, it is fundamentally a governance challenge. With responsibilities for energy spread across multiple ministries and institutions, a more coordinated policy architecture is essential to ensure energy security, accelerate the clean energy transition, strengthen domestic innovation, and build long-term resilience.



A unified policy architecture for India's energy future

India has made remarkable progress in transforming its energy landscape over the past decade. From achieving near-universal household electrification and expanding access to clean cooking fuel to becoming one of the world's fastest-growing renewable energy markets, it has demonstrated a strong commitment to ensuring energy access while advancing sustainable development.

As India looks ahead to the goals of energy self-reliance by 2047 and net-zero emissions by 2070, the next phase of the energy transition will require an increasingly integrated approach to planning and governance. A policy brief released by the Indian National Science Academy (INSA) in May 2026 highlights the importance of a unified national energy framework that can help align diverse energy resources, technologies and institutions towards common national objectives.

The complexity of India's energy system

The need for such an approach is evident from the scale and complexity of India's energy system. While domestic energy production continues to expand, there is a dependence on imports for a significant share of oil and natural gas requirements. At the same time, energy demand is expected to grow steadily as economic development, industrialisation and urbanisation continue. Managing these multiple priorities, energy security, affordability, sustainability and economic growth, requires coordinated planning across sectors and fuels.

India has already established strong foundations through initiatives such as the Saubhagya Scheme, the Pradhan Mantri Ujjwala Yojana, and ambitious renewable energy programmes. Renewable energy installed capacity has grown from approximately 40 GW in 2015 to approximately 260 GW by 2025, reflecting a determination to diversify the energy mix. As the energy ecosystem becomes more diverse, however, greater coordination among generation, transmission, storage, distribution and emerging technologies will become increasingly important.

How the framework works

The INSA policy brief proposes a framework built around four mutually reinforcing pillars: adequacy, access, affordability and appropriate sustainability.

First, adequacy focuses on ensuring reliable and diversified energy supplies through a balanced portfolio of conventional and emerging energy sources, supported by modern infrastructure, energy storage and digital technologies. The objective is to strengthen energy resilience while reducing long-term vulnerabilities.

Second, access emphasises reliable and equitable energy services for all citizens. Building on the country's achievements in electrification and clean cooking access, the framework advocates strengthening last-mile delivery, improving service quality and expanding decentralised energy solutions where appropriate.

Third, affordability recognises that a successful energy transition must remain economically viable for households, businesses and industries. The framework highlights the role of innovative financing mechanisms, efficient markets and consumer-focused safeguards in supporting an inclusive transition.

The fourth pillar, appropriate sustainability, underscores the importance of pursuing sustainability in a manner that is aligned with India's developmental priorities and resource endowments. Rather than adopting a one-size-fits-all approach, the framework advocates solutions that reflect India's unique social, economic and environmental context. This includes support for local communities, workforce development and region-specific transition pathways.

The policy brief also identifies circular economy practices and carbon capture, utilisation and storage (CCUS) as important cross-cutting enablers that can complement renewable energy deployment and contribute to reducing emissions from industrial sectors.

Recognising that energy transitions occur over decades, the framework proposes a phased approach. Near-term priorities include strengthening infrastructure, accelerating renewable energy deployment, supporting emerging technologies such as green hydrogen, and developing institutional mechanisms that can facilitate long-term coordination. Over time, the emphasis would shift toward deeper integration of low-carbon technologies, expanded use of bio-resources and the development of a more interconnected and resilient energy ecosystem.

Viewing energy as whole

At its core, the framework highlights the value of viewing India's energy system as an integrated whole. Coal, renewables, biomass, natural gas, waste-to-energy systems and emerging clean technologies each have a role to play in supporting the country's development aspirations. Their effectiveness can be enhanced through greater coordination and long-term strategic planning.

India's energy transition is not only about expanding capacity; it is about creating a resilient, affordable and sustainable energy system capable of supporting future growth. By providing a common framework for aligning diverse energy pathways, the proposed approach offers a constructive road map for advancing national priorities while strengthening energy security for generations to come.

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Famida Khan
Project Scientist-II, Indian National Science Academy

A policy brief from the INSA-Centre for Science, Technology, Innovation and Policy outlines a four-pillar framework