The Three Kartavyas and India's Moment of Transition in Science, Technology and Innovation

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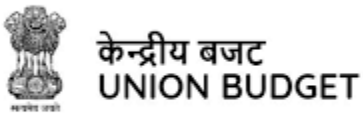

Anchored in the three kartavyas, the S&T budget makes way for an integrated innovation architecture through mega-science facilities, manufacturing programmes in semiconductors, biopharma, rare earths and chemicals that secure supply chains, and emerging technologies like AI, quantum and CCUS. The Survey's emphasis on productivity-led growth, technology diffusion can be viewed together with AI for governance, biologics for affordable healthcare and deep-tech for jobs and skills. The Budget charts a clear pathway whose impact will unfold through effective implementation, technology diffusion, and inclusive access. Sanjeev K. Varshney writes.

Framed around the three kartavyas, accelerating and sustaining economic growth, building capacity, and ensuring access and inclusion, the Union Budget 2026–27 reflects India's evolving self-perception and its strategic engagement with the global order. It situates the country at a moment of transition, moving decisively towards productivity, competitiveness, resilience, and the ability to shape outcomes in an increasingly uncertain global environment.

The Budget recognises that such a transition requires a supportive innovation ecosystem, with science and technology explicitly positioned as a force multiplier. In a world marked by geopolitical fragmentation, volatile supply chains, escalating climate risks, and recurrent disease outbreaks, science and technology have emerged as core strategic capabilities for productivity, competitiveness, and resilience. India's capacity to develop, deploy, and govern technology effectively underpins Atmanirbhar Bharat and the vision of Viksit Bharat, strengthening economic performance, social resilience, and strategic autonomy. Notably, science and technology investments are embedded across agriculture, health, power, renewable energy, digital infrastructure, education, space, and defence, rather than being confined to science ministries alone.

The Union Budget signals a shift towards technology-driven, climate-resilient agriculture. Increased emphasis on innovation through the Fund for Innovation and Adoption of Technology

(FIAT), mechanisation for value addition, and sustainability via the National Mission on Natural Farming highlights the productivity–sustainability balance. Strengthening Krishi Vigyan Kendras ensures that scientific advances reach farmers at the grassroots, while the NAMO Drone Didi initiative positions women's self-help groups as technology enablers.

Energy and environmental priorities demonstrate similar strategic foresight. The Budget prioritises clean-energy technologies and grid modernisation, with a ten-fold increase in allocations for grid-scale battery energy storage systems. Enhanced support for energy-efficient technologies in MSMEs, alongside the introduction of Carbon Capture, Utilisation and Storage (CCUS) with an allocation of ₹500 crore, reflects an intent to advance industrial decarbonisation.

India's digital drive continues unabated. The Budget strengthens Digital India, reflecting the need to secure a rapidly expanding digital economy. The Artificial Intelligence Mission is further bolstered, aligning with the Economic Survey's emphasis on AI as a general-purpose productivity tool and governance enabler. Semiconductors remain a national priority, and has made provision for Semiconductor Mission 2.0, targeting full-stack design, equipment manufacturing, supply-chain resilience, and skilled workforce development. Additional focus on electronics components and data centre investments reinforces digital infrastructure ambitions.

Space and defence allocations, though modest in absolute terms, are strategically meaningful. Funding for space sciences has more than tripled, while enhanced support for Asia-Pacific training centres strengthens international cooperation and reinforces India's leadership in regional space education and collaboration.

Health and biomedical research: Investments in nationwide laboratory networks, pandemic research platforms, AYUSH systems, and the launch of Biopharma SHAKTI signal an integrated approach to innovation-driven healthcare resilience.

Education and research spending highlight a decisive push towards knowledge-driven growth. Increased funding for Centres of Excellence in AI supports applications across education, health, and agriculture. Multidisciplinary research, digital learning initiatives, the newly introduced Prime Minister Research Chairs, together with the PM One Nation One Subscription programme aim to retain talent, expand global research access, integrate Indian Knowledge Systems, and strengthen indigenous innovation.

A dedicated funding targeting deep-tech startups, strategic technologies, and industrial R&D. Flagship missions in quantum science, geospatial technologies, biotechnology, astrophysics mega-projects, assistive technologies, and defence R&D position India strongly on the frontiers of twenty-first-century innovation.

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SCIENCE POLICY & DIPLOMACY

International S&T Cooperation

High Seas Treaty Enters into Force

The UN High Seas Treaty has officially come into force after reaching the required number of ratifications. It sets common rules to protect biodiversity in international waters beyond national jurisdiction. The agreement enables marine protected areas and environmental impact assessments.It also governs access to marine genetic resources and benefit-sharing. Countries will now begin work on implementation through the first conference of parties.

United States and Israel Launch Strategic Partnership on AI and Critical Technologies

The United States and Israel announced a joint initiative to deepen cooperation in artificial intelligence, advanced computing, robotics, and other critical technologies. The partnership aims to promote joint research, innovation, and secure technology supply chains between the two nations.

Ho Chi Minh City Seeks Stronger Science & Tech Ties with Daegu

Ho Chi Minh City is seeking to deepen cooperation with South Korea's Daegu in science, technology, and innovation. The city aims to connect its high-tech zones with Daegu's research institutes and tech firms, expand university exchanges, and collaborate in AI, robotics, biotechnology, and new energy. Leaders also hope to learn from Daegu's smart city experience in urban data management and intelligent transport, strengthening South Korea's role as a key partner in the city's innovation ecosystem.

Haryana and British Columbia Explore Partnership in Clean Technology and Innovation

Haryana and British Columbia engaged in discussions to strengthen collaboration in clean technology, digital solutions, AI, and innovation ecosystems. The talks also highlighted opportunities in sustainable energy, value-added agriculture, and food safety technology, reflecting a shared commitment to technology-driven economic growth and sustainable development.

New Zealand and Kiribati Sign Statement of Partnership to Deepen Pacific Cooperation

New Zealand and Kiribati formalised their strengthened partnership with a Statement of Partnership focused on shared Pacific priorities, including health, labour mobility, water security and regional cooperation. The agreement reflects long-standing ties and a mutual commitment to sustainable development and geopolitical engagement in the Pacific region.

Vietnam and United Nations Strengthen Partnership on Cybersecurity, Digital Transformation and Sci-Tech Cooperation

Vietnam met with the UN's technology envoy to expand cooperation in science, technology, innovation, digital transformation, AI and cybersecurity, seeking UN expertise and policy guidance to build capacity and governance frameworks. The discussions also aimed to deepen Vietnam's involvement in multilateral tech initiatives and bolster secure, inclusive digital development.

South Korea and Italy to Deepen Cooperation in AI and Semiconductor Technologies

South Korean President Lee Jae Myung and Italian Prime Minister Giorgia Meloni, during her state visit to Seoul, agreed to expand bilateral cooperation in cutting-edge sectors including artificial intelligence, semiconductors (chips), aerospace and critical minerals, signaling stronger tech and industrial ties between the two nations.

Emerging Tech & Governance

NBC Bearings and Ahamani EV Technology Join Forces to Advance India's Drone Technology

NBC Bearings, part of the CKA Birla Group, has acquired a 30 % equity stake in Ahamani EV Technology India to accelerate the commercialisation and adoption of next-generation drone technologies in India. The partnership combines Ahamani's advanced drone systems with NBC's engineering and manufacturing capabilities to expand scalable and cost-effective drone solutions across diverse sectors.

New Low-Energy Method to Control Quantum Materials

Scientists at Okinawa Institute of Science and Technology (OIST) Graduate University have found a way to tailor quantum materials using excitons instead of high-power lasers. The approach requires far less energy and avoids damaging materials. It could make it easier to design and control advanced quantum states for future devices.

Thin Silver Layer Could Improve Solid-State Lithium Batteries

Researchers at Stanford University have found that applying a nanoscale layer of silver to solid electrolytes can significantly strengthen them against cracking and failure. This coating may help make safer, more durable lithium metal batteries with higher energy density and faster charging potential.

EU Council Clears Path for AI "Gigafactories" to Boost Continental Tech Power

The Council of the European Union has adopted an amendment to the regulation governing the European High-Performance Computing Joint Undertaking (EuroHPC JU) that broadens its mission to include support for large-scale AI gigafactories and adds a dedicated quantum technologies pillar. These AI gigafactories are envisioned as world-class computing and data infrastructure hubs to strengthen Europe's industrial competitiveness, foster public-private cooperation, and support start-ups and scale-ups in developing advanced artificial intelligence capabilities.

New Cooling Method Could Boost Chip-Based Quantum Computers

Researchers have developed a cooling technique that helps make chip-based trapped-ion quantum computers more scalable and stable. By integrating photonic control on the chip, it reduces reliance on bulky external optics and improves heat management. This method could support larger numbers of qubits and pave the way for more compact, practical quantum processors.

Events & Meetings

IndiaAI and IIT Hyderabad Host Inclusion for Social Empowerment Working Group Meeting

The IndiaAI Mission, MeitY and IIT Hyderabad convened a working group meeting at IIT Hyderabad to advance inclusive, human-centric and responsible AI development, and to guide discussions for the upcoming India AI Impact Summit 2026.

World Economic Forum Annual Meeting 2026 in Davos Focuses on Innovation, Dialogue and Global Challenges

The 56th World Economic Forum Annual Meeting was held in Davos, Switzerland from 19–23 January 2026 under the theme *"A Spirit of Dialogue"*, bringing together leaders from government, business, academia and civil society to discuss pressing global issues. Sessions covered topics including advancing technology and innovation (such as AI and clean energy),

economic cooperation, climate and sustainability, and the role of science and technology in addressing global challenges.

INDIAN SCIENCE NEWS

ISRO Invites Private Firms to Build India's First Space Station

ISRO has called on private Indian space tech companies to contribute to the Bharatiya Antariksh Station (BAS), India's first space station in low Earth orbit. The initiative marks a significant step in public-private collaboration in India's space sector, combining government expertise with domestic innovation. It also supports India's goal of expanding its space infrastructure while promoting self-reliance in advanced space technologies.

CSIR-CRRI, JSW Steel Partner to Build Eco-Friendly Steel Slag Roads in Tamil Nadu

In an initiative promoting sustainable infrastructure and the circular economy, CSIR-CRRI and JSW Steel Limited, Salem Works have signed an agreement to use industrial steel slag as construction material for durable roads in Tamil Nadu. The collaboration aligns with the Government's 'From Waste to Wealth' vision, aiming to reduce waste, lower carbon footprints, and enhance resource efficiency in road projects.

New Porous Graphene Supercapacitor Promises Better Energy Storage

Researchers have developed a high-voltage supercapacitor using porous graphene nanocomposites, achieving improved energy density and stability. The technology could enhance performance in electric vehicles, portable electronics, and grid storage. It is produced through an eco-friendly process and supports India's clean-energy and self-reliance goals.

Sun-Powered Self-Charging Energy Device

Researchers have developed a photo-capacitor that can both capture and store solar energy in a single system. The device reduces the need for separate solar panels and batteries, improving efficiency. It shows strong stability and could be used in portable, wearable, and off-grid energy applications.

ADVANCES IN S&T

World's First Open-Source Quantum Computer Aims to Democratize Quantum Research

The Problem: Quantum computing and quantum information science have so far been driven largely by

proprietary hardware and software research, limiting access for many researchers and slowing broad participation in developing practical quantum systems. This creates barriers for algorithm testing, innovation, and community-based advancement of the field.

The Method: Researchers at the University of Waterloo and the Institute for Quantum Computing, through the non-profit Open Quantum Design (OQD), have built and released what they describe as the world's first *open-source, full-stack quantum computer*. This system uses trapped-ion hardware combined with open control electronics and software, enabling contributors worldwide to access, modify, and improve each layer of the quantum stack without proprietary restrictions.

Future Prospects: Open-source quantum hardware and software could democratize access to real quantum systems, helping more scientists and developers test algorithms and build expertise. The collaborative model may accelerate quantum research, support startups, and foster a broader community that drives the technology forward more quickly than closed-source approaches alone.

New Catalyst Boosts Plastic Upcycling Efficiency Over 10x

The Problem: Traditional catalysts like platinum are effective in chemical recycling and fuel synthesis but are expensive, scarce, and limited in supply, hindering cost-effective and sustainable plastic upcycling and CO_2 utilization.

The Method: Researchers discovered a specific phase of tungsten carbide, an abundant industrial metal, that can rival platinum's catalytic activity. They precisely controlled its atomic structure at high temperatures to enable efficient conversion of plastics and carbon dioxide into valuable chemicals.

Future Prospects: This cheaper catalyst could dramatically expand recycling and upcycling of plastic waste, support carbon-neutral chemical production, and advance a circular economy with broader industrial adoption.

INSIGHTS & RESOURCES

Helmholtz Launches €36M Research Initiatives in Future Technologies

The Helmholtz Association is funding three new initiatives with €36 million to advance strategic technologies. They focus on biomedical engineering, water safety and security, and practical

quantum applications. The programs aim to accelerate innovation, foster collaboration, and translate research into real-world solutions.

UNEP's Report titled 'State of Finance for Nature 2026' Released

The United Nations Environment Programme (UNEP) has released the "State of Finance for Nature 2026" report, which tracks global financial flows affecting nature and highlights large imbalances in investments needed to address climate change, biodiversity loss, and ecosystem degradation. Key findings include:

- Massive finance imbalance: For every US $1 invested in nature protection, about US $30 is spent on activities that harm ecosystems, with nature-negative flows around US $7.3 trillion in 2023 compared with US $220 billion for nature-positive investments.
- Investment gap for NbS: To meet global climate, biodiversity and restoration targets, finance in nature-based solutions (NbS) needs to rise 2.5 × to US $571 billion annually by 2030 — just 0.5 per cent of global GDP.
- Nature Transition X-Curve framework: The report introduces a roadmap to phase out harmful finance and scale up high-integrity NbS across economic sectors, aiming to help close the nature finance gap.
- Sector Priorities: Greatest opportunities exist in forestry, wetlands, agriculture, and coastal ecosystems for investment and restoration.
- Policy Recommendations: Governments and financial institutions are urged to redirect capital flows, de-risk nature-based investments, and incentivize sustainable practices.
- Global Collaboration: Success depends on international coordination, transparent reporting, and multi-stakeholder engagement to align finance with environmental targets.