23rd India-Russia Annual Summit: Takeaways

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India and Russia have a long-standing and multi-dimensional S&T cooperation. The recent Summit placed strong emphasis on science and technology cooperation between the two countries, covering a broad spectrum of strategic and emerging sectors that are crucial for energy security and advancing technological sovereignty. Sneha Sinha writes.

At the 23rd India-Russia Annual Summit held on 4-5 December 2025 in New Delhi, President Vladimir Putin paid a state visit to India at the invitation of the Prime Minister of India, Shri Narendra Modi. The Summit marks 25 years of the India-Russia Strategic Partnership based on mutual trust, respect for sovereign interests and strategic convergence. During the bilateral talks, PM Narendra Modi and President Vladimir Putin had extensive discussions on multi-faceted Special and Privileged Strategic Partnership which spans across political, economic and strategic alignment, defence and security, trade and investment, energy, science and technology, nuclear and space cooperation, global issues together with cultural, educational and humanitarian ties.

The Leaders welcomed the adoption of *Programme 2030* aimed at deepening economic cooperation in strategic sectors between the two countries, providing a structured roadmap to expand bilateral trade, investment and industrial collaboration. A total of 16 MoUs and Agreements were signed covering issues like migration and mobility, health and food safety, maritime cooperation and polar waters, customs and commerce, academic collaboration, and media collaboration. The outcomes also included efforts towards strengthening people-to-people ties, cultural cooperation and tourism, reflected in initiatives covering wildlife conservation, cultural exchanges and enhanced visa facilitation. The Leaders noted that while traditional areas of cooperation continue to deepen, both sides are actively exploring new avenues for a more contemporary and future-oriented partnership.

India and Russia have a long-standing and multi-dimensional S&T cooperation. The recent Summit placed strong emphasis on science and technology cooperation between the two countries, covering a broad spectrum of strategic and emerging sectors that are crucial for energy security and advancing technological sovereignty. Some areas of cooperation included healthcare, medical education and science, food safety and quality standards, joint mineral exploration, research and

development, fertilizers, as well as specialised training in polar waters. In nuclear energy, India and Russia agreed to deepen engagement across full fuel cycle, life-cycle support for the Kudankulam Nuclear Power Plant and peaceful use of nuclear energy, aligned with India's goal of achieving 100 GWof nuclear capacity by 2047. Outer Space cooperation was strengthened in human spaceflight, satellite navigation, planetary exploration and rocket engine development. India-Russia joint work on critical minerals and rare earth processing technologies could help in diversifying supply chains in a competitive global landscape. The Summit also reinforced collaboration in emerging and digital technologies, including cybersecurity, critical infrastructure protection and law enforcement technologies. Academic and research linkages were expanded through joint research, mobility programs, scientific exhibitions, and seminars, while partnerships with the private sector, particularly start-ups and SMEs, were promoted to encourage innovation, co-development of technologies, and solutions to societal challenges.

The strategic alignment between India–Russia S&T and economic cooperation also works within a broader global strategic convergence, supporting reforms in global governance and advocating for a rules-based international order. The focus on science and technology collaboration during the 23rd India-Russia Annual Summit, reflects a shift from sector-specific cooperation to a more integrated, innovation-driven partnership. Collectively, these initiatives underline a strategic, forward-looking framework for India-Russia S&T cooperation that integrates technology development, human capital and innovation systems. With the Summit's robust agenda, institutional coordination, streamlining of technology transfer and regulatory processes and focus on capacity building is crucial. Greater engagement of private sector, start-ups, and academia, together with sector-specific roadmaps and joint innovation initiatives could help convert research and collaborations into practical and scalable solutions.

SCIENCE POLICY & DIPLOMACY

International S&T Cooperation

Australia–South Korea Research Partnership

Australia and South Korea reinforced their scientific collaboration through the 6th Joint Committee on Science and Technology (JCST) meeting. The partnership focuses on emerging technologies, AI, quantum computing, and sustainable innovation, aiming to expand joint research, talent exchange, and innovation ecosystems between both countries.

IAEA and Algeria Sign Joint Statement to Reinforce Nuclear Cooperation

The joint statement aims to strengthen cooperation on the peaceful uses of nuclear science, technology and energy, reinforcing ties in nuclear safety, technical assistance, research and

capacity building. The agreement underscores both sides' commitment to advancing civil nuclear applications for socio-economic development and sustainable energy goals.

Gambia and Indonesia Strengthen Bilateral Cooperation

Gambia and Indonesia agreed to enhance collaboration in higher education, research, and science & technology, focusing on joint frameworks, capacity building, and expertise exchange. The partnership also covers agriculture, training, and future bilateral development initiatives.

Wärtsilä and Aalto University Renew Partnership for Clean Energy Innovation

They signed a new five-year R&D partnership to advance clean energy and decarbonisation technologies. Key focus areas include zero-emission marine fuels, hydrogen and ammonia-based energy, AI-driven research, advanced materials, and international collaboration, aiming to accelerate sustainable innovation in energy and maritime industries.

Tehran Hosts African Envoys to Strengthen Science & Health Cooperation

Tehran hosted ambassadors from 19 African countries to discuss a strategic health and science alliance, focusing on tropical disease research, vaccine and biosimilar production, joint education programs, and capacity building. The initiative aims to expand collaboration between 60+ universities and research centers, enhancing health diplomacy and scientific partnerships across Africa.

Emerging Tech & Governance

Partnerships Powering AI Advances in Agriculture

CGIAR and global partners launched the AI Agriculture Ecosystem in Abu Dhabi to leverage decades of agricultural data with AI technologies, providing real-time insights for planting, weather, resource management and policy support. The collaborative AI Hub and tools like AgriLLM aim to strengthen farmer resilience and accelerate innovation for food security worldwide.

Breakthrough 3D Wiring Architecture Enables 10,000-Qubit Quantum Processors

QuantWare developed a novel 3D wiring architecture, VIO-40K, allowing a single quantum processor to support 10,000 qubits—a 100-fold increase over current chips. The architecture uses vertical wiring and integrated chiplets, enabling compact, high-fidelity quantum processing, with first units expected to ship in 2028 from a new industrial-scale fab in Delft, Netherlands.

AI Centre of Excellence for Healthcare Set Up at IISc

The Ministry of Education has launched the TANUH AI Centre of Excellence at IISc Bengaluru to develop AI-driven healthcare solutions for early disease detection and treatment. The centre unites clinicians, data scientists, and researchers to address major health challenges like cancer, diabetes, and retinal diseases.

New Quantum Electron Breakthrough Could Accelerate Future Computing

Auburn University researchers have developed a novel class of materials that enables precise control of free electrons, a key step toward faster and more efficient computing and quantum technologies. This innovation could pave the way for next-generation computers capable of solving complex problems far beyond today's capabilities.

Syntax Bio's Cellgorithm™ Enables Programmable Stem Cell Differentiation

Syntax Bio unveiled Cellgorithm™, a CRISPR-based platform that automates and programs gene activation in human stem cells, replacing slow, manual differentiation processes. The technology allows faster, more reproducible generation of functional cell types, potentially accelerating therapies for diseases like diabetes, Parkinson's, heart failure, and vision loss.

Taiwan Boosts Sovereign AI with National Cloud Computing Centre

Taiwan inaugurated its first national cloud computing centre in Tainan to strengthen *sovereign AI* capabilities, hosting a high-performance supercomputer to support AI model training, cloud services, and semiconductor research. The initiative, part of broader AI infrastructure projects, aims to reduce dependence on foreign systems while enhancing domestic innovation and digital resilience.

NITI Aayog Unveils Roadmap to Transform India into a Quantum-Powered Economy

NITI Aayog's Frontier Tech Hub unveiled a roadmap to make India a global leader in quantum technologies, focusing on R&D, commercialization, and ecosystem development. The plan emphasizes collaboration among policymakers, scientists, and industry to build research capabilities, skilled talent, and competitive quantum infrastructure under the National Quantum Mission.

Events & Meetings

India–EU Ideathon to Combat Marine Plastic Pollution

The India–EU Ideathon on marine plastic pollution concluded in Bhubaneswar, selecting three winning teams—Ocean Resilience India, Nautilus Nexus, and TrashTrek App—addressing tracking, removal, and awareness of marine plastics. Organized by India's Office of Principal Scientific Adviser and the Delegation of the EU to India, the event aimed to foster innovation, scientific collaboration, and incubation support for scalable, sustainable solutions.

India International Science Festival (IISF) 2025

IISF 2025, held from 6–9 December in Panchkula/Chandigarh, brought together scientists, students, innovators and industry leaders under the theme "Vigyan Se Samriddhi: For Atmanirbhar Bharat," featuring over 150 technical sessions, exhibitions and outreach programmes aimed at bridging science with society and national development. The four-day event recorded a record turnout of more than 200,000 visitors, highlighting cutting-edge research, innovation and public engagement in science and technology.

K-Science & Technology Global Forum

South Korea's Ministry of Science and ICT and Ministry of Foreign Affairs co-hosted the Forum in Seoul. The event focused on multilateral cooperation, research security, and global research achievements in AI, quantum, biotechnology, and energy, highlighting Korea's strategic push to use advanced science and technology as a pillar of innovation and diplomacy.

MEA Organised International Conference on '50 Years of BWC: Strengthening Biosecurity for the Global South'

The conference highlighted international collaboration, research, and policy measures to prevent misuse of biological agents. It brought together diplomats, scientists, and policymakers to discuss strategies for strengthening biosafety and biosecurity frameworks globally.

IAP 2025 Conference & General Assembly: Bridging Science, Policy, and Society

The IAP 2025 Conference (8–11 Dec, Cairo/online) brought together scientists and policymakers to discuss trust in science, sustainable innovation, ethical tech governance, climate resilience, and science diplomacy, promoting evidence-based global solutions.

India-Japan Conference 2025 Held at IISc

The conference focused on empowering technologies, economic partnerships, sustainable futures and skilling for innovation under India-Japan synergy. The event featured panel discussions, competitions, and activities to strengthen research, innovation and collaborative ties in AI and Deep Tech, skilling for resilience and innovation and co-designing a sustainable future.

INDIAN SCIENCE NEWS

MIT-WPU Scientists Crack Hydrogen Transport Challenge

Scientists have developed a safer and more efficient hydrogen transport solution using a Liquid Organic Hydrogen Carrier (LOHC) system. The breakthrough enables stable, non-flammable hydrogen storage under moderate conditions, reducing costs and infrastructure challenges. This innovation could significantly support India's clean energy and green hydrogen ambitions.

Atal Innovation Mission and Hindustan Unilever Limited Partner to Accelerate Transition to Circular Economy

NITI Aayog's AIM and HUL launched a programme under Project Circular Bharat to support 50 high-potential circular economy start-ups over three years, focusing on plastics and other post-consumer waste. Selected start-ups will receive mentorship, funding, and pilot opportunities to scale innovative recycling, reuse, and sustainable material solutions.

First Indigenous Hydrogen Fuel Cell Passenger Vessel on Ganga

India's first fully indigenous hydrogen fuel cell passenger vessel began commercial service in Varanasi, offering zero-emission, eco-friendly transport with a 50-passenger capacity. Built by Cochin Shipyard and operated by IWAI, the vessel supports India's net-zero 2070 goals while advancing sustainable inland waterway transport.

Catalysts for Efficient Clean Hydrogen Production Developed

Researchers at CeNS, Bengaluru, developed a novel argon plasma treatment to activate Ni- and Co-based coordination polymers (COPs), creating coordinatively unsaturated metal sites (CUMSs) for water-splitting. This method significantly boosts electrocatalytic performance for the oxygen evolution reaction while preserving the polymer's bulk structure, paving the way for cost-effective, sustainable hydrogen production.

Breakthrough CRISPR Tool to Track Gene Editing in Real Time

Scientists at the Bose Institute have developed GlowCas9, a bioluminescent CRISPR protein that lights up while editing DNA, enabling real-time tracking of gene therapy in living cells and tissues. This thermostable innovation enhances precision in correcting hereditary mutations and opens new possibilities for safe, non-destructive gene therapy and crop improvement.

India Launches CCUS R&D Roadmap to Achieve Net-Zero Emissions by 2070

The Department of Science & Technology unveiled India's first R&D Roadmap for Carbon Capture, Utilization, and Storage (CCUS) to reduce emissions in sectors like power, steel, and cement. It promotes both commercial-ready technologies and breakthrough innovations. The roadmap also emphasizes workforce development, regulations, and shared infrastructure to support India's Net-Zero 2070 goals.

ADVANCES IN S&T

NUS Develops Microneedle Technology for Precision Biofertiliser Delivery

The Problem: Conventional fertiliser and biofertiliser application through soil is inefficient, leading to nutrient loss, uneven uptake, and environmental impact. Beneficial microbes often fail to reach plant tissues effectively due to soil variability and competition.

The Method: Researchers at the National University of Singapore developed dissolving microneedle patches that deliver living biofertilisers directly into plant tissue. Made from biodegradable materials, the microneedles release microbes rapidly, improving nutrient absorption and plant growth while using less fertilizer.

Future Prospects: The technology could enable precision agriculture, especially in urban, vertical, and high-value farming systems. Future work includes scaling the method, testing across more crops, and integrating it with automated and robotic farming platforms to support sustainable food production.

Graphene Membranes Offer Efficient, Low-Cost Option for Industrial CO_2 Capture

The Problem: Industrial plants such as natural-gas, coal, and cement facilities emit large amounts of CO_2. Existing carbon capture systems use solvent-based absorption, which are energy-intensive, require major infrastructure, and are expensive — especially problematic for dilute CO_2 levels in natural-gas flue gas.

The Method: Researchers at the École Polytechnique Fédérale de Lausanne (*EPFL*) studied pyridinic-graphene membranes, which are single-layer graphene sheets with engineered nanopores that preferentially allow CO_2 to pass while blocking other gases. The team combined experimental performance data
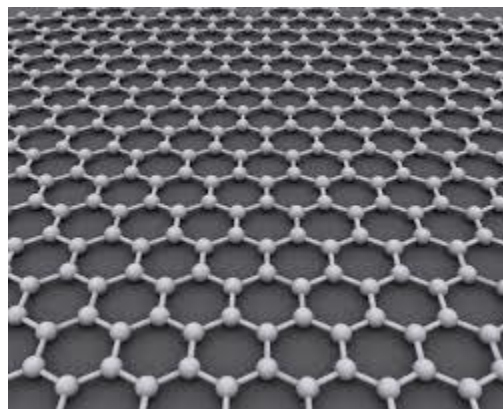
with realistic industrial modeling to evaluate energy use, selectivity, permeance, and cost scenarios for different plant types.

Future Prospects: The modeling suggests that graphene membranes could cut carbon capture costs to roughly USD 25–100 per ton while reducing energy use and equipment footprint compared with solvent systems. The approach looks promising for wide deployment if scale-up and selectivity, especially for difficult flue streams like cement continue to improve. Beyond CO_2 capture, this membrane technology could also advance hydrogen purification and oxygen production in industrial separations.

INSIGHTS & RESOURCES

EU Scientific Advice: AI in Emergency and Crisis Management

EU Scientific Advice Mechanism (SAM) released a report on artificial intelligence (AI) for crisis management, emphasizing its potential to enhance early warning, situational awareness, and decision-making, while stressing ethical oversight and human control. Key highlights include:

- AI excels at data-intensive monitoring, e.g., floods, wildfires, droughts, and damage assessment via social media.
- Human oversight is essential; AI should not make morally complex or novel decisions.
- Ethical deployment requires transparency, responsibility, and adherence to EU safety standards.
- Use of benchmarks, codes of conduct, and sandbox environments is recommended for safe AI testing.
- A EU-wide crisis management data framework is proposed to harmonize data sharing.
- AI can improve predictive modeling for disease spread, resource needs, and disaster impact.
- Integration of heterogeneous data sources (satellite imagery, IoT sensors, social media) enhances real-time situational awareness.
  Emphasis on robust validation and testing of AI models before deployment.
- Calls for cross-border collaboration to ensure interoperable AI tools across EU states.
- Capacity building, training, and public communication are crucial to maximize AI effectiveness and trust during crises.