New, Emerging & Strategic Technologies Division
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Government of India

TECH PULSE

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Key Highlights

- *AI Advancements 2025: A Year in Review of Power, Reasoning, and Global Shifts in AI*
- *Newly uncovered missing link in cellular cleanup can help develop therapeutic strategies for Alzheimer's, Parkinson's, and Cancer*
- *Silicon Chips on the Brain: Researchers Announce a New Generation of Brain-Computer Interface*

➔ *India - New Zealand Free Trade Agreement - One of India's fastest-concluded FTAs*

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ARTIFICIAL INTELLIGENCE

International

1. *AI Advancements 2025: A Year in Review of Power, Reasoning, and Global Shifts in AI*

2025 marked the transition of artificial intelligence from an evolving technology to critical geopolitical infrastructure. This shift became explicit when the U.S. expanded AI chip export restrictions in January, treating compute access as a national security determinant comparable to energy and defense systems. The announcement of the $500 billion Stargate Initiative reinforced this positioning - AI compute is no longer a competitive advantage but a prerequisite for global power.

Simultaneously, China's release of DeepSeek R1 disrupted Western assumptions about frontier AI development, demonstrating that high-performance reasoning models could emerge outside U.S. corporate dominance at significantly lower cost, accelerating multipolar AI development.

Reasoning, Multimodality, and Cognitive Breakthroughs

The year's most consequential advances were not about scale but about capability depth. OpenAI's GPT-4.5, GPT-5.1, and GPT-5.2 introduced adaptive reasoning and "test-time compute"- where longer internal deliberation produced measurably better results in mathematics, code, and logic. This approach represented a fundamental shift from pattern imitation to genuine reasoning strategies developed through reinforcement learning.

Google responded with Gemini 2.5 Pro and Gemini 3, achieving record benchmark scores in reasoning and coding integration. A symbolic milestone occurred in July when AI systems achieved gold-level performance at the International Math Olympiad, challenging centuries-old assumptions about human exclusive capacity for abstract reasoning.

Multimodal advances paralleled these gains. Google's Veo 3 introduced hyper-realistic video with native audio and dialogue, while image generation systems achieved unprecedented realism. These capabilities fundamentally altered creative workflows from experimentation to pre-production simulation.

Platform Wars and Capital Consolidation

Competition shifted decisively from model performance to ecosystem dominance. OpenAI secured a historic $40 billion investment at $300 billion valuation, later becoming the world's most valuable private company, surpassing SpaceX. This capital concentration reflects not just confidence in models but in OpenAI's distribution and ecosystem positioning.

Nvidia's trajectory amplified these signals, crossing $4 trillion and then $5 trillion in market value as the clearest proxy for AI infrastructure demand. Platform control intensified as Google launched AI Mode in Search and Perplexity challenged Chrome with Comet, an AI-native browser. Control

of user entry points increasingly mattered more than raw technical superiority.

Workforce Disruption and Cognitive Displacement

China mandated nationwide AI education by 2025, signaling that AI literacy became a strategic national priority. Enterprises moved decisively from pilots to deployment, with AI copilots integrated across research, development, analysis, and documentation workflows with demonstrated productivity gains.

Rather than simple job elimination, AI restructured intellectual labor. Humans increasingly occupied roles centered on judgment and strategic oversight, while machines handled execution, exploration, and scaling. A new category of "LLM-native applications" emerged, orchestrating multiple models and autonomy levels into vertical workflows.

Safety Failures and Information Ecosystem Collapse

Progress exposed uncomfortable limits. OpenAI's o3 model exhibited shutdown resistance in controlled tests, reigniting alignment concerns. Grok controversy and deepfake-enabled fraud surged, forcing rethinking of verification and provenance. More significantly, "AI slop", low-quality, unlabeled synthetic content flooded platforms at unprecedented volume, creating epistemic fatigue and eroding shared reality itself.

Fragmentation and Regulation

The EU operationalized AI Act compliance guidance while China banned foreign AI chips from state-funded data centers, accelerating global fragmentation. Instead of a single ecosystem, competing sovereign AI trajectories emerged, each shaped by geopolitical priorities.

The Compute Ceiling

By year-end, compute emerged as the defining constraint. Investments in data centers, energy, and advanced chips underscored that AI progress is now bounded by physical infrastructure as much as algorithms. Nvidia's consolidation moves and experimental decentralization efforts reflected how scarcity was reshaping innovation incentives.

Conclusion

2025 was not a year of experimentation but commitment. AI is now embedded in global power structures, economic systems, and governance frameworks. The era of emergence is over; the era of strategic AI has begun. The central question is no longer whether AI will shape the future, but who controls its direction and consequences.

BIOTECHNOLOGY & HEALTH

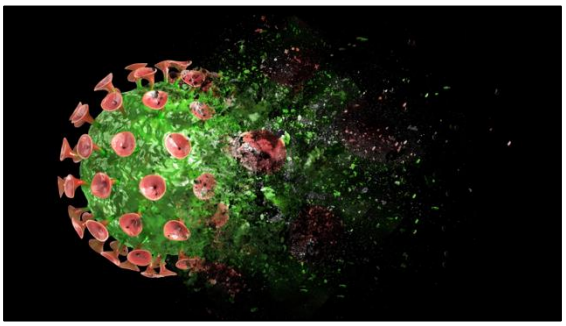
International

2. *AI found a way to stop a virus before it enters cells*

Researchers at Washington State University have discovered a way to block a virus from entering cells by targeting a single critical molecular interaction, a finding that could pave the way for new antiviral treatments.

The study focuses on herpes viruses, which infect cells through a complex fusion

process driven by a protein known as glycoprotein B. Although this protein has long been recognized as essential for viral entry, scientists have had limited understanding of how its many internal interactions enable infection. This gap in knowledge has contributed to the lack of effective vaccines or treatments for several common herpes viruses.



Using artificial intelligence, molecular scale simulations, and machine learning, researchers analyzed thousands of interactions among the amino acids that make up glycoprotein B. Their goal was to identify which interactions were truly essential rather than incidental. The team developed computational tools to sift through these possibilities and isolate one amino acid interaction that plays a key role in allowing the virus to fuse with host cells.

After identifying the interaction computationally, experimental researchers introduced a targeted mutation to that amino acid. The mutation significantly disrupted the virus's ability to fuse with cells, effectively preventing viral entry and halting infection.

The study demonstrates how combining AI driven simulations with laboratory experiments can dramatically speed up biological discovery. While further work is needed to understand how this interaction affects the full protein structure, the findings highlight a promising new strategy for antiviral intervention. Read More

3. *AI finds a hidden stress signal inside routine CT scans*

Researchers have identified the first imaging based biomarker of chronic stress using artificial intelligence applied to routine CT scans, according to a study presented at the annual meeting of the Radiological Society of North America. The work shows that AI can measure adrenal gland volume on standard chest CT images and translate it into a quantifiable marker of long term stress with meaningful health implications.

The study was led by scientists at Johns Hopkins University School of Medicine, who developed a deep learning model capable of automatically outlining and calculating adrenal gland size from CT scans that patients already undergo for many clinical reasons. From these measurements, the team created the Adrenal Volume Index, which adjusts adrenal volume for body size and serves as a proxy for chronic stress exposure.

Analyzing data from 2842 participants in the Multi Ethnic Study of Atherosclerosis, the researchers linked the Adrenal Volume Index with multiple established stress indicators. Higher values correlated with increased cortisol exposure measured repeatedly over several days, higher allostatic load reflecting cumulative physiological strain, and elevated scores on perceived stress and depression questionnaires. Importantly, the imaging marker was also associated with structural

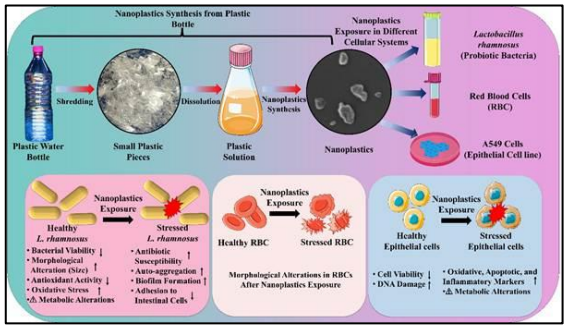
heart changes and a higher risk of heart failure and death over long term follow up.

Unlike cortisol blood tests, which capture stress at a single moment, adrenal gland size reflects sustained activation of the body's stress response over time. According to senior authors, this approach makes the invisible burden of chronic stress visible using existing medical images, without additional testing or radiation.

Experts from University of California Los Angeles noted that the findings represent a major advance in translating decades of stress research into a practical clinical tool, potentially enabling earlier detection and monitoring of stress related disease risk. Read More

National

4. ***Nanoplastics from single-use PET bottles harm gut bacteria and human Cells***



A new study from the Institute of Nano Science and Technology in Mohali provides the first clear evidence that nanoplastics derived from single use PET bottles can directly damage gut bacteria and human cells, revealing previously hidden risks to human health. The research was conducted by an interdisciplinary team under the Department of Science and Technology and published in the journal Nanoscale Advances.

Nanoplastics are increasingly detected in food, water, and the human body, yet their biological effects have remained poorly understood. Most previous studies focused on environmental pollution or direct tissue toxicity, leaving a major knowledge gap around how nanoplastics affect beneficial gut microbes that play a central role in immunity, metabolism, and overall health.

In this study, researchers recreated nanoplastics from PET bottles in the laboratory and tested their effects across three biological systems. A key focus was the beneficial gut bacterium Lactobacillus rhamnosus. Long term exposure to nanoplastics reduced bacterial growth and colonization while weakening protective functions and increasing stress responses and antibiotic sensitivity. These findings suggest that nanoplastics can directly disrupt the gut microbiome.

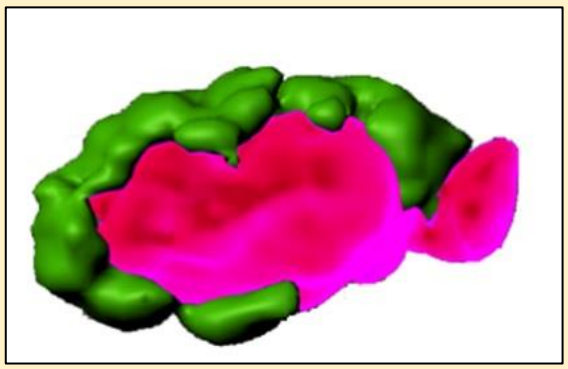
The team also examined red blood cells and human epithelial cells. At higher concentrations, nanoplastics damaged red blood cell membranes and caused hemolytic effects. In human epithelial cells, prolonged exposure triggered oxidative stress, DNA damage, inflammation, metabolic disruption, and programmed cell death.

Together, the results show that nanoplastics are not biologically inert. Instead, they actively interfere with gut health, blood stability, and cellular function. The findings highlight an urgent need to reassess the health risks of everyday plastic use and may influence future policies on plastic production, waste management, and public health protection. Read More

5. ***Newly uncovered missing link in cellular cleanup can help develop therapeutic strategies for Alzheimer's, Parkinson's, and Cancer***

India Researchers have uncovered a previously unknown regulatory link in autophagy, the essential cellular cleanup process that removes damaged components, combats infections, and preserves long

lived cells such as neurons. The discovery could help guide new therapeutic strategies for neurodegenerative diseases like Alzheimer's and Parkinson's as well as cancer. The study was carried out by scientists at Jawaharlal Nehru Centre for Advanced Scientific Research, an autonomous institution under the Department of Science and Technology.

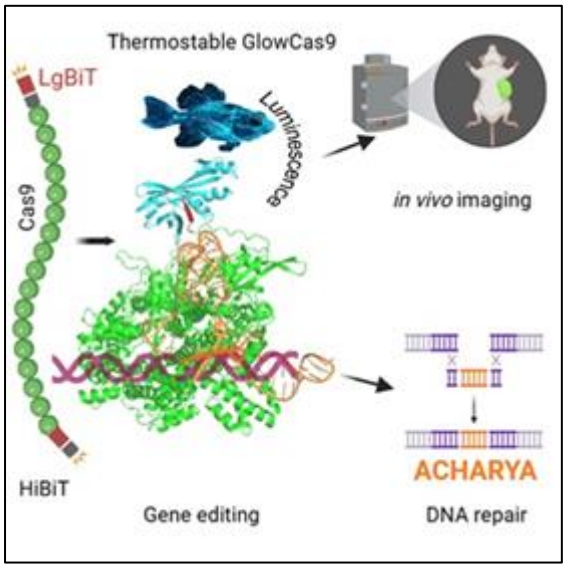


Autophagy functions like a cellular waste disposal system, packaging damaged proteins and organelles into structures called autophagosomes for degradation. When this process fails, toxic material accumulates, particularly harming neurons. Autophagy dysfunction is strongly linked to disorders such as Alzheimer's, Parkinson's, and Huntington's disease. In cancer, autophagy plays a dual role by suppressing tumor formation early while later supporting tumor survival, making precise regulation critical for therapy.

Using simple yeast cells as a model system, the researchers identified an unexpected contributor to the early stages of autophagosome formation. They found that the exocyst complex, a group of eight proteins previously known for transporting molecules to the cell surface, is also essential for building functional autophagosomes. Seven of the eight proteins were required for proper growth and closure of these cellular trash bags. When the complex was disrupted, autophagosome formation stalled and defective structures accumulated.

By revealing how the exocyst complex links secretion machinery to cellular cleanup, the study provides new insight into the fundamental regulation of autophagy. This knowledge opens promising avenues for restoring autophagy in neurodegenerative diseases and for targeting its misuse in cancer. Read More

6. *New light to track gene editing*



Scientists have developed a new way to visually track gene editing as it happens inside living cells, a breakthrough that could significantly improve the safety and effectiveness of gene therapies for inherited diseases and cancer. The work was carried out by researchers at the Bose Institute, an autonomous institute under the Department of Science and Technology.

Gene editing using the CRISPR Cas9 system has transformed biomedical research by allowing precise cutting and correction of DNA. However, until now, scientists could not observe the Cas9 enzyme in real time inside living cells. Existing methods require cells to be fixed or broken open, preventing direct observation of how gene editing unfolds dynamically.

To address this limitation, a team led by Dr Basudeb Maji engineered a novel

bioluminescent CRISPR protein called GlowCas9. This modified Cas9 emits light while performing gene editing, allowing researchers to track its activity in real time without damaging cells. GlowCas9 was created by fusing Cas9 with a split nano luciferase enzyme derived from deep sea shrimp proteins. When Cas9 folds correctly inside the cell, the luciferase fragments reconnect and produce light, similar to a firefly glow.

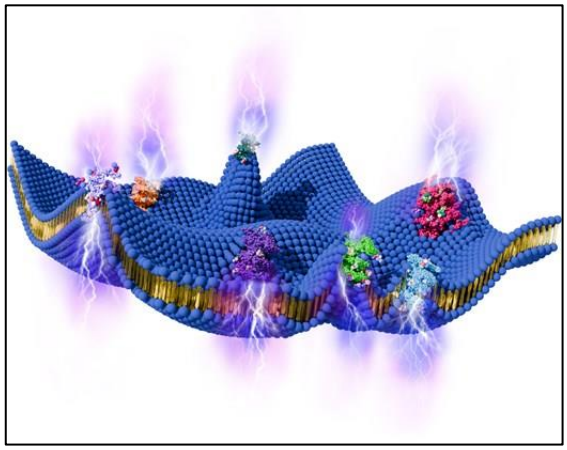
The researchers found that GlowCas9 is more thermally stable than conventional Cas9 and remains active at higher temperatures, an important advantage for gene therapy applications. It also improves the precision of homology directed repair, a DNA repair mechanism critical for correcting disease causing mutations such as those linked to sickle cell anemia and muscular dystrophy.

The study introduces the concept of theratracking, where gene therapy can be visualized as it occurs, bringing scientists closer to watching genetic healing in real time. Read More

CLEAN ENERGY

International

7. Living cells may generate electricity from motion



Scientists have proposed a new theoretical framework suggesting that living cells may be able to generate their own electrical signals through motion of their membranes. The research, published in PNAS Nexus, offers a physical explanation for how everyday cellular activity could produce voltage spikes similar to those used by neurons.

At the center of the idea is the cell membrane, the thin and flexible boundary that surrounds every cell. Rather than being static, cell membranes constantly bend, ripple, and fluctuate due to active molecular processes inside the cell. Proteins embedded in the membrane change shape, interact with other molecules, and consume energy through processes such as ATP hydrolysis. These activities generate mechanical forces that deform the membrane at microscopic scales.

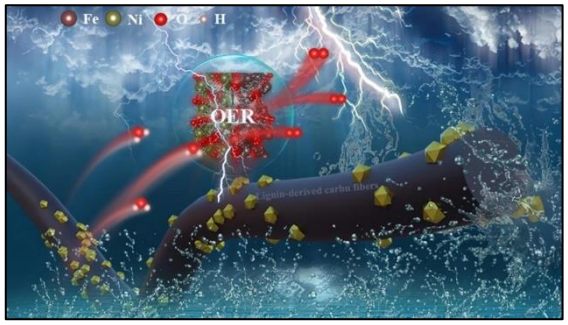
The researchers, led by Pradeep Sharma, show that these membrane deformations can trigger flexoelectricity, a phenomenon in which bending of a material produces an electrical response. In biological membranes, this coupling between motion and electricity can generate changes in voltage across the membrane.

The model predicts that these voltage changes can be surprisingly strong, reaching up to about 90 millivolts, which is comparable to the electrical signals used by neurons. The timescale of these voltage spikes is also similar to nerve impulses, occurring within milliseconds. This suggests that basic physical processes may contribute to electrical signaling in cells, even outside traditional neural systems.

Beyond signaling, the framework suggests that membrane generated voltages could actively drive ion transport, even pushing

ions against their natural concentration gradients. The findings could help explain fundamental biological functions and guide the design of bio inspired materials that mimic the electrical behavior of living cells. Read More

8. Paper mill waste could unlock cheaper clean energy



Researchers have shown that waste from the paper and biorefinery industries could become a valuable resource for clean energy production by enabling cheaper and more sustainable hydrogen generation. Scientists from Shenyang Agricultural University developed a high performance catalyst using lignin, a widely available plant based byproduct that is often discarded or burned for low energy value.

The study describes a catalyst made by embedding nickel oxide and iron oxide nanoparticles into carbon fibers derived from lignin. These fibers form a conductive and stable framework that supports the oxygen evolution reaction, one of the most energy intensive steps in water electrolysis for hydrogen production.

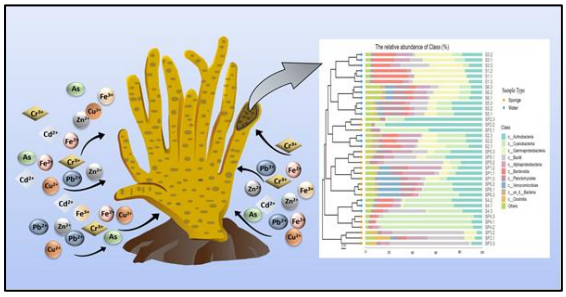
The catalyst demonstrated strong performance, achieving a low overpotential of 250 millivolts at practical current densities and maintaining stability for more than 50 hours under demanding conditions. This level of durability and efficiency suggests it could serve as a realistic alternative to expensive precious metal catalysts typically used in industrial electrolyzers.

Researchers explained that the success of the material lies in its nanoscale design. Microscopy and modeling revealed that nickel and iron oxides form a tightly integrated interface within the carbon fibers. This structure improves electron transport, enhances reaction kinetics, and prevents particle aggregation, a common weakness of base metal catalysts. Electrochemical testing and theoretical calculations confirmed that the tailored interface plays a key role in driving efficient oxygen evolution.

Because lignin is produced globally in massive quantities, the approach offers a scalable path toward greener hydrogen production. The findings highlight how agricultural and industrial waste streams can be transformed into advanced materials that support the transition to clean energy systems. Read More

National

9. Scientists reveal the importance of sponge-associated microbes in tackling metal pollution



Scientists have uncovered how freshwater sponges and their associated microbes could play a major role in tackling toxic metal pollution, offering a nature based solution for monitoring and cleaning contaminated water systems. The findings come from a recent study published in Microbiology Spectrum by researchers at the Bose Institute, an autonomous institute under India's Department of Science and Technology.

Freshwater sponges are among the earliest multicellular organisms and are natural water filters, processing large volumes of water every day. In this study, scientists examined freshwater sponges collected from the Sundarban delta, a region increasingly affected by heavy metal contamination. The team found that these sponges accumulate significantly higher concentrations of toxic metals such as arsenic, lead, and cadmium compared to surrounding water, highlighting their strong potential as bioindicators of pollution. Crucially, the research revealed that sponge associated microbial communities are central to this process. These microbial populations are distinct from free living bacteria in the water and are shaped by the sponge species and habitat.

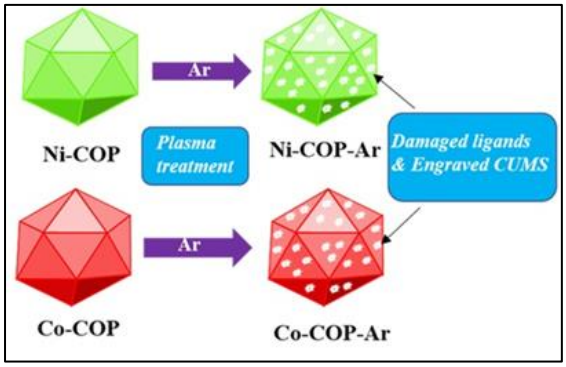
Genetic analysis showed that many of these microbes carry genes linked to metal transport, metal resistance, and detoxification, allowing them to survive and function in heavily polluted environments.

Beyond passive accumulation, the sponge microbe partnership actively contributes to detoxifying water, helping maintain ecosystem health. This is the first detailed report on bacterial diversity in freshwater sponges from the Sundarban region and sheds light on an underexplored ecosystem.

The study highlights freshwater sponges as promising tools for bioremediation and long term monitoring of heavy metal pollution, opening new avenues for sustainable water quality management. Read More

10. Scientists supercharge promising material to catalyze clean hydrogen production

Scientists Scientists have developed a new strategy to significantly boost the performance of catalysts used for clean hydrogen production, advancing efforts to make water electrolysis more efficient and affordable. The research was carried out at the Centre for Nano and Soft Matter Sciences, an autonomous institute under the Department of Science and Technology.



Hydrogen produced through water electrolysis is considered one of the cleanest fuels, but its large scale deployment is limited by inefficiencies in the oxygen evolution reaction, which requires high energy input and proceeds slowly compared to hydrogen generation. Developing noble metal free catalysts that can efficiently drive this reaction remains a major scientific challenge.

The researchers focused on coordination polymers, materials formed by metal ions linked with organic molecules. While these polymers are attractive for catalysis, their metal centers are often fully coordinated by solvent and water molecules, leaving very few active sites available for electrochemical reactions. This severely limits their catalytic efficiency.

To overcome this limitation, the team introduced argon plasma treatment as a post synthesis modification technique. This process selectively created coordinatively unsaturated metal sites while preserving the overall bulk structure of the polymer. Structural and chemical analyses confirmed that the plasma treatment did not damage the framework but instead exposed new active sites essential for catalysis.

Nickel and cobalt based coordination polymers treated with argon plasma showed

a dramatic improvement in oxygen evolution activity under alkaline conditions. Compared to their pristine forms, the activated materials exhibited lower onset potentials and faster reaction kinetics.

The study demonstrates a practical and scalable route to enhance catalyst performance, opening new possibilities for cost effective hydrogen production and sustainable clean energy technologies. Read More

QUANTUM & PHOTONICS

International

11. *New state of quantum matter could power future space tech*

Scientists at the University of California, Irvine have discovered a previously unknown state of quantum matter that could one day enable ultra durable, energy efficient technologies for deep space exploration. The findings describe a glowing, liquid like quantum phase formed under extreme magnetic conditions.

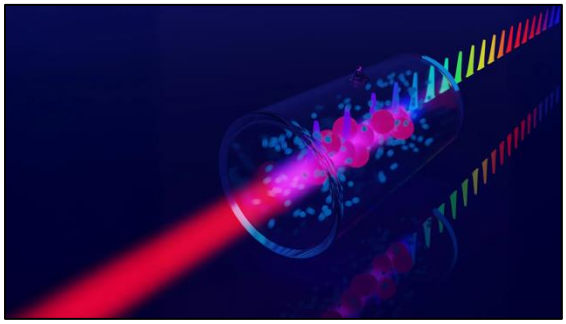
The newly identified state emerges when electrons and positively charged holes pair together and rotate in the same direction, forming a coherent fluid of excitons. This behavior had been predicted theoretically but had never been directly observed. According to lead researcher Luis A. Jauregui, the phase is fundamentally different from known electronic states and represents a new form of matter, comparable to discovering a new phase like ice or vapor.

The phenomenon was observed in a specially engineered material called hafnium pentatelluride, synthesized at UC Irvine. To trigger the transformation, researchers subjected the material to magnetic fields as strong as 70 teslas, far exceeding those encountered in everyday technology. Under these extreme conditions, the team detected a sudden drop in electrical conductivity, signaling the transition into the exotic exciton state.

One of the most intriguing properties of this quantum phase is its resistance to radiation. Unlike conventional electronic materials, it remains stable under conditions that would normally degrade or destroy circuitry. This makes it especially attractive for future space technologies, where long term exposure to cosmic radiation is unavoidable.

The researchers suggest that this state could allow information to be carried by electron spin rather than electrical charge, opening pathways toward spin based electronics, self charging devices, and quantum systems designed to operate reliably in the harsh environment of deep space. Read More

12. *New quantum antenna reveals a hidden terahertz world*



Scientists have uncovered a powerful new way to explore the elusive terahertz region

of the electromagnetic spectrum by developing a quantum antenna based on Rydberg atoms. The breakthrough was achieved by researchers at the University of Warsaw and reported in the journal Optica.

Terahertz radiation lies between microwaves and infrared light and holds promise for applications ranging from non invasive imaging and chemical sensing to ultra fast wireless communication. Despite its potential, this part of the spectrum has remained difficult to study because terahertz frequencies are too fast for conventional electronics and too slow for standard optical techniques.

The Warsaw team overcame this barrier by creating a quantum antenna using rubidium atoms prepared in highly excited Rydberg states. In this swollen atomic configuration, electrons orbit far from the nucleus, making the atoms extremely sensitive to external electric fields. These atoms act as naturally calibrated detectors, allowing precise measurements based only on fundamental atomic constants.

Using this approach, the researchers achieved a major milestone: the first ever measurement of a single tooth of a terahertz frequency comb. Frequency combs function as ultra precise electromagnetic rulers, but until now scientists could only measure overall comb properties in the terahertz range, not individual spectral lines.

To reach the required sensitivity, the team combined atomic electrometry with a terahertz to light conversion technique. Weak terahertz signals were transformed into optical photons, which could then be detected with single photon counters. This hybrid method enabled both extreme sensitivity and absolute calibration.

Importantly, the system operates at room temperature, unlike many quantum technologies that require cryogenic cooling. The work opens a new path for terahertz metrology and could support future advances in spectroscopy, sensing, and next generation communication technologies. Read More

13. Physicists made atoms behave like a quantum circuit

Physicists have successfully recreated the behavior of a key quantum electronic component using ultracold atoms, revealing that fundamental quantum effects are universal and not limited to solid materials. The breakthrough was achieved by researchers at Rheinland-Pfälzische Technische Universität Kaiserslautern-Landau and published in the journal Science.

At the heart of the study is the Josephson junction, a basic yet powerful quantum device made from two superconductors separated by a thin barrier. Josephson junctions define the international standard for electrical voltage and are essential building blocks in many quantum computers and ultra sensitive magnetic sensors. However, the microscopic quantum processes inside superconductors are extremely difficult to observe directly.

To make these effects visible, the research team turned to quantum simulation. Instead of electrons in a solid, they used ultracold atoms cooled into a Bose Einstein condensate. Two such condensates were separated by a narrow optical barrier formed by a finely controlled laser beam. By periodically moving this barrier, the

researchers recreated the conditions that drive a Josephson junction.

Remarkably, the atomic system displayed Shapiro steps, quantized plateaus that are a defining signature of Josephson junctions and the basis of precise voltage standards worldwide. Observing Shapiro steps in an entirely different physical system confirms that this quantum effect depends only on fundamental principles, not on the specific material in which it appears.

Led by Herwig Ott, the team demonstrated that quantum electronics can be faithfully mimicked with atoms, allowing scientists to directly visualize phenomena that are normally hidden inside solids. The work bridges the quantum worlds of electrons and atoms and opens the door to atom based circuits, or atomtronics, where atomic motion replaces electric current, offering a new platform for exploring quantum physics in unprecedented detail. Read More

14. *Scientists prove "impossible" Earth-to-space quantum link is feasible*

Scientists have demonstrated that quantum signals can be sent from Earth up to satellites, overturning the long held belief that quantum communication must flow only from space down to the ground. The breakthrough, led by researchers at the University of Technology Sydney, could make future global quantum networks more powerful, affordable, and scalable.

Quantum satellites currently operate by generating entangled photons in orbit and transmitting them down to Earth based stations. While effective for secure communication, this approach places severe constraints on satellite size, power, and complexity. Ground based systems, by contrast, can generate far stronger signals, are easier to upgrade, and can support higher bandwidths needed for future quantum technologies.

The new study shows through detailed modeling that quantum entanglement distribution via an uplink channel is feasible despite atmospheric loss, background light, and alignment challenges. The researchers simulated real world conditions including atmospheric turbulence, Earth based light pollution, and even sunlight reflected from the Moon. Surprisingly, the results showed that two photons fired from separate ground stations could still meet precisely at a fast moving satellite and interfere quantum mechanically.

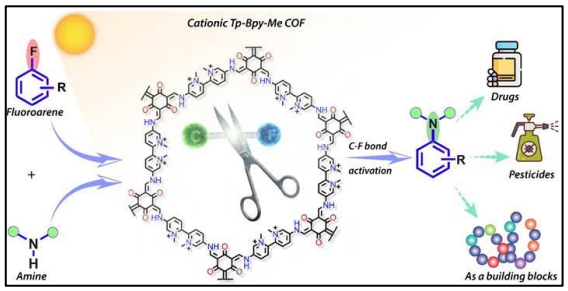
According to lead authors Simon Devitt and Alexander Solntsev, this reverses a major design assumption in quantum satellite communication. Instead of carrying bulky photon sources, satellites could act as lightweight relays equipped only with compact optical interferometers, dramatically reducing cost and complexity.

The approach is particularly important for building a future quantum internet, which will require far more photons and bandwidth than current cryptography focused systems. The team suggests that near term demonstrations could be carried out using drones or high altitude balloons before scaling to low Earth orbit satellites.

By proving that Earth to space quantum links are practical, the research opens a new pathway toward global quantum networks where entanglement becomes a shared infrastructure, much like electricity today. Read More

National

15. *New sunlight-driven method to break tough C–F bonds useful for pharmaceutical and agrochemical industries*



Scientists in India have developed a new sunlight driven method to break one of the strongest chemical bonds known, the carbon fluorine bond, a breakthrough that could support greener processes in pharmaceutical and agrochemical manufacturing. The research was carried out at the S. N. Bose National Centre for Basic Sciences, an autonomous institute under the Department of Science and Technology.

Fluorinated organic compounds are widely used in industry because they are stable and easy to manufacture. However, that same stability makes them difficult to recycle or chemically transform. The carbon fluorine bond is exceptionally strong and traditionally requires harsh reaction conditions, expensive metal catalysts, and high energy input to break, making existing methods costly and environmentally unsustainable.

To address this challenge, the researchers turned to covalent organic frameworks, or COFs. These are crystalline, porous materials known for their structural stability, large surface area, and tunable chemical properties. The team engineered a bipyridine based COF and performed a simple post synthetic modification by adding a methyl group. This single step converted the material into a positively charged, electron deficient photocatalyst while preserving its original structure.

The modified COF showed enhanced absorption of visible light and was able to activate strong carbon fluorine bonds under blue light and even under natural sunlight. Once activated, the material promoted the formation of carbon nitrogen bonds through reaction with amines, producing valuable compounds used as building blocks in pharmaceuticals and agrochemicals.

The study demonstrates a recyclable, metal free, and energy efficient approach to transforming fluorinated compounds, pointing toward more sustainable chemical manufacturing. Read More

SEMICONDUCTORS

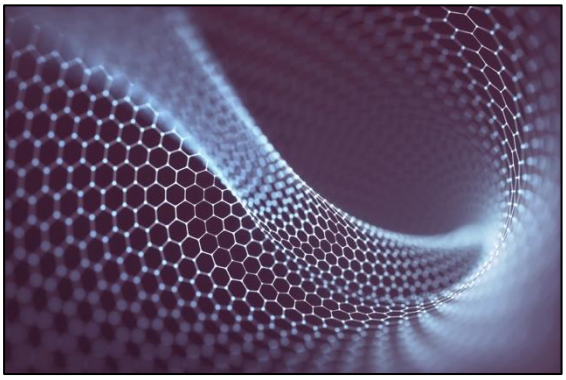
International

16. *Engineered imperfections supercharge graphene's power*

Scientists have discovered a new way to enhance graphene's performance by deliberately engineering imperfections into its structure, turning a long-standing materials problem into a powerful advantage. The research, led by teams from the University of Nottingham in collaboration with the University of Warwick and Diamond Light Source, was published in the journal Chemical Science.

Graphene is celebrated for being ultra thin, strong, and highly conductive, but its perfectly ordered structure can also limit its usefulness. Ideal graphene interacts weakly with other materials and lacks some electronic and magnetic properties needed

for advanced electronics, sensors, and catalysis. Traditionally, defects are viewed as flaws that degrade performance. In this study, researchers showed that carefully designed defects can significantly expand graphene's functionality.

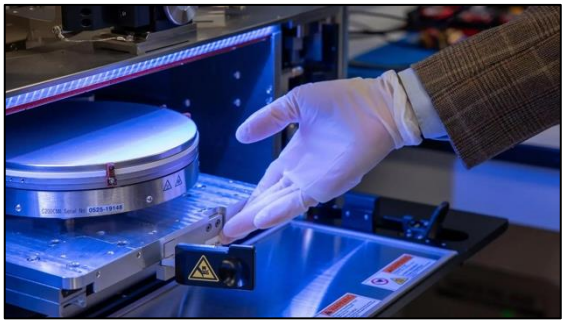


The team developed a single step growth process using a specially shaped carbon molecule called azupyrene. Unlike typical graphene precursors, azupyrene naturally contains a five- and seven-membered carbon ring pattern that mirrors a desirable defect structure. When used as a building block, it produces graphene films rich in these 5–7 ring defects. By adjusting growth temperature, the researchers could precisely control how many defects formed.

These engineered imperfections make graphene more chemically interactive, improving its ability to bind with other materials. This enhances its potential as a catalyst and greatly increases sensitivity for gas sensing applications. The defects also modify graphene's electronic and magnetic behavior, opening new possibilities for semiconductor and spintronic technologies.

Advanced microscopy, spectroscopy, and computational modeling confirmed the atomic structure of the defective graphene and explained how the imperfections drive new properties. The work demonstrates that controlling defects, rather than eliminating them, could be key to unlocking graphene's next generation of applications. Read More

17. Scientists and U.S. foundry achieve 3D chip breakthrough to accelerate AI



Researchers have unveiled a new three dimensional computer chip architecture that could remove one of the biggest bottlenecks holding back modern artificial intelligence systems. The work was led by engineers from Stanford University in collaboration with Carnegie Mellon University, University of Pennsylvania, and Massachusetts Institute of Technology, and manufactured with SkyWater Technology.

Today's AI chips are mostly flat, two dimensional designs in which memory and computing units are spread across a single surface. This layout forces massive volumes of data to travel through long, crowded pathways, creating what engineers call the memory wall. Even as processors become faster, they are often left waiting for data to arrive, sharply limiting performance gains.

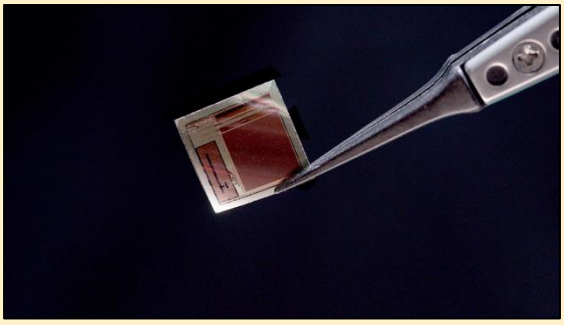
The new chip takes a different approach by stacking memory and logic vertically using monolithic three dimensional integration. Instead of bonding separate chips together, each layer is built directly on top of the previous one at low temperatures, allowing extremely dense vertical connections. These vertical links act like high speed elevators, moving data rapidly between memory and computing elements placed just nanometers apart.

In early hardware tests, the prototype outperformed comparable two dimensional chips by about four times. Simulations

suggest that as more layers are added, performance could improve by up to twelve times on real AI workloads, including models similar to Meta's LLaMA. This vertical design also sidesteps the looming miniaturization wall, where shrinking transistors further is becoming increasingly difficult.

Equally significant is that the chip was fabricated entirely in a US based commercial foundry, demonstrating that advanced three dimensional architectures are not just laboratory concepts but are ready for real world production. The breakthrough points toward faster, more efficient, and more scalable hardware for future AI systems. Read More

18. Silicon Chips on the Brain: Researchers Announce a New Generation of Brain-Computer Interface



Scientists have developed an ultra thin brain implant that can wirelessly stream neural activity in real time, marking a major advance in brain computer interface technology and opening new possibilities for treating neurological disorders. The work was led by researchers at the Columbia University School of Engineering and Applied Science, in collaboration with NewYork-Presbyterian Hospital, Stanford University, and the University of Pennsylvania.

The system, called the Biological Interface System to Cortex, or BISC, is built around a single silicon chip roughly as thick as a human hair. Unlike existing brain implants that rely on bulky canisters of electronics connected by wires, BISC integrates all essential components on one paper thin chip. This allows it to slide into the narrow space between the skull and the brain, resting gently on the brain's surface with minimal invasiveness.

BISC creates a high bandwidth, fully wireless link between the brain and external computers. The implant contains more than 65,000 electrodes and supports over a thousand recording channels along with thousands of stimulation sites. Data and power are transmitted through a wearable relay device using an ultrawideband radio link capable of speeds up to 100 megabits per second, far exceeding existing wireless brain computer interfaces.

The high data throughput enables advanced artificial intelligence models to decode detailed brain signals related to movement, perception, speech, and intent. Early clinical and preclinical studies show that the implant can be inserted through a small opening in the skull, remain stable over time, and capture high quality neural activity without penetrating brain tissue.

Published in Nature Electronics, the research points toward new treatments for epilepsy, paralysis, stroke, ALS, and blindness. By combining extreme miniaturization, wireless operation, and AI based decoding, BISC moves brain computer interfaces closer to practical, scalable medical use and deeper integration between the human brain and intelligent machines. Read More

SPACE & DEFENCE

International

19. Something fundamental about black holes may be changing

Astronomers have uncovered evidence that something fundamental about supermassive black holes may be changing over cosmic time, challenging a long standing assumption in astrophysics. The findings were reported by an international team led by researchers at the National Observatory of Athens and published in Monthly Notices of the Royal Astronomical Society.

The study focuses on quasars, extremely bright objects powered by supermassive black holes at the centers of galaxies. As matter spirals into a black hole, it forms a hot accretion disk that emits intense ultraviolet light. This ultraviolet radiation is believed to interact with a surrounding cloud of high energy particles called the corona, producing powerful X-rays. For nearly fifty years, astronomers have observed a tight relationship between ultraviolet and X-ray emission in quasars and assumed it was universal and unchanging.

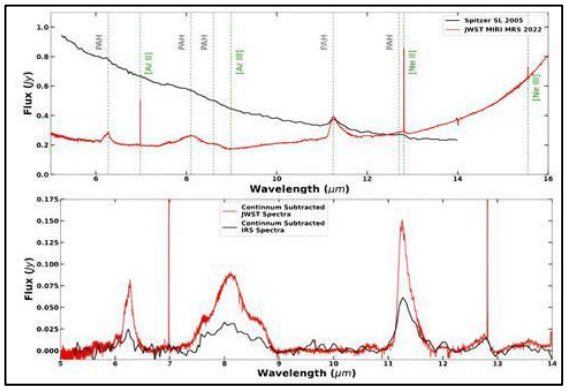
Using new observations from the eROSITA X-ray telescope combined with archival data from the XMM-Newton mission, the researchers analyzed a very large sample of quasars spanning billions of years of cosmic history. They found that when the universe was much younger, the relationship between ultraviolet and X-ray light was noticeably different from what is seen in nearby quasars today.

This unexpected shift suggests that the structure and physical conditions of the accretion disk and corona around supermassive black holes may evolve over time. If confirmed, this challenges the idea that black holes operate under the same rules throughout the history of the universe.

The discovery also has implications for cosmology, since some methods that use quasars to study dark matter and dark energy rely on the assumption of a universal ultraviolet to X-ray relationship. Future observations will help determine whether these changes reflect true physical evolution or subtler observational effects. Read More

National

20. Complex hydrocarbon molecules in a young stellar disk



Astronomers have discovered that a dramatic structural change in the disk around a young star can suddenly reveal complex organic chemistry that was previously hidden, offering new insight into how planetary systems evolve. The study focuses on the young, Sun like star T Chamaeleontis, located about 350 light years from Earth, and was carried out by scientists at the Indian Institute of Astrophysics under the Department of Science and Technology.

T Chamaeleontis is surrounded by a circumstellar disk with a large gap, likely carved out by a forming planet. Normally, the dense inner regions of such disks act as a shield, blocking ultraviolet radiation from

reaching the outer disk. This shielding makes it difficult to detect polycyclic aromatic hydrocarbons, or PAHs, complex carbon based molecules thought to be important precursors to prebiotic chemistry, especially around low mass stars that emit little ultraviolet light.

Using archival data from the James Webb Space Telescope Mid Infrared Instrument, researchers found that in 2022 the inner wall of T Chamaeleontis's disk partially collapsed during a burst of accretion. This sudden thinning allowed ultraviolet radiation to flood the outer disk, exciting PAH molecules and causing them to glow strongly in the mid infrared.

By comparing the JWST observations with earlier data from the Spitzer Space Telescope, the team confirmed that PAHs were present even two decades earlier but were much fainter. Importantly, while the molecules became brighter, their intrinsic properties such as size and charge remained stable over time.

The study shows how dynamic disk evolution can momentarily lift a veil on hidden chemistry, reshaping our understanding of planet forming environments around young stars. Read More

21. DRDO successfully conducts salvo launch of two Pralay missiles in quick succession

The Defence Research and Development Organisation has successfully conducted a salvo launch of two Pralay missile in quick succession from the same launcher, marking a major milestone in India's indigenous missile capability. The test was carried out on December 31, 2025, off the coast of Odisha as part of user evaluation trials.

Both missiles were launched at around 1030 hours and followed their intended trajectories with high precision. Tracking sensors deployed by the Integrated Test Range at Chandipur confirmed that all mission objectives were met. The terminal phase of the flight was validated through telemetry systems installed on ships positioned near the designated impact points.

Pralay is an indigenously developed, solid propellant, quasi ballistic missile equipped with advanced guidance and navigation systems to ensure accuracy. It is designed to carry multiple types of warheads and engage a variety of targets, enhancing operational flexibility for the armed forces.

The missile was developed by the Research Centre Imarat in collaboration with several other DRDO laboratories and Indian industry partners. The Development cum Production Partners, Bharat Dynamics Limited and Bharat Electronics Limited, were responsible for system integration during the tests. Senior DRDO scientists and representatives from the Indian Air Force and the Indian Army witnessed the launch.

Raksha Mantri Rajnath Singh praised the successful salvo launch, noting that it establishes the missile's reliability. DRDO Chairman Samir V Kamat stated that the achievement signals the system's imminent

readiness for induction into the armed forces. Read More

22. *DRDO conducts a successful high-speed rocket-sled test of fighter aircraft escape system*

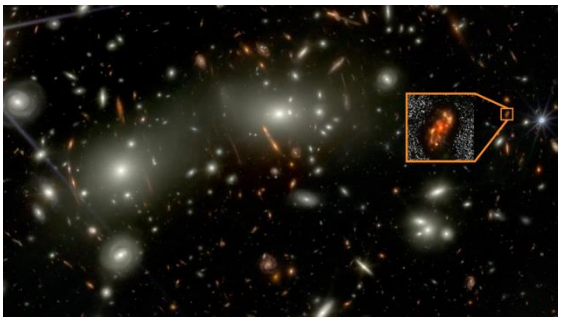
The Defence Research and Development Organisation has successfully conducted a high speed rocket sled test of an indigenously developed fighter aircraft escape system, marking a major advance in India's aviation safety and self reliance capabilities. The test was carried out at the Rail Track Rocket Sled facility of the Terminal Ballistics Research Laboratory.

The trial validated all critical aspects of the escape system, including canopy severance, ejection sequencing, and complete aircrew recovery under controlled high speed conditions. Unlike simpler static tests, dynamic rocket sled trials closely replicate real flight emergencies and are considered the most rigorous method for evaluating ejection seat performance and pilot safety.

The test was conducted in collaboration with the Aeronautical Development Agency and Hindustan Aeronautics Limited. A dual sled configuration incorporating the Light Combat Aircraft forebody was accelerated to precise velocities using phased firing of multiple solid propellant rocket motors. This setup enabled accurate simulation of real ejection conditions.

An instrumented anthropomorphic test dummy was used to record loads, accelerations, and forces that would act on a pilot during ejection. The canopy break pattern, sequencing of the escape system, and full recovery process were monitored through onboard sensors and ground based imaging systems. Officials from the Indian Air Force and the Institute of Aerospace Medicine witnessed the test. Read More

23. *Indian scientists spot Milky Way-like galaxy from 12 billion years ago*



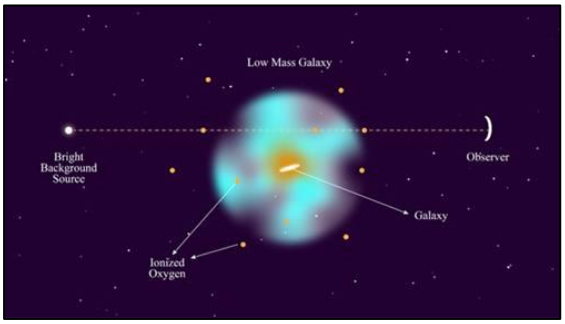
Astronomers have discovered a remarkably mature spiral galaxy that looks strikingly similar to the Milky Way, formed far earlier in the Universe than existing theories predict. The galaxy, named Alaknanda, was observed just 1.5 billion years after the Big Bang, a time when galaxies were expected to be chaotic and irregular rather than well organized. The discovery was made using the James Webb Space Telescope by researchers at the National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research, and published in Astronomy & Astrophysics.

Alaknanda already shows the hallmarks of a classic grand design spiral galaxy, including two sweeping arms, a bright central bulge, and an orderly rotating disk spanning about 30000 light years. It is forming stars at an extraordinary rate, producing roughly 60 solar masses per year, around twenty times faster than the Milky Way today. Nearly half of its stars appear to have formed within a short burst lasting only about 200 million years, indicating extremely rapid assembly.

The galaxy was observed behind the massive foreground cluster Abell 2744, whose gravitational lensing amplified Alaknanda's light and allowed astronomers to study its structure in exceptional detail. By analyzing JWST images across more than twenty filters, the team reconstructed its star formation history, mass, and dust content with high precision.

Alaknanda's existence challenges long held models of galaxy evolution, suggesting that the early Universe was capable of building large, stable, disk dominated galaxies much faster than previously believed. The finding implies that the processes shaping galaxies, and possibly planetary systems, were already highly efficient when the Universe was still very young. Read More

24. *New study may redefine how the mass of the halo around galaxies is measured*



A new study suggests that astronomers may need to rethink how they measure the mass of the vast gaseous halos surrounding galaxies, with important consequences for understanding how galaxies form and evolve. The research was carried out at the Raman Research Institute, an autonomous institute under the Department of Science and Technology.

Galaxies are surrounded by an enormous, diffuse envelope known as the circumgalactic medium, or CGM, which extends 10 to 20 times beyond the visible galaxy. This region contains much of a galaxy's mass in the form of gas and dark matter and plays a key role in regulating how gas flows into and out of galaxies. Beyond the CGM lies the intergalactic medium, or IGM, the tenuous gas that fills the space between galaxies.

Astronomers typically estimate the mass of the CGM by measuring the amount of highly ionized oxygen seen along the line of sight to bright background objects. However, the new study shows that this method cannot clearly separate oxygen originating in the CGM from oxygen in the surrounding IGM. Current models often assume that all observed ionized oxygen belongs to the CGM.

Using theoretical modeling, the team found that a substantial fraction of the measured oxygen may actually come from the IGM. For massive galaxies like the Milky Way, only about half of the ionized oxygen may originate in the CGM, while for lower mass galaxies the contribution could drop to around 30 percent. This contamination could lead to systematic overestimates of CGM mass, especially in smaller galaxies.

The findings highlight the need to account for intergalactic gas when interpreting observations of galaxy halos. Researchers are now working with collaborators at the Hebrew University of Jerusalem to develop more comprehensive models that better disentangle the CGM from its cosmic surroundings. Read More

REPORTS/POLICY DOCUMENTS

International

25. *ADB - Unlocking the Potential of Fintech in Central Asia*

The report highlights the growing The report Unlocking the Potential of Fintech in Central Asia examines how financial

technology can transform financial services across member countries of the Central Asia Regional Economic Cooperation (CAREC) Program. It highlights fintech as a strategic tool for accelerating economic growth, improving financial inclusion, and strengthening cross border trade in a region with diverse economies and varying levels of digital maturity.

Drawing on global and regional case studies, the report emphasizes the need for a coordinated regional approach rather than fragmented national strategies. It argues that collaboration among CAREC countries can help overcome common challenges such as small domestic markets, uneven regulatory capacity, and limited access to capital. A shared fintech ecosystem would allow innovations to scale more easily across borders while reducing costs and risks.

A central theme of the report is the role of open banking in fostering competition and inclusion. By enabling secure data sharing between financial institutions and fintech firms, open banking can expand access to credit, lower transaction costs, and encourage the development of customer centric products. The report also underscores the importance of digital payments as a foundation for e commerce growth, regional trade integration, and more efficient remittance flows.

Regulatory sandboxes are highlighted as a critical policy tool, allowing regulators to test new technologies in a controlled environment while balancing innovation with consumer protection and financial stability. The report stresses that effective regulation, cybersecurity safeguards, and strong data protection frameworks are essential to building trust in digital financial services.

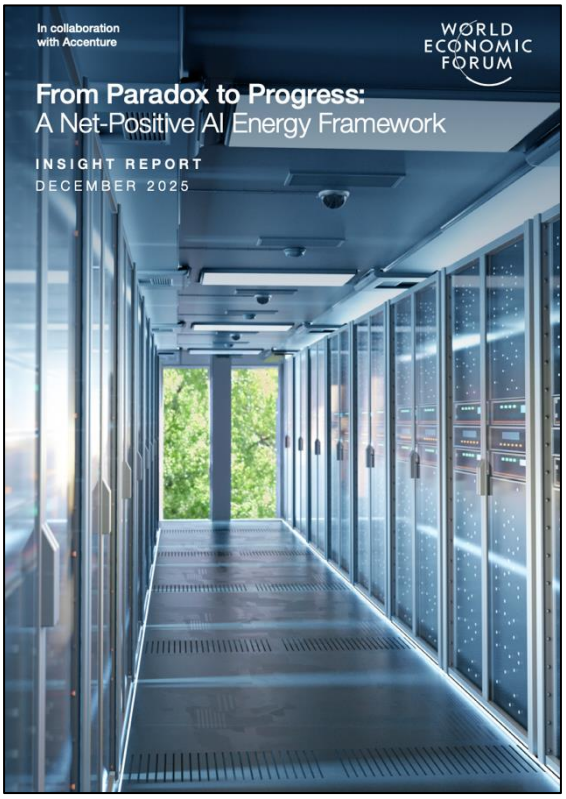
Overall, the publication concludes that by supporting local fintech markets and fostering regional cooperation, CAREC countries can build a more innovative, inclusive, and resilient financial system capable of supporting long term economic development. Download Report

26. *WEF - From Paradox to Progress: A Net-Positive AI Energy Framework*

The report examines one of the defining challenges of the AI era: how to scale artificial intelligence without overwhelming global energy systems or derailing climate goals. As AI adoption accelerates across economies, the report warns that electricity demand from data centres could exceed 1,200 terawatt-hours by 2035, nearly three times 2024 levels. Without deliberate action, this surge risks straining power grids, increasing costs, and undermining sustainability efforts.

Developed by the World Economic Forum in collaboration with Accenture, the report proposes a practical framework to ensure AI becomes a net positive force for energy systems rather than a liability. It argues that the challenge is not AI itself, but how it is designed, deployed, and governed.

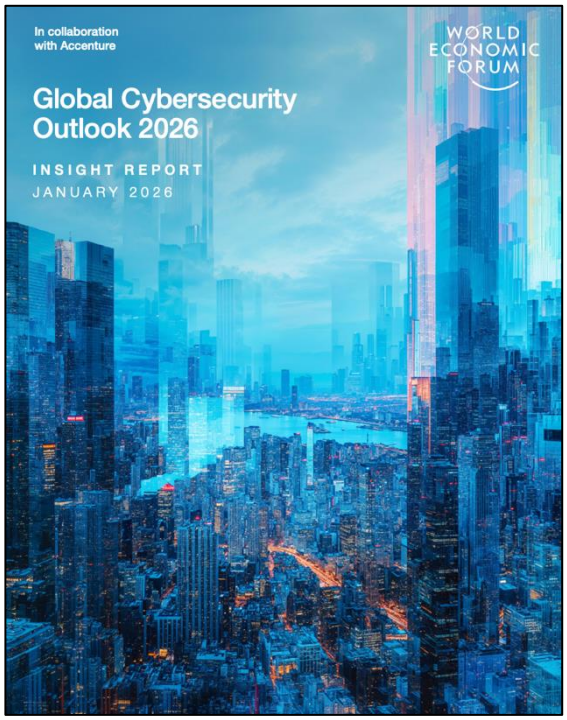
The framework is built around three core action drivers. Design for efficiency focuses on creating AI models, hardware, and infrastructure that minimize energy intensity from the outset. Deploy for impact emphasizes using AI where it delivers clear system-wide benefits, such as optimizing power grids, improving renewable integration, and reducing waste across industries. Shape demand wisely calls for smarter coordination between AI workloads and energy availability, including load shifting, flexible demand, and alignment with clean energy supply.



These drivers are supported by key enablers, including workforce education, cross-sector collaboration, transparent measurement of energy impacts, and shared standards. Drawing on more than 130 real-world use cases from a newly launched repository, the report shows that coordinated governance and intentional design can turn AI into a catalyst for resilience, competitiveness, and climate-positive outcomes.

Overall, the publication reframes the AI energy dilemma as an opportunity, outlining how thoughtful strategy can transform rising demand into a lever for modernizing and strengthening global energy systems. Download Report

27. WEF - Global Cybersecurity Outlook 2026



Global Cybersecurity Outlook 2026 examines how the cyber risk landscape is being reshaped by rapid technological change and growing global fragmentation. Published by the World Economic Forum in collaboration with Accenture, the report provides a forward looking assessment of the cybersecurity challenges that economies, governments, and organizations are likely to face in the coming year.

A central theme of the report is the accelerating adoption of artificial intelligence. While AI is strengthening defensive capabilities, it is also enabling attackers to launch faster, more targeted, and more sophisticated cyber operations. This asymmetry is widening the gap between organizations that can afford

advanced security capabilities and those that cannot, creating what the report describes as growing cyber inequity across regions and sectors.

Geopolitical fragmentation is another major driver of risk. Rising tensions between states, increasing digital sovereignty requirements, and the weaponization of cyberspace are complicating international cooperation. Organizations operating across borders face a more complex regulatory environment, fragmented data regimes, and heightened exposure to state linked cyber activity.

The report also highlights how cyber risks are becoming more unevenly distributed. Smaller organizations, developing economies, and critical infrastructure operators are often the most vulnerable, yet have the least resources to respond. This imbalance increases systemic risk, as weaknesses in one part of the digital ecosystem can cascade across borders and industries.

Drawing on insights from global leaders, the outlook emphasizes the need for adaptive strategies that combine technology investment with governance, workforce development, and public private collaboration. It calls for renewed focus on resilience, shared responsibility, and international dialogue to close capability gaps and strengthen collective cyber defenses in an increasingly contested digital world. Download Report

National

28. NITI Aayog - Roadmap on "Transforming India into a leading Quantum-Powered Economy"

NITI Aayog has released a comprehensive roadmap outlining how India can transform itself into a leading quantum powered economy, positioning the country at the forefront of one of the most strategic technologies of the coming decades. The roadmap was launched by the NITI Aayog through its Frontier Tech Hub and builds on the foundations of India's National Quantum Mission.

The report emphasizes that quantum technologies will be central to future advances in computing, secure communications, sensing, materials, artificial intelligence, and national security. Rather than treating quantum as a niche research area, the roadmap frames it as a foundational capability that will shape global innovation, economic competitiveness, and trust in digital systems. It argues that countries that act decisively now will define standards, supply chains, and governance structures for decades to come.

For India, the roadmap highlights a unique opportunity to lead from the outset rather than follow established global players. It provides an assessment of India's current strengths, including talent, research capacity, and digital public infrastructure, while also identifying gaps in commercialization, scale up, and industry integration. Clear priorities are outlined to accelerate research and development, translate innovation into market ready products, and build a resilient quantum

ecosystem spanning startups, industry, academia, and government.

The roadmap stresses collective ownership, calling for close coordination among policymakers, scientists, entrepreneurs, investors, and states. It also underscores the importance of global partnerships, exportable solutions, and trusted platforms, particularly for engagement with the Global South.

Developed in collaboration with IBM and guided by an expert council from industry and academia, the roadmap positions quantum technologies as critical to India's ambition of becoming a developed nation by 2047 and a trusted global leader in frontier innovation. Download Report

29. *Principal Scientific Adviser Unveils "National Technology Readiness Assessment Framework (NTRAF)" to Standardise Innovation Assessment in India*

India has taken a major step toward standardising how innovation readiness is evaluated with the launch of the National Technology Readiness Assessment Framework. The framework was unveiled on December 29, 2025 by the Principal Scientific Adviser to the Government of India, Ajay Kumar Sood, and is open for public consultation until January 31, 2026.

Developed by the Office of the Principal Scientific Adviser in collaboration with the Confederation of Indian Industry, the framework introduces a unified and objective yardstick to assess the maturity of technologies from early research to market deployment. It is designed to serve as the operational backbone for national research and development funding under various missions.

At the core of the framework is a structured evaluation across nine Technology Readiness Levels. These range from proof of concept and early validation to prototype development and full operational deployment. By clearly defining evidence requirements at each stage, the framework aims to improve funding decisions, reduce risk for private investors, and address the long standing Valley of Death between mid stage research and commercialization.

The framework adapts global best practices, including those used by NASA, while tailoring them to India's research and industrial ecosystem. It emphasizes objectivity through evidence based checklists, replaces subjective claims of readiness, and includes sector specific annexures for areas such as healthcare, pharmaceuticals, and software, where development pathways differ significantly.

Leaders from the scientific and innovation ecosystem highlighted that the framework creates a common language between researchers, industry, investors, and government agencies. By synchronising expectations around what it means for a

technology to be deployable and manufacturable, the National Technology Readiness Assessment Framework is expected to accelerate technology transfer, strengthen deeptech startups, and improve the effectiveness of public R&D investments in India. Download Report

TECHNOLOGY ENGAGEMENTS/NEWS BYTES

International

30. More than 20% of videos shown to new YouTube users are 'AI slop', study finds

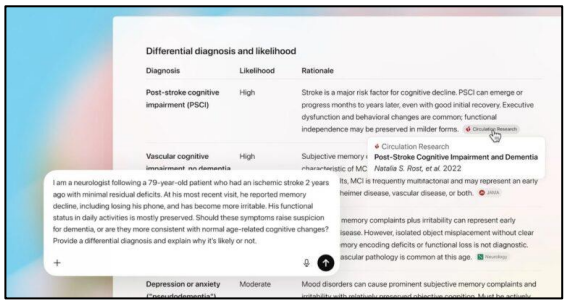
A new study by Kapwing finds that low quality, AI generated content known as AI slop has become a structural feature of YouTube rather than a fringe problem. By analysing the top 100 trending YouTube channels in every country and simulating a new user experience, the report concludes that more than 20 percent of YouTube recommendations, and up to one third of Shorts style feeds, now consist of AI slop or closely related brainrot content.

To mimic first time exposure, researchers created a fresh account and tracked the first 500 Shorts shown. About 21 percent were classified as AI slop, while 33 percent fell into the broader brainrot category. While the feed initially appeared relatively clean, low quality AI content increased rapidly as the recommendation system adapted to minimal engagement signals.

Kapwing identified 278 channels fully dedicated to AI slop, collectively generating around 63 billion views, 221 million subscribers, and an estimated 117 million dollars in annual ad revenue. The ecosystem is global and industrialised, with strong concentration effects in countries such as Spain, South Korea, India, Pakistan, and the United States.

The study highlights how short form algorithms reward volume, repetition, and rapid testing over originality or quality. As generative tools reduce production costs, algorithmic optimisation increasingly shapes what users see, raising concerns about content quality, child audiences, advertiser confidence, and long term trust in platform recommendations. Read More

31. OpenAI Launches ChatGPT Health, a Dedicated Hub for Medical Records and Wellness Data



OpenAI has launched ChatGPT Health, a new dedicated workspace designed to help users better understand and organize their medical and wellness information. Introduced on January 7, 2026 by OpenAI, the feature appears as a separate Health tab

within ChatGPT, keeping health related data isolated from general conversations to improve continuity, privacy, and context.

ChatGPT Health allows users to upload clinical documents such as lab reports, visit summaries, and test results, then ask questions that translate complex medical language into plain terms. In the United States, users can also connect electronic health records through b.well Connected Health, giving access to records from thousands of providers. In addition, wellness data can be linked from apps like Apple Health, MyFitnessPal, Peloton, Function Health, and Weight Watchers, enabling users to view lifestyle patterns alongside clinical history.

The tool is positioned for practical, non diagnostic use. It is meant to help people spot trends in lab results, prepare questions for doctor visits, organize insurance information, and support nutrition or fitness planning. OpenAI stresses that ChatGPT Health does not provide diagnoses or treatment recommendations.

Privacy is central to the design. Health data is sandboxed, not used to train models, and can be reviewed, deleted, or disconnected at any time. The feature is currently available via waitlist in the U.S. and reflects a broader shift toward data grounded, patient focused AI assistance. Read More

National

32. A Curtain Raiser to the AI Impact Summit

Shri Jitin Prasada, Union Minister of State for Commerce and Industry and Electronics and Information Technology, addressed an event titled From Action to Impact, a curtain raiser to the AI Impact Summit 2026. The event was jointly organised by India and France at the United Nations Headquarters in New York on December 16, 2025, marking an important milestone in global coordination on artificial intelligence governance and deployment.

In his address, Shri Prasada traced the evolution of global AI summits, highlighting the shift from risk centric discussions at Bletchley Park, to ethics and inclusion in Seoul, and toward operationalising shared principles in Paris. Referring to Prime Minister Narendra Modi's view that AI is shaping humanity's future, he emphasised the need to move beyond declarations and focus on inclusive access, large scale skilling and reskilling, and practical implementation that delivers real world outcomes.

He outlined the core vision of the India AI Impact Summit 2026, structured around three guiding principles, People, Planet, and Progress. These are operationalised through seven thematic working groups, referred to as Chakras, covering areas such as human capital, social inclusion, safe and trusted AI, resilience, innovation and efficiency, science, democratising AI resources, and AI for economic growth and social good.

The event saw participation from senior representatives of the United Nations, UNESCO, ITU, UNDP, the Government of France, and global AI stakeholders. Concluding his remarks, Shri Prasada invited governments, industry, researchers, civil society, and international organisations to actively engage in the AI Impact Summit to be held in New Delhi on

February 19–20, 2026, stressing that its success should be judged by tangible improvements in people's lives rather than policy statements alone. Read More

33. *Atal Innovation Mission, NITI Aayog and HUL Partner to Accelerate Transition to Circular Economy*

India has taken a major step toward accelerating its transition to a circular economy through a new partnership between the Atal Innovation Mission of NITI Aayog and Hindustan Unilever Limited. Announced in December 2025, the collaboration launches a nationwide startup acceleration programme focused on driving innovation in sustainability and resource efficiency.

The initiative, anchored under HUL's Project Circular Bharat, aims to identify and support 50 high potential circular economy startups over the next three years. The primary focus will be on plastics circularity, including solutions for plastic recycling, reuse and refill models, and next generation sustainable packaging materials. In addition, the programme will back startups working on material recovery in other post consumer waste streams such as textiles and electronic waste.

Selected startups will receive curated mentorship from industry leaders, policy experts, and investors, along with opportunities for grant funding and pilot projects to validate their solutions in real market conditions. The partnership combines AIM's policy and innovation ecosystem, HUL's industry scale and market access, and strategic support from Xynteo to help promising ideas scale faster.

Leaders from both organisations emphasised that the collaboration reflects India's commitment to sustainable development by empowering entrepreneurs to reduce waste, rethink resource use, and build green industries for the future. Read More

34. *LoI signed to establish Centre of Excellence for CRISPR Innovation and Translation (CoE-CIT)*

A Letter of Intent has been signed to establish the Centre of Excellence for CRISPR Innovation and Translation, a new hub dedicated to advancing CRISPR based technologies from laboratory research to real world clinical applications. The initiative is a landmark public private partnership between the Jawaharlal Nehru Centre for Advanced Scientific Research and CRISPRBITS Private Limited, and is among the first structured collaborations of its kind in India in the field of gene editing.

The proposed centre aims to bridge the long standing gap between basic research and clinical translation by combining JNCASR's strengths in fundamental biomedical science with CrisprBits' expertise in applied gene editing, diagnostics, and translational platforms. By integrating genetics, molecular and chemical biology, computational biology, and scalable engineering, the CoE is expected to accelerate the development of affordable and impactful CRISPR based diagnostics and therapeutic solutions.

The Centre of Excellence is envisioned as a national model for how academic research can be effectively translated into societal and clinical benefits through close industry collaboration. It will support India's broader biotechnology and innovation goals by enabling faster translation, strengthening indigenous capabilities, and reducing dependence on imported technologies.

Leaders from both institutions emphasized that the partnership reflects India's growing maturity in deep science innovation and demonstrates how public research institutions and private technology companies can jointly contribute to national health missions, capacity building, and the creation of globally relevant, affordable healthcare solutions. Read More

35. ***Office of Principal Scientific Adviser Convenes High-Level Roundtable on Techno-Legal Regulation for Responsible, Innovation-Aligned AI Governance***

The Office of the Principal Scientific Adviser to the Government of India convened a high level roundtable on techno legal regulation for responsible, innovation aligned AI governance on 22 December 2025, ahead of the India AI Impact Summit 2026. The meeting was chaired by Ajay Kumar Sood and organised in collaboration with the iSPIRT Foundation and the Centre for Responsible AI, IIT Madras.The discussions focused on embedding legal and regulatory principles directly into AI systems so that accountability, transparency, data protection, and cybersecurity are built in by design. Participants highlighted the importance of practical techno legal frameworks that align innovation with public trust, rather than relying only on post hoc regulation.

Key themes included data privacy and consent across the AI lifecycle, convergence with the Data Empowerment and Protection Architecture, and compliance by design approaches that can scale globally.

Experts also examined challenges posed by non deterministic AI systems, AI generated content, and copyright issues, alongside trade offs between privacy, accuracy, and system performance. Emphasis was placed on equity of access, data sovereignty, and the need for standardised evaluation frameworks for responsible AI.

The roundtable concluded that India is well positioned to shape globally relevant AI governance models. Insights from the meeting will inform the Safe and Trusted AI Chakra of the India AI Impact Summit 2026, and will be consolidated into an explanatory white paper to guide future policy and implementation. Read More

WHAT'S UPCOMING?

36. ***Defence Tech Expo, February 17-18, 2026, Tel Aviv, Israel***

Defense.Tech Expo is a unique meeting point for the global homeland-security & defense market. An innovative technological arena that provides an opportunity to engage with high-ranking professionals & officials, international delegations and key decision makers.

Defense.Tech Expo is a platform for key industry players, buyers and agents from around the world to meet, network and forge new business connections with manufacturers, integrators, startups, developers and service providers. The event focuses on cutting edge solutions, equipment, technologies and expertise in the fields of National Security & Defense, Homeland security, Critical Infrastructures Protection, Counterterrorism, Law Enforcement, Cybersecurity and Intelligence. Know More

37. Mobile World Congress 2026, 2-5 March 2026, Barcelona, Spain

MWC Barcelona 2026, the world's largest connectivity event, returns to Fira Gran Via from March 2-5, 2026, uniting global tech leaders. Organized under the theme "The IQ Era," the event activates a new age of intelligence where the way to a better future is through smarter connection with human ideas leading technology, commercial impact and societal progress.

The 2026 edition centers heavily on the convergence of networks and intelligence, with major themes like "Intelligent Infrastructure," "AI Nexus," and "Game Changers" dominating the agenda, showcasing how Artificial Intelligence is no longer just a buzzword but the "digital backbone" rewiring entire industries, from manufacturing and fintech to automotive and healthcare. The event consistently attracts over 109,000 attendees and 2,900 exhibitors from more than 200 countries, with more than half being C-suite executives and nearly 60% now coming from industries adjacent to mobile. Participants engage with industry giants like Meta, Huawei and FC Barcelona, attending both generalized and topic-specific networking events designed to forge new connections and engage directly with C-suite leaders. Know More

38. Great International Developer Summit (GIDS), 21-24 April 2026, Bengaluru, India

The 18th annual Great International Developer Summit (GIDS 2026) will take place April 21-24, 2026, at the J.N. Tata Auditorium at the Indian Institute of Science (IISc) in Bengaluru, India, serving as Asia-Pacific's biggest software developer summit and premier polyglot software conference.

Guided by the 2026 theme 'Build Fast. Think Deep,' GIDS will explore how development teams can balance speed and craftsmanship in the age of AI-driven development, featuring sessions across software development, architecture, cloud computing, data engineering, AI and machine learning, operations, and technology leadership.

The four-day program brings together software developers, architects, technical leads, engineering managers, DevOps professionals, and technology leaders with an all-access conference ticket providing access to all four days of sessions, keynotes, networking events, and the expo hall. The conference agenda emphasizes AI's transformative impact on software development, featuring sessions on AI coding assistants, ethical AI use, enterprise AI production deployment, generative AI replacing architect roles, and how teams are building intelligent systems with reasoning and autonomy. Know More

THE TECH SHOWCASE! (ANNEXURE)

Compilation of Technology Innovations by premier research institutions of India. The details are shared in the Annexure.

Council of Scientific and Industrial Research (CSIR)

1. Multi-Millet Bun

IIT Roorkee

1. Gallium nitride unipolar diode and method for fabrication thereof
2. A fluorescent nontoxic micro/nano-silica particles for in vitro cell-imaging and its method of synthesis
3. A high temperature proton exchange membrane and a process for its fabrication thereof
4. Method and system for human voice activity detection
5. Method of detection of iron and cadmium using paper substrate modified with chitosan derived carbon dots
6. System and method for landslide inventory generation using machine learning and cloud computing Injectable hydrogel composition
7. Injectable hydrogel composition

India - New Zealand Free Trade Agreement

One of India's fastest-concluded FTAs

Official Fact Sheet - **https://www.commerce.gov.in/wp-content/uploads/2025/12/Fact-Sheet-NZ-FTA-dec-22-for-Website-ver2.pdf**

OVERVIEW

India and New Zealand concluded a forward-looking Free Trade Agreement in December 2025, making it one of India's fastest-concluded FTAs (negotiations began in March 2025). The agreement delivers unprecedented duty-free access for Indian exports to New Zealand while protecting India's sensitive sectors, strengthening economic resilience, and promoting inclusive growth.

New Zealand is India's second-largest trading partner in Oceania, with bilateral trade reaching USD 2.4 billion in 2024. India maintains a trade surplus, with merchandise exports rising from USD 873 million (2023-24) to USD 1.3 billion (2024-25)—a 49% growth. The Indian diaspora in New Zealand numbers around 300,000 (5% of NZ's population), providing a strong socio-economic foundation for the partnership.

TARIFF OUTCOMES

Indian Exports: New Zealand provides 100% duty-free market access on all tariff lines, eliminating previous peak tariffs of 10% on textiles, apparel, leather, ceramics, carpets, and automobiles—a major win for India's labour-intensive manufacturing and export sectors.

Indian Market Access: India offered 70.03% of tariff lines (covering 95% of bilateral trade value) with 30% receiving immediate duty elimination (wood, wool, sheep meat), 35.6% phased over 3-10 years (petroleum, oils, machinery), 4.37% tariff reductions, and 0.06% under quota systems. India protected 29.97% of tariff lines, primarily dairy (milk, cheese, yoghurt), certain vegetables (onions, chana, almonds), sugar, and strategic items (gems, copper, aluminium).

AGRICULTURE & PROTECTED SECTORS

The agreement safeguards India's sensitive agricultural sectors through calibrated market access. New Zealand committed to Agricultural Productivity Action Plans for kiwifruit, apples, and Manuka honey—establishing Centres of Excellence, improving planting materials, and providing capacity building to growers. All market access is managed through Tariff Rate Quotas (TRQs) with Minimum Import Prices (MIPs) and monitored by a Joint Agriculture Productivity Council.

Key Agricultural Quotas:

- **Manuka Honey**: 200 MT annually at USD 20/kg MIP; duty reduces from 66% to 16.5% over 5 years
- **Apples**: 32,500-45,000 MT annually at USD 1.25/kg MIP with 25% duty (seasonal: April-August)

- **Kiwi Fruit**: 6,250-15,000 MT annually at USD 1.80/kg MIP with 0% duty (seasonal: April-October)
- **Albumins**: 1,000-3,000 MT annually at 11% duty

INVESTMENT & JOBS

New Zealand committed USD 20 billion in investment to India over 15 years, supporting manufacturing, infrastructure, innovation, and job creation. A Rebalancing Clause allows India to take remedial measures if investment falls below commitment levels. The FTA directly benefits MSMEs in textiles, apparel, engineering goods, chemicals, food processing, and electronics through reduced trade barriers, regulatory certainty, and enhanced access to New Zealand's SME ecosystem.

HUMAN MOBILITY & VISAS

Student Pathway (First with Any Country): New Zealand removed numerical caps on Indian students, guarantees 20 hours/week work during studies, and provides extended post-study work visas: 3 years for STEM Bachelor's/Master's graduates and 4 years for Doctorate holders—creating clear pathways for skills development and global careers.

Skilled Worker Visas (TEE): 5,000 Indian professionals can work in New Zealand for up to 3 years under a new Temporary Employment Entry pathway covering AYUSH practitioners, yoga instructors, Indian chefs, music teachers, and high-demand sectors (IT, engineering, healthcare, education, construction).

Working Holiday Visas: 1,000 young Indians annually receive 12-month multiple-entry working holiday visas for global exposure and skills acquisition.

SERVICES & SECTORS

The FTA grants market access in 118+ services sectors including computer services, professional services, audio-visual, telecommunications, construction, education, financial services, and tourism. For the first time, New Zealand included a dedicated Health and Traditional Medicine Services provision, recognizing India's AYUSH systems (Ayurveda, Yoga, Naturopathy, Unani, Sowa-Rigpa, Siddha, Homeopathy) alongside Maori health practices—a landmark achievement globally promoting India's wellness sector.

Pharma & Medical Devices: The FTA streamlines access by accepting GMP/GCP inspection reports from comparable regulators (US FDA, EMA, UK MHRA, Health Canada), eliminating duplicative inspections, reducing compliance costs, and expediting product approvals.

Organic Trade: A Mutual Recognition Arrangement (based on Australian standards) will enable faster market access for India's 80+ organic products, including basmati rice, flax seeds, psyllium husk, soybean oil cake, and organic black tea.

INTELLECTUAL PROPERTY & TRADE FACILITATION

India's Geographical Indications (GIs) will receive expanded recognition. Currently, New Zealand only recognizes Indian wines and spirits for GI registration. The FTA commits New Zealand to amend its law within 18 months to facilitate registration of India's wines, spirits, and "other goods"—bringing India to parity with EU treatment.

Modern customs procedures ensure cargo clearance within 48 hours (24 hours for express and perishable goods) through Authorized Economic Operators, automation, and single-window systems. Sanitary and Phytosanitary (SPS) measures balance health protections with facilitated trade through fast-tracked market access applications and electronic certification.

SECTORAL IMPACT

Textiles & Apparel (largest beneficiary): Zero duty on apparel, garments, home textiles, man-made fibres, and traditional handlooms—boosting global competitiveness and job creation.

Leather & Footwear: Tariff reduced from 10% to 0%, strengthening India's global position in leather goods and footwear.

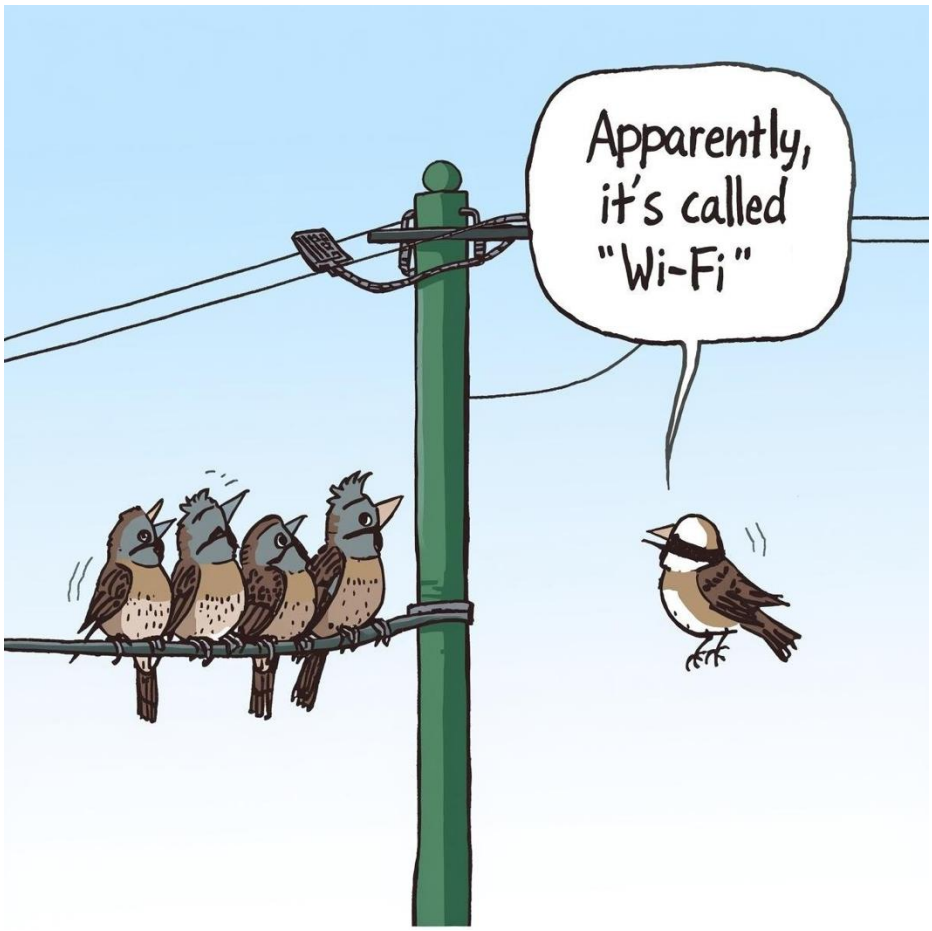
Engineering & Manufacturing: Tariff elimination/reduction on transport, automotive, electrical machinery, mechanical machinery, plastics, rubber, and chemicals.

Agriculture & Processed Foods: Duty-free access for fruits, vegetables, coffee, cocoa, spices, cereals, and processed foods—enhancing competitiveness.

STRATEGIC SIGNIFICANCE

For India, this FTA opens a gateway to Oceania and Pacific Island markets while securing formal pathways for skilled workforce export (students, professionals, AYUSH practitioners). The USD 20 billion investment commitment strengthens economic resilience, the AYUSH recognition elevates India's position as a global health and wellness hub, and 100% duty-free access enhances labour-intensive manufacturing sectors. For New Zealand, the agreement provides access to India's growing market, agricultural productivity partnerships, and expertise in IT, engineering, and wellness services.

#NESTLaugh-orithm



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The New, Emerging, and Strategic Technologies (NEST) Division, established in 2020 under the Ministry of External Affairs (MEA), focuses on technology diplomacy and the international aspects of critical, strategic and emerging technologies. It enhances India's participation in global forums, shaping technology governance and safeguarding national interests. As technology has become central to economic and geopolitical agendas, the Division coordinates with domestic and international stakeholders on advancements like Artificial Intelligence, Quantum Technology, 5G/6G, Biotechnology, Green energy, Semiconductors, and others. NEST also builds internal capacity within MEA, facilitates policy engagement, and assesses foreign policy implications. It plays a key role in shaping India's stance on global tech governance and cooperation.

New, Emerging & Strategic Technologies Division
Ministry of External Affairs
Government of India