



इस अंक में:

- नाभिकीय नारे
- तकनीकी सत्र
- नाभिकीय आंकड़ा
- नाभिकीय समाचार
- शब्द कोश
- क्या आप जानते हैं?
- विशेष आलेख
- नाभिकीय सामान्य ज्ञान

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स्थल निदेशक,
कुडनकुलम न्यूक्लियर
पावर प्रोजेक्ट

प्रिय पाठकगण,

दिनांक 6 अप्रैल, 2026 को कल्पाक्कम में प्रोटोटाइप फास्ट ब्रीडर रिएक्टर की पहली क्रांतिकता की प्राप्ति, भारत की नाभिकीय यात्रा में एक ऐतिहासिक मील का पत्थर है। जैसा कि हमारे माननीय प्रधान मंत्री द्वारा उजागर किया गया है कि यह उपलब्धि हमारे नाभिकीय कार्यक्रम के दूसरे चरण को आगे बढ़ाने में एक प्रभावी कदम का प्रतीक है। असाधारण वैज्ञानिक और अभियांत्रिकी की उत्कृष्टता का प्रदर्शन करते हुए, रिएक्टर भारत के विशाल थोरियम संसाधनों के उपयोग का मार्ग प्रशस्त करता है। पढ़कर आनंदित हों...

अध्यक्ष, जन जागरूकता समिति



अप्रैल 2026 के विशिष्ट बिंदु

1

केकेएनपीपी स्थल पर 34 और स्थल के बाहर 04 जन संपर्क कार्यक्रम आयोजित किए गए

2

1,552 घंटों का जन संपर्क, 3,333 लोगों से संपर्क

3

5,917 जन जागरूकता प्रकाशन वितरित किए गए



केकेएनपीपी का जलवायु परिवर्तन के न्यूनकरण में योगदान

जलवायु परिवर्तन आज वैश्विक पर्यावरण मुद्दों में सर्वाधिक महत्वपूर्ण है। नाभिकीय विद्युत न्यूनतम कार्बन प्रौद्योगिकियों में से एक है जो बढ़ती हुई आबादी एवं सामाजिक-आर्थिक विकास के लिए विद्युत उत्पादन करते हुए ग्रीन हाउस गैसों (जीएचजी) के उत्सर्जन (अधिकतर CO₂) में कमी लाती है। CO₂ के उत्सर्जन में कमी लाने में केकेएनपीपी का योगदान (दिनांक 30 अप्रैल 2026 को) अब तक इस प्रकार है।



कुल उत्पादित विद्युत इकाई

127,644
मिलियन यूनिट



केकेएनपीपी द्वारा कुल CO₂ उत्सर्जन में कमी

109,646,465
टन

नोट: कोयले एवं नाभिकीय ऊर्जा के औसत जीवन चक्र ग्रीन हाउस गैस उत्सर्जन क्रमशः 888 एवं 29 (टन/गीगावाट घंटा) है।

Public Awareness e-Newsletter

Kudankulam Nuclear Power Project

April 2026

Issue –166

In this issue:

- Nuclear Slogan
- Technical session
- Nuclear Database
- Nuclear News
- Lexicon
- Did you know?
- Feature article
- Nuclear Trivia

Snap shot



A glimpse of **Blue-faced malkoha** near Anuvijay Township, Chettikulam.

Photography by
Sh Rathina Pandi
Senior Technician/H
MMU, KKNPP

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Aves
Order:	Cuculiformes
Family:	Cuculidae
Genus:	Phaenicophaeus
Species:	P. viridirostris

Binomial name:

Phaenicophaeus viridirostris

Source: en.wikipedia.org

Dear Readers,

The attainment of first criticality of the Prototype Fast Breeder Reactor at Kalpakkam on April 06, 2026, marks a historic milestone in India's nuclear journey.

As highlighted by our Hon'ble Prime Minister, this achievement signifies a defining step in advancing the second stage of our nuclear programme. Demonstrating exceptional Scientific and Engineering excellence, the reactor paves the way for harnessing India's vast thorium resources. Read on happily!

-Chairman, PA Committee



Spotlight of April 2026

1

34 on-site & 04 Off-site outreach programme organised

2

1,552 hours of Public Outreach, reached 3,333 people

3

5,917 PA Publications distributed



KKNPP's contribution to climate change mitigation

Climate change is the foremost global environmental issue today. Nuclear power is one of the low carbon technologies that can contribute to reducing greenhouse gas (GHG) emissions (mostly CO₂) while generating electricity for growing populations and socioeconomic development. KKNPP's contribution in preventing the CO₂ emissions till now (As on Apr 30, 2026) is given below.



No. of units of electricity generated 127,644 Million Units

Total CO₂ emissions avoided by KKNPP 109,646,465 Tonnes

Note: Average lifecycle GHG emissions for Coal & Nuclear is 888 & 29 (tonnes/GWh) respectively.

PM congratulates scientists and engineers as Prototype Fast Breeder Reactor at Kalpakkam attains criticality

India has taken a defining step forward in its civil nuclear journey, marking significant progress in the second stage of its nuclear programme. The advanced reactor, which has the capability to generate more fuel than it consumes, showcases the country's strong scientific capabilities and robust engineering expertise. This achievement paves the way for effectively harnessing India's vast thorium reserves under the third stage of the nuclear programme. A proud moment for India. Congratulations to our scientists and engineers.



Shri Narendra Modi
Hon'ble Prime Minister of India

Source: www.pmindia.gov.in dated Apr 06, 2026.



NPCIL Mission:

To develop nuclear power technology and to produce Nuclear Power as a safe, environmentally benign and economically viable source of electrical energy to meet the increasing needs of country.

Growing recognition of nuclear fuel cycle's importance

“This was a moment of profound importance for nuclear energy - and especially in times of geopolitical uncertainty, a stable fuel supply lies at its heart.

Nuclear power doesn't run just on technology, but also on trust: trust that fuel will be delivered on time and this global network will remain reliable”



Jennifer Uhle

Vice President of Technical & Regulatory Services, Nuclear Energy Institute

Source: WNA, www.aiche.org



Technical session

Electricity and Energy Storage

(Source: World Nuclear Association)

Early in 2016 the UK's National Grid got a strong response to a tender for 200 MW enhanced frequency response (EFR). It offered four-year contracts for capacity able to provide 100% active power output in a second or less of registering a frequency deviation. Some 888 MW of battery capacity was offered, 150 MW of interconnection, 100 MW of demand-side response and 50 MW of flywheel capacity. All but three involved battery storage. In August the winning bids were announced – the eight chosen tenders being from 10 MW to 49 MW (totalling 201 MW) and costing £66 million in total. The winning bids ranged from £7 to £12 per MW of EFR/h, with an average of £9.44/MW of EFR/h. Batteries are also expected to become the main choice for firm frequency response, slightly slower than EFR.

In the UK storage is treated as generation for licensing purposes, but on connection to a distribution network it has to comply with two different connection and charging methodologies, with one half connecting as demand and the other as generation. A single storage connection methodology is proposed, and the Department for Business, Energy & Industrial Strategy and energy regulator Ofgem are aiming to define 'electricity storage' in legal and regulatory terms so as to expedite deployment. The Electricity Storage Network, an industry body, supports the move.

On demand response, the UK government said providers should have easier access to a range of markets so they can compete fairly with large generators, including the balancing market, ancillary services, and the capacity market. There is concern over whether storage and demand response providers should be able to access the same length capacity market contracts as new diesel generators. In this area the response needs to be over hours, and batteries are less economical.

To be continued in May 2026



Updated as on May 10, 2026

Source: <https://pris.iaea.org/PRIS>

OPERATIONAL REACTORS

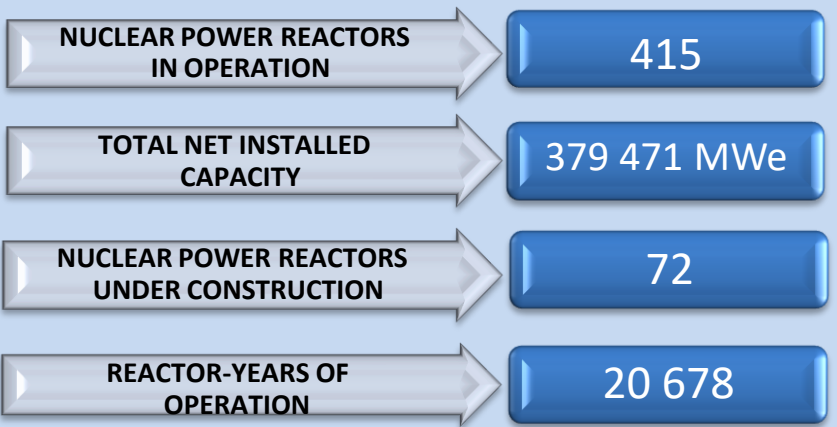
Country	MWe #	No. of Reactors
ARGENTINA	1641	3
ARMENIA	416	1
BELARUS	2220	2
BELGIUM	2056	2
BRAZIL	1884	2
BULGARIA	2006	2
CANADA	12714	17
CHINA	58770	60
CZECH REP	3963	6
FINLAND	4369	5
FRANCE	63000	57
HUNGARY	1916	4
INDIA	7550	21
IRAN	915	1
JAPAN	12631	14
KOREA	25609	26
MEXICO	1552	2
NETHERLANDS	482	1
PAKISTAN	3262	6
ROMANIA	1300	2
RUSSIA	27969	34
SLOVAKIA	2308	5
SLOVENIA	688	1
SOUTH AFRICA	1854	2
SPAIN	7123	7
SWEDEN	7008	6
SWITZERLAND	2973	4
UKRAINE	13107	15
UAE	5348	4
UK	5883	9
USA	96952	94
Total	379471	415

Net Electrical Capacity

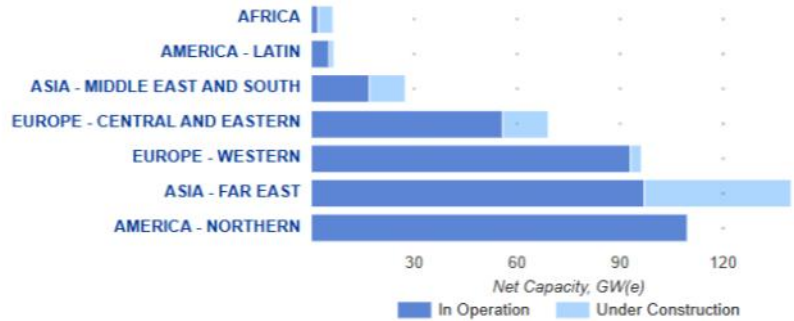
Source: <https://pris.iaea.org/PRIS>
www.nucnet.org



Current Status:



Regional Distribution of Nuclear Power Plants:



New connections to the grid: (Year 2026)



Source: www.nucnet.org & www.neimagazine.com





Flushing of safety systems begins for Kudankulam unit 3 28 Apr



The flushing of safety systems at unit 3 of India's Kudankulam Nuclear Power Plant is described as a key moment, signifying the beginning of the active commissioning phase. Nuclear Power Corporation of India Limited (NPCIL) called it "a significant stride in India's journey towards energy security and sustainability". The flushing process, using demineralised water, is designed to check everything has been installed correctly and remove impurities from pipelines, check pump sets, process safety systems and normal operation systems.

Source: www.world-nuclear-news.org

Fuel loading begins for Bangladesh's first nuclear power plant 28 Apr



A ceremony has been held in Bangladesh to mark the start of the loading of 163 nuclear fuel assemblies into Rooppur Nuclear Power Plant's first unit. Loading of nuclear fuel in a new reactor is a key moment in the construction of any new nuclear power reactor. It is the first stage of the unit's key startup phase and, according to reports in the Bangladesh press, will take about 45 days to complete. The next step will see the reactor being brought to a minimum controllable power level, with checks and tests before the level is increased in stages.

Source: www.world-nuclear-news.org



Prototype Fast Breeder Reactor at Kalpakkam attains First Criticality 6 Apr



In a landmark achievement for India's nuclear energy programme, the 500 MWe Prototype Fast Breeder Reactor (PFBR) has successfully attained first criticality (start of controlled fission chain reaction) on 6th April 2026 at 08:25 PM marking a historic step in providing long-term energy security and advancing indigenous nuclear technology capabilities. With the achievement of first criticality, India moves closer to realizing the full potential of its three-stage nuclear power programme. Fast breeder technology forms the vital bridge between the current fleet of pressurized heavy water reactors and the future deployment of thorium-based reactors, leveraging the country's abundant thorium resources for long-term clean energy generation. Achieving this milestone demonstrates the strength of India's indigenous design, engineering and manufacturing ecosystem.

Source: <https://dae.gov.in> & www.world-nuclear-news.org

EDF, NTPC sign MoU to explore new Indian nuclear projects 09 Apr

The non-binding Memorandum of Understanding sees India's largest integrated power utility come together with the French international energy company to explore cooperation in developing new nuclear power projects in India. The MoU was signed following approval from Indian ministries and government departments, NTPC said. It establishes a framework for both companies to jointly assess the feasibility and approach for collaboration, including understanding EDF's EPR technology and its suitability for Indian requirements, exploring opportunities to maximise localisation for large-scale deployment, examining economic and tariff aspects, developing human resource capabilities through training programmes, evaluating potential project sites, and providing technical support as mutually agreed.



Source: www.world-nuclear-news.org

CNL to produce demonstration ANEEL fuel bundles 17 Apr



Nuclear fuel company Clean Core Thorium Energy has signed an agreement with Canadian Nuclear Laboratories for the manufacture of demonstration irradiation bundles of its patented ANEEL thorium and high-assay low-enriched uranium fuel. ANEEL has been developed for use in pressurised heavy water reactors and Candu reactors (its name is taken from Advanced Nuclear Energy for Enriched Life). Demonstration irradiation (DI) bundles are full-scale ANEEL fuel bundles matching actual reactor fuel bundles designed for interface and irradiation testing. Manufactured by Canadian Nuclear Laboratories (CNL) at the Chalk River Laboratories, these bundles will enable Clean Core Thorium Energy to conduct demonstration irradiation which will provide practical, in-reactor data to support future qualification and potential deployment of ANEEL fuel in Candu reactors and other PHWRs. CNL will lead the development, qualification, and manufacturing of ANEEL fuel under Canadian Standard Association requirements for manufacturing nuclear fuel.

Source: www.world-nuclear-news.org



QUICK FACTS

New Isotopes in Nuclear Medicine

In 2026, nuclear medicine is shifting toward **alpha-emitter therapies** for higher precision and effective tumor destruction. There is a growing focus on **multi-isotope platforms like the Terbium family**, enabling integrated diagnosis and treatment. The field is advancing toward **personalized radiopharmaceuticals**, tailored to individual patients, while **AI is increasingly used** to optimize isotope selection, imaging analysis, and dose planning for improved clinical outcomes.

Key Isotopes are:

Isotope	Type	Use
Lu-177	Beta (+γ)	Therapy (NETs, Prostate)
Ac-225	Alpha	Advanced cancer therapy
Ga-68	Positron	Diagnosis
Cu-64	PET	Imaging + emerging therapy
Cu-67	Beta	Therapy
Tb-152	PET	Diagnosis
Tb-161	Beta + Auger	Therapy
Ra-223	Alpha	Bone metastasis
Zr-89	PET	Immuno-imaging

Source: IAEA



Nuclear Slogan

Remote or Urban — Nuclear Keeps the Lights On.

REMOTE AREAS
From the mountains to the coasts, nuclear power delivers reliable electricity where it's needed most.

URBAN CENTRES
Fueling industries, businesses, hospitals, schools and homes—nuclear energy powers our progress and our future.

POWERING TODAY SUSTAINING TOMORROW
Nuclear energy is low carbon, high reliability and energy secure.

Reliable. Clean. Powerful. Nuclear energy powers every corner of India, every single day.

CLEAN ENERGY
Low carbon, for a greener planet

RELIABLE POWER
24x7 power you can depend on

ENERGY SECURITY
Strengthening India's self-reliance

EMPOWERING LIVES
Enabling development, improving lives

BUILT ON EXCELLENCE
By India's scientists, for India's future

From every village to every city, Nuclear energy keeps India bright.

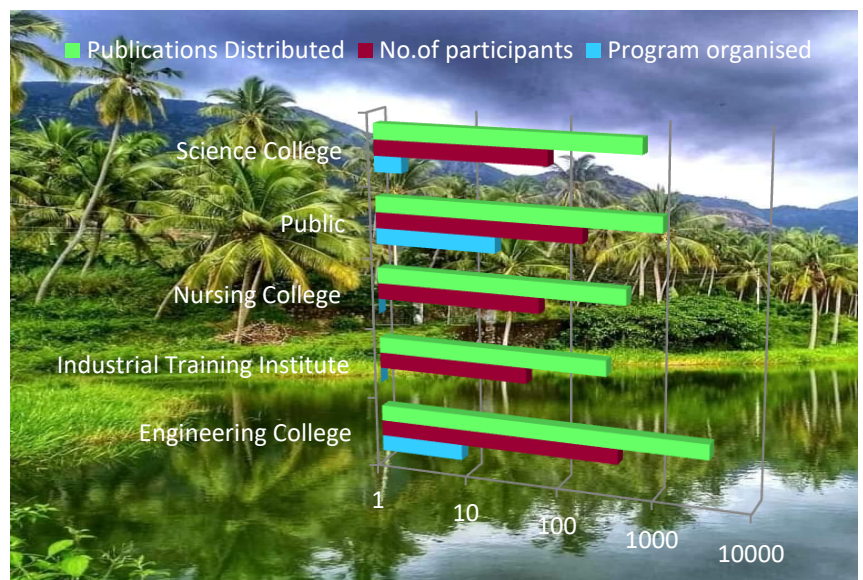
Nuclear Energy: Clean. Secure. Sustainable.



PA activity conducted at KKNPP Site



As a part of public awareness programme, visits of Public from districts such as Tirunelveli, Kanyakumari and Tuticorin and also from Kerala to KKNPP were organised. The visitors of KKNPP were provided with a detailed information on nuclear power generation and its safety principles.





Few glimpses from Site Visit

At site

**Trinity College of Engineering
Thiruvananthapuram
(01 Apr)**



**Nandha Engineering College (Autonomous)
Vaikkalmedu, Erode
(02 Apr)**

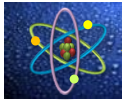


**S.T.Hindu College
Nagercoil
(04 Apr)**



**Mahatma Gandhi College
Thiruvananthapuram
(06 Apr)**





Few glimpses from Site Visit

At site

**Knowledge Institute of Technology (Autonomous)
Kakapalayam, Salem
(07 Apr)**



**Mepco Schlenk Engineering College (Autonomous)
Sivakasi
(08 Apr)**



**S.A. Engineering College (Autonomous)
Thiruverkadu, Chennai
(09 Mar)**



**Nandha Engineering College (Autonomous)
Vaikalmedu, Erode
(10 Apr)**





Few glimpses from Site Visit

At site

**Maulana Abul Kalam Azad
ITI, Sivakasi
(16 Apr)**



**Members with their
families from Rotary Club of
Madurai West
Madurai, (17 Apr)**



**Staffs from Kerala State
Electricity Board Limited
(KSEB)
Neyyattinkara, Kerala
(17 Apr)**



**Unnamalai Institute of
Technology
Kovilpatti
(20 Apr)**



 *Few glimpses from Site Visit*


At
site

**Nehru Nursing College
Vallioor, Tirunelveli
(Apr 21)**



**Alumni of the VTMNSS
College (1985-1987 Batch)
Dhanuvachapuram, Kerala
(Apr 21)**



**Members from Palukal
Vattara Thozhil Varthakar
Sangam
Palukal, Kanyakumari
(25 Apr)**



**Erode Sengunthar
Engineering College
(Autonomous)
Perundurai, Erode
(28 Apr)**



More on OS-5

In Russia's push toward a "closed nuclear fuel cycle", the **OS-5 fuel assembly** represents a critical evolution in fourth-generation fast reactor technology. The defining feature of the OS-5 fuel element is the use of a **liquid metal sublayer** (often lead or a lead-based alloy) between the fuel pellet and the cladding, replacing the traditional gas gap (usually helium).

-Thermal Conductivity: Nitride fuel has high thermal conductivity

- Expansion Management: The liquid sublayer acts as a "buffer," allowing the pellet to expand more freely without causing immediate mechanical stress or depressurization of the cladding

- Higher Burnup: Russia's current goal is to increase the average burnup of SNUPP fuel from the current 6% of heavy atoms to 12%. The OS-5 design is the vehicle intended to reach these higher efficiency targets by improving the mechanical and thermal reliability of the pins.

-Russia's OS-5 uses Nitride fuel. Nitride is "denser" than **MOX**, meaning more fissile material per volume, which improves the "breeding ratio" (making more fuel than you burn) and allows for a more compact core.

**OS-5**

The **OS-5 (Opytnaya Sboroka-5; Translated: Experimental Assembly-5)** is a novel nuclear fuel assembly developed by Rosatom (Russia) for fourth-generation fast neutron reactors, such as the BREST-OD-300. It features mixed nitride uranium-plutonium fuel with a liquid metal sublayer, which improves heat transfer, lowers operating temperatures, and reduces thermal expansion stress on cladding.

Key Features and Advantages:

Liquid Metal Sublayer: A unique layer between the fuel pellet and its protective cladding, which acts as a shock absorber.

Reduced Stress: The design reduces thermal expansion, preventing high pressure from the fuel pellet on the cladding and lowering the risk of depressurization.

Improved Efficiency: Designed to allow higher fuel burnup and support a closed nuclear fuel cycle.

Fast Reactor Focus: Specifically engineered for advanced fast reactors to improve economic efficiency and operational reliability.

The OS-5 assembly was developed by the Fuel Division of Rosatom and manufactured at the Siberian Chemical Plant. It is a critical component for Russia's Proryv (Breakthrough) project, aiming to advance fast-neutron reactor technology.



Fuel pellets are sealed inside a protective metal tube called cladding

The manufacture of the OS-5 fuel assembly is part of a large-scale programme of work to improve the efficiency of mixed nitride uranium-plutonium (SNUPP) nuclear fuel for the BREST-OD-300 fast neutron reactor. Since 2014, Rosatom scientists and engineers have been conducting pilot industrial operation of SNUPP fuel in the BN-600 reactor and post-reactor studies of irradiated fuel elements.

As a part of PA outreach activity, Seminars, Workshop, Lectures and exhibitions were conducted at Educational Institutions and Organizations.

PA lecture at CAPE Institute of Technology, Tirunelveli Dist.

EEE Department, CAPE Institute of Technology, Tirunelveli District organized a national level symposium.

Date: Apr 09, 2026

Shri A Madavan, Head(IS&F) KKNPP, participated as resource person and delivered a talk on "Nuclear Power Plant and its Safety Features" to the students and staff during the event.

PA lecture at Nellai College of Engineering Tirunelveli Dist.

Nellai College of Engineering, Maruthakulam, Tirunelveli district organized a college event "NEXORA 2026".

Date: Apr 10, 2026

Shri A. V. Sathish, OIC-Nuclear Information Centre, KKNPP, participated as resource person and delivered a talk on "Nuclear Power Plant and its Safety Features" to the students and staff during the event.



PA outreach programme conducted outside KKNPP:

Outside KKNPP

Date	Name of the Institution	No. of participants	Publications distributed
09 Apr	Cape Institute of Technology, Levengipuram, Tirunelveli	250	0
10 Apr	Nellai College of Engineering	350	0
17 Apr	St.Xavier's Catholic College of Engineering, Kanyakumari district	1300	0
21 Apr	Sri Sarada College for Women, Tirunelveli	700	0
Grand Total		2600	0

Few glimpses

PA lecture at CAPE Institute of Technology, Tirunelveli district On Apr 09, 2026



No. of participants 250



PA lecture Nellai College of Engineering, Maruthakulam, Tirunelveli district On Apr 10, 2026



No. of participants 350

PA lecture at St.Xavier's Catholic College of Engineering, Nagercoil

Tech Fest 2026 was organized at St.Xavier's Catholic College of Engineering, Nagercoil, KK District.

Date: Apr 17, 2026

Shri A. V. Sathish, OIC– Nuclear Information Centre, KKNPP, participated as the Chief Guest and delivered an motivational speech to the students on nuclear power and also the career opportunities in the nuclear sector.

PA Lecture at Sri Sarada College for Women Tirunelveli

The 37th Graduation Ceremony was organized at Sri Sarada College for Women Tirunelveli with great enthusiasm and academic spirit, with the participation of around 700 students.

Date: Apr 21, 2026

Smt. E. T. Vijaya Rani, Head (HR), Kudankulam Nuclear Power Project, attended the function as a distinguished guest. She conferred degrees upon the graduating students and delivered a motivational address encouraging them to pursue excellence, build confidence, and contribute meaningfully to society and nation-building through dedication, continuous learning, and positive values.



Few glimpses

Outside KKNPP

PA lecture at St.Xavier's Catholic College of Engineering, Nagercoil, KK Dist. on Mar 13, 2026



No. of participants: 1300



PA lecture at Sri Sarada College for Women Tirunelveli on Apr 21, 2026





Feature article

Nuclear Energy and Sustainable Development

Source: World Nuclear Association



Role of BHAVINI in India's Nuclear Programme

► "BHAVINI is crucial for India as it operates fast breeder reactors that ensure fuel sustainability, enable thorium utilization, and strengthen long-term energy security and technological self-reliance."



► **Backbone of Stage-II Nuclear Programme:** Operates Fast Breeder Reactors (FBRs), Converts U-238 → Pu-239 and Essential step linking uranium use to thorium utilization

► **Enables Thorium-Based Future:** Provides fissile material required for Stage-III (Thorium cycle), Supports India's long-term goal of U-233 based reactors

► **Energy Security & Sustainability:** FBRs produce more fuel than they consume, Reduces dependence on imported uranium. Thus Ensures long-term fuel availability

► **Indigenous Technology Development:** Strengthens self-reliance (Atmanirbhar Bharat)

► **Strategic & Global Importance:** Positions India among few countries with FBR capability

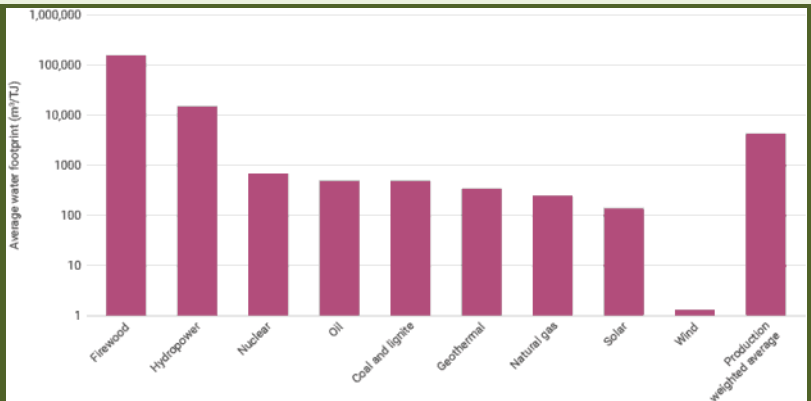
► **Bridge to Future Nuclear Systems:** Supports development of Generation-IV reactors and Advanced fuel cycles

Source: www.pib.gov.in, www.indiascienceandtechnology.gov.in, www.neimagazine.com,

The environmental pillar

Land and water use :

Whilst nuclear power plants require significant quantities of water for cooling, their ability to provide large amounts of power is increasingly being used to secure water supplies in areas of scarcity. Where potable water cannot be obtained from streams and aquifers, desalination of seawater, mineralized groundwater or urban waste water is required. Most desalination at present is powered by fossil fuels, but nuclear desalination has been used for many years in countries such as Japan, India and Kazakhstan.



Water consumption per unit of electricity and heat produced 2008-2012 (source: Mekonnen et al., 2015)

Waste: The careful management of waste streams is a key sustainability consideration in order to prevent short- or long-term harm to humans and the environment. All energy-producing technologies create waste, but the amount produced, the risk it poses, and the means of management vary widely.

The energy density of fuel used for electricity generation is one key determinant of the magnitude and manageability of waste streams. Uranium's exceptionally high energy density means a relatively small amount of fuel is required per unit of energy produced. Using less fuel reduces the scale of fuel extraction activities and transport requirements – in turn reducing the chance of unintended environmental releases – and results in the creation of less waste. Contrary to popular belief, therefore, one of the benefits of producing electricity from nuclear energy is that its waste streams are small, and therefore innately manageable. It is for this reason that nuclear energy is the only form of electricity generation to fully contain its emissions, effluents and waste.





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Why is Helium-3 (^3He) considered the "Holy Grail" of future fusion fuel?

The Challenges Remaining:

Despite its advantages, Helium-3 is currently viewed as a second or third-generation fusion fuel because of significant hurdles:

Extremely High Temperatures required:

Fusing Helium requires temperatures far higher than the 150 million degrees Celsius needed for D-T fusion, making it much harder to achieve.

Logistics of Mining:

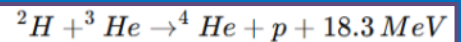
Extracting from lunar soil requires massive industrial operations on the Moon and transportation back to Earth.

Minor Neutron Generation:

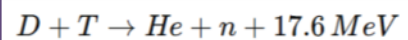
Even in a reactor, secondary D-D reactions can occur, which still produce some neutrons, meaning fusion is "low-neutron" rather than truly zero-neutron.

Source: Wikipedia,
www.helionenergy.com,
www.energyencyclopedia.com,
next.101.school

Helium-3 (^3He) is considered the "Holy Grail" of future fusion fuel primarily because it offers the promise of aneutronic fusion—a reaction that generates immense energy without producing high-energy neutrons, thus avoiding the radioactive waste and material degradation challenges associated with current fusion experiments. The key reaction:



While traditional Deuterium-Tritium (D-T) fusion generates neutrons that turn reactor walls radioactive. Most current fusion research (like D-T fusion) produces high-energy neutrons:



Fusion (typically with Deuterium) produces charged particles, making the process cleaner, safer, and potentially more efficient.

Here is why Helium-3 is considered the ultimate fusion fuel:

1. Cleaner and Safer Energy Production

- **Aneutronic/Low-Neutron Yield:** Unlike D-T fusion, the Deuterium-Helium-3 (^3He -D) reaction produces few neutrons.
- **Direct Electricity Conversion:** Because fusion produces charged particles (protons and alpha particles) rather than neutral neutrons, the energy can, in theory, be converted directly into electricity using electromagnetic fields, bypassing the need for inefficient heat-based steam turbines. This could theoretically offer efficiencies of 60%–70%.
- **No Radioactive Fuel:** Helium-3 is non-radioactive, unlike Tritium, which is used in conventional fusion experiments. Helion +6

2. Massive Energy Potential

- **Abundant Supply on the Moon:** While extremely rare on Earth, He-3 is deposited on the Moon by solar winds. Estimates suggest 1–1.1 million tons of it are embedded in the lunar regolith.
- **Power for Centuries:** It is estimated that 25–40 tonnes of He-3 could power the entire United States for a year. The total lunar supply could potentially satisfy global energy needs for thousands of years.
- **High Power Density:** One ton of He-3 can produce 10000 Mwe of electrical energy.