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The Transformation of India's Uranium Dominion: Strategies for Nuclear Ambition

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Abstract:
India's audacious 2025 policy reforms, which dismantle the erstwhile state monopoly on uranium exploration, mining, and imports, herald a transformative epoch for its nuclear energy dominion. These reforms are indispensable to achieving a twelvefold augmentation of nuclear power capacity to 100 GW by 2047, consonant with the Viksit Bharat vision and the nation's solemn pledge to attain net-zero emissions by 2070. This treatise, composed for erudite scholars, policymakers, corporate magnates, and governmental authorities, presents a meticulous disquisition on India's uranium resources, energy imperatives, supply-demand disparities, domestic and international stratagems for resource acquisition, the rationale for liberalisation, and the exigent need for cultivating a skilled cadre. Anchored in authoritative sources such as the IAEA/NEA *Uranium 2024* report and recent policy pronouncements, it propounds a robust framework for workforce reskilling and upskilling, emphasising synergistic industry-academia collaboration to ensure sustainable progress and global pre-eminence in clean energy.

Keywords: Uranium liberalization, Nuclear expansion, Workforce development, Reskilling, Industry-academia collaboration, Energy security, Sustainable growth

1. Global Uranium Deposit Types and Occurrences

Uranium deposits are classified based on geological settings, with the IAEA's UDEPO database identifying several key types (Fig. 1) (Dhurandhar 2004, 2007, 2009, and IAEA 2024). An overview of major deposit types and their global occurrences based on the latest available data are given below:

- **Unconformity-related Deposits**: Found primarily in Canada (Athabasca Basin, 53 deposits) and Australia (21 deposits). These are high-grade deposits associated with unconformities between sandstone and basement rocks. They account for 79 deposits globally with significant resources (e.g., Canada's 1,074,449 tU).
- **Sandstone Deposits**: The most numerous, with 384 deposits globally, prominent in Kazakhstan (25 deposits), the USA (152 deposits), Uzbekistan (24 deposits), and Niger (28 deposits). These are typically low- to medium-grade but large in volume, often mined using in-situ leaching (ISL).
- **Hematite Breccia Complex Deposits**: Notable in Australia (7 deposits, e.g., Olympic Dam) and South Africa (26 deposits). These are associated with iron oxide-copper-gold systems and hold significant resources (e.g., Australia's 1,939,970 tU).
- **Quartz-pebble Conglomerate Deposits**: Found in South Africa (26 deposits) and Canada (8 deposits). These are older, low-grade deposits but historically significant (e.g., South Africa's 426,265 tU).

- **Volcanic-related Deposits**: Present in Australia (4 deposits), China (4 deposits), and Mongolia (4 deposits). These are associated with volcanic rocks and have moderate resources.
- **Intrusive Deposits**: Found in Namibia (10 deposits) and Canada (16 deposits), often linked to granitic intrusions. Namibia's resources are significant at 444,221 tU.

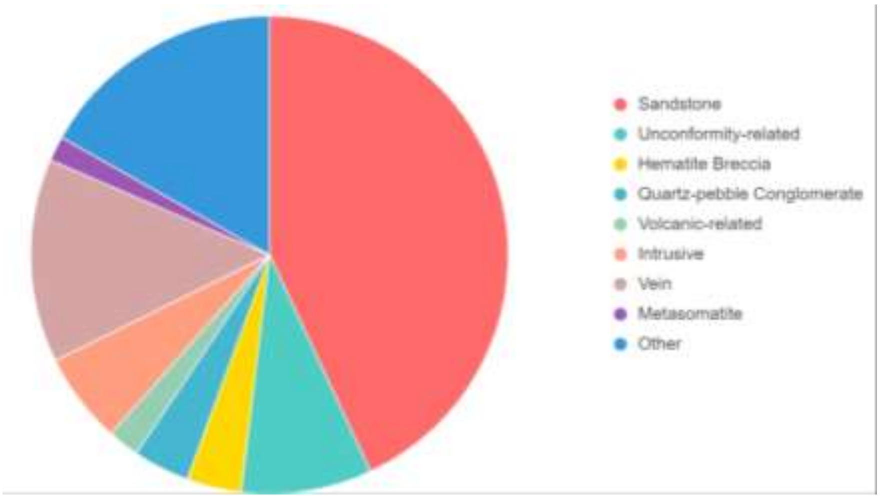

Fig. 1 Global Uranium Deposits by type (Number of Deposits)

- **Vein Deposits**: Common in France (32 deposits), Kazakhstan (27 deposits), and Russia (20 deposits). These are structurally controlled and vary in grade and size.
- **Metasomatite Deposits**: Occur in Russia (10 deposits) and Ukraine (4 deposits), associated with sodium metasomatism.
- **Other Types**: Include metamorphic, surficial, collapse breccia pipe, phosphorite, lignite, skarns, and black shale deposits, totalling 150 deposits globally (e.g., USA's 20 deposits, Morocco's 4 phosphorite deposits, Madagascar).

Total global uranium deposits number 1,024, with resources estimated at 11,462,607 tU, though exact figures may vary due to incomplete data (Fig. 2a and 2b). In 2023, global recoverable uranium resources remain steady at approximately 6.1 million tonnes at a cost of up to \$130/kg U, consistent with 2021 estimates but refined with updated exploration data, particularly for Uzbekistan and Mongolia (Fig. 3). Australia leads with 28% of global reserves, driven by the Olympic Dam mine, while Kazakhstan's reserves, at 736,000 tonnes in 2024 data, are slightly lower due to revised cost thresholds. The "Rest of World" category, including smaller contributors like Finland and Zimbabwe, accounts for 7% of reserves. Increased exploration spending (USD 800 million in 2022, projected USD 840 million in 2023) has bolstered estimates, with total resources reaching 7.9 million tonnes at \$260/kg U. Unconventional sources, such as phosphate rocks, could add 9–22 million tonnes if viable, ensuring supply for nuclear demand through 2050, though sustained investment is essential. Major producers include Kazakhstan, Canada, Australia, Namibia, and Niger, with Kazakhstan leading production at ~43% of global output in recent years (Table 1) the global uranium demand-supply and production are depicted in Fig.4.

Table 1: Global known Recoverable Uranium Resources

Country	Uranium Resources (tonnes)	Share of Global Reserves (%)

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Australia	16,84,100	28%
Kazakhstan	7,36,000	12%
Canada	5,88,700	10%
Russia	4,70,100	8%
Namibia	4,70,100	8%
Uzbekistan	3,85,000	6%
South Africa	3,20,900	5%
Niger	3,11,100	5%
Brazil	2,76,100	5%
China	2,23,900	4%
Mongolia	57,000	1%
Ukraine	57,000	1%
Rest of World	4,49,500	7%
Total	**60,75,200**	**100%**

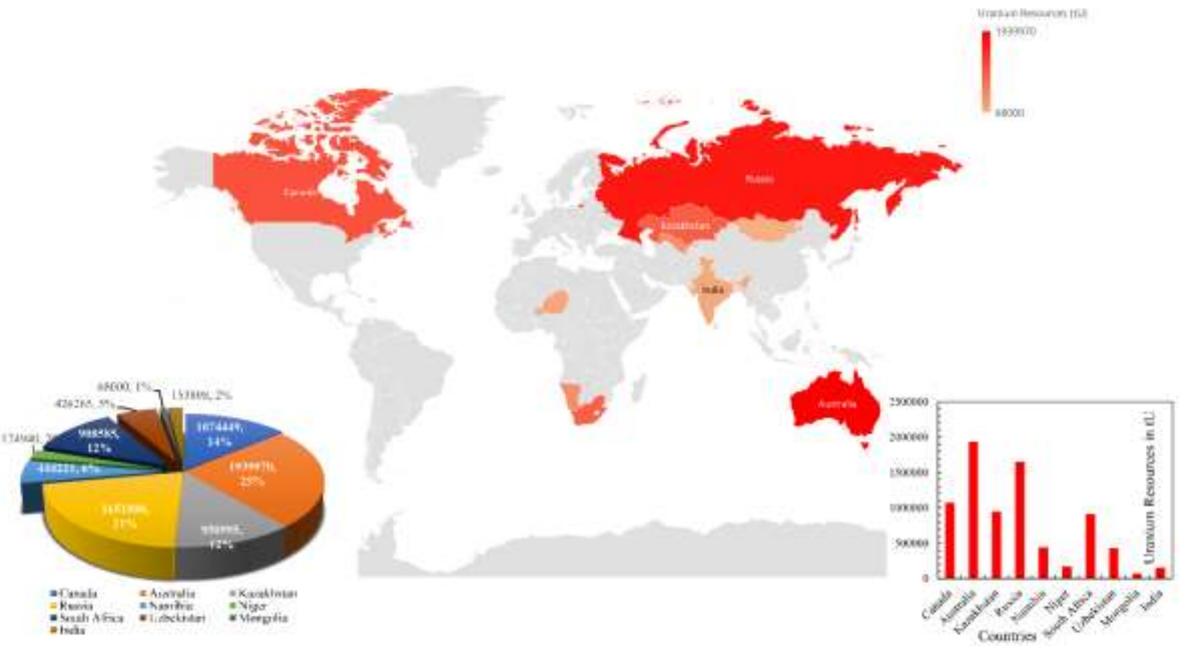

Fig. 2: Uranium Resources by key countries /Regions, Bar chart and pie chart showing the uranium resources by countries in the inset figures.

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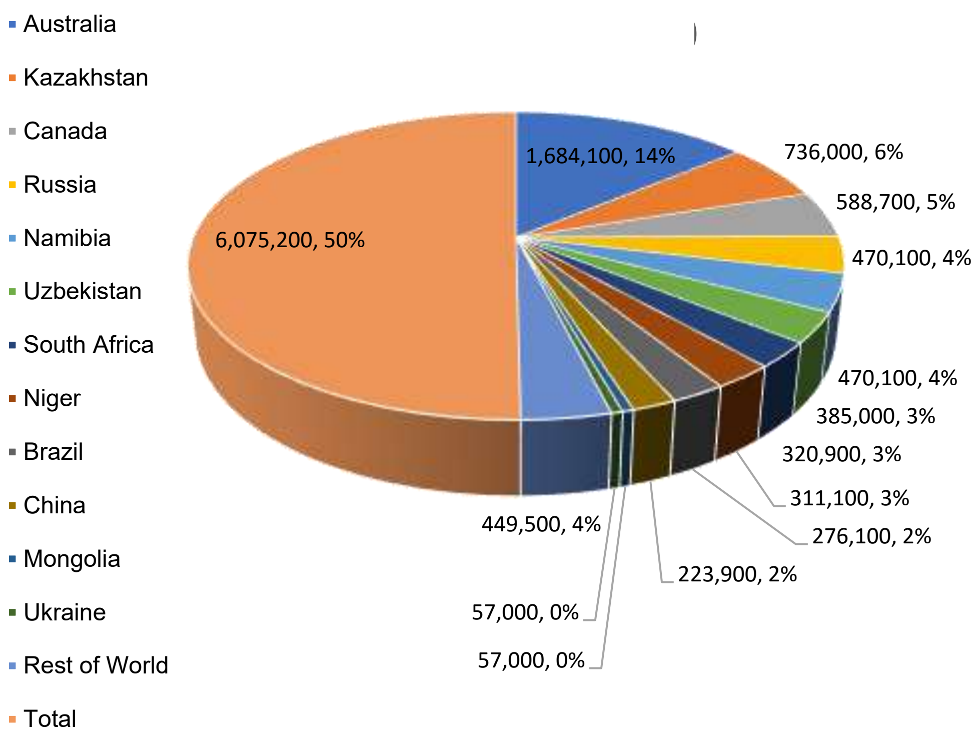

Fig. 3: Global Recoverable Uranium Resources in tU and in % share.

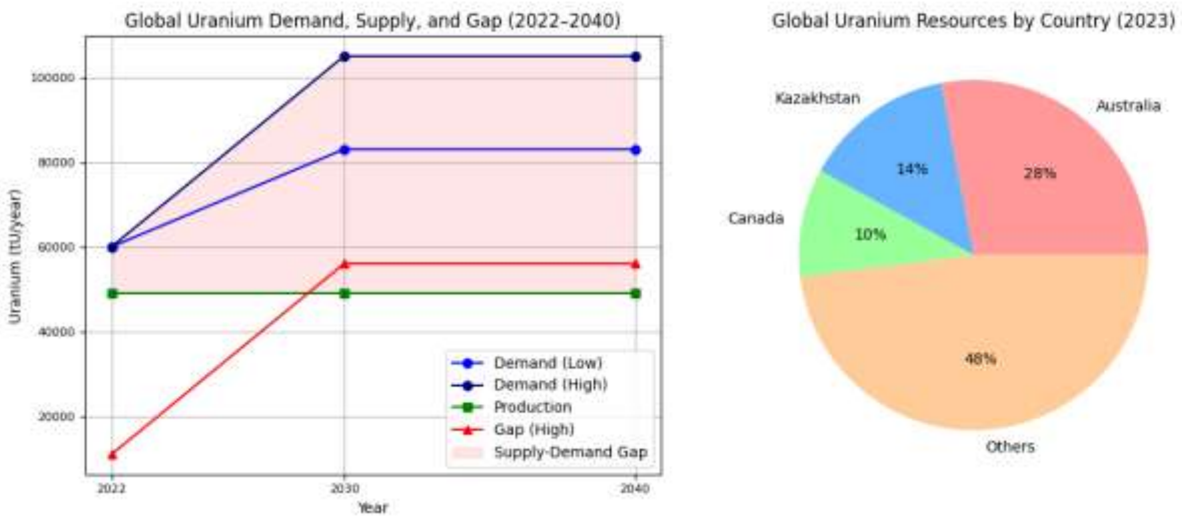

Fig. 4: Global uranium demand-supply and global uranium resources distribution by countries.

2. India's Uranium Resources and Reserves

India's uranium resources are limited, with only a small part of its landmass geologically favourable for deposits. The *Journal of the Geological Society of India* (2022) and the Red Book highlight: India has 11 known uranium deposits, including unconformity (3), sandstone (2), vein (4), metasomatite (1), and other types (1). Total identified resources are ~153,898 tU, with major deposits in Jaduguda (Jharkhand), Tummalapalle (Andhra Pradesh), and Cuddapah Basin. Grades are lower than the global average, posing extraction challenges. India's uranium endowments, though noteworthy within its borders, are but a modest fraction when juxtaposed against the prodigious reserves of nations such as Australia and

Kazakhstan, which command 1.7 million tU and 906,800 tU, respectively. The IAEA/NEA *Uranium 2024: Resources, Production and Demand* avers that India possesses 252,500 tonnes of uranium (tU) recoverable at costs below USD 260/kgU, with in-situ estimates reaching 335,000 tU (Table 2). The Department of Atomic Energy (DAE) posits a marginally higher figure of 292,867 tU in-situ, encompassing 282,401 tU as reasonably assured resources, fortified by recent discoveries yielding 13,230 tU in Andhra Pradesh, Jharkhand, and Rajasthan. Principal deposits include Jharkhand's Jaduguda, Turamdih, and Mohuldih, collectively holding approximately 70,000 tU; Andhra Pradesh's Tummalapalle, the nation's largest at 120,229 tU; Telangana's Lambapur-Peddagattu; and Meghalaya's Domiasiat-Mawthabah with 9,500 tU. These reserves, predominantly low-grade at 0.1–0.2% U_3O_8, necessitate costly extraction at USD 130–260/kgU, far exceeding the global mean of USD 40–80/kgU. In 2023, India's output languished at a mere 485 tU, constituting a paltry 1% of global production, processed at facilities such as Jaduguda (2,500 t/day) and Tummalapalle (3,000 t/day, expanding to 4,500 t/day). Geological intricacies, exorbitant extraction costs, and societal opposition profoundly curtail domestic production, satisfying a mere 36–40% of extant demand (IAEA/NEA, 2024; Department of Atomic Energy, 2021). The resources and reserves figure claimed by AMD are likely to be revised as most of the deposits are over projected so the independent evaluations under the standard classifications by JORC, NI43-101, CRIRSCO, or IAEA classification will further reduce the figures at least by 30%.

Table 2: India's Uranium Resources and Production (2022–2040)

Category	**2022 Actual**	**2030 (Low)**	**2030 (High)**	**2040 (Low)**	**2040 (High)**
Recoverable Resources (tU)	252,500	252,500	252,500	230,000	230,000
In-Situ Resources (tU)	335,000	335,000	335,000	300,000	300,000
Production (tU/year)	488	960	1,300	960	1,300
Key Sites	Jaduguda, Tummalapalle	Jaduguda, Tummalapalle, New Mines	Same	Same	Same

Sources: IAEA Red Book 2024, DAE 2021

3. Energy Imperatives and the Nuclear Imperative

With a populace exceeding 1.4 billion and an economy burgeoning with unparalleled vigour, India confronts an insatiable demand for energy that necessitates a robust, low-carbon paradigm. As of 2025, nuclear power contributes a modest 3% to the nation's electricity, generating 48.2 TWh from 25 reactors with a combined capacity of 8.88 GWe. The Viksit Bharat vision aspires to an ambitious 100 GWe by 2047, furnishing 9–10% of India's electricity to satiate rising demand whilst fulfilling the solemn covenant of net-zero emissions by 2070. Nuclear power's steadfast reliability, scalability, and zero-carbon credentials render it an indispensable bulwark, complementing renewables and facilitating hydrogen production for a sustainable economic tapestry. By 2031, India aims to amplify capacity to 22.48 GWe, with 11 reactors (8.7 GWe) under construction, encompassing Pressurized Heavy Water Reactors (PHWRs) and Kudankulam VVERs. The advent of Bharat Small Modular Reactors (SMRs) by 2033 promises enhanced efficiency and diminished uranium intensity. Yet, the paucity of domestic uranium imperils this lofty ambition, underscoring the imperative for sagacious resource strategies (World Nuclear Association, 2023; Government of India, 2025).

4. Demand, Supply, and the Widening Chasm

India's nuclear aspirations are fettered by a profound disparity between uranium demand and supply. In 2022, the 8.88 GWe capacity demanded approximately 1,350 tU annually, with reactor-specific requisites varying: 220 MW PHWRs consume ~45 tU/year, 540 MW PHWRs ~100 tU/year, and 700 MW PHWRs ~125 tU/year at an 85% capacity factor. Domestic production, however, languished at 488 tU, meeting a mere 36% of demand, with imports bridging the 862 tU shortfall. Projections portend a steep escalation, with capacity expansion to 15–20 GWe by 2030 necessitating 2,000–3,000 tU/year, and cumulative imports projected at 9,000 tU from 2025–2033, a fourfold surge from the 2,600 tU imported between FY20–FY24 (Table 2). By 2050, demand may soar to 6,000–12,000 tU/year to sustain 50–100 GWe, precipitating a cumulative shortfall of 100,000–200,000 tU (Table 3). The historical spectre of fuel paucity, exemplified by 40% reactor load factors in 2008 due to pre-NSG trade embargoes, underscores the urgency of redressing this chasm (Fig. 5). Domestic production, forecast to plateau at 960–1,300 tU/year by 2030–2040 absent significant intervention, renders imports and abroad mining indispensable (IAEA/NEA, 2024; World Nuclear Association, 2023, Table 3).

Table 3: India's Uranium Demand and Supply Projections (2022–2050)

Year	Capacity (GWe)	Demand (tU/year, Low)	Demand (tU/year, High)	Domestic Production (tU/year)	Shortfall (tU/year, High)
2022	8.88	1,350	1,350	488	862
2030	15–20	2,000	3,000	960–1,300	1,700–2,040
2040	40–60	4,000	6,000	960–1,300	4,700–5,040
2050	50–100	6,000	12,000	960–1,300	10,700–11,040

Sources: IAEA/NEA (2024), World Nuclear Association (2023).

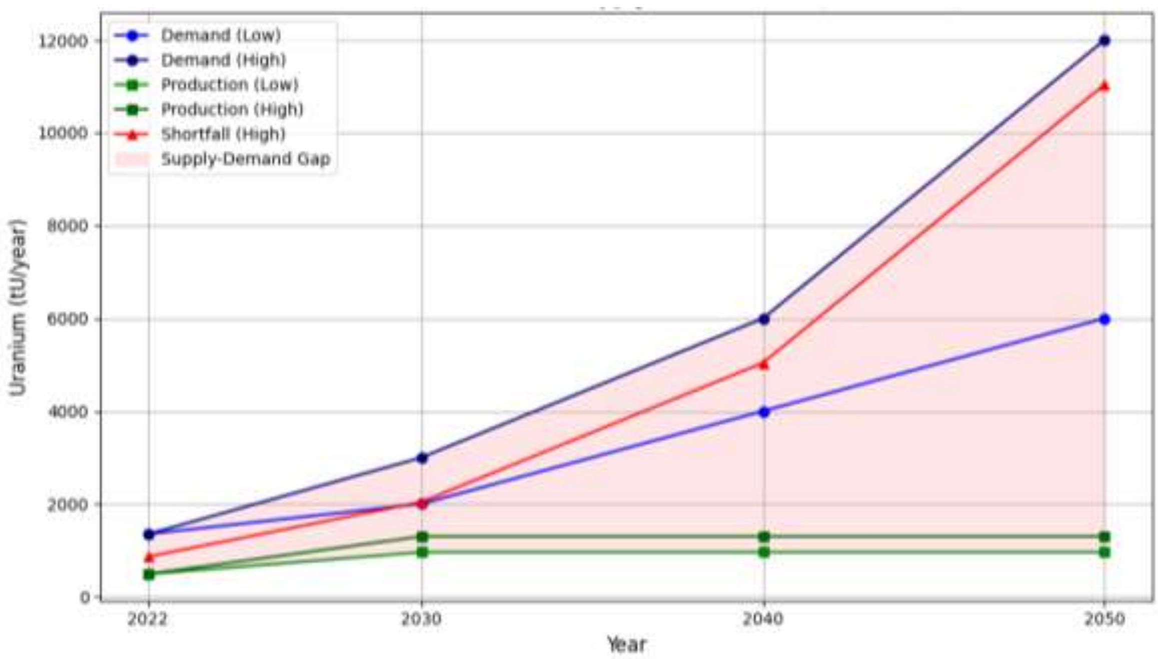

Fig.4: India's Uranium demand, supply and shortfall (2022-2025)

5. Stratagems for Securing Uranium: Domestic and International Ventures

To surmount the supply-demand chasm, India must orchestrate a dual strategy of domestic augmentation and international enterprise. Domestically, the Atomic Minerals Directorate (AMD) has intensified exploration, expending USD 75 million in 2023 and drilling 900,333 meters from 2020–2023 across regions like Cuddapah and Singhbhum Shear Zone. Nascent projects, such as Gogi and Lambapur-Peddagattu, each yielding 130 tU/year, aim to elevate production to 960–1,300 tU/year by 2030. Yet, low-grade ores, societal opposition in regions like Meghalaya, and protracted mine development timelines (10–15 years) impede scalability. On the global stage, the 2025 policy reforms empower private Indian firms to pursue abroad mining in uranium-rich domains such as Kazakhstan, Canada, and Australia through alliances with titans like Kazatomprom and Cameco, or in African nations like Namibia and Niger. Imports, presently fulfilling 60–70% of demand, are pivotal, with 4,458 tU secured by 2014 and 9,000 tU projected by 2033. Principal suppliers include Kazakhstan (5,000 tU from 2009–2019, targeting 20–30% of imports), Russia (TVEL's $780M contracts for 2,000 tU, targeting 30–40%), Australia (2015 agreement, targeting 15–25%), and Africa (Namibia and Niger, targeting 10–20%). These stratagems, buttressed by governmental incentives, are vital to securing supply amidst global competition (IAEA/NEA, 2024; WNA 2025, Table 4).

Table 4: Import Sources and Projections (2025–2050)

Region/Country	Production (tU) 2022	Current Share	Projected Share (2030–2050)	Key Contracts
Namibia	5,612	5–10%	10–15%	2009 Agreement
Niger	2,000	0–5%	5–10%	Post-2008 Exploration

Kazakhstan	21,279	20–25%	20–30%	5,000 tU (2009–2019), 2,000 tU
Uzbekistan	3,561	5–10%	10–15%	2,000 tU (2014–2018), 350 tU
Russia	2,600	25–30%	30–40%	TVEL $780M, Kudankulam Fuel
Australia	4,555	0–5%	15–25%	2015 Agreement

Sources: IAEA Red Book 2024, WNA 2025.

Uranium Resources from Africa and CIS Breakaway Republics, Russia, and Mongolia

Africa is a significant player in global uranium production, with substantial resources primarily in sandstone and intrusive deposits. Niger holds 174,940 tU across 28 sandstone deposits, with major mines like Somair and Cominak utilizing in-situ leaching (ISL), though political instability has disrupted production. Namibia, with 444,221 tU in 24 mostly intrusive deposits, is a leading global supplier through mines like Rössing and Husab, contributing 5,613 tU in 2022. South Africa has 908,585 tU across 30 deposits (hematite breccia and quartz-pebble conglomerate), but production remains limited due to environmental and regulatory constraints. Tanzania's 63,056 tU in three deposits, particularly the Mkuju River project with Russia's Rosatom, positions it as an emerging producer with a $1.2 billion investment. Other countries like Botswana (29,934 tU), Malawi, and Zambia (15,950 tU) have smaller resources but are seeing growing exploration interest. Madagascar, though not listed among the top producers, has significant potential with 72,600 tU estimated across five deposit types (hydrothermal-metasomatic, sandstone, hydrothermal-magmatic, pegmatite, and heavy mineral placer), particularly in regions like Tranomaro and Antsirabe, with historical mining at Vatovory and Bekitoly (Dhurandhar 2004, 2007, and 2009).

CIS Breakaway Republics, Russia, and Mongolia: Kazakhstan leads global uranium production with 950,995 tU across 67 sandstone deposits, producing 21,227 tU in 2022 using cost-effective ISL methods at mines like Inkai and Tortkuduk. Uzbekistan, with 426,265 tU in 34 deposits, is a key supplier for India, also using ISL for sandstone deposits. Russia, holding 1,651,800 tU across 80 diverse deposits, supplies 27% of U.S. enriched uranium and is a major exporter to India, though geopolitical tensions may impact future trade. Mongolia's 68,000 tU in eight volcanic and sandstone deposits remains underdeveloped but shows promise for future supply through exploration. Smaller players like Kyrgyzstan (11,837 tU), Tajikistan (6,701 tU), and Ukraine (283,780 tU) face political and infrastructural challenges, limiting their output. These regions collectively hold ~3.1 million tU, ensuring long-term resource availability despite geopolitical risks (Dhurandhar 2009).

Resource Availability

Africa's uranium resources total ~1.9 million tU, with Namibia and Niger offering stable, high-volume supply through flagship operations like Husab and Somair, though Niger's political risks and South Africa's environmental concerns constrain production. Tanzania's Mkuju River project could add significant capacity if fully developed. Madagascar's 72,600 tU, distributed across crystalline basement (66%) and sedimentary formations (33%), remains largely untapped, with exploration ongoing in areas like Tranomaro and Bekitoly. In the CIS, Kazakhstan and Uzbekistan provide reliable, cost-efficient ISL-based supply, while Russia's large resource base and enrichment capabilities make it a critical player, though U.S. sanctions by 2028 may disrupt trade. Mongolia's resources are promising but require significant investment. Globally, ~8 million tU of identified resources can sustain current consumption for over 100 years, but regional production constraints necessitate strategic sourcing for countries like India (Dhurandhar 2004, 2007, and 2009).

India's Options in Africa and CIS

India can secure uranium supply by leveraging diplomatic and trade ties. In Africa, Namibia offers long-term contracts through Rössing and Husab, supported by strong bilateral relations. Niger's Somair and Cominak mines, operated by Orano, are viable despite political risks, requiring careful navigation. Tanzania's Mkuju River project, backed by Rosatom, aligns with India's ties to Russia, offering potential offtake agreements. South Africa's dormant mines could be revived through partnerships, though stringent regulations pose challenges. In the CIS, expanding agreements with Kazakhstan's Kazatomprom ensures stable ISL-based supply, while Uzbekistan's Navoi Mining provides cost-effective uranium. Russia remains a reliable supplier of enriched uranium, despite geopolitical risks, and Mongolia offers opportunities for exploration and joint ventures leveraging India's mining expertise. Madagascar could be a future option for India, given its 72,600 tU potential and proximity, though it requires investment in exploration and infrastructure development.

SWOT Analysis of India's Uranium Strategy

Strengths: India's 22 operational reactors and expansion plans demonstrate robust nuclear infrastructure. Strong diplomatic ties with Russia, Kazakhstan, and Uzbekistan ensure reliable import channels, while expertise in processing low-grade ores (e.g., Tummalapalle) supports domestic efforts (Fig.5).

Weaknesses: Limited domestic resources (~153,898 tU) cover only ~40% of demand, forcing heavy import reliance. Slow domestic exploration and mine development exacerbate supply vulnerabilities, exposing India to global market and geopolitical risks (Fig.5).

Opportunities: India can expand imports from stable African suppliers like Namibia and emerging ones like Tanzania, leveraging Rosatom partnerships. Strengthening ties with Kazakhstan and Uzbekistan ensures cost-effective supply, while Mongolia's untapped 68,000 tU offers long-term investment potential. Recent policy reforms allowing private sector involvement in mining and imports could enhance supply chains. Madagascar's resources, particularly in Tranomaro and Antsirabe, present an untapped opportunity for joint ventures (Fig.5).

Threats: Political instability in Niger, Ukraine, and Russia, coupled with potential sanctions, threatens supply reliability. Global uranium price volatility impacts import costs, while environmental and regulatory challenges in Africa (e.g., South Africa, Namibia) could limit output. Competition from China for African and CIS resources adds pressure. Madagascar's environmental risks, tied to radioactive by-products, and governance issues could complicate development (Fig.5).

The SWOT analysis shows in Fig.5 The strengths in Nuclear Infrastructure and Diplomatic Ties, both scoring 8 out of 10, with Ore Processing also strong at a score of 7. The main weaknesses are Limited

Resources and Import Reliance, both at 6, and Slow Exploration at 5. For opportunities, African Supply and CIS Partnerships both score 7, while Domestic Reforms score 6. The primary threats are Geopolitical Risks and Price Volatility, both with scores of 6, and Competition at 5.

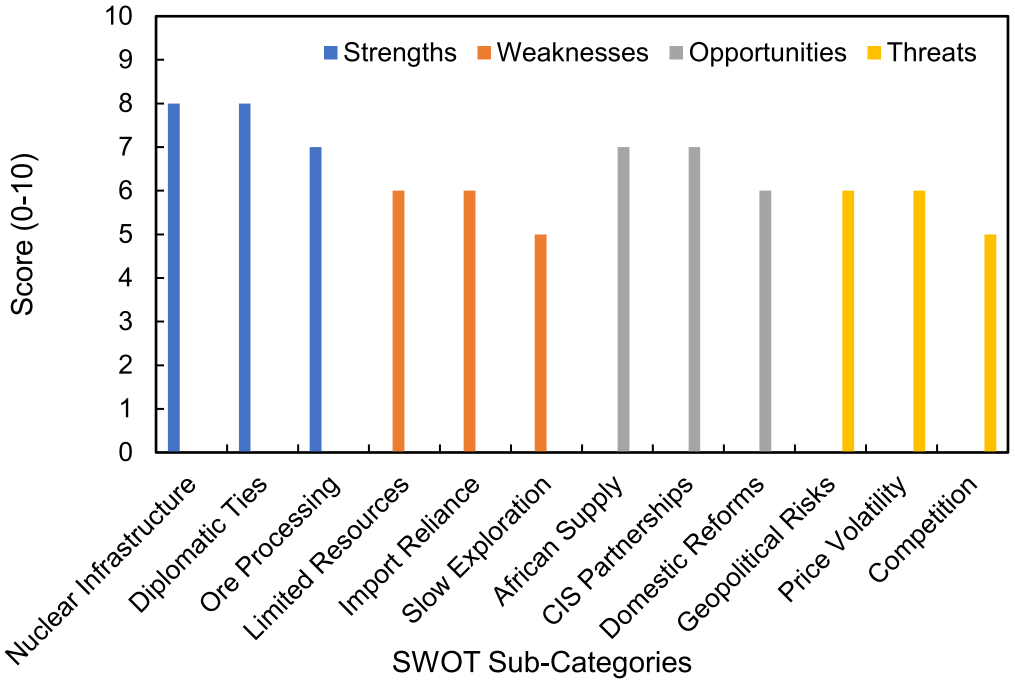

Fig. 5: SWOT Analysis of India's uranium Strategy

6. Rationale for Dismantling the State Monopoly

For nigh on six decades, the Atomic Energy Act of 1962 vested uranium exploration, mining, and processing exclusively in the Uranium Corporation of India Limited (UCIL), stifling progress. This state monopoly constrained investment, with a mere USD 75 million allocated to exploration in 2023, and retarded project development through bureaucratic lethargy and public dissent, as evidenced by Meghalaya's Domiasiat-Mawthabah project. The paucity of private expertise further curtailed workforce development, leaving India ill-prepared for escalating uranium demands. In 2022, domestic production met only 36% of the 1,350 tU required, necessitating heavy reliance on imports. The 2025 reforms, promulgated in the Union Budget, dismantle this monopoly by amending five statutes, including the Atomic Energy Act, to permit private firms to engage in mining, imports, and processing, with up to 49% Foreign Direct Investment (FDI). This liberalisation seeks to attract prodigious capital, potentially augmenting production by 500–1,000 tU/year by 2030, enhance operational alacrity through cutting-edge technologies, and diversify supply chains by enabling direct imports

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Table 5: Investment Opportunities (2025–2040)

Strategy	Potential Impact (tU/year)	Timeline	Key Partners
Private Mining	500–1,000	2027–2035	Domestic Firms, Cameco
FDI in Processing	200–500	2030–2040	Holtec, Westinghouse
SMR Deployment	Reduce demand by 10–20%	2033–2050	GE-Hitachi, Rosatom

Multilateral Agreements	Assured 1,000–2,000	2025–2040	IAEA, Russia

Sources: IAEA/NEA (2024), World Nuclear Association (2025).

By aligning with Nuclear Suppliers Group (NSG) and IAEA safeguards, these reforms facilitate technology transfers and fortify global partnerships, positioning India to realise its nuclear ambitions whilst upholding non-proliferation commitments (Government of India, 2025, IAEA/NEA 2024, World Nuclear Association, 2025; Table 4).

7. The Imperative for Workforce Cultivation

The liberalisation of India's uranium sector demands a cadre of consummate professionals, necessitating rigorous reskilling and upskilling across manifold disciplines. Geoscientists must attain mastery in radiometric surveying with instruments such as Geiger counters and gamma-ray spectrometers, and advanced gamma ray spectrometry, uranium equilibrium disequilibrium in uranium assays, portable field equipment's like portable XRF, palm tops for recording field data alongside multispectral remote sensing at visible and near infrared region (VNIR), hyperspectral remote sensing and GIS geophysical methods like airborne gamma-ray spectrometry, electromagnetics and aeromagnetic to discern uranium deposits. Proficiency in geochemical analysis and the safe handling of radioactive samples is paramount, as is expertise in exploration drilling techniques like core drilling to mitigate environmental impact. Adherence to Atomic Energy Regulatory Board (AERB) and AMD protocols is non-negotiable. Mining engineers require erudition in specialised techniques such as in-situ recovery (ISR) for sandstone deposits and cut-and-fill methods for deep-seated ores, with an unwavering focus on radiation safety, encompassing the monitoring of radon gas and dust. Advanced ventilation systems and radioactive waste management are indispensable to avert environmental contamination. Mineral processing engineers must excel in hydrometallurgical processes, such as acid and alkaline leaching and solvent extraction, to produce uranium oxide concentrate, whilst vigilantly managing radiation levels and treating radioactive effluents. Instrumentation engineers are tasked with maintaining critical equipment, whilst physicists and chemists devise sophisticated radiation detection systems. Software savants are essential to implement artificial intelligence for geological modelling and blockchain for supply chain transparency (Dhurandhar 2004, 2007, and 2009).

To address these exigencies, the National Skill Development Corporation (NSDC) and the National Critical Minerals Mission (NCMM), with its Rs. 100 crore training allocation, must institute uranium-focused certification programmes. Private firms entering the sector should establish in-house training, leveraging alliances with global luminaries like Cameco to impart practical expertise. Academic institutions, including the Indian Institutes of Technology (IITs), the Indian School of Mines (ISM) Dhanbad, and the Homi Bhabha National Institute (HBNI), must expand curricula to encompass uranium-specific modules, with NIT Raipur's MTech in Nuclear Geology serving as an exemplar. Digital platforms such as Coursera and SWAYAM offer scalable avenues for disseminating knowledge in pertinent fields. Gender inclusivity, through scholarships and bespoke training initiatives, is imperative to forge a diverse workforce. Challenges encompass historical skill deficits, regulatory delays in implementing reforms, and societal opposition to mining ventures. To surmount these, India must establish DAE-led uranium training academies to cultivate 5,000 professionals by 2030, proffer tax incentives for private sector training, forge global partnerships for best practices, promote lifelong learning through SWAYAM, and equip professionals with acumen in community engagement to assuage social concerns (Pandey and Vishwakarma, 2024).

Conclusion

India's uranium sector stands at a pivotal crossroads, with the 2025 reforms poised to metamorphose its nuclear energy landscape. Constrained by modest domestic resources (252,500 tU) and meagre production (485 tU in 2023), India must orchestrate a multifaceted strategy encompassing enhanced domestic exploration, abroad mining ventures, and diversified imports from Kazakhstan, Russia, Australia, and Africa. The emancipation from state monopoly to private sector participation unlocks vast reservoirs of capital, expertise, and efficiency, addressing a projected 100,000–200,000 tU shortfall by 2050. Yet, the linchpin of this endeavour lies in cultivating a skilled cadre through targeted reskilling, academic innovation, and global alliances. By executing these stratagems with unwavering resolve, India shall secure its uranium supply, propel sustainable energy growth, and ascend as a paragon of clean energy on the global stage, fulfilling the Viksit Bharat vision and its net-zero covenant by 2070.

To secure India's uranium supply and advance its nuclear ambitions, the government should fast-track private mining reforms by 2027, diversify imports to source 20–30% from CIS countries, 30–40% from Russia, 15–25% from Australia, and 10–20% from Africa, while investing in thorium and small modular reactors (SMRs) for post-2035 self-reliance. Strengthening multilateral ties through deeper engagement with the IAEA, NSG, and BRICS, alongside expanding training at the Global Centre for Nuclear Energy Partnership (GCNEP) to support 100 GWe operations, will enhance capacity. Additionally, addressing community opposition to mining and maintaining a strategic stockpile of 2,000–3,000 tU will mitigate geopolitical risks and ensure supply stability.

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