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The Power to Empower

VIKSIT BHARAT 2047

WOMEN IN STEM AND INDIA'S GROWTH VISION

September 2025

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The Power of Empower

Foreword by

Poonam Sharma, President, FICCI FLO

The vision for a 'Viksit Bharat 2047' is not merely an economic target; it is a commitment to harnessing the full potential of our nation. This insightful white paper, "Women in STEM and India's Growth Vision," compellingly argues that our most powerful, yet underleveraged, asset is our women in STEM. At FICCI FLO, we have long championed the cause of women's economic empowerment, and this report underscores a critical frontier for that mission. The 'leaky pipeline' it describes, where highly qualified women drop out between graduation and leadership, represents a profound loss of innovation and growth. To build a trillion-dollar economy, we must invest in this incredible talent pool. By fostering entrepreneurship, creating inclusive workplaces, and providing robust support networks, we can ensure that women are not just participants, but leaders in scripting India's technological and economic destiny. This paper is a vital roadmap for that essential journey.

Foreword by

Mamta Bakliwal, National Initiative Lead, Women in STEM

India stands at a pivotal moment. We are a global leader in producing women **STEM** graduates, a testament to the aspiration and brilliance of our young women. Yet, as this crucial white paper highlights, the journey from the classroom to the C-suite is fraught with systemic barriers. The **"Women in STEM"** initiative is dedicated to dismantling these obstacles. This report provides the data-driven clarity and strategic direction needed to accelerate our efforts. It brings to life the stories of our 'Rocket Women' at ISRO and grassroots innovators, proving what is possible when opportunity meets talent. Our collective mission must be to fix the 'leaky pipeline' by fostering mentorship, championing visible role models, and driving policy changes that create truly equitable environments. This paper is more than an analysis; it is a call to action to ensure every girl who dreams of a career in science and technology can build a future for herself and for India.

Table of Contents

EXECUTIVE SUMMARY

The vision of '**Viksit Bharat 2047**'—transforming India into a developed nation by its centennial of independence—is predicated on achieving a technology-driven, knowledge-based economy with a target GDP of around $30 trillion.[1] This ambitious national goal cannot be realized without leveraging the full potential of its entire population.[2] This report contends that India's most underutilized strategic asset is its vast and growing pool of qualified women in Science, Technology, Engineering, and Mathematics (STEM). The inclusion and advancement of women in STEM is not merely a matter of social equity but a critical imperative for national innovation, economic competitiveness, and the successful realization of the Viksit Bharat vision.[3]

1.1 Key Statistics and Insights

The report presents a data-driven analysis of the current landscape, identifying a profound paradox at the heart of India's STEM ecosystem. While India is a global leader in producing female STEM graduates, with women constituting approximately 43% of total enrolments in STEMM.[5] However, only 14% transition into STEM career.[6] This phenomenon, termed as 'leaky pipeline', signifies a colossal waste of human capital and a direct impediment to innovation.[8] In critical Research and Development (R&D) establishments, women account for only 16.6% of the personnel.[9] The economic cost of this exclusion is significant. According to government-recognized startup platforms, increasing women's participation in the labour force could add substantially to the GDP.[12] Promoting women's entrepreneurship alone has the potential to create 150-170 million jobs by 2030.[12] This study deconstructs the systemic barriers—from entrenched socio-cultural norms and the disproportionate burden of unpaid care to workplace biases and a formidable 'glass ceiling'—that contribute to this leaky pipeline.[8] It also highlights the catalytic impact of enablers such as targeted government initiatives (e.g., WISE-KIRAN, GATI), the inspirational power of visible role models like the women scientists of the Indian Space Research Organisation (ISRO), and the burgeoning startup ecosystem supported by Startup India.[14]

1.2 Key Recommendations

To bridge the gap between educational attainment and workforce participation, this study proposes a strategic, multi-stakeholder roadmap with headline recommendations, including:

1. **Establishing a National Mission for Retention of Women in STEM:** A high-level, cross-ministerial mission to implement, monitor, and scale up policies focused on retaining women post-education, with clear targets for industry and academia.
2. **Mandating Gender-Disaggregated Data and Pay Gap Reporting:** Requiring all public and private STEM-sector organizations above a certain size to publicly report gender-disaggregated data on hiring, promotion, leadership, and remuneration to drive transparency and accountability, in line with the spirit of the Science, Technology, and Innovation Policy (STIP) 2020.
3. **Creating a Dedicated 'Deep-Tech Women's Fund':** Earmarking a significant portion of government-backed startup funds (e.g., Startup India Seed Fund) to specifically invest in women-led startups, capital-intensive sectors like AI, clean energy, and biotechnology.

Ultimately, this report concludes that the women of India are not just potential beneficiaries of the Viksit Bharat vision; they are its indispensable architects. Fixing the leaky pipeline in STEM is the single most powerful lever available to unlock India's innovation potential and secure its destiny as a developed nation by 2047.

CONTEXT: INDIA'S GROWTH ASPIRATIONS UNDER AMRIT KAAL VIKSIT BHARAT 2047

The Government of India's **'Viksit Bharat @2047'** initiative represents a national aspiration to transition India into a developed country by the 100th anniversary of its independence.[1] This vision extends beyond traditional economic metrics to encompass social advancement, environmental sustainability, and effective governance.[3] The economic objectives are particularly ambitious, targeting a GDP of around $30 trillion.[1] Central to this vision is the transformation into a "technology-driven and knowledge-based economy".[25] The period leading up to 2047 has been termed Amrit Kaal, or the 'Era of Elixir', a 25-year window for accelerated progress.[26] The Union Budget 2023-24, the first in Amrit Kaal, outlined seven guiding priorities, or 'Saptarishi', to steer this transformation: Inclusive Development, Reaching the Last Mile, Infrastructure and Investment, Unleashing the Potential, Green Growth, Youth Power, and Financial Sector.[25] Most of these priorities are intrinsically linked to a robust STEM ecosystem.

2.1 STEM as a Driver of Innovation, Jobs, and Global Competitiveness

The journey from a middle-income to a high-income nation, a core objective of Viksit Bharat, hinges on escaping the "middle-income trap" that has stalled many developing economies. This requires sustained high growth rates, driven not by low-cost labor but by innovation, productivity, and competitiveness in high-value sectors. STEM is the foundational disciplines that power these sectors, including artificial intelligence (AI), biotechnology, clean energy, advanced manufacturing, and space technology.

The abstract importance of STEM translates into concrete economic reality. Data from official Indian sources and global bodies confirms that the knowledge-based economy, fueled by STEM, is not a future concept but a present-day growth driver.

1. **Contribution to GDP:** India's digital economy, a direct product of its STEM talent, is expanding at a rate 2.4 times faster than the Indian economy itself. According to the Ministry of Electronics and Information Technology (MeitY), Govt. of India, it is on track to contribute over 20% to India's GDP by 2026.
2. **High-Value Job Creation:** As per government estimates, the technology industry alone directly employs over 5.4 million people, many in high-skilled, high-wage positions. The demand for specialists in AI, data science, and cybersecurity is projected to add millions more jobs, fundamentally altering the employment landscape.
3. **Global Innovation:** India's rising rank in the Global Innovation Index (GII) to 40th place is cited by the government as a key indicator of the success of policies like 'Make in India' and 'Startup India'. This climb is overwhelmingly attributed to performance in sectors like ICT services exports, venture capital recipients, and graduates in science and engineering.

STEM professionals are the architects of this economic transformation. They conduct the R&D that leads to new products and patents, build the digital infrastructure for a modern economy, and develop the sustainable technologies required for green growth. A report from UNESCO titled 'Engineering for Sustainable Development' emphasizes that an engineering and technology-driven workforce is essential for achieving the Sustainable Development Goals (SDGs), particularly in areas of clean water, sustainable energy, and resilient infrastructure.

Consequently, any deficit in the STEM talent pool acts as a direct constraint on India's ability to achieve its Viksit Bharat targets. The underrepresentation of women—who, according to AISHE reports, now constitute **over 43% of STEM graduates**—in this critical workforce is not just a social issue but a severe economic bottleneck. This "leaky pipeline," where a large pool of qualified talent does not transition into the workforce, limits the scale, scope, and diversity of innovation required to propel India into the league of developed nations.

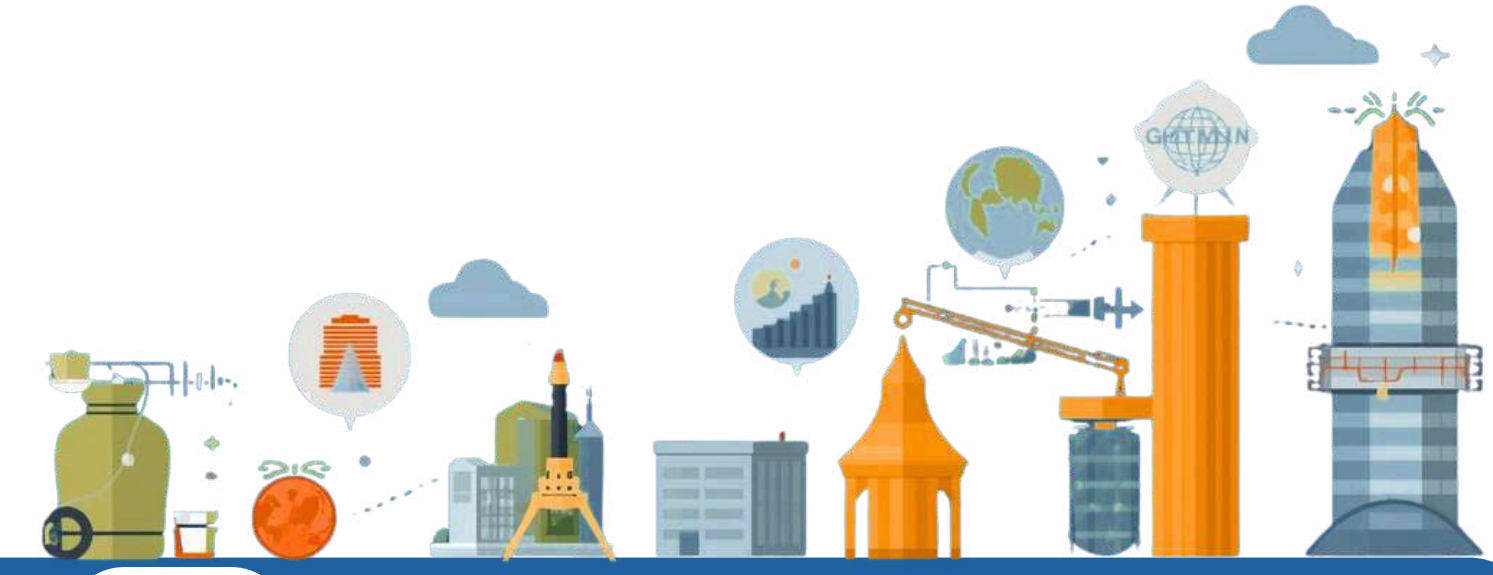
STEM's Potential Economic Enhancement by Sector

The integration of STEM is not uniform across the economy. It acts as a force multiplier in all sectors, but its potential impact varies based on the sector's current technological maturity and the scope for innovation. The table below provides a conceptual illustration of the potential value-add from targeted STEM interventions.

Table 1: STEM's Potential Economic Enhancement by Sector

Economic Sector	Key STEM Interventions	Potential Productivity Enhancement (Illustrative)
Primary (Agriculture, Mining)	Precision Agriculture (Drones, IoT Sensors), Biotechnology (High-Yield Crops), Satellite Mapping, AI-based Crop Monitoring	**20% - 35%**
Secondary (Manufacturing)	Industrial Automation (Robotics), AI for Quality Control, 3D Printing, Smart Supply Chains, Advanced Materials	**30% - 50%**
Tertiary (Services, IT, Finance)	Artificial Intelligence, Big Data Analytics, FinTech, Telemedicine, EdTech, Digital Communication	**40% - 60%**

Note: The figures are illustrative and represent the potential enhancement over a medium-to-long-term horizon with sustained investment in STEM R&D and adoption. The actual impact can vary based on policy implementation, investment levels, and skill development. The data reflects the consensus from various reports by NITI Aayog, MeitY, and studies from IITs on the transformative capacity of technology in each sector.



2.2 Amrit Kaal Priorities & The Role of STEM

Table 2: Amrit Kaal Priorities, STEM Contribution & Role of women

S.NO.	Amrit Kaal Priority	STEM's Contribution	The Vital Role of Women in STEM
1	Inclusive Development	Develops accessible health-tech (telemedicine), agri-tech for small farmers, and Ed-tech platforms to bridge learning gaps. Data science helps in targeted welfare delivery.	Women leaders design solutions focused on maternal health, nutrition, and child development. They create tech that addresses the specific social and economic barriers faced by women, ensuring true inclusivity.
2	Reaching the Last Mile	Employs geospatial mapping, drone technology for delivering essentials (vaccines, supplies), and off-grid renewable energy solutions (micro-grids) to connect remote areas.	As engineers and community organizers, women are crucial in designing and implementing last-mile solutions for clean water, sanitation, and energy access, as they are the primary stakeholders in households.
3	Infrastructure & Investment	Utilizes advanced engineering for creating smart, climate-resilient infrastructure. AI and IoT optimize logistics, while new material science makes construction sustainable and cost-effective.	Female architects and urban planners bring diverse perspectives, designing infrastructure that is safe, accessible, and community-centric. Their leadership can drive investment towards socially impactful projects.
4	Unleashing the Potential	Drives innovation through R&D in AI, robotics, and biotech. Powers e-governance for transparency and efficiency, and enables skilling in emerging digital domains.	By leading R&D, women expand the pool of innovative ideas. As mentors and educators, they are essential for skilling the next generation, especially girls, breaking barriers and inspiring participation.
5	Green Growth	Powers the development of renewable energy (solar, green hydrogen), circular economy models through waste-to-wealth technologies, and climate modeling for risk mitigation.	Women environmental scientists lead research in climate adaptation and sustainable agriculture. They excel at translating complex scientific solutions into actionable, community-level programs for conservation.
6	Youth Power (Yuva Shakti)	Revolutionizes education with a focus on practical skills like coding, data analytics, and AI. Fosters an innovation mindset through tinkering labs and start-up incubation centers.	As role models, women in STEM shatter stereotypes and encourage more girls to pursue technical fields. As educators, they can design inclusive curricula that nurture a diverse pipeline of future innovators.
7	Financial Sector	Fuels the FinTech revolution with digital payments (UPI), blockchain for security, and AI-driven data analytics for credit scoring, enhancing financial inclusion and stability.	Women FinTech innovators design financial products tailored to women entrepreneurs and self-help groups. Their expertise in building user-friendly and secure platforms increases digital financial literacy and adoption among women.

The philosophy of ***Sabka Saath, Sabka Vikas, Sabka Vishwas, and Sabka Prayas*** (Together with all, for the development of all, with the trust of all, and with the effort of all) explicitly includes women as central to this inclusive development model.[25]

CURRENT STATUS OF WOMEN IN STEM: LEAKY PIPELINE & TRACING WOMEN'S JOURNEY

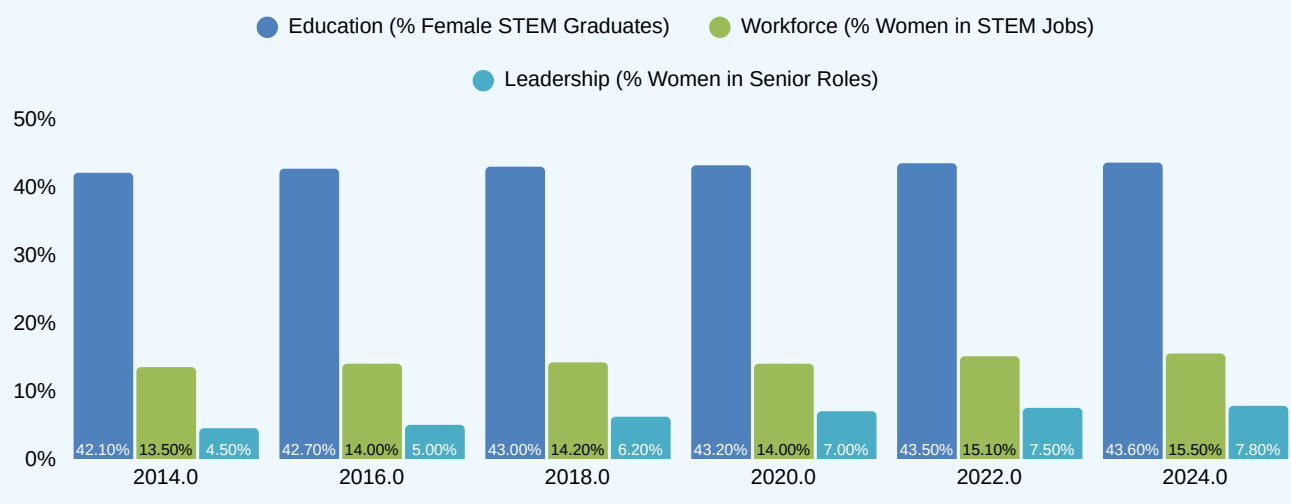
The term "leaky pipeline" is a powerful metaphor for the continuous and disproportionate loss of women as they progress in their STEM careers. In India, this phenomenon is particularly stark. While women have achieved near parity and, in some cases, a majority in STEM education at the graduate level, their representation dwindles sharply in the workforce and plummets at the leadership and senior management levels.

The journey can be broken down into three critical stages:

1. **Education (The Entry Point):** Bolstered by societal encouragement and policy support, a high percentage of young women are enrolling in and graduating from STEM programs. Data from the All-India Survey on Higher Education (AISHE)64 consistently shows that women constitute around 43% of STEM graduates, one of the highest percentages globally. This demonstrates a robust and promising talent pool at the entry point of the pipeline.
2. **Workforce (The First Leak):** The transition from campus to career marks the first major leak. Despite the large pool of graduates, women's participation in the core STEM workforce drops to approximately 14%71. This drastic fall is attributed to a combination of factors, including a lack of inclusive workplace policies, limited mentorship opportunities, societal pressures related to marriage and childcare, and implicit biases in hiring and promotion processes. This data is corroborated by multiple reports from organizations like the World Bank and Department of Science and Technology (DST).
3. **Leadership (The Final Drop):** The final and most significant drop occurs at the leadership level. The journey to senior management, R&D leadership, and board positions is fraught with even greater challenges, leading to extremely low representation. Studies from academic institutions like the IIMs and specific industry reports indicate that the percentage of women in senior STEM leadership roles falls into the single digits, often estimated between 4-7%71. This reveals a critical deficit of female role models and decision-makers at the highest echelons of science and technology.

Figure below illustrates the gap that emerges and widens as women move from education toward leadership.

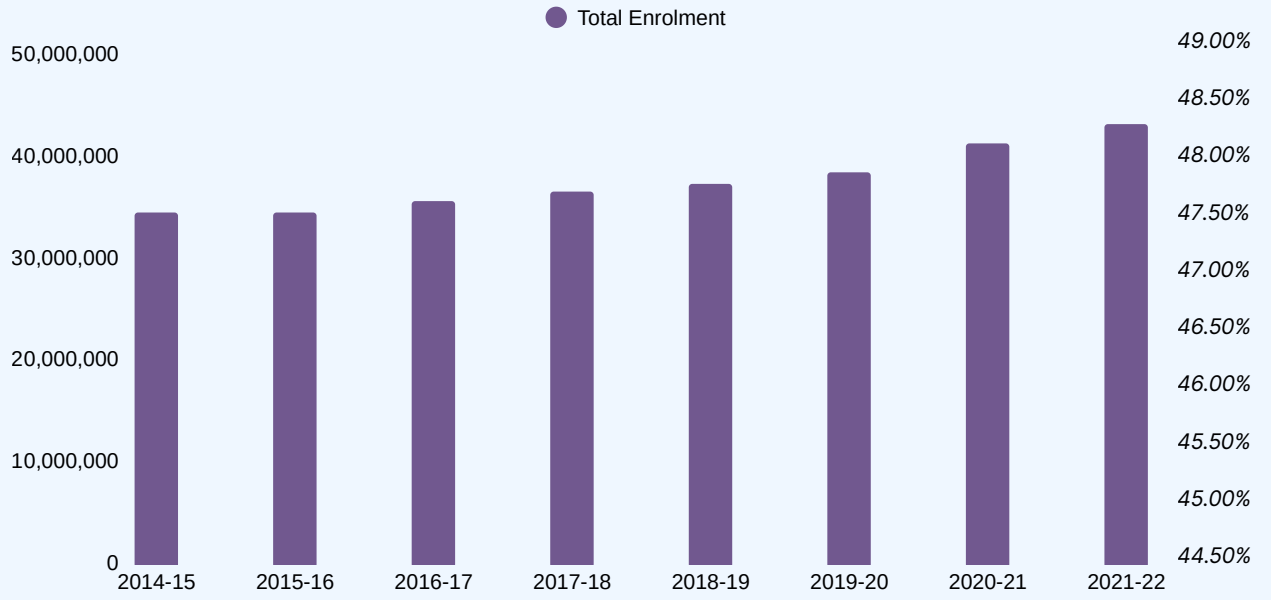
Figure 1 Year-wise demonstration of women participation in STEM[64]



3.1 Female Enrolment in Higher Education in India

Since the commencement of the AISHE in 2010-11, there has been a consistent and noteworthy increase in the enrolment of female students in higher education across India. This growth is evident in the absolute numbers of female students as well as their proportional representation in the total student body.

Figure 2: Total female enrolment in higher education[64]



3.2 Key Female Enrolment Indicators in STEM

While the AISHE reports focus on educational statistics rather than labour force indicators, they provide crucial insights into the pipeline of women entering the STEM fields. The data on female enrolment in key STEM streams highlights the growing interest and participation of women in these traditionally male-dominated areas.

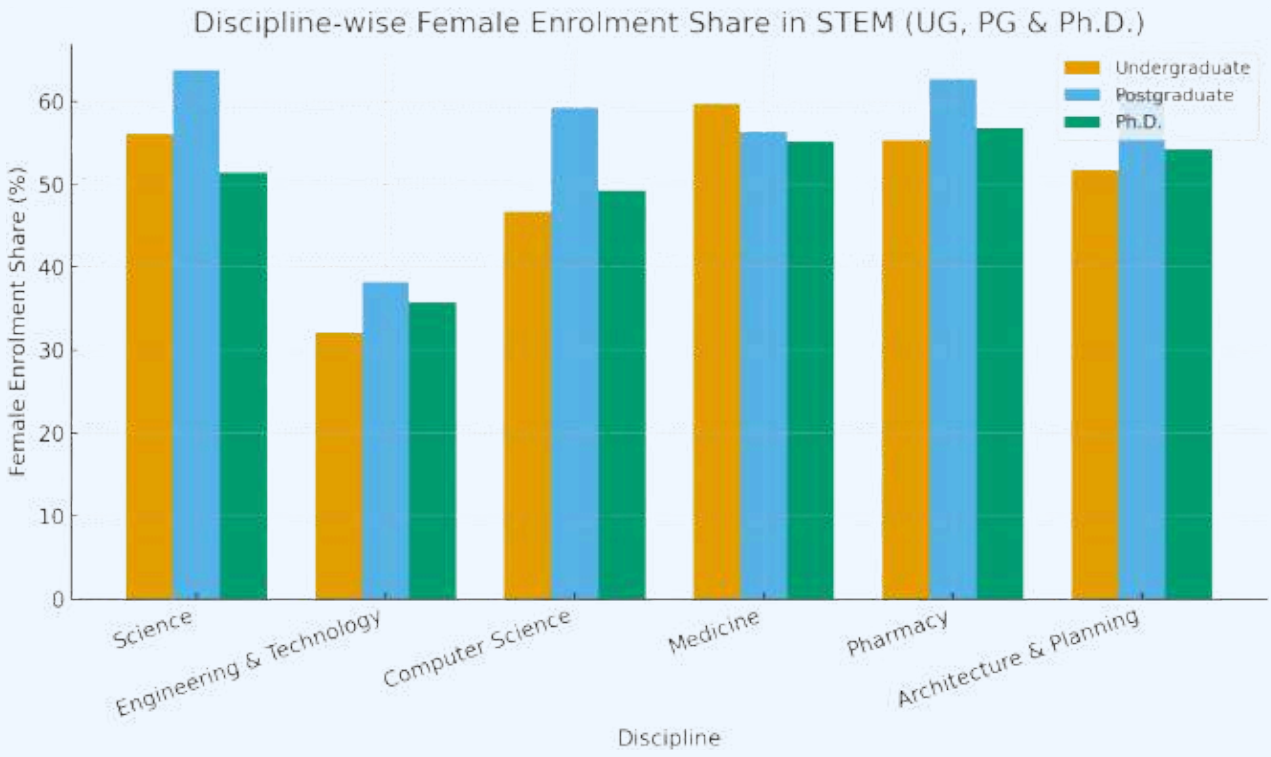
A significant trend observed is the substantial representation of females in undergraduate science courses, particularly in Bachelor of Science (B.Sc.) programs. In the 2021-22 academic year, female students constituted over half of the enrolment in B.Sc. degrees. In the field of technology and engineering, while the overall proportion of female students is lower, there has been a steady increase in their enrolment in Bachelor of Technology (B.Tech.) and Bachelor of Engineering (B.E.) programs over the years.

3.3 Discipline-wise Female Enrolment Share in STEM (UG, PG & Ph.D.)

A granular look at the discipline-wise enrolment provides a clearer picture of female representation across different levels of STEM education.

The figure below presents the percentage of female enrolment in various STEM disciplines at the undergraduate, postgraduate, and doctoral levels for the academic year 2021-22.

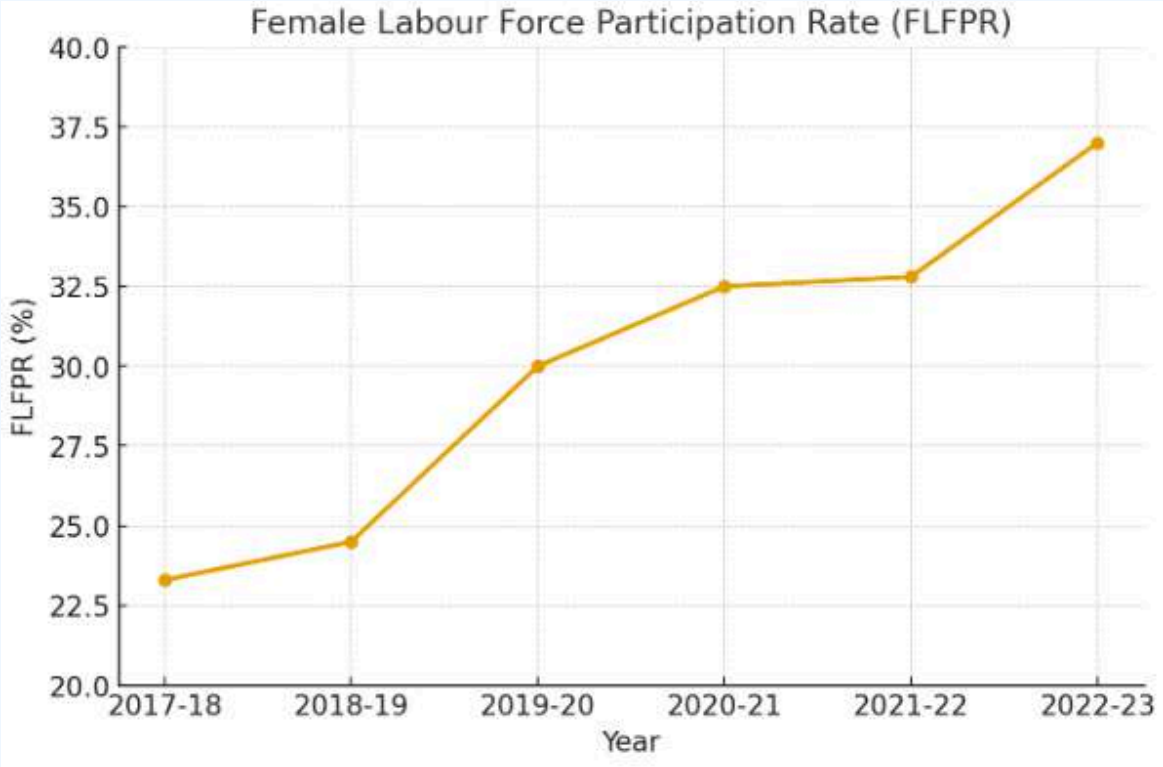
Figure 3: Discipline wise female enrolment in STEM[64]



3.4 Overall Female Labour Force Participation Rate (FLFPR)

The most consistent data comes from the government's official labor force surveys. The FLFPR has shown a significant positive trend in recent years. This rate is for individuals aged 12 years and above.[59]

*Figure SEQ Figure * ARABIC 5: Female labour force participation*[59]



3.5 FEMALE STEM WORKFORCE PARTICIPATION

This is one of the most widely cited yet difficult-to-track annual statistics. The figure represents the gap between graduation and employment. While a precise year-on-year trend is not available, reports from different years highlight a persistent issue.

The widely cited statistic: Several reports from the mid-2010s to the early 2020s state that while women form around 43% of STEM graduates, their representation in the STEM workforce remains low.

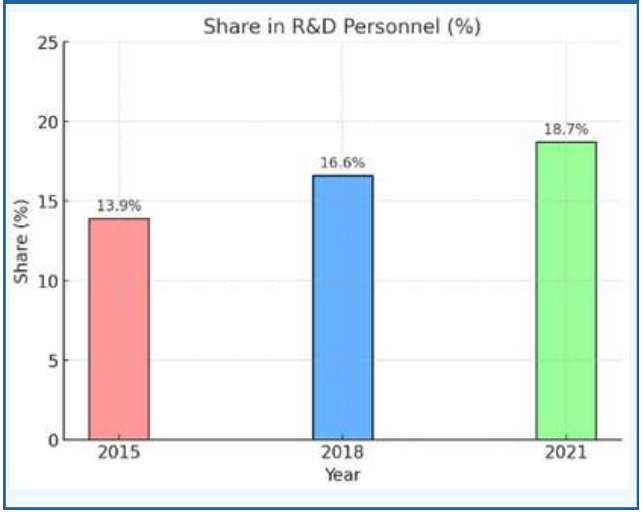
- **2018:** A World Bank report estimated female participation in the STEM workforce to be around 14%.[71]
- **2020:** A report by the Initiative for What Works to Advance Women and Girls in the Economy (IWWAGE) also placed the figure at 14%.[71]

This suggests that the number has remained stubbornly low over the years, indicating a consistent "leaky pipeline."

3.6 Share of Women in R&D Personnel

Data from the Department of Science and Technology (DST)[69] shows a slow but steady increase in the involvement of women in formal research and development activities.

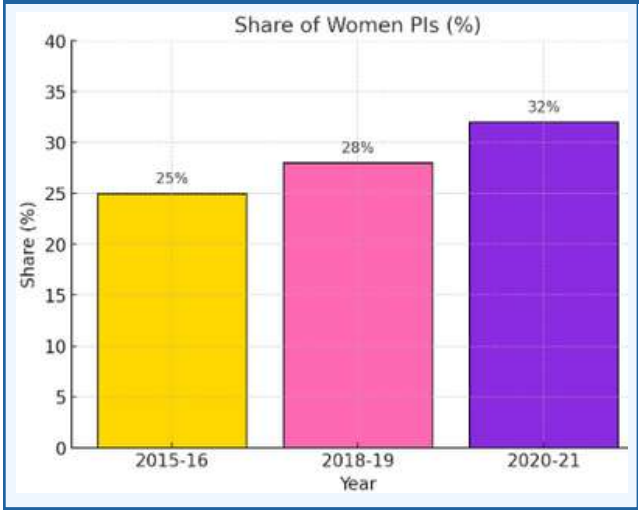
Figure 6: Share of the women in R&D Personnel[69]



3.7 Share of Women as Principal Investigators (PIs)

The participation of women in leading government-funded research projects has seen a notable improvement.[70]

Figure 7: Share of the women Investigators[70]

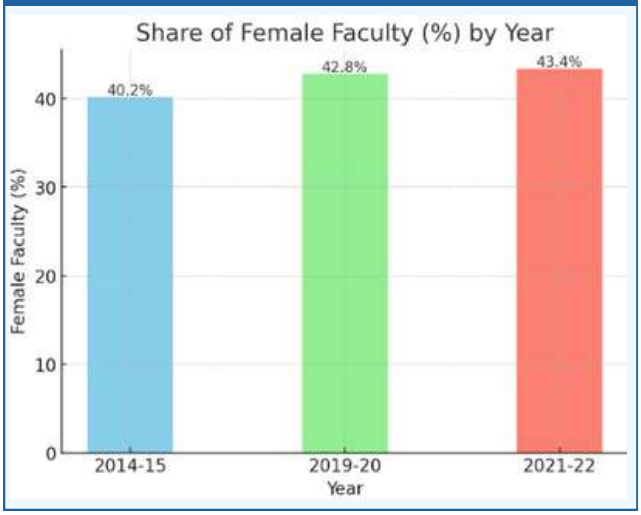


3.8 Share of Women in STEM Faculty

A significant gap exists between the overall representation of women in academic positions and their specific presence within STEM departments. While data from AISHE shows a healthy and growing proportion of female faculty across all disciplines, targeted studies reveal that this parity does not extend to core science and technology fields.

This data reflects the percentage of female teachers in all higher education institutions in India.[64]

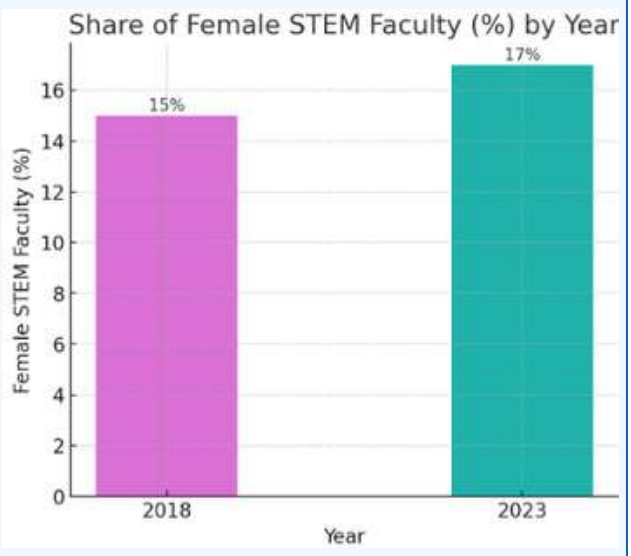
Figure 8: Overall Female Faculty representation[64]



3.9 Female Faculty in STEM Departments

This data is derived from specific studies focused on STEM departments in Indian universities and scientific institutions.

*Figure SEQ Figure * ARABIC 9: Share of female STEM Faculty[64]*



The data clearly indicates that while nearly 44% of all faculty members are women, they hold less than 20% of the faculty positions within the STEM disciplines, highlighting a major point of leakage in the academic pipeline.

PRIMARY DATA INSIGHTS: THE STORY OF FIELD

To understand the ground-level realities behind the national statistics, a targeted survey was conducted among 50 women in STEM across various stages of their careers—from undergraduate students to seasoned professionals. The respondents were distributed across rural, semi-urban, and urban locations, providing a diverse snapshot of the challenges and aspirations that define their journeys. The survey aimed to decode the primary motivations for entering STEM, the most significant barriers they face, and the key enablers that could help retain them in the workforce.

4.1 PRIMARY DATA INSIGHTS: THE STORY OF FIELD

4.1.1 Motivations for Entering STEM: A Mix of Aspiration and Pragmatism

The decision to pursue STEM is driven by a blend of personal passion and practical considerations.

- **Job prospects** emerged as a dominant motivator across all categories, from students to industry professionals, underscoring the perceived economic security of a STEM career.
- **Inspiration from role models and personal interest/passion** were the other two significant drivers. This highlights the powerful impact of visible female scientists and the intrinsic curiosity that draws women to these fields.
- Interestingly, **scholarships and financial aid** were also crucial factors, particularly for students from rural and semi-urban backgrounds, indicating that financial support is a key enabler for entry into STEM education.

4.1.2 Barriers: A Persistent Battle Against Systemic and Social Hurdles

The survey reveals a landscape of persistent challenges that contribute directly to the 'leaky pipeline'.

- **Work-life balance challenges** were a significant concern, rated as a major barrier across all career stages, from students anticipating future struggles to senior professionals navigating current ones.
- **Lack of financial support** and **gender stereotypes** were the most acutely felt barriers among undergraduate and postgraduate students. Many students, especially from semi-urban and rural areas, rated the lack of financial support as a 5 out of 5 challenge.
- For professionals and PhD scholars, **workplace discrimination/bias** becomes a more pronounced issue. A significant number of respondents in these groups rated this challenge highly, suggesting that bias becomes more apparent upon entering the professional workforce.
- **Safety and mobility issues** were a particularly high-rated concern for respondents from rural and semi-urban areas, often acting as a deterrent to accepting jobs or research positions far from home.

Table 4: Key Barriers Faced by Women in STEM

Barrier	Percentage of Respondents	Key Insight
Lack of financial support	70%	A significant hurdle, especially for students.
Work-life balance challenges	68%	A consistent concern across all career stages.
Gender stereotypes	62%	A persistent societal pressure affecting choices.
Lack of mentorship/role models	60%	The need for guidance is a recurring theme.
Workplace discrimination/bias	60%	Becomes a more prominent issue for professionals.
Safety and mobility issues	60%	A major concern, particularly for those in rural areas.

The barriers cited by the respondents are also corroborated by the secondary research. It highlights that the significant attrition of women from STEM careers in India is not a random phenomenon but the result of a complex interplay of systemic barriers.[13]

- Deep-rooted societal norms and gendered expectations represent a formidable barrier for women in STEM.[8] Socio-cultural constraints and stereotypes often perpetuate the notion that certain professions are better suited for men, steering women away from STEM disciplines from a young age.[8] Even for those who successfully complete a STEM education, women encounter systemic biases related to domestic burdens, family care responsibilities, and relocation issues, which contribute to the 'leaky pipeline' phenomenon where women gradually drop out of the workforce.[8]
- The professional environment itself is often fraught with obstacles that hinder the growth of women in STEM. There is evidence of a persistent pay gap where women in STEM occupations earn less than their male counterparts for similar work.[49] This disparity is attributed not only to occupational segregation but also to structural discrimination.[49]
- The path to leadership is particularly challenging. Women remain significantly underrepresented in leadership positions in research, academia, and industry.[13] This visible lack of women at the top creates a "glass ceiling" that seems impenetrable to many aspiring women.[14]

4.1.3 Structural Issues: Mid-Career Dropouts and Lack of Mentorship

The structure of STEM careers is often rigid and unforgiving of breaks, which disproportionately affects women. A lack of supportive workplace policies and structured re-entry programs forces many women to drop out mid-career.[13] Furthermore, the scarcity of women in senior positions leads to a lack of mentors and sponsors who can guide younger women and advocate for their advancement, thus perpetuating a cycle of underrepresentation.[13]

4.1.4 Enablers: What Women in STEM Really Need to Thrive

When asked what would best support their careers, the respondents provided clear and actionable insights.

- **Scholarships for women and more mentorship opportunities** were the top-rated needs among students, reinforcing that financial support and guidance are critical during the educational phase.
- **Flexible work policies and work-life balance initiatives** were overwhelmingly prioritized by working professionals (professors, doctors, industry experts), indicating that a supportive workplace structure is essential for retention.

A cross-cutting demand was for **equal pay policies**. This was consistently ranked as one of the top three desired changes, highlighting a strong perception of a persistent gender pay gap.

Table 5: Most Desired Enablers for Career Growth

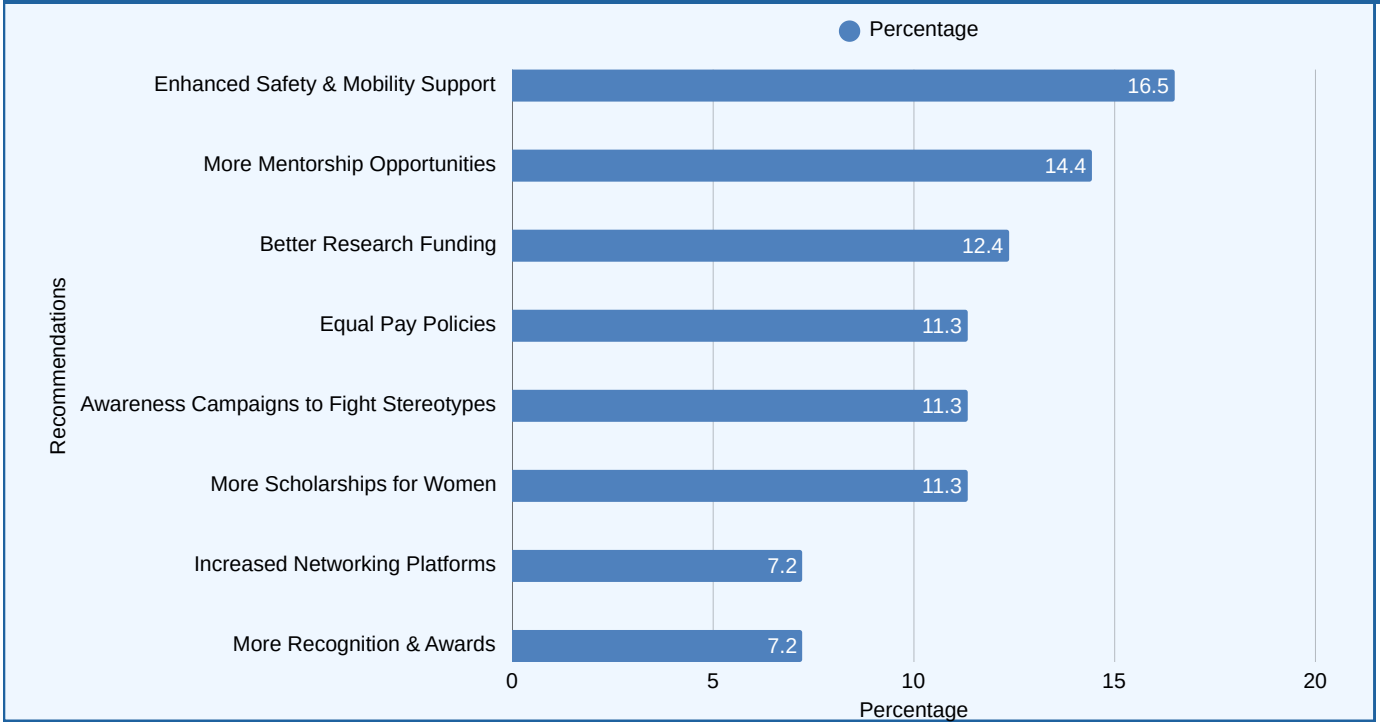
Enabler	Percentage of Respondents	Key Insight
Flexible work policies	78%	Overwhelmingly the top need for working professionals.
Scholarships for women	72%	Critical for enabling access to STEM education.
Mentorship programmes	68%	A strong demand for structured guidance and support.
Networking opportunities	65%	Important for career progression and collaboration.
Recognition and awards	60%	Acknowledgment is seen as a key motivator.

4.1.5 Future in STEM: A Tale of Ambivalence

The survey responses paint a concerning picture of future retention. A staggering number of current students, despite their passion, responded "No" or "Not Sure" when asked if they see themselves remaining in STEM in 10 years. This suggests that the barriers they currently face or anticipate are significant enough to make them reconsider their long-term career paths, providing direct evidence of the 'leaky pipeline' at its most critical juncture.

These primary findings underscore the narrative of the report: while Indian women are successfully entering STEM education with high aspirations, their journey is fraught with systemic barriers. Addressing these challenges through targeted financial support, structured mentorship, and, most importantly, gender-sensitive workplace policies is not just a matter of equity but a crucial strategic step to harnessing their full potential for the Viksit Bharat 2047 vision

Figure 10: Recommendations for Change from Respondents



CATALYTIC ENABLERS

Despite these significant barriers, a growing ecosystem of enablers is working to plug the leaks in the STEM pipeline and foster a more inclusive environment.

5.1 Policy Interventions

The Government of India, particularly the Department of Science and Technology (DST), has launched several targeted initiatives to support women in science.[16]

- **WISE-KIRAN (Women in Science and Engineering-KIRAN):** This is a flagship umbrella scheme designed to address various challenges faced by women scientists. Key components include fellowships for women looking to re-enter the scientific workforce after a career break (WISE-PDF), support for women pursuing doctoral research (WISE-PhD), and training in alternative career paths like Intellectual Property Rights (WISE-IPR).[15] Between 2018 and 2023, the WISE-KIRAN scheme has benefited over 2,153 women scientists.[5]
- **GATI (Gender Advancement for Transforming Institutions):** Recognizing that individual fellowships are insufficient without institutional change, the GATI initiative pilots a model for systemic transformation.[15] It encourages universities and research institutions to conduct a rigorous self-assessment of their policies and culture regarding gender equity and develop action plans to address identified gaps.[15]
- **Startup India and Atal Innovation Mission (AIM):** These broad-based initiatives have created a more vibrant and accessible ecosystem for all entrepreneurs.[12] Programs like the NIDHI-Seed Support Program (NIDHI-SSP) provide crucial early-stage funding, while incubators offer mentorship and resources.[18] AIM's Atal Tinkering Labs (ATLs) are building a foundation for innovation from the school level, which disproportionately benefits girls in underserved areas.[41]

5.2 The Power of Role Models

The visibility of successful women in STEM serves as a powerful catalyst for change. The nationwide celebration of the women scientists behind ISRO's missions has created a new generation of inspirational figures.[14] Similarly, the rise of women to the helm of major technology corporations and industry bodies provides tangible proof that leadership positions are attainable.[52] These role models demystify STEM careers, challenge stereotypes, and provide aspiring girls and young women with a vision of what is possible.

5.3 The Startup Ecosystem

The startup ecosystem is emerging as a significant enabler for women in STEM. It offers an alternative career path to traditional corporate or academic structures, allowing women to build organizations based on their own vision and values. Women-led startups in cutting-edge fields like AI and biotechnology are not only commercializing innovative solutions but are also creating more inclusive and flexible work cultures.[6] These ventures act as powerful agents of change, demonstrating that women can lead at the frontiers of technology and innovation.

5.4 The Economic Value of Women in High-Growth Industries

The economic case becomes even more compelling when examined through the lens of strategic sectors vital for the Viksit Bharat 2047 vision.

- **Artificial Intelligence & Digital Economy:** As India's AI market is projected to grow significantly, increasing the participation of its highly skilled female STEM graduates is essential for building robust, ethical, and innovative AI solutions.[6] The India AI Mission, with a budget of over ₹10,000 crore, aims to foster an inclusive AI ecosystem, supporting women entrepreneurs and job creation.[2] Women-led AI startups are already demonstrating the potential to create high-value, socially impactful products.[6]
- **Clean Technology & Green Growth:** India's transition to a green economy and its commitment to Net Zero emissions will create millions of new jobs.[25] However, women are severely underrepresented in the clean energy sector. Including women is critical for filling a looming green skills gap and bringing diverse perspectives to solve complex climate challenges.
- **Advanced Manufacturing & 'Make in India':** The future of manufacturing lies in high-tech domains like semiconductors and electric vehicles (EVs). In these emerging sectors, women already constitute a significant part of the workforce (25% in semiconductors, 11-15% in EVs), and companies are actively hiring more women for their precision and skills.[38] Scaling up women's participation in these high-value manufacturing chains is crucial for enhancing productivity and achieving the goals of the 'Make in India' initiative.
- **Health and Agriculture:** Women form the backbone of both healthcare delivery and agriculture in India. As these sectors become increasingly technology-driven, the deep domain expertise of women is invaluable for designing and implementing effective health-tech and agritech solutions. Government initiatives like "Namo Drone Didi" are actively training women-led SHGs in using new agricultural technologies.[48]

The economic argument for including women in STEM thus transcends the simple logic of increasing the labor supply. A more diverse workforce is consistently linked to enhanced innovation and more creative problem-solving. Therefore, the underrepresentation of women in India's technology and R&D sectors is not merely a labor market inefficiency; it is a direct constraint on the nation's innovation capacity.

CASE STUDIES IN EXCELLENCE

AMIDST THE SYSTEMIC CHALLENGES, SEVERAL POCKETS OF EXCELLENCE AND IMPACTFUL INITIATIVES DEMONSTRATE THE IMMENSE POTENTIAL OF WOMEN IN INDIAN **STEM**. THESE CASE STUDIES SERVE AS POWERFUL EXAMPLES AND PROVIDE BLUEPRINTS FOR BROADER REPLICATION.

6.1
Case Study 1: The 'Rocket Women' of ISRO – Breaking Barriers in Space Research

The Indian Space Research Organisation (ISRO) stands out as a remarkable success story for nurturing female talent in a high-stakes, technology-intensive environment. Women scientists and engineers have been integral to India's most prestigious space missions, earning the moniker **'Rocket Women of India'**.[14]

...., an **aerospace engineer**, served as the Deputy Operations Director for the Mars Orbiter Mission (Mangalyaan), where she was responsible for conceptualizing and executing the craft's critical autonomous systems.[14] For the historic **Chandrayaan-3 mission**, which successfully landed on the lunar south pole, over 100 women scientists and engineers played a direct and significant role in its conception, design, testing, and execution.[40] These women have occupied mission-critical leadership positions, challenging entrenched stereotypes and inspiring millions of young girls to pursue careers in science and space exploration.

6.2

Case Study 2: Grassroots Innovation – The Impact of Atal Tinkering Labs on Rural Girls' Coding Skills

Atal Tinkering Labs (ATL), launched by NITI Aayog under the Atal Innovation Mission, has set up over 10,000 labs across India in 35 states/UTs and 722 districts. These labs engage more than 1.1 crore students in hands-on work with tools like 3D printers, robotics, and IoT. A majority of ATLs (over 60%) are in government or government-aided schools, and around 96% are girls' or co-educational schools, ensuring broad reach beyond elite urban areas.

One success story: Supriya **Sharma and Choden Tamang,** Class 9 students from Paljor Namgyal Girls' School, Sikkim, developed a *sensor-based robotic accident prevention system* for hill-roads using ATL resources. Their project won the "School of the Month" challenge and was among the top exhibits at the SAATHI meet during the India International Science Festival (IISF) in 2018. They were also felicitated by senior government officials.

The innovation quickly drew attention. Their school won the **AIM School of the Month Challenge**, and the duo went on to represent their work at the **Science and Technology for Harnessing Innovations (SAATHI) meet** during the **India International Science Festival (IISF) 2018** in Lucknow. Their project was chosen among the **Top 5 Exhibits nationally**, and they were felicitated by senior officials including **Dr. Renu Swarup (DBT)** and **Dr. Ashutosh Jain (DST)**.. [44]

6.3

Case Study 3: The New Frontiers – Women-Led Startups in Agritech and Clean Energy

The Indian startup ecosystem, supported by government initiatives like Startup India and the Department for Promotion of Industry and Internal Trade (DPIIT), is witnessing the rise of a new generation of women entrepreneurs.[12] NITI Aayog's Women Transforming India (WTI) Awards have recognized many of these trailblazers.[46]

In the agritech sector, entrepreneurs are revolutionizing a traditional industry. The government's "Namo Drone Didi" initiative aims to train 15,000 women-led Self-Help Groups (SHGs) to become licensed drone operators for applications like crop monitoring and pesticide spraying.48 In clean energy, women are making significant inroads into the Electric Vehicle (EV) sector, where they make up 11-15% of the workforce, a number projected to rise substantially.38 These women-led ventures demonstrate a powerful trend: the application of cutting-edge STEM solutions to grassroots problems, creating both economic value and social impact.

PATHWAYS TO 2047: A STRATEGIC ROADMAP FOR ACTION

To transform India's high potential in female STEM education into a tangible economic and innovation dividend for Viksit Bharat 2047, a concerted, multi-stakeholder effort is required. This roadmap outlines strategic pathways with specific, actionable recommendations for the government, the private sector, and industry bodies.

1. **Establishing a National Mission for Retention of Women in STEM:** A high-level, cross-ministerial mission to implement, monitor, and scale up policies focused on retaining women post-education, with clear targets for industry and academia.
2. **Mandating Gender-Disaggregated Data and Pay Gap Reporting:** Requiring all public and private STEM-sector organizations above a certain size to publicly report gender-disaggregated data on hiring, promotion, leadership, and remuneration to drive transparency and accountability, in line with the spirit of the Science, Technology, and Innovation Policy (STIP) 2020.
3. **Creating a Dedicated 'Deep-Tech Women's Fund':** Earmarking a significant portion of government-backed startup funds (e.g., Startup India Seed Fund) to specifically invest in women-led startups, capital-intensive sectors like AI, clean energy, and biotechnology.

7.1 Education & Skilling: Girls in STEM at school, digital skilling, coding for rural youth

The goal is to strengthen the pipeline at its source and ensure that educational choices are not limited by stereotypes or lack of exposure.

Policy Measures:

- Scale up the **Vigyan Jyoti** programme, which encourages meritorious schoolgirls to pursue STEM, to cover all districts in India, creating a robust and inclusive national pipeline.[16]
- Integrate mandatory gender sensitization and unconscious bias training into all teacher training and certification programs to create more inclusive classroom environments.
- Utilize the **GATI (Gender Advancement for Transforming Institutions)** framework as a basis for a national ranking system that publicly recognizes and rewards universities and research institutions for excellence in gender equity metrics, thereby incentivizing systemic change.[15]

Private Sector Actions:

- Establish corporate-funded scholarships and create endowed 'Women in Tech' professorial chairs at leading engineering and science institutes to foster excellence and create role models.
- Actively partner with universities, especially women's colleges, to co-design industry-relevant curricula and offer dedicated internship programs and apprenticeships for female students.

FICCI FLO's Role:

- Launch a national-level digital mentorship platform, 'STEM-Sisterhood', connecting senior women professionals with female college students for career guidance and support.
- Organize and fund a series of STEM career fairs and innovation challenges specifically in Tier-2 and Tier-3 cities to broaden exposure and aspirations beyond metropolitan areas.

7.2 Entrepreneurship: Women-led startups, access to finance, incubation

The objective is to create a supportive ecosystem that enables women to transition from innovators to successful entrepreneurs, particularly in deep-tech sectors.

Policy Measures:

- Earmark a minimum of 30% of funds under the Startup India Seed Fund Scheme and the DST's NIDHI-Seed Support Program (NIDHI-SSP) for startups with at least one woman founder, with a special focus on capital-intensive deep-tech and manufacturing ventures.[18]
- Simplify regulatory and compliance processes for enterprises recognized as 'women-owned' by Startup India, offering fast-track approvals and reduced fees.[18]

Private Sector Actions:

- Venture capital firms and corporate venture arms should set and publicly declare targets for investing in women-founded companies to drive accountability.
- Large corporations should launch targeted accelerator programs for women-led startups that can be integrated into their supply chains and vendor ecosystems.

FICCI FLO's Role:

- Establish and manage a dedicated angel investor network focused on providing seed capital to women entrepreneurs in STEM.
- Create a 'FLO Startup Hub' to provide members with pro-bono or subsidized access to essential services like legal counsel, financial planning, IP filing, and marketing support.

7.3 Employment & Industry: Gender-friendly workplaces, STEM hiring targets, mentoring networks

This pathway aims to fix the 'leaky pipeline' by transforming workplace cultures and structures to attract, retain, and promote female talent.

Policy Measures:

- Mandate the public disclosure of gender pay gap data for all listed companies and firms with over 500 employees, as recommended by the Science, Technology, and Innovation Policy (STIP) 2020.22
- Strengthen and rigorously enforce existing laws regarding flexible work options, gender-neutral parental leave, and the mandatory provision of high-quality crèche facilities.

Private Sector Actions:

- Implement structured, formal mentorship and sponsorship programs that pair high-potential women with senior leaders who can advocate for their advancement.
- Conduct mandatory, periodic unconscious bias training for all managers involved in hiring and performance evaluation.
- Establish formal 'Returnship' programs—paid, structured internships for experienced professionals returning to the workforce after a career break—to create a viable re-entry pathway.

FICCI FLO's Role:

- Develop and publish an annual 'Best Places to Work for Women in STEM' index for India, recognizing companies with exemplary policies and inclusive cultures.
- Create a formal charter of best practices for gender inclusivity, which member organizations can publicly commit to and adopt.

7.4 Leadership & Research: Women as CEOs, professors, policy leaders.

The focus here is on shattering the 'glass ceiling' and ensuring women are represented in decision-making roles across academia, research, and industry.

Policy Measures:

- Strictly enforce the STIP 2020 recommendation to ensure at least 30% representation of women in all government-constituted scientific selection, evaluation, and advisory committees.[22]
- Expand the WIDUSHI programme, which supports senior and retired women scientists to continue their research, thereby retaining valuable expertise and creating a cohort of senior mentors.[16]

Private Sector Actions:

- Set clear, time-bound diversity targets for senior management, executive leadership roles, and corporate boards.
- Create dedicated leadership development tracks and executive coaching opportunities for high-potential women employees to prepare them for C-suite roles.

FICCI FLO's Role:

- Host exclusive leadership summits and high-level networking events for senior women in STEM to foster collaboration and peer support.
- Partner with leading executive search firms to build and maintain a comprehensive database of board-ready women leaders from STEM backgrounds to share with corporate India.

7.5 Global Leadership: Positioning India as a hub of women-led innovation in STEM by 2047

This pathway aims to leverage India's unique strength in producing female STEM graduates to project its leadership on the global stage.

Policy Measures:

- Actively showcase the achievements of Indian women in STEM, such as the ISRO teams and WTI award winners, at international forums to build 'Brand India' as a hub of female scientific talent.[14]
- Incorporate gender equity in STEM as a key pillar of India's international S&T collaborations and diplomatic outreach.

Private Sector Actions:

- Indian technology majors should take a leading role in global industry conversations on diversity and inclusion, sharing their successes and challenges.
- Prominently feature their inclusive practices and female leaders in global branding and talent acquisition campaigns to attract the best international talent.

FICCI FLO's Role:

- Organize and lead international trade and investment missions focused specifically on promoting women-led STEM businesses from India.
- Forge strategic partnerships with global women's business organizations to facilitate cross-border market access, collaboration, and knowledge sharing.

Table 6: Summary of Policy Recommendations for Stakeholders

Pathway	Key Government Policy Measures	Key Private Sector Actions	Key FICCI FLO Role
Education & Skilling	Scale up Vigyan Jyoti; Use GATI for university rankings.	Fund scholarships & 'Women in Tech' chairs; Offer dedicated internships.	Launch national mentorship platform; Organize career fairs in Tier-2/3 cities.
Entrepreneurship	Earmark 30% of startup funds for women-led ventures.	Set VC funding targets for women founders; Launch supplier accelerators.	Create an angel investor network; Provide incubation support services.
Employment & Industry	Mandate pay gap reporting; Enforce flexi-work & childcare laws.	Implement formal 'Returnship' programs; Conduct unconscious bias training.	Publish 'Best Places to Work' index; Develop an inclusivity charter.
Leadership & Research	Enforce 30% women on S&T committees; Expand WIDUSHI program.	Set diversity targets for leadership/boards; Create executive development tracks.	Host leadership summits; Build a database of board-ready women.
Global Leadership	Showcase women's achievements at global forums.	Lead global industry dialogues on diversity; Showcase inclusive branding.	Lead international trade missions; Partner with global women's organizations.

CONCLUSION

WOMEN AS THE UNASSAILABLE GROWTH ENGINE FOR VIKSIT BHARAT 2047

The pursuit of **Viksit Bharat 2047** is, at its core, a quest for an innovative, self-reliant, and prosperous India.[2] This comprehensive analysis demonstrates unequivocally that the journey towards this national ambition is inextricably linked to the empowerment and integration of its women in Science, Technology, Engineering, and Mathematics. The evidence presented moves the conversation beyond the realm of social justice to the center of national economic strategy.

India stands at a unique and advantageous juncture. Unlike many nations struggling to attract women to STEM, India has successfully built a formidable educational pipeline, producing one of the world's largest cohorts of female STEM graduates annually.[5] This is a testament to the aspirations of Indian women and the success of foundational educational policies. Yet, this extraordinary asset is squandered through a systemic failure of the post-education ecosystem to absorb, retain, and promote this talent. The 'leaky pipeline' is not just a metaphor; it is a drain on India's most critical resource for a knowledge-based future.[8]

The economic case is compelling and clear: closing the gender gap in the workforce represents a significant opportunity to boost India's GDP.[12] In high-growth sectors crucial for the future—from Artificial Intelligence and clean energy to advanced manufacturing and biotechnology—the inclusion of women is not just about meeting workforce demand. It is about enhancing the very quality of innovation, mitigating biases in new technologies, and bringing diverse perspectives to solve the complex challenges that lie ahead.

The path forward requires a paradigm shift. The focus must move from simply encouraging girls to enter STEM—a battle largely won—to a relentless and concerted effort to dismantle the barriers that await them in the professional world.[13] This demands a multi-stakeholder compact, where the government enacts and enforces transformative policies on workplace equity and entrepreneurial support; where the private sector re-engineers its culture to be truly inclusive and meritocratic; and where industry bodies and civil society build the networks of mentorship and support that enable women to thrive.

The inspirational stories of the 'Rocket Women' of ISRO, the grassroots innovators from Atal Tinkering Labs, and the trailblazing women entrepreneurs in deep tech are not outliers; they are a preview of the immense potential waiting to be unlocked on a national scale.[14] By implementing the strategic pathways outlined in this report, India can fix the leaky pipeline and transform it into a powerful conduit for talent. In doing so, it will ensure that women are not merely participants or beneficiaries of the Viksit Bharat story, but are its principal authors and unassailable growth engine, driving the nation towards its 2047 destiny.

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ANNEXURE

Annexure Table A: State-wise Female Enrolment in Higher Education (AISHE 2021-22)

State/UT	Total Female Enrolment	Female GER
Uttar Pradesh	3,589,359	27.1
Maharashtra	2,223,071	33.2
Tamil Nadu	1,403,047	46.2
Madhya Pradesh	1,188,675	26.5
West Bengal	1,126,458	21.6
Rajasthan	1,104,389	26.5
Karnataka	1,088,963	34.3
Gujarat	824,111	24.3
Andhra Pradesh	799,754	32.7
Kerala	710,321	42.1
All India	**20,708,169**	**28.5**

Source: All India Survey on Higher Education (AISHE) 2021-22, Ministry of Education, Government of India. [27] Note: Table shows top 10 states by female enrolment and the national total.

10.1 Annexure Table B: Detailed Discipline-wise Female Enrolment in Engineering & Technology (UG), 2021-22

Discipline (B.E./B.Tech)	Female Share (%)
Computer Engineering	34.2
Electronics Engineering	28
Mechanical Engineering	5.9
Civil Engineering	22.7
Electrical Engineering	27.3
Information Technology	38
Chemical Engineering	23.2
Aeronautical Engineering	27.6
Metallurgical Engineering	22.7
Total (All Engg. & Tech.)	**29.1**

Source: All India Survey on Higher Education (AISHE) 2021-22, Ministry of Education, Government of India. [27]

10.2 Annexure Table C: State-wise Female Labour Force Participation Rate (Ages 15+, Usual Status, %), PLFS 2022-23

State/UT	Total Female LFPR (%)
Himachal Pradesh	58.7
Chhattisgarh	50.1
Sikkim	47.5
Andhra Pradesh	48.2
Telangana	44.9
Meghalaya	47.1
Karnataka	40.9
Tamil Nadu	42.1
Mizoram	43.8
Maharashtra	38.8
Uttar Pradesh	32.1
Bihar	29.4
Delhi	24.7
All India	**37**

Source: Periodic Labour Force Survey (PLFS) Annual Report 2022-23, National Statistical Office, MoSPI.[35] Note: Table shows a selection of states for illustrative purposes and the national total.

10.3 Annexure Table B: Detailed Discipline-wise Female Enrolment in Engineering & Technology (UG), 2021-22

Scheme/Year	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24	FY 2024-25
DST-WISE-KIRAN (Funds in Crore Rs.)	79.1	95	96.8	79.72	77.59
DBT-BioCARe Fellowship (Funds in Crore Rs.)	4.44	3.9	0.5	10.36	5.7
DHR-WSS (Funds in Crore Rs.)	5.3	4.2	6.77	6.79	13.46

Source: Press Information Bureau, Ministry of Science & Technology.[15]

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