

India's Skewed Gender Representation in the STEM Workforce: Need for Change

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India is one of the world's fastest growing economies. She is also the fifth largest economy in the world. The International Monetary Fund predicts that India is likely to become the third largest economy in the world in the next five years (World Economic Outlook Database, October 2022). Policy recognition and investment in science and technology are big drivers for this projected growth. It has resulted in creating new opportunities, new jobs - one only need look at India's vibrant startup ecosystem as a testament to this - but there is a major problem in this growth story. There is a noticeable lack of women in the science, technology, engineering and mathematics (STEM) workforce. In this essay, a reflection of the current canvas is presented and the imperative to attract more women to the workforce and correct the gender gap.

The Indian STEM landscape is male dominated and fraught with inclusivity and equity challenges. Given the aspirational growth ambitions India has, it is sensible to empower our brightest talent to fuel this growth, irrespective of gender, caste and other social constructs. A McKinsey study suggests that India has one of the largest opportunities in the world to boost GDP by advancing women's equality, almost to the tune of USD 770 billion of added GDP by 2025 (Woetzel et al., 2018).

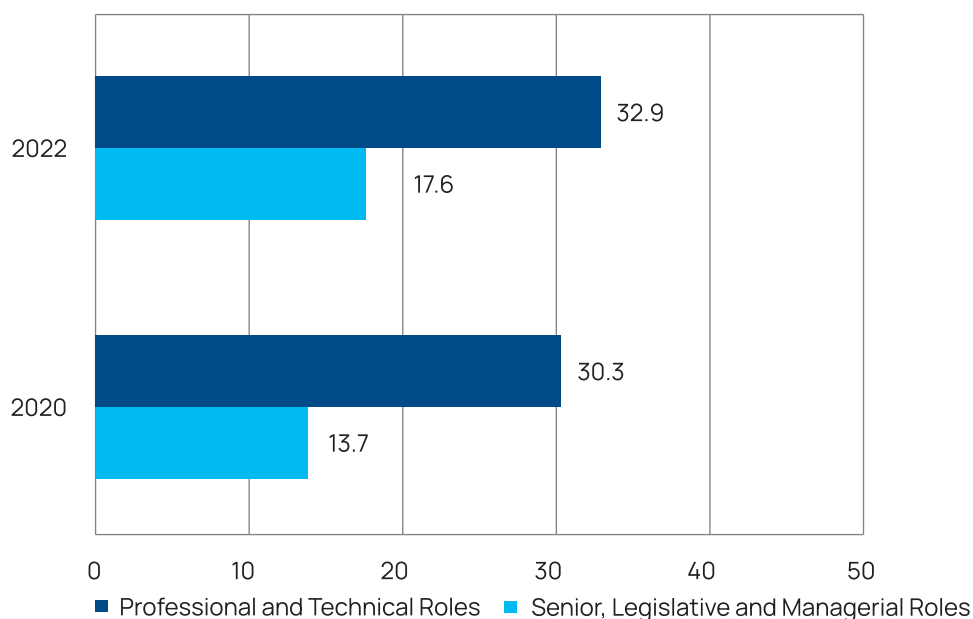
■ **Low Participation in the STEM Workforce**

In this section, we look at the participation of women in the STEM workforce in the public and private sector using different sources of publicly available data. Before delving into STEM specific observations, the reader should note that the participation of Indian women in the overall workforce is among the lowest in the world. The Global Gender Gap rankings measure the gender gap across economic participation and opportunity, educational attainment, health and survival, and political empowerment. India ranked 140 out of 156 countries in the 2021 Global Gender Gap report, dropping from 112 in the previous year's ranking (World Economic Forum, 2021). It must be said that poor rankings in similar indices have been the norm for India, rather than an exception.

Coming back to STEM, we looked at the share of women in professional and technical roles and senior and managerial positions in the Global Gender Gap reports (2020 and 2021) as a proxy to understand the participation of women in the STEM workforce. The reader should note that the selected indicators include professions outside of STEM such as the law profession.

The share of women in professional and technical roles was 29.2 percent in 2021 and 32.9 percent in 2022. The share of women in senior and managerial positions showed a modest increase from 14.6 percent in 2021 to 17.6 percent in 2022. An analysis of the same indicators from previous versions of the report shows that the overall trend is low participation of women in professional and technical roles and an even lower presence in senior and managerial positions.

Figure 1 Share of Women in Workforce for India

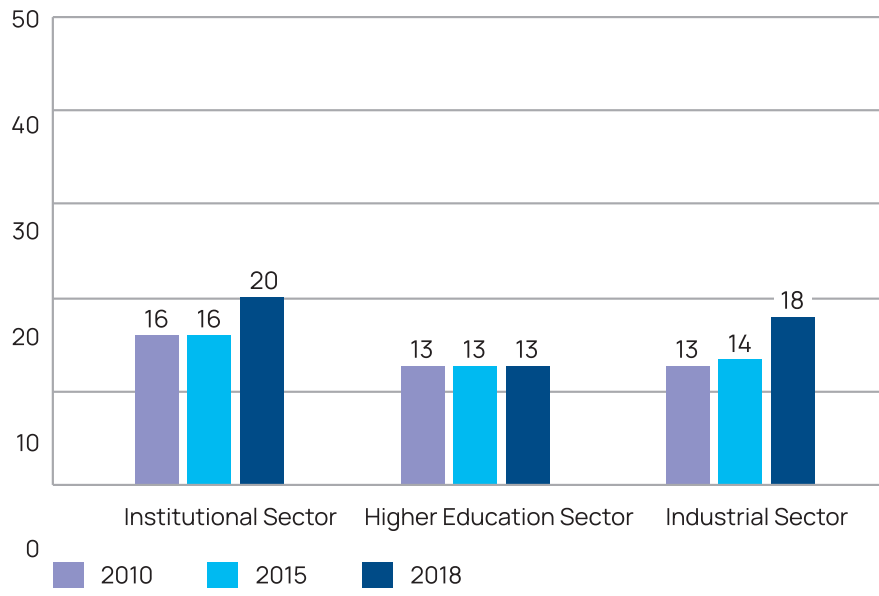


Source: Global Gender Gap Report, World Economic Forum, various years

This kind of underrepresentation of women in STEM is a global problem. The UNESCO Institute for Statistics reports that women accounted for less than 30 percent of the world’s researchers (UNESCO UIS, 2020). The situation is worse in India. One only needs to look at the official statistics from the Department of Science and Technology to see the stagnation of women researchers in the workforce (see Figure 1). The number of women researchers in the institutional (public) and industrial (private) sector have remained at less than 20 percent in almost a decade. In the higher education sector, the share has remained stagnant at 13 percent.

Data on women researchers from a 2021 study, ‘The Evaluation of Innovation Excellence Indicators; Report on Public Funded R&D Organisations’ conducted jointly by the Office of the Principal Scientific Adviser to the Prime Minister’s Office (O/o PSA), Confederation of Indian

Figure 2 Share of Women Researchers in Workforce (2010 - 2018)



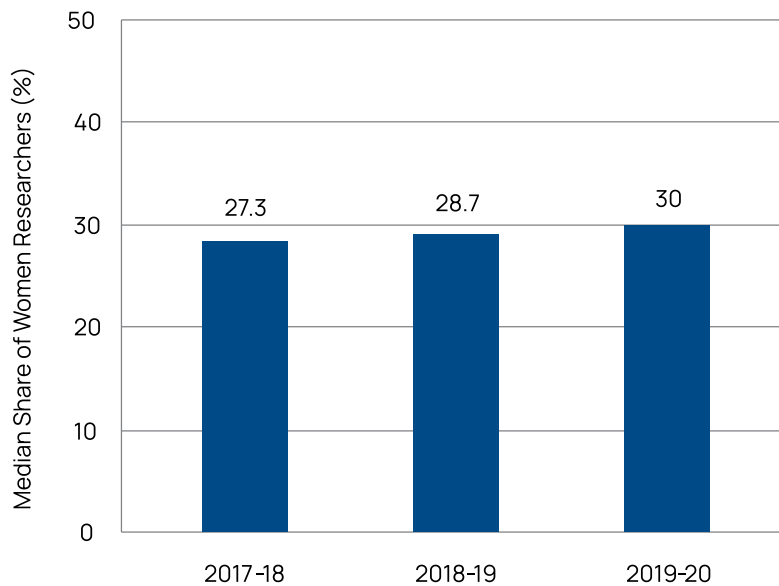
Source: R&D Statistics, Department of Science and Technology, Government of India

- Note: (i) Institutional Sector consists of Major scientific agencies, Central government ministries/ departments and State governments
- (ii) Industrial Sector consists of Public sector including joint sector, Private sector and Scientific and Industrial Research Organisations

Industry (CII) and Centre for Technology, Innovation and Economic Research (CTIER), showed a similar story. The study looked at 193 research laboratories across the major scientific departments minus the strategic departments of Department of Space, Department of Atomic Energy and the Defence Research and Development Organization. Findings show there has been a nominal increase in the median value of the share of women researchers in scientific staff between 2017-18 and 2019-20 across these 193 research laboratories but the overall share remains low.

Coming to the private sector, we looked at data available for the manufacturing sector, the IT sector, the biotechnology sector and startups. In the manufacturing sector, the Annual Survey of Industries 2019 data shows that the share of women in manufacturing remains stagnant at 19 percent. Most women work in apparel, textile and leather industries and food and tobacco industry (Dhamija, 2023). In the IT sector, studies estimate that the share of women in the IT sector to be around 35 percent (Nerurkar, 2020). A study from the Association of Biotechnology Led Enterprises (ABLE) shows the percentage of women in the biotechnology industry in India is estimated to be around 30 percent.

Figure 3 Share of Women Researchers in Workforce across 193 Research Laboratories



Source: Evaluation of Innovation Excellence Indicators; Report on Public Funded R&D Organisations

A study by Inc.42 of approximately 50,000 employees across more than 150 startups found that women accounted for 35 percent of the workforce in Indian startups. Another study (Johny, 2023) estimates that around 18 percent of startups are led by women. There is a noticeable absence of women leadership as startups become bigger and turn into unicorns. Of the reported 105 unicorns in 2022, only 18 have at least one woman co-founder (Inc42, 2023).

All in all, irrespective of the public or private sector, women are a minority in the STEM workforce in India. Gender gaps in the workforce are driven and affected by many factors, including long-standing structural barriers, socio-economic and technological transformation, as well as economic shocks (WEF, 2022). The Covid-19 pandemic, however, may have served as a trigger to change this situation. There has been an attitudinal shift towards working from home that has opened up previously closed opportunities for women. Issues linked to the work-from-home situation such as the 'double burden syndrome' need to be addressed to fully realise this opportunity. But it is clear that the pandemic has pushed some companies to hire women in jobs that were predominantly male bastions like pharmaceutical sales, or hire more women than they previously would (Bahree, 2021). It is important to build on this momentum.

■ But We have Gender Parity in STEM Education

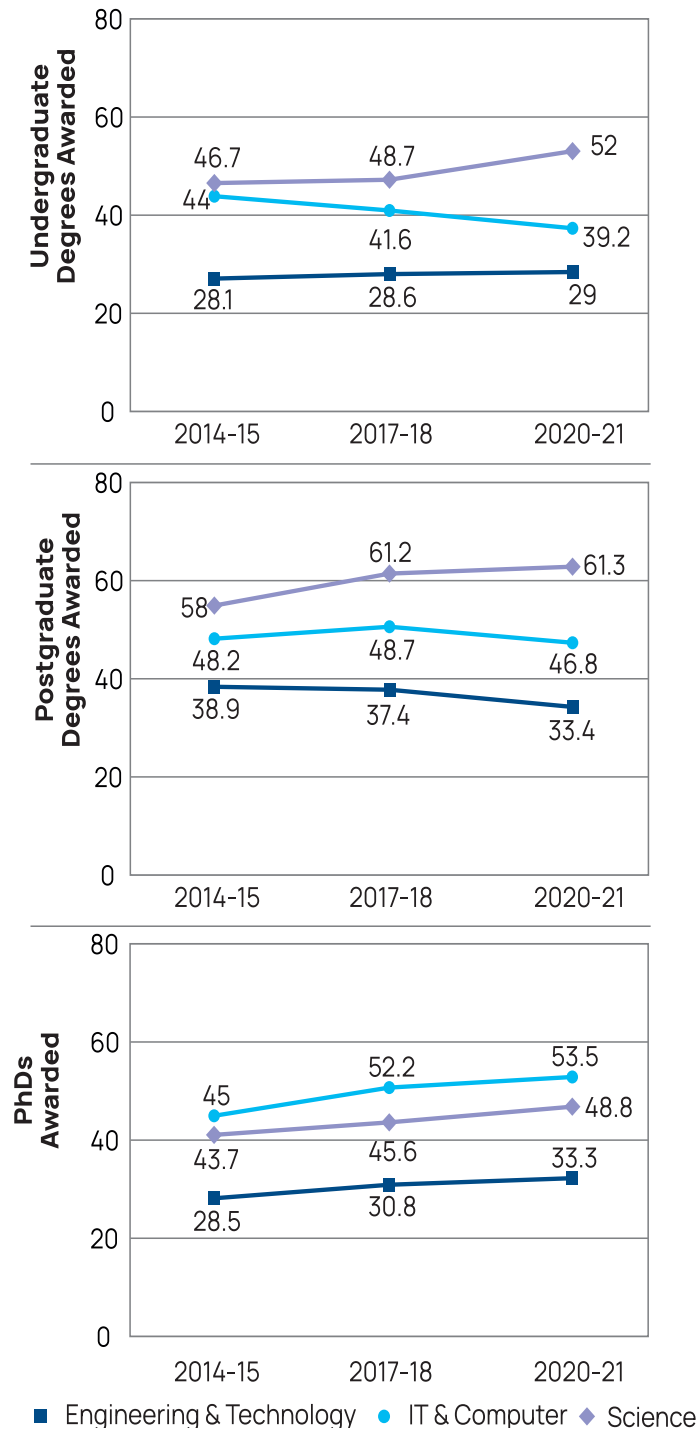
A sharp contrast to the low shares of workforce participation is the noteworthy progress made towards gender parity in STEM education. The effects of the policy push towards education for girls is visible in higher education across disciplines.

The share of women graduating from STEM subjects is around higher in the sciences and IT & computer as compared to engineering & technology at all levels of higher education. For all the three years at undergraduate level, science witnessed the highest share of women graduates when compared to the other two disciplines. At the undergraduate level, the share of women science graduates has increased to 54 percent in 2020-21 from 49.1 percent in 2014-15. In IT & computer, the share has decreased from 46.8 percent in 2016-17 to 43.9 percent in 2020-21. In engineering & technology, graduates have dropped from 32.3 percent in 2014-15 to 29.9 percent in 2019-20.

For all the three years at postgraduate level, science witnessed the highest women graduates when compared to the other two disciplines. Between 2014-15 and 2020-21, the share of women science graduates at the postgraduate level saw an increasing trend from 55.5 percent in 2014-15 to 63.5 percent in 2020-21. A similar jump in the share of graduates was seen in IT & computer from 46.8 percent in 2014-15 to 51 percent in 2020-21. However, the share of women graduates in engineering & technology has declined from 40 percent in 2014-15 to 37.7 percent at the postgraduate level.

For all the three years at the PhD level, the IT & computer discipline witnessed the highest share of women graduates when compared to the other two disciplines. However, the share within IT & computer has dropped from 57 percent in 2014-15 to 50.8 percent in 2020-21, while the share of women graduates jumped from 38.7 percent in 2014-15 to 49.1 percent in 2020-21 in science and from 25.4 percent in 2014-15 to 31.4 percent in 2019-20 in engineering & technology.

Figure 4 Share of Degrees Awarded to Women in STEM



Source: Ministry of Human Resource Development, Department of Higher Education, All India Survey on Higher Education (AISHE) Report (various years), Centre for Technology, Innovation and Economic Research (CTIER)

■ **Poor Retention and Stagnation are Everyone's Problems**

There are many narratives to unpack in order to understand this gap between gender parity in education and the low participation of women in the workforce. There is a wealth of research on the different visible and invisible factors that contribute to this situation. These factors include gender differences in competitiveness, incompatibilities of a scientific career with family obligations, the possibility that stereotype threats lead to the undervaluation of work by female researchers, patriarchal attitudes at the workplace and the rampant issue of pay gap across sectors (Reuben et al. 2014). All these factors add up to poor retention and career stagnation for women, ultimately leading to dropouts in the STEM workforce.

Within academia and research, the stagnation of career progression of women researchers in scientific institutions is not only a worrying trend of the present but bodes ill for the next generation of aspiring women researchers. A recent UNESCO publication on women in science in India highlights the percentage of female principal investigators (PIs) in R&D projects 2000-17 in public R&D laboratories has hovered around 20 percent (Christopher et al., 2022). The same report also shows the low percentage of female fellows at three Indian science academies viz. Indian Academy of Sciences, Indian National Science Academy, Interacademy Panel on Women in science.

The situation is not much brighter in the private sector. The IT sector, where women's representation is higher compared to other sectors, has similar retention issues as seen above. A recent study shows that women make up 51 percent of entry-level IT recruits, 25 percent of those in managerial positions and less than 1 per cent in the top level positions (Pailoor, 2023).

While other similar sector-specific studies are not easily available, the low number of women in senior and leadership positions is a common theme. The failure of organisations to promote and retain women in technical roles not only reflects the broken promotion system that perpetuates gender disparity but also results in fewer women being prepared for senior roles (Gascoigne et al., 2022).

An analysis of data from LinkedIn of women working in the private sector in India reveals that women get stuck at the same positions early in

their careers. Career progression is a major issue in the absence of equal opportunities for advancement. The 2021 analysis shows that the number of women starting in technical roles in India is already low at 28 percent as compared to the global 44 percent. The under-representation gets more acute up the seniority ladder, with the maximum drop seen at the manager level with only 18 percent representation of women and 15 percent women in C-suite positions.

Why should we care about this data that shows poor retention and career stagnation? Several research studies have highlighted the social, moral and economic advantages of women participation in the STEM workforce. There is strong evidence that gender diversity can enhance knowledge outcomes (Maes et al., 2012; Valantine and Collins, 2015), particularly the unique types of knowledge women may develop (Schiebinger, 2008, Xie, 2020). Women are an untapped resource for a firm's innovations, and the investigation of women's role in R&D teams is timely and critical to improve innovation performance (Xie et al., 2020). Widespread acceptance that women can contribute substantially in scientific R&D and high-tech industries can help address some of the reasons that have caused poor retention and career stagnation for women in STEM.

■ Ongoing Efforts are not Enough

The issue of underrepresentation of women is not a new one. There have been several efforts to investigate and address the causes. In a CTIER policy brief, 'Inclusivity and Gender in Science - An Uphill Climb' we highlighted the different interventions that various scientific departments have in place. These include schemes that focus on career opportunities for women scientists and technologists, especially those who had a break in their career, address relocation issues of working women scientists, mitigate gender disparity in science and engineering research funding and encourage women entrepreneurship.

In the private sector, there have been several noteworthy efforts. Companies like L'Oréal (in partnership with UNESCO), Larsen & Toubro, IBM, CISCO, Microsoft, Adobe, Intel, and Google, among others, have actively promoted women's participation in science as part of their CSR activities (Christopher et al., 2022). Industry organisations such as CII, NASSCOM and the Federation of Indian Chamber of Commerce &

Industry (FICCI) have specific verticals dedicated to encouraging and facilitating greater women participation.

Manufacturing companies too have introduced several programs to encourage greater participation of women. For example, Tata Steel has hired 38 female heavy earthmoving machinery operators at its mines in Jharkhand's West Bokaro and Noamundi as part of its Women@Mines programme (Tata Steel, Press Release 2019). Hindustan Coca-Cola Beverages (HCCB) launched its primarily women-driven, vertical factory in Siliguri, West Bengal - India's first ever vertical beverage manufacturing plant in India (HCCB, 2022).

In the startup world, there have been initiatives to encourage more women entrepreneurs. Venture funds like Sequoia Capital with the Spark programme, Kalaari Capital's CXXO initiative, the Small Industries Development Bank of India (SIDBI) backed She Capital programme are some examples of mainstream venture funds investing in women-led startups. From the government side, the NITI aayog led "Women Entrepreneurship Programme", various state government allowances for women entrepreneurs all reflect the intention to support women entrepreneurs.

The data shows we are a long way away from making any significant dent in addressing these issues. Even with such welcome initiatives, gender inclusion continues to be a seemingly unbreakable barrier.

■ **A Crucial Missing Link - Lack of Gender Disaggregated Data**

Where are we lacking in implementation? Why does the women STEM workforce have a retention problem? What more do we need to do to increase recognition of the link between diversity and inclusion and India's growth? What is the kind of support required for women to stay and succeed in STEM careers?

It is difficult to answer any of these questions as we do not collect enough data on gender disaggregation, whether it is in education or at the workplace. There is no way to learn and adapt strategies from previous and current policy interventions without proper institutional mechanisms to collate, collect and make such data available.

For any worthwhile strategy to counter stubborn structural barriers or find fruitful solutions to improve the participation of women in the STEM workforce, we need to collect gender specific data at a large scale across the public and private sector. The collection of such data can enable better research on specific needs, demands and struggles of working women.

Even in cases where some data is available, we risk continual policy silos and ineffective solutions if the data is not made available at all levels of governance. Take, for example, the AISHE data where national gender disaggregated data is available on enrolment and degrees awarded. This same data is not available at the regional level. Nor is data on state level subject wise breakdown available. Such issues pose a barrier for designing any regional interventions to address gender issues.

■ **It is not all Doom and Gloom**

Despite structural barriers and incentives, the situation is changing in how women participate in the STEM workforce. We looked at two datasets - LinkedIn and Tracxn, both of which show an increase in the number of women preferring to start their companies. To be fair, not all the companies have a STEM focus but we present the data to show that there seems to be an emerging trend of women creating their own leadership and career opportunities.

The LinkedIn data, which uses information available on the platform of founders, shows that the number of women starting their companies has been on the rise since 2010 with a sharp increase 2018 onwards. According to various reports that cite Tracxn data, the share of total funding that women-led startups receive, albeit small, is seeing a steady increase. Similarly, the reports also suggest a steady increase in the number of active investors investing in women-led startups since 2010.

Another positive development that can have an effect on increasing the participation of women in the STEM workforce is the increased representation of women on Indian boards. According to an Ernst and Young analysis, women representation on boards has increased three times in the last decade, from 6 percent in 2013 to 18 percent in 2022. Part of this can be attributed to a mandate in Indian corporate law that requires women representation on boards. While this is a good

step in increasing the number of women as directors, care must be taken to ensure the women are not a token presence with little role in consequential decision making (Aguilera R., Kuppaswamy K and Anand R., 2021).

There is also a buzz around the potential of increased participation of women in manufacturing as more automation is introduced to the shop floor. One such example of this change is the increased number of women in the electronics and EV manufacturing space. As the EV market has grown exponentially, the number of factories to meet demand have increased, thus opening doors for women in manufacturing, design and leadership roles (Srivastava & Nagaraj, 2022). Ola Cabs and Piaggio have all-women shop-floors at their factories in Tamil Nadu and Maharashtra respectively. Recruitment agency TeamLease Digital, which scouts talent for EV firms, reports hiring of both sexes has increased more than 30 percent in the last two years (ibid).

The IT sector and the biotech sector present two leapfrog opportunities to address the skewed gender representation in STEM for India. The IT sector is expected to grow to USD 350 billion Information Technology Business Process Management (IT BPM) sector revenue) within the next three to five years. According to a recent report, the current gap between demand and supply of talent is about 21 percent in India (Majumdar, 2022). Similarly the Indian Bioeconomy is expected to grow to USD 150 billion by 2025 (BIRAC, 2022). The highest number of graduates as seen in the AISHE data are science graduates, indicating talent availability. There is ample space for Indian women to fill this talent gap.

■ **We Need Reforms on the Scale of the 1991 Economic Reforms**

It is clear that current policy initiatives and efforts underway are simply not enough to address this issue. Traditional programme and scheme models that put the participation burden on women do not produce the desired results. They do not support a woman's fundamental right to work. Poor retention and career stagnation are institutional failures in acknowledging the needs and demands of women in the STEM workforce. The design of any scheme to increase the participation of women in the STEM workforce needs to factor in the fact that institutions need to be enabling places for work.

Report after report highlighting the importance of women in the STEM workforce and piecemeal solutions are not enough. We need to recognise that the current system is not fit for purpose to bring the radical transformation required to correct the gender imbalance in the workforce. We have seen what is possible when public and private efforts are focused together towards the same purpose. The positive change in education, particularly gender parity in science education, is proof of that.

The ongoing technological shift and the upcoming automation age is transforming the nature of work globally. This is an opportunity for India if we can create the right kind of structures, support and incentives for women in the STEM workforce to build the skills and lower pervasive barriers for career progression. We can compound the incremental gains of the women STEM workforce from the last few decades if we invest wisely in creating a genuine social contract where women are equal partners with the same access to opportunities, pay and rights as their counterparts.

India's skewed gender representation in the STEM workforce needs to move from being a footnote in the grand scheme of interventions for India's growth ambitions to being front and centre at the strategy of fulfilling these growth ambitions. Maintaining the status quo diminishes India's chances at achieving the growth ambitions she has set for herself.

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