

Gender issues in science and engineering

Various gender issues influence the number of female graduates at the tertiary and doctoral level, and the number of female researchers in science and engineering (S&E). While recent data show an increase in the number of female doctoral graduates and researchers, the female share is still lower than that of men, especially in S&E fields. Greater gender equality in educational attainment and labour force participation can strengthen the research system. However, women, to a large degree, still remain an untapped resource for science and innovation. Different factors explain why women do not choose S&E careers. The issue of gender issues in S&E is closely related to broader questions, such as research careers, pay and workplace conditions, and accountability regimes. Many OECD countries are implementing various policy actions to address the issue of low female participation in science and engineering.

What are gender issues in science and engineering (S&E)?

Various gender issues influence the number of female graduates at the tertiary and doctoral level, and the number of female researchers in science and engineering (S&E). Overall, despite the fact that significant progress has been achieved in the last few decades, gender differences still remain in educational attainment, labour force participation, the number of women in posts of responsibility, such as professors in universities or research directors, hours spent in paid and unpaid work, employment conditions, and earnings. Long-standing gender differences suggest that underlying features in education systems or societies may foster such gaps. Evidence shows that gender differences are particularly noticeable in the S&E fields.

What impact do gender issues have in science and engineering?

Women's contributions as researchers in S&E are seen as essential in today's increasingly knowledge-based economy (OECD, 2006). The potential benefits to the research community of greater gender equality include:

- Greater supply of researchers: there is a growing demand for researchers with high-level science and technology knowledge and skills across OECD countries. A larger number of female researchers with S&E skills would increase the overall capacity of the research community.
- Improve the quality and/or diversity of S&E research: women researchers may also increase the quality of the research system since they have different interests, increasing the diversity and richness of human knowledge and understanding (Tilghman, 2004). For example, the contributions of women researchers as engineers and users are slowly introducing changes in the infrastructure and design of automobiles and robots (OECD, 2006).

Likewise, greater gender equality in labour force participation can have a positive effect on sustainable economic growth (OECD, 2012b).

- Sustainable economic growth: women with S&E skills can play a crucial role in transforming investments in knowledge into productivity and growth. The increased entry of women into the labour market in recent years has contributed to the economic development of many

OECD economies (OECD, 2011). Given the increasing female participation in higher education, women will account for a larger share of the labour market. This also should, in principle, have a positive impact on the number of women in posts of responsibility.

- Demographic factors: using female S&E skills available in the labour market is vital for promoting long-term economic growth. As demographic pressure grows across OECD countries, meeting the challenge of aging populations and declining birth rates requires the full participation of women's S&E skills and competencies in the economy. By instituting policy actions that create incentives for balancing work and family life, a number of countries have encouraged women to participate in S&E careers and to remain in the workforce.

What factors affect female participation in science and engineering careers?

While women account for more than half of tertiary graduates across OECD countries, the percentage of degrees awarded to women at the tertiary education and doctoral level in S&E is still much lower than the percentage of men and women awarded degrees in other scientific fields, such as health and education. Gender issues discouraging women from pursuing research careers in S&E fields can be categorized as horizontal segregation (i.e. related to the concentration of women in certain fields of scientific research and/or certain sectors of employment) and vertical segregation (i.e. related to the lower percentage of women among senior staff).

- Gender stereotypes: some fields, including S&E, seem to be less attractive to women because they are traditionally viewed as more suitable for men. Data show most women pursue education and health related degrees, while they remain under-represented in such fields as engineering (see Figure 1). Gender stereotypes might contribute to excluding capable women from and/or limiting their opportunities in S&T degree fields.
- Individual factors: research suggests that women and men may be driven by gender-specific priorities when making personal choices, such as whether to pursue a career in a certain field (Becker, 1971). It is argued that women choose certain fields, such as education or medicine, because these career options are beneficial both for their professional and family objectives and commitments (OECD, 2006).
- Interpersonal factors: the issue of role models can be considered a significant factor in changing low female participation in S&E fields (OECD, 2006). Networking activities in S&E fields, or a lack thereof, may influence women's career choices in certain scientific fields. Research has shown that a lack of role models in certain sectors can have an impact on the career choices of women.
- Gender differences in mathematics: differences in mathematical ability between boys and girls are thought to influence the participation of women in scientific education and careers. Girls have recently caught up with or even surpassed boys in science proficiency in most OECD countries; however, this improvement has not led to an increase of interest among girls to pursue science-related careers (OECD, 2012a).

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Vertical segregation

- **Access to senior positions:** on average, women are under-represented in management positions across OECD countries. This includes a low number of women in posts of responsibility, such as professors in universities or research directors in S&E related careers. Lower productivity has been cited in explaining differences in promotion between men and women. However, productivity is also affected by access to team leader positions, and incentives and opportunities for the promotion of women may be reduced by lack of access to team leader positions early in their careers (OECD, 2006).
- **Earnings differentials between genders with the same educational attainment:** a gender gap in earnings is attributed, in part, to differences in occupations and in the amount of time spent in the labour force (OECD, 2011). However, the fact that women are more likely to work part-time in order to combine work and family responsibilities often comes at a cost to their earnings prospects and long-term careers (OECD, 2012b).
- **Discriminatory social norms:** women are still generally expected to be the primary caregivers in our societies. Therefore, it is suggested that women, on average, have greater pressures on their time than men and, as a result, are more likely to work on a temporary and part time basis (OECD, 2006). This is a potential factor in persistent gender differences in career profiles.
- **Scientific excellence gap:** some research suggests that there is gender bias in the system for the evaluation of scientific excellence, which may impact on possibilities for career advancement.

Figure 1. Share of Women in university graduates, (ISCED2011 levels 6 to 8) general/academic programmes, all fields

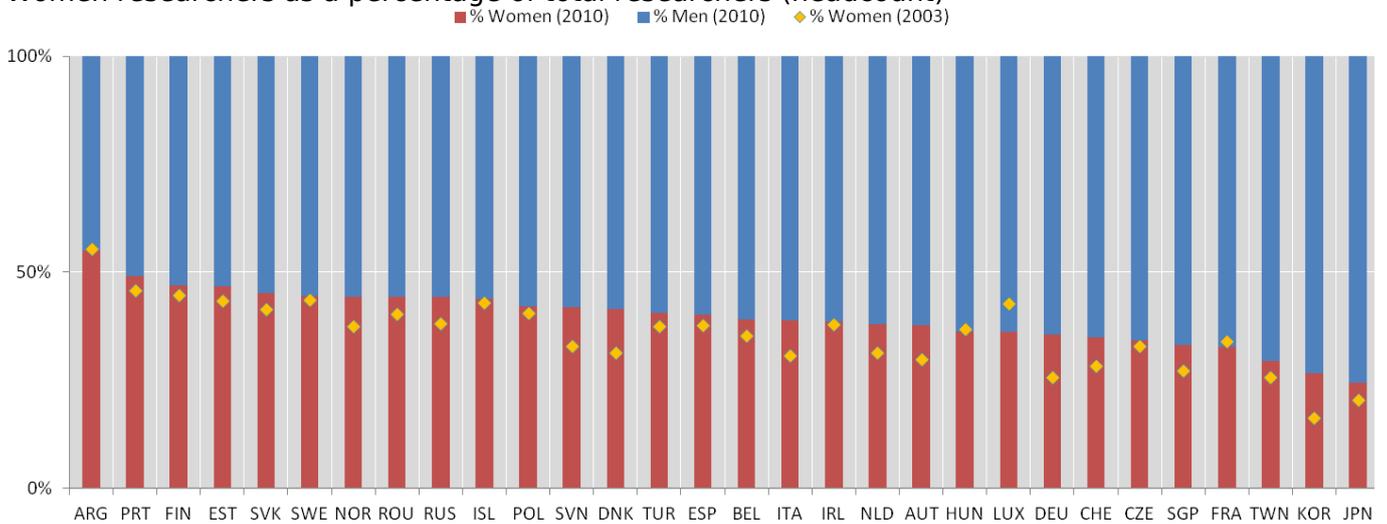
What is the evidence on gender issues in science and engineering?

Statistics on tertiary graduates and doctoral holders give an indication of the significant gender differences in the supply of labour. Figure 2 shows that, in the OECD area, women graduates account for more than half of tertiary graduates, yet they remain under-represented in S&E degrees. With regard to doctoral holders, the same figure shows that female graduates account for less than half of the doctorates. The female doctoral rate is significantly lower in S&E fields. Figure 2 also shows an overall increase in the female share of tertiary and doctoral graduates for the period given. Concerning S&E fields in particular, these figures point to an increasing female share of both tertiary and doctoral graduates, especially in S&E doctoral graduates.

With regard to women researchers in the higher education sector, Figure 3 shows an overall increased presence of women researchers across most OECD countries. Nevertheless, women researchers make up a much lower percentage of total researchers than do male researchers.

Figure 3. Higher education sector

Women researchers as a percentage of total researchers (headcount)



Source: OECD, Main Science and Technology Indicators, January 2013.

Note: For Austria values used account for 2002 and 2009, for Belgium and Iceland values used are from 2009, and for Estonia and Switzerland values used are from 2002.

Concerning the employment rate of doctorate holders, Figure 4 shows that the female employment rate is lower than that of men for most OECD countries. In terms of gender earnings differences, it can be seen in Figure 5 that a woman with a tertiary education in the OECD area can expect to earn, on average, 70% of what a man with the same qualification earns.

Figure 4. Employment rate of doctorate holders by gender, 2009

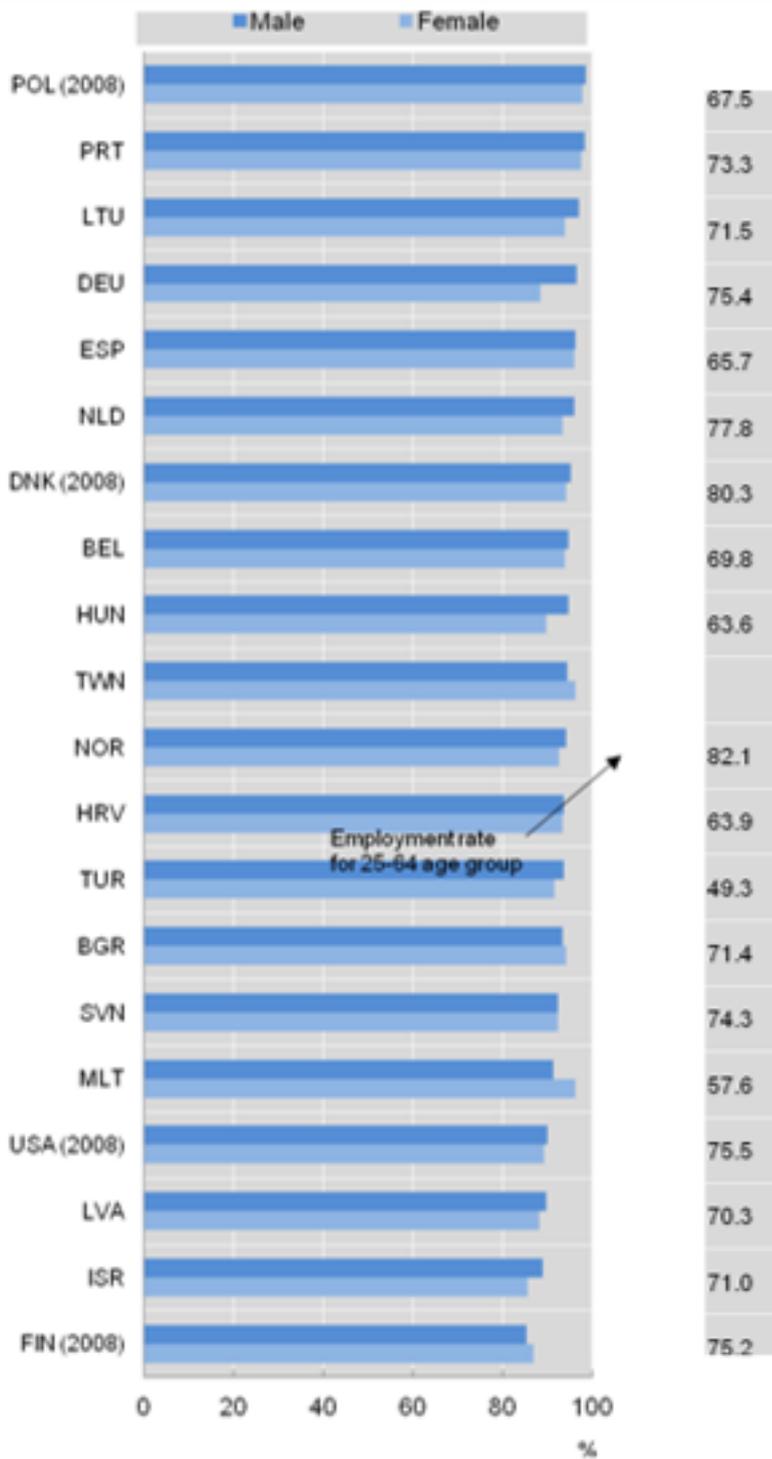
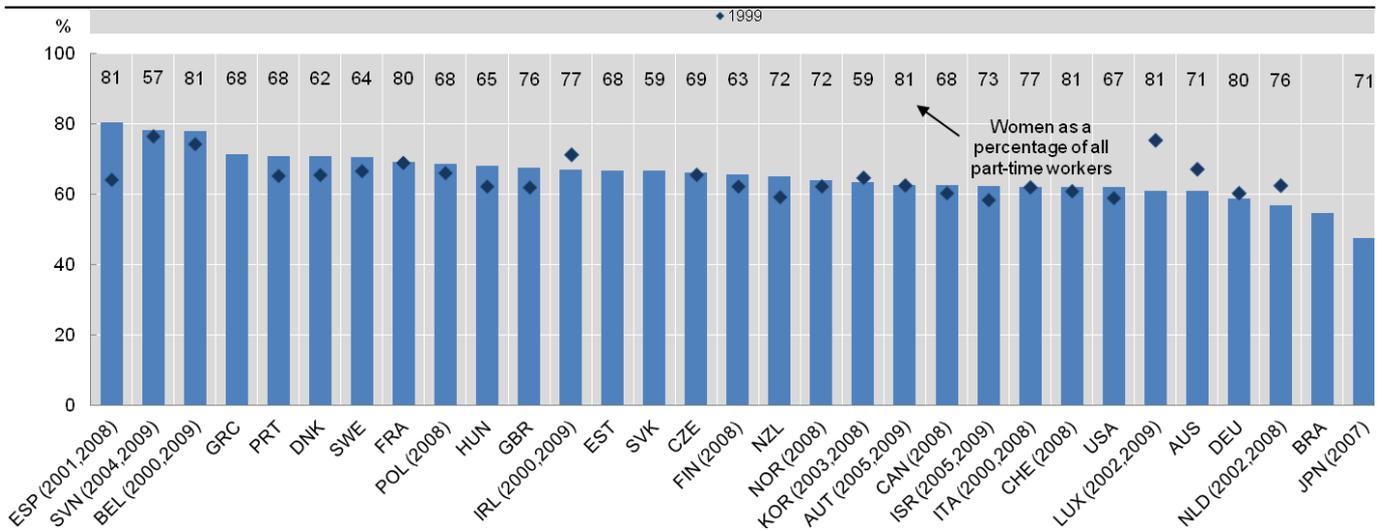


Figure 5. Earning differentials at tertiary-level educational attainment, 1999 and 2009

Average annual earnings of women as a percentage of men's earnings



Source: OECD (2011), Education at a Glance 2011: OECD Indicators, OECD, Paris and OECD Employment Database, June 2011.

Figure 2. Share of women doctorates graduates (ISCED2011 level 8)

Figure 3. Women researchers, % of total researchers

What other topics relate to gender issues in science and engineering?

The issue of gender issues in S&E is closely related to such broader questions as:

- Research careers, pay and conditions: factors such as earnings and working conditions influence the career choices of doctoral graduates. Women who have completed tertiary education and/or engaged in research careers still face the gender gap in earnings and lack of access to senior positions. This results in a reduced female labour supply and under-utilization of their skills, hampering economic growth (OECD, 2012b).
- Accountability regimes associated with universities and PRIs: transparency in decision making processes, accountability of decision makers and penalties for non-compliance with transparency measures are expected to reduce potential gender biases (OECD, 2006). Likewise, evaluation programmes and initiatives to promote women in S&T are expected to feed back into policy and practices.
- Education and training arrangements: the use of targeted scholarships and research grants to encourage women researchers to pursue careers in S&T fields could help to reduce gender differences.
- R&D collaboration (e.g. with firms): the development of formal and informal networks of women researchers, including partnerships between researchers in firms and universities,

could encourage and facilitate women in advancing their S&T careers.

What policies relate to gender issues in science and engineering?

Policies and programmes to promote female participation in S&E careers range from targeted scholarships to the dissemination of career stories of successful women. On the employment side, policy actions may include grants to support senior positions for women at universities, preferential recruitment policies for equally qualified women candidates, equal opportunity policies, flexible working hours and parental leave. To this end, a range of programmes and strategies has been provided in Table 1.

Table 1. Recent policy developments to promote open science

Policy instrument	Objective of the policy	Rationale	Mechanism
Policy strategies, from initiatives at schools to S&E careers.	Increasing female's motivation for participating in S&T careers.	Framework failure (deficiencies in culture and social values)	Regulatory
Dissemination of successful women careers stories in S&E. Development of formal and informal networks of women researchers. Coaching and mentoring.	Improving perception of women participating in S&E fields to attract women among and within public research institutions.	Network failure	Service or information
Evaluation and monitoring.	Strengthening the transparency and fairness of public sector employment systems and policies.	Institutional failure	Regulatory
Legal assistance.	Discouraging employers to adopt discriminatory practices.	Institutional failure	Regulatory or economic
Preferential recruitment policies in S&E fields (e.g. targeted awards, funded chairs for women faculty, gender mainstreaming research programmes).	Encouraging women researchers to pursue careers in S&E fields.	Framework failure	Regulatory
Quotas for the nomination of women to top senior positions.	Encouraging employers to hire women researchers.	Institutional failure	Regulatory
Equal earning policies.	Improving working conditions for women.	System failures (lack of gender equality)	Economic
Support of flexible working hours and parental leave.	Promoting work and family balance initiatives.	Framework failure	Regulatory or economic
Partnerships between researchers in firms and in universities.	Enhancing female participation in the labour force.	System failures	Regulatory or economic

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Related Link: Production of R&D-related skills by universities and PRIs
Scientists and engineers
Research specialisation
R&D funding organisations
Research careers, pay and conditions

Source URL: <https://www.innovationpolicyplatform.org/content/gender-issues-science-and-engineering>

Links

[1] <http://dx.doi.org/10.1787/eag-2012-en>

[2] http://dx.doi.org/10.1787/sti_scoreboard-2011-en