

## Environmental scan report

# 30 by 30 and beyond

**Strategic priority 3: recruitment, retention, and professional development of women in the engineering profession**



## Executive Summary

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In May 2018, Engineers Canada's Board of Directors approved a new strategic plan, which highlighted, in strategic priority 3 (SP3), the need to drive cultural change in the engineering profession in order to attain 30 by 30. Engineers Canada's Strategic priority 3: Recruitment, retention, and professional development of women in the engineering profession expanded the 30 by 30 initiative to include the retention and professional development of women. SP3 is aimed at ensuring that, in partnership with the regulators, actions plans are developed and implemented to achieve an expanded scope.

This environmental scan assesses the internal and external environments that impact Engineers Canada's SP3. The report draws on survey data provided by the 30 by 30 Champions to present a history of women in engineering work that has been supported at Engineers Canada, a snapshot of the current state of the 30 by 30 initiative, statistics and research on the barriers to women's participation in engineering, as well as an analysis of the role of Engineers Canada.

The scope of this environmental scan is limited due to available time and resources. Information for this document was drawn from Engineers Canada's archives, Engineers Canada's National Membership reports, Engineers Canada's Enrolment and Degrees Awarded reports, external reports, academic literature, and the SP3 survey of 30 by 30 Champions. The intention is to provide an overview and summary of relevant history and data, a current state analysis, as well as background information from outside the engineering profession to assist Engineers Canada and the 30 by 30 Champions in developing the strategy for SP3.

The scan finds that Engineers Canada must continue to act as a backbone organization, fostering collaboration with engineering regulators, and other engineering stakeholders, to work collectively and share authority, decision-making, and accountability to influence the achievement of 30 by 30. The work of the 30 by 30 network shows that a great deal is being done by regulators, higher education institutions, and some companies to reach out to young women and also to retain women once they are in the profession. However, more measures need to be taken to address the conversion between graduation and licensure, and to better address the retention and professional development situation in engineering workplaces. A greater emphasis on collaboration between stakeholders (ie. higher education institutions and regulators, regulators and employers), as well as evaluation frameworks for programs could help improve existing programs. The scan also highlights the need for men to play a significant part in changing the engineering culture. Engineers Canada must work with the 30 by 30 Champions to ensure male allyship is developed and encouraged throughout the SP3 action plans, as well as to foster collaboration and partnerships, particularly with employers, to facilitate the culture shift in the workplace that is needed to make engineering a more welcoming place for women.

# Contents

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- Section 1: Overview of 30 by 30 ..... 5
  - 1.1 History of 30 by 30 ..... 5
  - 1.1 Key Insights from the history of 30 by 30 (2001-2018)..... 11
  - 1.2 Current State 30 by 30 ..... 12
  - 1.3 Key insights from 30 by 30 Champions’ survey ..... 14
    - Organizational structure and tools ..... 14
    - Programs and activities..... 15
    - Partnerships ..... 21
- Section 2: Statistics on women’s participation in engineering ..... 23
  - 2.1 Early education ..... 24
  - 2.2 Post-secondary education..... 26
  - 2.3 Engineering profession ..... 29
- Section 3: Barriers to women in engineering ..... 32
  - 3.1 Barriers to recruitment ..... 32
  - 3.2 Barriers to retention ..... 34
  - 3.3 Barriers to professional development ..... 36
- Section 4: Overview of external trends that relate to Engineers Canada’s gender equity strategy ..... 39
  - 4.1 Women in leadership ..... 39
  - 4.2 Unconscious and implicit bias ..... 40
  - 4.3 Electricity Human Resource Council ..... 41
  - 4.4 Law Society of Ontario ..... 42
  - 4.5 Natural Sciences and Engineering Research Council of Canada (NSERC) ..... 43
  - 4.6 Equal by 30 - NRCan ..... 43
- Section 5: The role of Engineers Canada ..... 45
  - 5.1 Internal environment ..... 45
- Section 6: Analysis and recommendations ..... 47
  - 6.1 Engineers Canada ..... 47
  - 6.2 Recruitment ..... 49
  - 6.3 Retention ..... 49

6.4 Professional development ..... 50

## Section 1: Overview of 30 by 30

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The 30 by 30 goal first took shape due to the recognition, by engineering regulators, that the underrepresentation of women in the profession necessitated an intervention. Increasing women's participation was seen as part of the effort to increase diversity in the engineering profession, which would come with the following benefits: meeting labour market needs, improved economic performance as research shows companies with the highest share of women in leadership outperform all-male executive committees, and an engineering profession that reflects the diversity of Canada's population. The following section provides a history of work on gender equality by the engineering profession, based on Engineers Canada's archives and records.

### 1.1 History of 30 by 30

In 1990, Industry Science and Technology Canada initiated the formation of the Canadian Committee on Women in Engineering (CCWE) under an Industrial Agreement of Employment and Immigration Canada. The main signatories to the agreement were the Canadian Council of Professional Engineers (CCPE), which later became Engineers Canada, the Association of Consulting Engineers of Canada, the Association of Universities and Colleges of Canada, and the Canadian Manufacturer's Association. The CCWE was chaired by Monique Frize who was the first Natural Sciences and Engineering Research Council (NSERC) Chair for Women in Science and Engineering at the University of New Brunswick.

In 1992, the CCWE published a report, *More than just numbers*, which was foundational in terms of women in engineering in Canada.<sup>1</sup> At the time of the report, women represented just under four percent of professional engineers in the country and came only two years after the massacre at École Polytechnique in Montréal of 13 engineering students who are women. The report provides evidence gathered through research and community consultations from across the country and outlined recommendations focused on changing attitudes and creating women-friendly environments:

1. **Commitment from the top.** Change in attitudes and the environment will not happen without commitment from senior management in the elementary and secondary school system, universities, and workplaces. They will need to commit, in principle and practice, to attracting women to the profession and creating women-friendly environments.
2. **Gender sensitivity and awareness.** Real social change will not occur unless everyone understands and accepts that women deserve equal status as people and as engineers. This acceptance is especially important in faculties of engineering where some male students and professors still discriminate covertly against women students, and in the workplace where many women engineers do not have the respect of staff, co-workers, and supervisors. Changing attitudes will take time, but will be accelerated by education and awareness programs that reinforce gender sensitivity.
3. **Women involved in the process of change.** In the elementary and secondary school system, more women must become mathematics and science teachers and be appointed as school administrators. In universities, more women must be seen in the ranks of senior management

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<sup>1</sup> 1992 CCWE. *More than just numbers*. Report of the Canadian Committee on Women in Engineering. April 1992

and as professors in faculties of engineering. In the workplace, more women must be named to boards of directors and promoted to senior management. In associations of professional engineers, women must sit on councils and committees at the national, provincial, and territorial levels.

4. **Co-operation from educators, employers, and engineers.** Co-operation is required from all those involved in the making of an engineer: parents, other caregivers, teachers, and guidance counsellors; engineering deans, faculty, and students; employers of engineers; and associations of professional engineers. By working together to change the image of engineering and to improve the learning and working environments of engineers, women will be convinced that the engineering profession offers a challenging and rewarding career.
5. **Realistic and challenging goals.** Organizations must set realistic and challenging goals for attracting, retaining, and advancing the careers of women engineers. To illustrate, the CCWE has set schedules for success as guidelines for implementing the recommendations. Individual organizations will need to set their own pace for change based on their own situations.
6. **Mechanisms to measure and report on progress.** Organizations that represent the key stakeholders in the elementary and secondary school system, universities, workplaces, and associations of professional engineers must be made responsible for monitoring the implementation of the CCWE's recommendations and strategies. Such monitoring must include regular and public reports on progress.

Though the recommendations are almost twenty years old, they remain relevant today. The report also outlined five goals to be achieved in five years (by 1997):

1. Girls and boys will pursue mathematics and science in equal numbers, especially at advanced levels throughout high school.
2. Women will comprise 25-35 per cent of first-year students, 20 per cent of masters students, 10 per cent of doctoral students, and five per cent of the professorate in faculties of engineering across Canada.
3. Women will comprise at least 18 per cent of graduates from undergraduate engineering programs.
4. More women engineers will be in senior management positions and on boards of directors of companies employing engineers.
5. More women engineers will be elected members of council and appointed members of committees of associations of professional engineers.

After almost two decades, the goals are close to being achieved. Section 3 provides statistics on the women's participation in engineering and some of the recent trends.

In 2001, the Women in Engineering Advisory Group (WIEAG) was created to provide a national forum for discussion on issues for women in engineering. WIEAG was made up of women engineers in academia and industry and reported to the CEO of CCPE. The CCPE had a Women in the Engineering Profession Policy Statement that included a commitment to achieving gender balance on the Board and committees, a statement on requiring different approaches to engage a diverse community that is

representative of Canadian society, and that the CCPE recognize and publicly celebrate the contribution of women engineers. A section on retention included the following policy statements:

- “A work environment, that allows engineers to achieve a professional and personal balance enhances the profession, supports the retention of members, and promotes career path choices. A respectful, flexible, and satisfying work environment encourages the retention of members.
- Harassment policies ensure a respectful and secure work environment.
- Flexible work options contribute to a satisfying workplace and enable women to participate more fully in their profession.
- Equitable compensation contributes to career satisfaction.
- Retention of members through their career evolution maintains diversity in the profession.”

Between 2005 and 2008, the WIEAG worked to identify and collaborate with representatives from each province and territory to establish a national network. The members participated in a number of conference calls, compiled and shared a large number of research reports and articles, and met together in-person at the Canadian Coalition of Women in Engineering, Science, Trades and Technology (CCWESTT) conference to begin developing action plans to address the ongoing shortage of women in engineering.

In 2008, Engineers Canada held a consultation session on ‘Combating the decline of women in engineering.’ At the time, based on the 2006 Census, women accounted for only 12.3 per cent of the engineering profession. Enrolment trends of women in engineering had declined between 2001 and 2006, which was contrasted by rises in women’s enrolment in medicine and law programs.

At the June 2008 Board workshop, the Engineers Canada Board discussed the major trends, factors, and forces shaping the environment for the engineering profession in the coming years. The discussion revolved around five interconnected themes, including equity and diversity in the engineering profession, where it was noted that: “the profession is not representative of the make-up of society (proportion of women in the profession in particular). This is an urgent issue if engineering is to join the ranks of other professions which benefit from full engagement of Canada’s human resources.” It was agreed that there is a critical need to address barriers and impediments to the full participation of women, Indigenous Peoples, and visible minorities in the engineering profession. As a result, a proposed new priority for 2008 was to go to the interested parties, such as Engineers Canada’s Women in Engineering Advisory Group and the National Council of Deans of Engineering and Applied Science, to lay out Engineers Canada’s interest and readiness to help move this issue forward. Engineers Canada asked for guidance from these groups to determine what the priorities for action would be, and how Engineers Canada could be helpful in terms of action or dollars. The Women in Engineering Task Force (WIETF) was created in the Fall of 2008 to examine the issues facing the profession, to develop goals and objectives to increase the representation of women in engineering, and to provide recommendations to the Engineers Canada Board on how to proceed in these areas. Based on the results of a facilitated session held in April 2009, a series of recommendations (listed below) were developed and approved by



the Board in May 2009. The role of the task force was to work with WIEAG to look at ways to implement these recommendations. Some suggested tactics are listed here:

- **Raise the profile and improve the image of the profession**, including partnerships with universities and student associations to enhance the awareness of engineering and to reflect the exciting nature of engineering work
- **Explore how engineering curriculum and its delivery could, without compromising the high standards of the Canadian system, become more attractive to a greater diversity of students.** This could be done in collaboration with the National Council of Deans of Engineering and Applied Science and the Canadian Engineering Accreditation Board.
- **Demonstrate the value of diversity in engineering education and in the workplace.** This included creating a ‘women in engineering’ repository on Engineers Canada’s website, and setting ‘gender visibility’ as the theme for the 2010 edition of the Enrolment and Degrees Awarded survey.
- **Help better prepare engineers who are women for the workforce.** The task force worked on developing a seminar to help women act as change agents to shift organizations’ culture, as well as improving access to training programs.
- **Promote information-sharing on mentorship programs and the importance that mentors have in the attraction and retention of women in engineering.**
- **Work with industry on methods to help improve the retention of engineers who are women in the workforce and diversity in general.** Engineers Canada sponsored and presented at the Natural Science and Engineering Research Council (NSERC) Summit on increasing women’s participation in science and engineering on November 16, 2010, in Ottawa, ON. The Summit also provided Engineers Canada with the opportunity to meet with Prime Minister Stephen Harper and Status of Women Minister Rona Ambrose to discuss the issue of women in engineering, as well as committing to helping NSERC in its efforts to increase women in engineering. The task force and WIEAG also began developing a ‘Welcoming Workplaces for Women’ guideline for industry, to support the retention of women in engineering. Two brochures on the topic of diversity in the engineering profession –*Welcoming Workplaces* and *Good for Business*- were distributed in 2013.
- **Creation of a Women in Engineering Committee (WIEC)** to oversee Engineers Canada’s women in engineering activities (approved May 11, 2011 by the Board).
- **Promoting existing training programs to women to better prepare them for the male-dominated workforce** (ie. negotiation skills, communication skills, assertiveness training, gender/diversity awareness, etc.).
- **Promoting mentorship program best practices and showcasing existing mentorship programs.**
- **Recognizing engineering accomplishments** (ie. press release listing employees who received their licence, engineers who received awards, and other major achievements by members of the engineering profession).
- **Improving the retention of engineers who are women in the workforce and diversity in general** through a variety of potential tactics (ie. provide training for CEOs on retaining



employees who are women and the value of diversity in the workforce, industry CEOs to sign pledges on increasing retention rates).

The task force worked jointly with WIEAG (which had an established national network) between 2009 and 2011 to further develop action plans and priorities. WIEAG also continued to meet by teleconference outside the joint task force during this time and held an in-person meeting at the CCWESTT conference in May 2010. The task force provided additional recommendations to the Board in early 2011, which included a recommendation to “establish a national goal of increasing the participation of women in the engineering profession to 30 per cent by the year 2030.”

WIEAG and the Women in Engineering Task Force continued to work jointly on further actions and eventually, further evolved to become the Women in Engineering Committee, with specific objectives to help the CEO on this file—a very different purpose from an advisory group.

A key outcome of the WIEAG was that many members ran for their regional Councils and some became President—partly due to the encouragement and accountability from the WIEAG network. Other WIEAG members made presentations to their Councils and these presentations were influential on the Councils, eventually bringing about formal commitment from the regulators to participate in 30 by 30.

In 2011, the Association of Professional Engineering and Geoscientists Alberta (APEGA) launched a provincial initiative called 30 by 2030. In August of that year, Engineers Canada’s newly created Women in Engineering Committee evaluated the feasibility of achieving a national engineering licensure rate of 30 per cent women by 2030. A research sub-committee of the Women in Engineering Committee met by teleconference and a research team from Prism Economics and Analysis was contracted to work on a preliminary analysis of the data. By September 2012, Prism completed two preliminary research pieces and continued to assist in the process to obtain cohort data for 30 by 30. A revised 30 by 30 goal was adopted by Engineers Canada’s Board as a proposed national goal.

The first regulators to adopt the goal were Alberta, New Brunswick, Nova Scotia, and Prince Edward Island. In February 2014, as a recommendation from the Engineers Canada’s Women in Engineering Committee, which received its charges from the CEO of Engineers Canada, Engineers Canada agreed to develop an immediate action plan to obtain formal support from all regulators for the revised 30 by 30 goal. With input from the WIEC, an endorsement letter for 30 by 30 was sent out by Engineers Canada’s then-CEO, Kim Allen. In order to support the 30 by 30 goal, regulators were asked to:

- bring a motion for support to their Council and communicate the progress with Engineers Canada
- identify steps that could be taken within their province/territory
- develop proposals to formalize plans
- share best practices
- nominate a Champion to represent the regional 30 by 30 initiative

The Women in Engineering Committee also developed a resource, *Promising Practices to Increasing Diversity and Inclusion in Engineering*, which was based on a resource developed by the WIEAG in 2012.

The Women in Engineering Committee was active in developing a promotional and research plan for 30 by 30 and provided guidance and advice to Engineers Canada's staff.

Under Engineers Canada's 2015 *Strategy for a Sustainable Profession*, the Women in Engineering Committee and two other subcommittees were combined into a single committee—the Sustainable Profession Committee—which focused on women, Indigenous Peoples, and newcomers.

As of February 2015, seven regulators had signed on to the 30 by 30 goal: Alberta, Manitoba, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Engineers Canada continued to reach out to the remaining regulators to encourage their involvement and sent an invitation to the National Council of Deans in Engineering and Applied Sciences (NCDEAS) asking engineering schools to endorse 30 by 30. In 2015, a dedicated 30 by 30 webpage was created on Engineers Canada's website, branding and messaging resources were produced, and the first national numbers on newly licensed engineers who are women were published as part of Engineers Canada's *National Membership Report 2015*. The report recorded the number of newly licensed engineers who were women at 17.0 per cent in 2014.

In 2015, Engineers Canada also released [\*Reaching 30 by 30: Promising Practices for Increasing Diversity & Inclusion in engineering\*](#). This guide outlined nine best practices:

1. Appoint a woman in engineering champion
2. Create and support a woman in engineering or diversity and inclusion committee to support staff efforts
3. Track progress towards 30 by 30 in your jurisdiction
4. Create and/or support an award for employers who support and promote women in engineering
5. Create and/or support scholarships for engineering students who are women who act as role models to girls in middle and high schools
6. Women in engineering magazine, newsletter, or articles
7. Women in engineering webpage section
8. Visibility in the community
9. Support members by celebrating diversity and inclusion

The Reaching 30 by 30 guide was used by Champions to guide and spark their women in engineering efforts, though it has not been updated since its initial publication in 2015.

Regulators continued to communicate with Engineers Canada on their commitments, and in November 2016, the 30 by 30 network held its first teleconference with 23 participants with representation from all 12 provinces and territories. In addition to 11 engineering regulators (Professional Engineers Ontario [PEO] had not yet signed on), the following universities were involved: University of Manitoba, Queen's University, University of Toronto, University of Regina, and the Université de Sherbrooke. Engineers Without Borders and the Ontario Society for Professional Engineers (OSPE) also participated.

In 2016, Engineers Canada sent out a survey to inventory the work being done by the 30 by 30 network. Information was received from nine regulators: Engineers and Geoscientists British Columbia, APEGA,

Engineers Yukon, Engineers Geoscientists Manitoba, Association of Engineers and Geoscientists Saskatchewan, Ordre des Ingénieurs du Québec, Engineers Nova Scotia, Engineers and Geoscientists New Brunswick, and Engineers Prince Edwards Island. OSPE also submitted an inventory of their programs and activities in Ontario. A summary of the inventories was presented to the 30 by 30 network in the fall of 2017.

Observations from the inventories of these nine regulators and OSPE included:

- Many similar programs/initiatives with different titles
- Efforts heavily skewed towards recruitment and outreach
- Substantial reliance on volunteers
- Partnerships with universities appear to be limited
- Little awareness around whether provincial governments are taking action
- Reach of programs appears limited, primarily through small, targeted events

Inventories were also received from four higher education institutions (HEIs) who were members of the 30 by 30 network: University of Regina, University of Toronto, Université de Moncton, and McGill University.

In September 2017, PEO Council passed a motion to endorse 30 by 30, which would include a coordinated effort in Ontario between PEO and OSPE.

In January 2018, Engineers Canada hosted the first in-person meeting of the 30 by 30 network in Ottawa, ON. Each regulator was represented, except for Professional Engineers and Geoscientists Newfoundland and Labrador. Champions attended from the following institutions and organizations: University of Saskatchewan, University of Toronto, University of Ottawa, York University, McGill University, Université de Moncton, and University of Prince Edward Island. During the day and a half meeting, Champions were able to network and share best practices, and broke out into small groups to identify the most impactful activities, programs, resources, and supports needed to achieve 30 by 30. The group created a list of Top Commitments Agreed Upon (Appendix A).

Throughout 2018, the Champions held four teleconferences, and started receiving regular 30 by 30 email updates aimed at sharing program updates, best practices, and Engineers Canada's work on the newly approved SP3, which was approved in May 2018 by the Engineers Canada's Board as an expansion of the existing 30 by 30 initiative.

In June 2018, 30 by 30 Champions participated in a communications effort for International Women in Engineering Day, which included a social media video campaign and joint messaging on the experience of women in the engineering profession.

## 1.2 Key insights from the history of 30 by 30 (2001-2018)

- Acknowledgement of the need to diversify the profession and support for increasing women's participation in engineering dates back to 1990.

- 30 by 30 is based on nearly two decades of work by several different women in engineering committees and groups, within Engineers Canada and made up of passionate women and men from across the engineering continuum (industry, academia, associations). The majority of those participating have been professional engineers.
- Recommendations and research from the CCWE, WIEAG, and the WIETF remain relevant today.
- From the research into Engineers Canada’s archives, the work that was done since 1990 on women in engineering focused on partnerships with individuals and organizations in engineering education, government, and women in engineering groups. These partnerships included the Association of Consulting Engineers of Canada (now the Association of Consulting Engineering Companies-Canada), NCDEAS, CCWESTT, Ontario Network of Women in Engineering (ONWiE), and WinSETT Centre. These partnerships facilitated a formal and informal network of organizations and individuals collaborating and supporting each other in increasing women’s participation in engineering across the country since the early 2000s. The importance of these networks cannot be measured in this environmental scan given the scope and time needed to conduct this research; however, it important to note that Engineers Canada has played a significant historic role in supporting a national network on women in engineering.
- The work of these committees and groups focused on several areas along the engineering continuum, including research into the trends of women’s participation, best practices to increase gender balance, improving retention in the workplace, and making the engineering curriculum more accessible to a diverse community.
- The number of women in the profession was 12 per cent in 2006. In the last 14 years, it has increased to 14 per cent. The development of the current women in engineering strategy needs to enhance and perhaps diverge from the previous tactics in order to result in the significant changes we need in order to reach 30 by 30.

### 1.3 Current State 30 by 30

As of November 1, 2018, the 30 by 30 network of Champions included the following members:

Province/Territory	Organization	Champion
National	Engineers Canada’s Board of Directors	Sarah Devereaux
	CEO Group Champion	Kimberly King
	Engineers Without Borders	Erica Lee Garcia
	Association of Consulting Engineering Companies- Canada	Todd Smith
	Canadian Academy of Engineers	Jeannette Montufar
Yukon	Engineers Yukon	Kirsten Hogan
Northwest Territories and Nunavut	Northwest Territories and Nunavut Association of	Melanie Williams

	Professional Engineers and Geoscientists (NAPEG)	
British Columbia	Engineers and Geoscientists British Columbia	Susan Hayes
	University of British Columbia	Sheryl Staub-French
	University of British Columbia-Okanagan	Yang Cao
	University of Victoria	TBD
	British Columbia Institute of Technology	Phyllis Chong
Alberta	Association of Professional Engineers and Geoscientists of Alberta (APEGA)	Mohamed El Daly
	University of Alberta	Ania Ulrich
	University of Calgary	Qiao Sun
Saskatchewan	Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS)	Margaret Anne Hodges
	University of Saskatchewan	Dena McMartin
Manitoba	Engineers Geoscientists Manitoba	Kathryn Atamanchuk
Ontario	Professional Engineers Ontario	Helen Wojcinski
	Ontario Society of Professional Engineers	Sandro Perruzza, Angela Wojtyla
	Ontario Network of Women in Engineering	Kim Jones
	University of Windsor	Jacqueline Stagner
	Western University	Lesley Mounteer
	Conestoga College	Karen Cain
	McMaster University	Kim Jones
	University of Toronto Faculty of Applied Science & Engineering	Lisa Camilleri
	York University	Marisa Sterling
	Carleton University	Cynthia Cruickshank
	University of Ottawa	Jacques Beauvais
Québec	Ordre des ingénieurs du Québec (OIQ)	Kathy Baig
	McGill University	Fabrice Labeau

	Université de Sherbrooke-	Eve Langelier
New Brunswick	Engineers and Geoscientists New Brunswick	Christine Plourde
	Université de Moncton	François Duguay
Nova Scotia	Engineers Nova Scotia	Sarah Devereaux, Len White
	Dalhousie University	Jason Gu
Prince Edward Island	Engineers PEI	Glenda MacKinnon-Peters
	University of Prince Edward Island	Amy Hsiao
Newfoundland and Labrador	Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL)	Justin Haley
	Memorial University	Darlene Spracklin-Reid

In October 2018, a survey was sent to the 30 by 30 Champions. The SP3 survey was conducted in order to better understand organizational trends and practices aimed to recruit, retain, and improve the professional development of women in the engineering profession. The survey was developed by Engineers Canada in August 2018, and was sent to all 30 by 30 Champions, national engineering associations, and some private companies. Responses represented 100 per cent of regulator Champions, 65 per cent of HEI Champions, and five engineering associations (Canadian Academy of Engineering, OSPE, Association of Consulting Engineering Companies, Institute of Electrical and Electronics Engineers, Ontario Network of Women in Engineering), and two companies (Arup International and TAG Engineering/Tagyk). The survey was also sent to the following companies that did not respond: Pratt & Whitney, Siemens, S&C, Stantec, GHD, and Wood PLC.

#### 1.4 Key insights from 30 by 30 Champions' survey

##### Organizational structure and tools

The first section of the survey was focused on the structures for gender equity work, such as committees, internal policies, staff and training resources, and the use of gender analysis tools, in place within the Champions' organizations. This showed that the 30 by 30 Champions have in place some useful organizational tools towards gender equity. The survey found that 87 per cent of respondents had a governing representing body (i.e. committee) or individual (i.e. board champion) responsible for promoting the increased participation of women in engineering, and 86.7 per cent have a dedicated staff person working on increasing women's participation. Of the regulator Champions, three have a Council/Board Champion, and eight have a committee/task force/working group aimed at supporting women in engineering. Since the completion of the survey, three regulators have hired full-time diversity coordinators, while all regulators indicated having a staff person who is responsible to work towards increasing women's participation in engineering.

When asked if they use gender analysis or equity and inclusion tools to help ensure their programs/services suitably meet the needs of men and women, 57 per cent of respondents use these kinds of tools most or some of the time, while 44 per cent either never use these tools or are unaware/not applicable. Of the specific gender equity tools used, the top were: targeted consultation with women’s groups (63%); equal opportunity program for hiring (57%); and collection of gender disaggregated data (47%).

Responding to this question on gender analysis tools, fifty per cent of regulators indicated either ‘never’ using these kinds of tools, or not knowing if they are used. A follow-up question asked if training is available on gender analysis and 83 per cent of respondents said this kind of training is not available, with only one regulator indicating training is available. This identifies a gap in the application of gender equity within all organizations and alludes to a future goal of establishing and implementing the use of gender equity tools (ie. gender equity action plans, equal opportunity hiring, gender impact assessments of programs, etc.) for the 30 by 30 network.

### Programs and activities

The survey asked respondents a series of questions regarding their programs and activities, broken down into the three areas: recruitment, retention, and professional development. The following section summarizes information on recruitment activities.

The majority of recruitment efforts target elementary schools, secondary schools, and engineering graduates. Among those surveyed, organizations recruit in the following areas:

- **50 per cent elementary schools**
- **68 per cent secondary schools**
- 32 per cent post-secondary schools
- **39 per cent engineering graduates**
- 36 per cent EITs/MITs
- 29 per cent Licensed professionals

The following is a list of recruitment activities and programs listed by the 30 by 30 network:

Elementary schools	Go ENG Girl, Go CODE Girl, Girl Guide Day, Brownie Day, Scouts Day, Cub Scouts Day, science teacher training and workshops, National Engineering Month events, science games/Olympics for grade schools, DiscoverE programs, classroom presentations, career booklets, EnGenious online games
Secondary schools	Go ENG Girl, Go CODE Girl, Girl Guide Badge Days, mentorship programs connect high school students with university students and engineers, teacher training and workshops, outreach to career counsellors and educators, career fairs, scholarships, Cybermentor program, DiscoverE programs, male allyship group, WISE Kid-Netic Energy
Post-secondary schools	Outreach and recruitment events, scholarships, male allyship group, networking and skills development events with industry professionals
EITs/MITs	Peer mentorship programs



Licensed professionals	Mandatory equity training for hiring committees, improved spousal hire program, peer mentorship programs, recognition awards and events for engineers who are women, networking events
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Some other highlights from the recruitment activities include, Engineers Geoscientists Manitoba’s (EGM) Council, approved \$800,000 funding for two years out of their reserve funds. EGM has hired two full-time staff and a consultant to conduct an environmental scan, as well as a marketing firm to develop and deliver a campaign to middle school students.

The Association of Professional Engineers and Geoscientists of New Brunswick (APEGNB) has developed scholarships and partnerships with local universities, and as of the survey, were scheduled to hire a full-time diversity coordinator in December 2018.

Engineers and Geoscientists British Columbia (EGBC) engage over 8,000 youth per year through their annual Science Games, have rebranded their career awareness materials to be more inclusive, and are implementing the results of their 30 by 30 strategy consultation through an action plan and creating a diversity coordinator position.

The Association of Professional Engineers and Geoscientists of Alberta (APEGA) have a powerful outreach program, including annual Science Olympics, classroom presentations, career booklets, Innovation in Education Awards, and teacher’s professional development resources.

Engineers Nova Scotia’s outreach includes Girl Guide Day, Brownie Day, Scouts Day, Cub Scouts Day, Science Teacher conference presentations, and Peer-Mentorship programs for EITs and P.Eng. members.

The Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS) focused its National Engineering Month outreach on sponsoring the screening of the movie ‘Dream Big’ at every school in Saskatchewan. APEGS staff travelled to all the schools that registered and facilitated discussions on engineering with students from all grade levels.

In addition, the recruitment programs of the Ontario Network of Women in Engineering (ONWiE), such as Go ENG Girl and Go CODE Girl, have created a critical path for engaging young girls and their parents on the topic of engineering. For example, Go ENG Girl offers girls in grades 7-11 the chance to learn more about engineering through a series of fun hands-on activities and exhibits. Undergraduate students, professional engineers, and professors take part in the day to share their stories of passion, inspiration and success. These programs are driven by the higher education institutions and create important connections between young girls and local engineering faculties.

Other regional programs include Geering UP (University of British Columbia), WISE Kid-Netic Energy (University of Manitoba, which reaches 25,000-30,000 kids), robotics and summer camps. Some of these programs are also based on partnerships with national outreach organizations such as ACTUA and Let’s Talk Science. There are also mentorship programs that engage young girls, such as the online Cybermentor program for girls in grades 6-12 at the University of Calgary, or the engineering mentorship program at the University of Alberta, which partners high school girls with undergraduate and graduate

engineering students over several events each year. All these programs engage thousands of girls across the country. For example, the University of Alberta’s programs engage 80 communities, 27,000 youth, of which 49 per cent are women. Though a detailed analysis of their impact is beyond the scope of this scan, these programs play an important role in introducing young girls to engineering, connecting them to local faculties, providing role models of engineers who are women, and fostering near-peer networks for young girls.

Though the framework for the survey and the questions asked in the 2017 30 by 30 inventory were different, any information that can be compared is useful. In 2018, there was an increase in the occurrence of partnerships with government, non-government, and community organizations from the previous 2017 30 by 30 inventory. In 2018, 71 per cent of respondents were engaged in partnerships for their women in engineering programs.

When asked if a gender lens was applied to their recruitment programs, 54 per cent responded positively, whereas 25 per cent did not apply a gender lens and 21 per cent responded, ‘not applicable’. A tool to assist organizations in applying a gender lens to make their recruitment programs more effective for women and girls would improve the delivery of programming.

The following section summarizes information on retention activities. Based on responses from the 30 by 30 network, the target groups for retention efforts are weighted towards post-secondary students, EITs, and licensed professionals. Among those surveyed, organizations focus their retention efforts on the following demographics:

- 15 per cent elementary schools
- 23 per cent secondary schools
- **54 per cent post-secondary schools**
- **58 per cent EITs/MITs**
- **69 per cent licensed professionals**

Two respondents listed engineering faculty who are women and professors as retention targets, and one respondent listed internationally trained engineers who are women as a category for their retention efforts.

The following is a list of retention activities and programs, divided by target group, listed by the 30 by 30 network:

Post-secondary schools	Women in engineering student groups, networking events, mentorship program, faculty/staff advising.
Licensed Professionals	Parental leave and parental leave top-up, flexible work time, part-time options, programs to help research continuity during parental leaves, reduction of dues for parental leave and unemployment, networking and professional development events, peer-mentoring, pay equity (including advocacy with government), research on salaries and retention challenges, mobile training application, WinSETT workshop, Women in Engineering and Geoscience Division.

There are many programs in place to retain women in engineering, as the list above indicates. Mentorship programs are connecting engineering students to women in early career and senior professionals, facilitating the sharing of experiences and creating peer support networks for students and professional engineers alike.

Another highlight comes from Ontario, where OSPE's retention work includes working with the provincial government to bring in pay equity legislation, annual salary surveys, mentorship programs, and the development of a mobile training application as a targeted tactic to retain women in the workplace.

From the survey data, it is unclear which specific programs are targeting EITs/MITs. Respondents indicated that 58 per cent of their efforts involved EITs/MITs. A further investigation is needed to determine what activities are being specifically implemented for EITs/MITs. This is especially important given that there is a loss of women between graduation and the number of newly licenced engineers who are women (see section 2.3 and 2.4). Training and supports that assist young women through the EIT/MIT program and assist them in finding the career path and professional development learning that best suits their needs are vital tactics in retaining women along the engineering continuum. Programs for EIT/MITs who are women are also important because they help women as they take their initial steps into the engineering workplace. As mentioned in the 'Barriers' section, workplace culture in engineering can be sexist and discriminatory against women, leading to adverse effects on women's success in the profession. To address the workplace culture barrier for women, employers need to make changes to become more welcoming, and young engineers need to be supported through retention efforts until gender equality is established.

Some of the challenges listed by the regulator Champions in retaining women include, that some regulators do not license firms and overall, they have limited influence on the workplace. One regulator respondent indicated that:

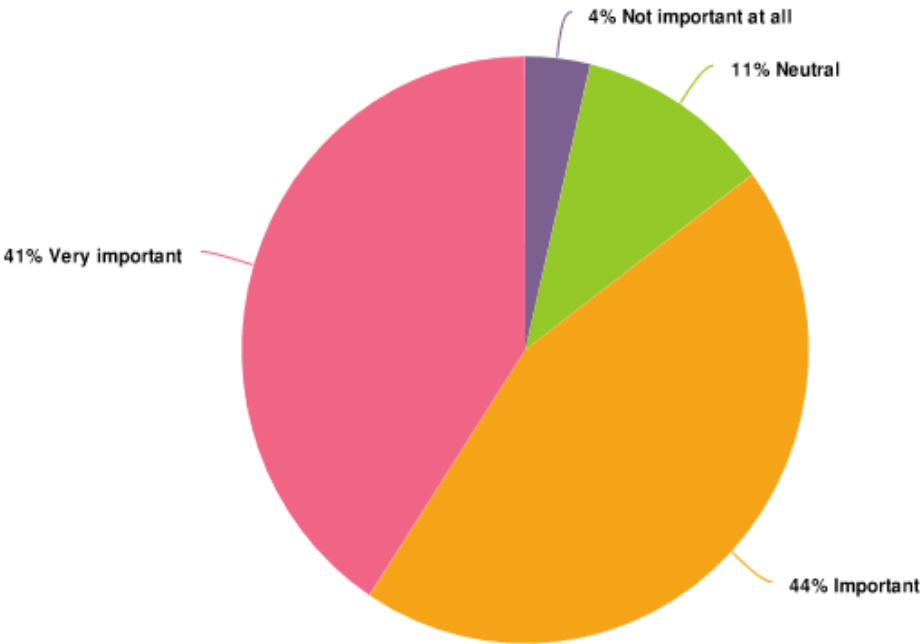
"Women say they don't feel like they "fit" the definition of an engineer. They question if their application of engineering "counts". Some do not feel accepted by their peers at work. The challenge we have is to create a welcoming environment so at least with the regulator women feel they belong in the profession."

A challenge for retention of women in engineering listed by some of the higher education institutions is the lack of recognition that women faculty receive, as well as the research pressures they face; however, several of these respondents indicated that they are successfully able to retain the students who are women after first year. This preliminary analysis shows that retention efforts in higher education institutions need to improve their support of faculty members who are women, while respondents indicated that students who are women are more of a focus for recruitment and outreach efforts. A future analysis to compare the number of students who are women in each year (ie. first year to final year) of undergraduate studies across the country would help capture a full picture of the path of students who are women in engineering.

When asked if they provide employment benefits that help retain women in engineering, forty-one per cent indicated 'yes', while 69 per cent indicated with 'no' or 'not applicable.' Some of the examples included, flexible work time, part-time options, dues reduction for parental leave, pay increase to faculty who are women to bridge the pay gap, parental leave top-up, and funds to cover a post doctoral salary during a faculty's leave to allow research to continue at a high level.

The following section summarizes information on professional development activities. Based on responses from the 30 by 30 network, 85 per cent of participants reported that professional development was central to the goal of increasing women in engineering.

Figure 1 How important is professional development to the goal of increasing women in engineering?



Among those surveyed, professional development opportunities were largely applied to the following demographics:

- **68.4 per cent post-secondary schools**
- **68.4 per cent EITs/MITs**
- **78.9 per cent newly licensed engineers**
- **84.2 per cent mid- and late-career professional engineers**

Of the challenges faced by the respondents in providing professional development opportunities for women in engineering, the following categories are mentioned by several respondents:

- low number of senior women (ie. faculty, practising engineers) available to act as mentors
- low registration numbers due to a variety of potential factors: training can be too costly, participants do not have the time to take courses

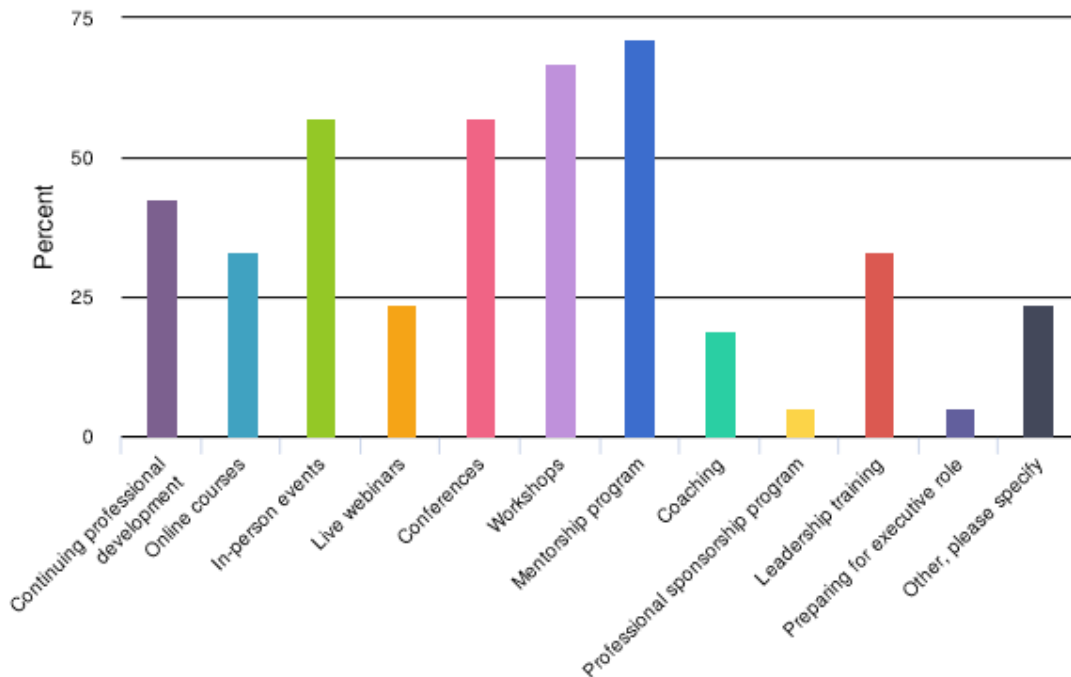
- lack of support from men: resistance to recognizing that "women in leadership" can be different than for male counterparts, as well as a lack of interest/engagement from men to be mentors to women

Out of all respondents, 39 per cent reported that their organizations provided training that specifically targeted women, while 50 per cent reported that it was not available. A follow-up question asked respondents to identify which type of professional development opportunities were made available to women in their organizations. There were more responses for this second question than the initial 39 per cent that said they provided training for women, which indicates a confusion on the part of the survey participants regarding the definition of professional development, or due to the wording of the survey question. The following list indicates the types of activities and responses for each.

<b>Type of activities</b>	<b>% responses</b>
Continuing professional development	42.90%
Online courses	33.30%
In-person events	57.10%
Live webinars	23.80%
Conferences	57.10%
Workshops	66.70%
Mentorship program	71.40%
Coaching	19.00%
Professional sponsorship program	4.80%
Leadership training	33.30%
Preparing for executive role	4.80%
Other, please specify	23.80%

Out of all responses, mentorship programs are the most offered activities (77 per cent), followed by conferences (67 per cent), in-person events and workshops (each 57 per cent). Figure 2 provides the accompanying chart of the responses.

Figure 2 What type(s) of professional development do you provide to women in engineering?



Workshop topics that are/have been offered include leadership, management, pathways to licensure, employment services, and diversity training.

Though there are a variety of programs and activities being offered to engineering students and engineers who are women, there is little information on the effectiveness and evaluation of these programs. Evaluation frameworks would help organizations understand the impact of their programs and whether or not they need to make changes to existing programs or shift their focus altogether.

A major gap in the information on professional development is the lack of data from employers. Given that only two employers responded to this survey and professional development activities largely apply to engineers who are women working in firms, public departments, or companies, engineering companies play a significant role in establishing and implementing professional development for women. The information gathered through this survey on professional development paints a picture of the current barriers and programs as they apply to the regulators and higher education institutions, which encompass regulator members and faculty who are women. However, a second survey that is specific to engineering companies could be more effective in gathering information on the professional development that engineers who are women have access to in the workplace.

### Partnerships

The effectiveness of women in engineering programs can often be amplified in the building of partnerships and collaborations. The survey asked respondents to indicate if they have engaged with government, non-governmental organizations, external institutions, or community groups, in their gender equity work. Though there seems to be an increase in responses on partnerships and

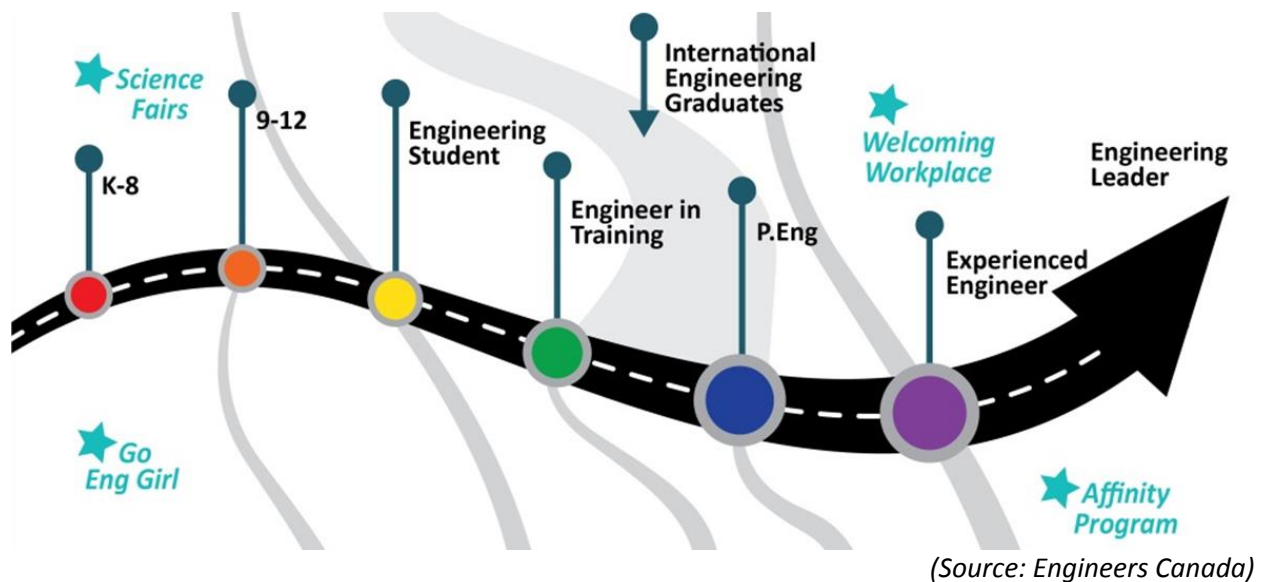
collaboration between the 2018 survey and the 2017 30 by 30 inventory (71 per cent of respondents indicated engaging in partnerships or collaborations) of the regulators, three responded with either a 'no', or 'not applicable.' Given the importance of regional networks and the connection between regulators and higher education institutions in reaching young women, increasing the occurrence of partnerships, especially in recruitment and retention efforts, could strengthen the impact of current programs.



## Section 2: Statistics on women’s participation in engineering

In order to influence the number of newly licensed engineers who are women by 2030, we need to understand the rates of participation of girls and women at various points during the engineering continuum (see Figure 3). From an early age, young girls decide to enter or avoid science, technology, engineering, and math (STEM) subjects. There are many points during a woman’s educational path and career where she might choose to enter or leave engineering. The following section captures some of the sources that record the participation and attrition rates of women in engineering and attempts to present both representation (percentages) and numbers of engineers who are women.

Figure 3 Engineering continuum

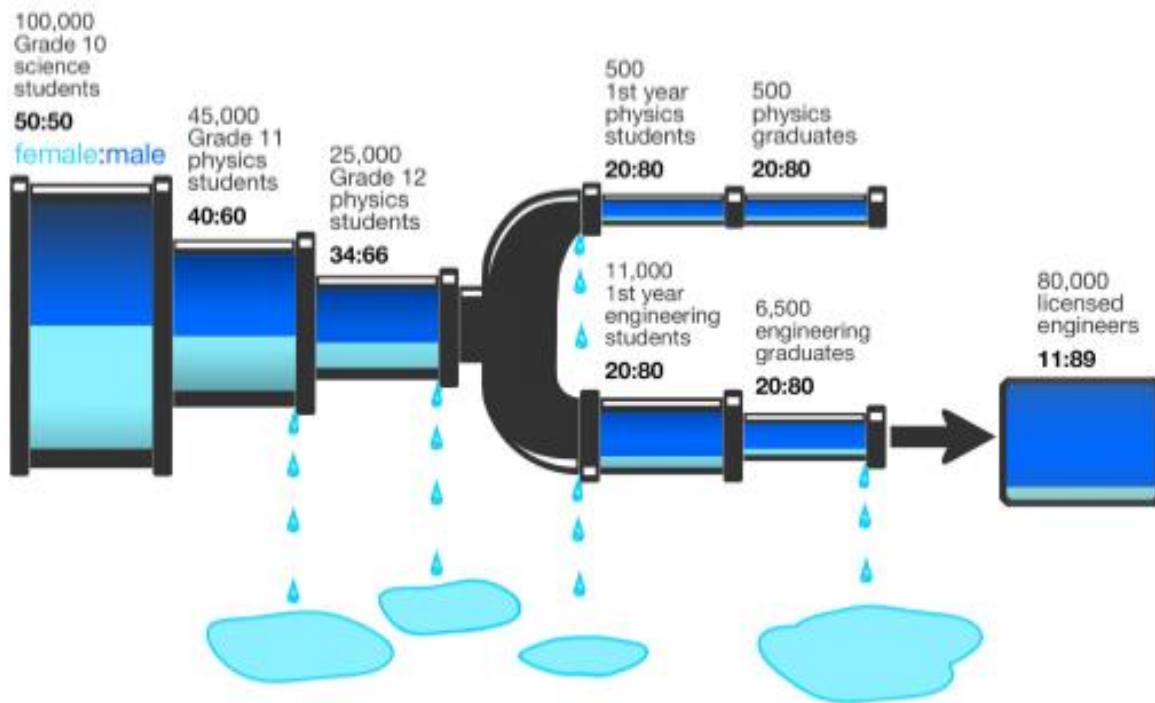


The engineering continuum indicates stages for girls and women during which they can engage with engineering (ie. K-8, grades 9-12, post-secondary student, Engineer-in-Training, obtaining their engineering licence, etc.), as well as examples of interventions (ie. Go ENG Girl, science fairs, welcoming workplace initiatives). The grey streams that intersect with the continuum road represent women joining and leaving the profession (ie. international engineering graduates arrive in Canada, women transfer out of engineering post-secondary programs).

The engineering continuum has also been described by some as a ‘leaky pipeline.’ In the white paper by Wells et al., *Closing the gender gap in engineering and physics: the role of high school physics*, the leaky pipeline of Ontario women in engineering education illustrates the fact that the largest leaks occur during the high school years and after post-secondary graduation (see Figure 4).<sup>2</sup> Being able to identify where girls and women are leaving engineering at the highest rates will help us prioritize areas for interventions and potential tactics.

<sup>2</sup> 2018 Wells, Williams, Corrigan, and Davidson. Closing the gender gap in engineering and physics: the role of high school physics. College of Engineering and Physical Sciences. University of Guelph.

Figure 4 Ontario's leaky pipeline of women in engineering education



(Source: Wells et. al., 2018)

## 2.1 Early education

The importance of reaching girls at an early age is a crucial part of improving women's participation in engineering. Research shows that by the age of six, North American children already have implicit stereotypes associated with boys being better at math than girls.<sup>3</sup> Though there are many programs that engage young girls with engineering and STEM fields broadly in the stages of K-8 and grades 9-12, it is difficult to extract the number of girls in engineering during these stages, especially in the K-8 stage. The public education system in most Canadian schools does not teach engineering-specific courses, therefore there are few data sources for the number of K-8 girls enrolled in engineering-related classes. A recent report by the Toronto District School Board on STEM teaching and learning, indicated that though teachers and administrators value STEM learning, some elementary school teachers felt engineering is a concept to be covered in high school and in post-secondary schools.<sup>4</sup> Though there might not be engineering curriculum offered on a large scale in classrooms across the country, there are STEM educator positions in many schools and school boards. These positions can coordinate school- and board-wide maker-spaces, design labs, and other STEM programs. STEM coordinators work with local institutions and experts to create, implement, and monitor STEM programming and partnerships. In Canada, there does not appear to be a national organization that monitors the success of regional STEM

<sup>3</sup> 2018 ESS. The Development of Implicit Gender Stereotypes. Engendering Success in STEM.

[Http://Successinstem.ca](http://Successinstem.ca)

<sup>4</sup> 2017 Sinay, Sriskandarajah, Nahornick. STEM teaching and learning in the Toronto District School Board. Research series II: Deepening, sustaining, building coherence and fostering student learning and equity (Research Report No. 1617-17). Toronto, Ontario, Canada: Toronto District School Board.

coordinators. Though it is beyond the scope of this scan to collect national data on classroom STEM engagement, it would be a valuable to understand how many girls in K-8 and grades 9-12 participate in STEM programs.

A report on the *Current state of women in STEM in Yukon*, reviewed territorial student information from 2014 and shows that at both the Grade 4 and 7 levels, “girls and boys performed comparably in the numeracy tests, however, girls outperformed boys in the reading and writing tests.”<sup>5</sup> The gender gap widens in upper-level academic programs where girls only make up a third of participants in STEM-related camps. The report points out that “these markers suggest that upper-level academic program choices may be influenced by interest as well as by lower self-perceived mathematic abilities when compared to one’s relative abilities in the humanities.”

In high school classrooms, we have a better understanding of the numbers of girls engaged in the engineering continuum, as we can examine the number of students enrolled in high school courses required for entry into engineering undergraduate programs. (ie. grade 12 physics, grade 12 advanced functions, grade 12 calculus and vectors, grade 12 chemistry). Wells et al., indicate there is a 50:50 ratio of females to males in grade 10 science in Ontario, largely due to grade 10 science being the last mandatory science course students need in order to graduate high school in Ontario. Between grade 10 science and grade 12 physics, Ontario classrooms see an approximately 70 per cent loss of male students and approximately 85 per cent loss of female students. Wells et al. explain that closing the gender gap in high school physics is necessary to increase the number of women able to apply to engineering undergraduate programs.

Further research that includes the demographics in high school physics, advanced math and science in each province and territory would give us a clearer reflection of the national state. At this time, our sources are limited to the above research based on Ontario and the Yukon.

For more information on the number of girls interested and/or engaged in engineering we can look to the organizations offering STEM programming outside the classroom, such as ACTUA, Let’s Talk Science, Girl Guides Canada, and others. These organizations work to expose girls to engineering concepts, as well as science, technology, and math learning, through various activities and programs. For example, ACTUA reaches over 250,000 youth very year across Canada through the delivery of summer camps, classroom workshops, clubs, and community outreach activities.<sup>6</sup> Let’s Talk Science had over 300,000 children and youth interactions in 2018, in 501 distinct communities across the country.<sup>7</sup> In 2015-2016, Engineers Canada partnered with DiscoverE (US) and debuted Canada’s very first Future City Competition (grades 6-8) in the Durham region of Ontario and Prince Edward Island. Since its inception, Future City Canada has had over 5,000 student participants over three years.

Though the success of these direct-to-student STEM outreach programs (meaning they are not systemically integrated into the elementary curriculum) is measured by positive feedback from students, teachers, parents, and administrators, the challenge is that there is no way to disaggregate the number of children engaged in engineering activities from the broader STEM programs, or to track the progress

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<sup>5</sup> 2018 Anderson, et. al. Current state of women in science, technology, engineering and mathematics (STEM) in Yukon. Nov. 30, 2018

<sup>6</sup> 2018 ACTUA. How we deliver. <https://actua.ca/en/about>

<sup>7</sup> 2018 Let’s Talk Science. Our Impact in 2017-2018. <http://letstalkscience.ca/Programs/Lets-Talk-Science-Outreach>

of these individuals into engineering fields. These programs are vital in sparking the interest of future generation of engineers, along with classroom STEM programs. Though the correlation between K-12 programs and the number of engineers who are women is difficult to clearly measure, the engagement of young girls in engineering concepts is an essential part of sustained growth in the number of women in engineering.

## 2.2 Post-secondary education

Based on Statistics Canada data, the total number of students enrolled in architecture or engineering programs increased by nine per cent between 2012 and 2017. The number of female students enrolled in the same fields increased by 18.6 per cent for the same time period.<sup>8</sup> The percentage of graduates from architecture or engineering programs between 2012 and 2017 went from 16.4 per cent to 17.8 per cent of total graduates.<sup>9</sup>

Engineers Canada's *Enrolment and Degrees Awarded Report* indicates female enrolment between 2015 and 2016 went from 16,340 to 17,481 students across accredited engineering faculties in Canada, accounting for 19.9 per cent to 20.7 per cent of student enrolment (see Figure 5).<sup>10</sup> In 2017, women accounted for 21.8 per cent of undergraduate students and 25.7 per cent of post-graduate students. As of 2017, the total number of females enrolled in undergraduate-level engineering programs has increased by 3.7 per cent since 2016 and 32.2 per cent since 2013. Meanwhile, total undergraduate enrolment (men and women) increased by 14.4 per cent since 2013, to 82,480 students enrolled in accredited engineering programs.

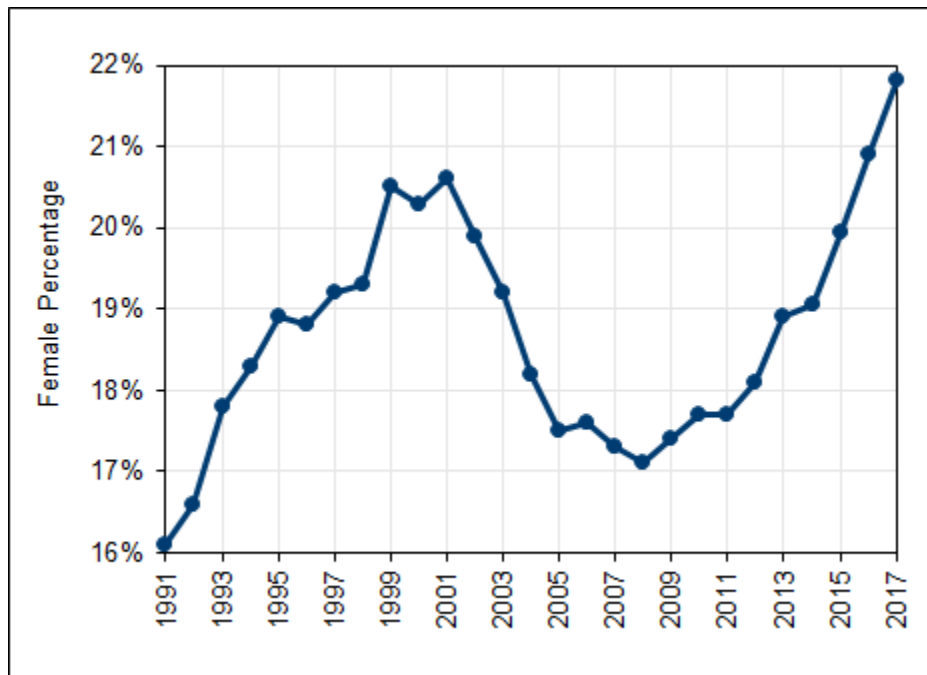
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<sup>8</sup> 2018 Statistics Canada. [Postsecondary enrolments, by registration status, institution type, status of student in Canada and sex](#). Table 37-10-0018-01.

<sup>9</sup> 2018 Statistics Canada. [Percentage of females relative to total postsecondary graduates](#).

<sup>10</sup> 2018 Engineers Canada. [Canadian Engineers of Tomorrow: trends in engineering enrolment and degrees awarded 2013-2017](#).

Figure 5 Female undergraduate enrolment



(Source: Engineers Canada)

The disciplines that presented the highest percentages of female undergraduate enrolment in 2017 were biosystems engineering, environmental engineering, and chemical engineering, with 47.5 per cent, 41.2 per cent, and 39.3 per cent of total enrolment, respectively.

Some research has been done on the attrition rates within post-secondary education of engineering students and students who are women specifically, though it is not comprehensive. The enrolment numbers indicate a drop between first-year and second-year engineering, though there is not a significant difference between females and males. The challenge here is that we do not understand why students leave engineering during their post-secondary education, whether they were required to withdraw due to academic standing, or whether they discovered engineering was not a good fit for them. The *Heeding canaries in the coal mine* report observes the following:

“just as women chose to pursue engineering for different reasons than men, they will also leave for different reasons. While male students are most likely to leave due to poor academic performance, female students most often leave because of a lack of interest or fit.”<sup>11</sup>

The lower number of women studying engineering, and other STEM fields, is not unique to Canada. The U.S. National Science Foundation shows that countries such as Finland and Lithuania have the highest ratio of female graduation from natural science and engineering degrees, while Canada ranks 28<sup>th</sup> on the list.<sup>12</sup> Data out of the US from the American Society for Engineering Education (ASEE), indicates in post-secondary participation has increased overall between 2016 to 2017 (from 523,855 to 525,589) and that

<sup>11</sup> 2010 Calnan and Valiquette. *Heeding the canaries in the coal mine*. Engineer Canada. p.15

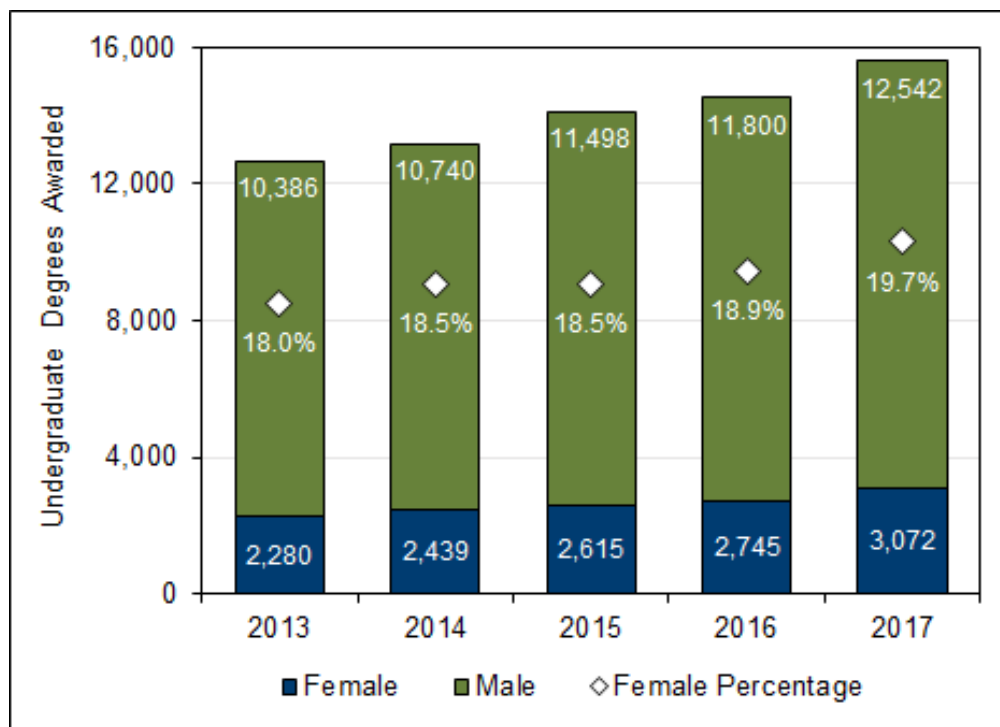
<sup>12</sup> 2010 National Science Board. *Science and Engineering indicators 2010*. Appendix tables <https://www.nsf.gov/statistics/2018/nsb20181/data/appendix/>

the proportion of female students in US schools increased from 21.7 in 2016 to 22.3 per cent in 2017 (from 144,935 to 150,800).<sup>13</sup>

Of the 15,782 engineering degrees awarded in 2017 in Canada, 3,244 were awarded to women, accounting for 20.6 per cent of the sampled population. Cumulatively, the number of degrees awarded to male and female students has increased 23.3 per cent from 2013.<sup>14</sup>

Since there is some variation in the response rate for Engineers Canada’s survey, we have chosen to compare the data from engineering programs that have consecutively responded each year in order to analyse the change in numbers over time. Figure 6 provides data on undergraduate degrees awarded between 2013-2017, discounting for inconsistent reporting. When comparing engineering programs that consecutively responded to the survey, the number of female graduates increases by 34.7 per cent between 2017 and 2013, which is an increase of 792 graduates. The report from 2013-2017 indicates there was not any significant gender difference in completion rates in engineering undergraduate programs, meaning female students graduated at the same rate as their male counterparts. This trend is supported by the 30 by 30 2018 survey, where higher education institutions indicated that retention (ie. from first-year to graduation) was not a major issue for their female engineering students.

Figure 6 Female undergraduate degrees awarded



(Source: Engineers Canada)

<sup>13</sup> 2018 ASEE. PRISM- American Society for Engineering Education. September 2018 newsletter. <http://www.asee-prism.org/>

<sup>14</sup> 2018 Engineers Canada. [Canadian Engineers of Tomorrow: trends in engineering enrolment and degrees awarded 2013-2017.](#)

Figure 1 Engineering continuum refers to internationally trained engineers who are women entering the engineering continuum between the point of graduation and licensure. Engineers Canada's National Membership reports capture the number of intentionally trained engineers who are women who are licensed by provincial and territorial regulators each year. In 2017 the number of intentionally trained engineers who are women was 489 across Canada, making up 27.7 per cent of the total of newly licensed engineers who are women, but only 16 per cent of all the internationally trained licensees (men made up 84 per cent of internationally trained licensees). More information is needed to understand the needs of internationally trained women and how to better reach them as they are a potentially significant talent pool for the profession. Further to this point, a Natural Sciences and Engineering Research Council of Canada (NSERC) 2010 report noted that the "future skilled labour force growth in Canada will be heavily dependant on immigration." The report goes on to explain that "the number of skilled immigrant women coming to Canada with degrees in the NSE [natural sciences and engineering] peaked in 2001 and has fallen considerably in recent years", and that the number of internationally trained men outnumber that of women, creating an even greater gender gap in this area.

### 2.3 Engineering profession

The pathway for women between post-secondary education and the engineering profession can be variable, meaning some women graduate and choose to go directly into an EIT/MIT program, then they might choose to leave for another profession or they might complete the program but then not choose to get their licence at the end of their EIT/MIT program. Otherwise, someone can come to engineering with an undergraduate degree in a similar field, such as geoscience, and switch over to engineering with continuing education courses. Clearly the pathway to engineering is non-linear and complex, but given our data we are able to paint a partial national picture of women's participation in the profession.

Currently, we have snapshots of the participation of women at various stages between graduation and the profession. According to the Engineers Canada's *Enrolment and Degrees Awarded Report 2013-2017*, in 2013, 2,280 females graduated with engineering degrees in Canada (18 per cent of total graduates). If we assume this cohort completed a four-year EIT/MIT program, in 2017 they would attain their engineering licence. In 2017, the number of newly licensed engineers who are women was 1,763 (17.9 per cent of total newly licensed) and the number of Canadian Engineering Accreditation Board (CEAB) trained new licensees who are women was 1,153 (11.7 per cent of total newly licensed engineers). The number of newly licensed engineers also include new licensees who are internationally trained or have received training from non-CEAB programs. These additional sources of licensees contribute to the lower percentage (11.7 per cent) of CEAB trained engineers who are women in the total of newly licensed engineers.

As a next step, we would like to measure the conversion rate between graduation and licensure for women in this cohort (graduation in 2013 and newly licensed in 2017) we need to focus on CEAB trained licensees as they represent the graduates recorded in the *Enrolment and Degrees Awarded* reports. Therefore, the conversion rate is (number of graduates who are women / total graduates who are women in 2013 for this cohort:  $1,153/2,280 = 51$  per cent) 51 per cent, meaning there that just over half of the engineering graduates who are women go on to obtain their licence.<sup>15</sup>

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<sup>15</sup> 2018 Engineers Canada. [Canadian Engineers of Tomorrow: trends in engineering enrolment and degrees awarded 2013-2017.](#)



The number of CEAB trained new male licensees in 2017 was 5,046 (51.2 per cent of total newly licensed engineers). Looking at the numbers of male graduates and newly licensed male engineers for the same 2013-2017 cohort, the conversion rate was 49 per cent in 2017 (number of male graduates /total male graduates in 2013: 5,046/ 10,386 = 49 per cent). This indicates the conversion rate is similar regardless of gender between graduation and licensure. The tactics to address the loss of potential engineers at the point of graduation will need to address the reasons why young women *and* men are not interested in enrolling in EIT/MIT programs and obtaining their licence, while also focusing on the specific needs of graduates who are women in order to meet the goal of 30 by 30. A further investigation is required to address these barriers and challenges to recruiting graduates into EIT/MIT programs and engaging them in the licensure process. Moreover, there are several assumptions in the above analysis that need to be investigated further. For example, the time it takes a person to complete their EIT/MIT program is unknown. The minimum is listed at four years; however, different jurisdictions allow for different maximum EIT/MIT terms. A survey to determine the average length of EIT/MIT programs for participants would allow for a more robust forecast of the conversion between graduation and licensure. In addition, a break down of the number of EIT/MITs by year would also facilitate a better understanding of the conversion rate. Currently, we have the number of EITs/MITs between 2013-2018, but these numbers do not breakdown the participation in each of the four to seven years of the EIT/MIT program, meaning we cannot track a specific graduate cohort. This information is likely available to each of the engineering regulators and could be part of another research report.

Engineers Canada's *National Membership Report 2015* recorded the number of newly licensed engineers who were women at 17.0 per cent in 2014. This was the first year the number of newly licensed engineers who are women was reported. The most recent report puts the number of newly licensed engineers who were women in 2017 at 17.9 per cent. Though there has been an overall increase in the number of engineers who were women, from 1,517 in 2014 to 1,763 in 2017, there was also an overall increase in newly licensed engineers over this period.

There is a need for further research in order to better understand the pathway to licensure. A study of the average number of years between graduation and licensure, by gender, would provide useful information. Another useful topic of research would include a provincial and territorial breakdown of the pathway to licensure on a regional level. Given that each region has different demographics, population needs and size, number of post-secondary institutions, and economic realities, which all influence the pathway to licensure and participation in the engineering profession, a regional analysis would be helpful for the effectiveness of outreach and retention programs.

From OSPE's *Breaking Barriers* report, we see that though women continue to make strides to increase their presence in STEM workplaces, gender inequity persists. Of all the STEM professions, physical and life sciences have the largest proportion of women, whereas engineering has the lowest.<sup>16</sup> The 2016 Census indicates that women make up 45 per cent of professionals in medicine, dentistry, optometry and veterinary medicine (not including nursing and pharmacy). According to the 2016 National Occupation Survey by Statistics Canada, there were 670,925 Canadians under the engineering and

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<sup>16</sup> 2018 OSPE. *Calling all STEM employers: why workplace cultures must shift to change the gender landscape*. Breaking barriers for women in STEM.

engineering technology skill level category. Of those, 371,125 are listed under engineering as their occupation, of which 59,570 (16.1 per cent) are women.<sup>17</sup>

Another data point that helps paint the picture of women in the engineering profession is data on salaries. Based on Statistics Canada's data for 2014, women who graduated with undergraduate degrees in architecture or engineering had a median employment income of \$55,900. For male graduates in the same fields of study, it was \$61,000. Further research would be helpful to understand the differences experienced by women in the engineering workplace in Canada.

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<sup>17</sup> 2016 Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016280.

## Section 3: Barriers to women in engineering

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For the purposes of Engineers Canada’s strategy development, which focuses on three areas related to women’s participation in engineering (ie. recruitment, retention, and professional development), a summary of the barriers for each of the three areas is provided below. Based on the current activities of the 30 by 30 Champions, the focus areas relate to different target groups. For example, recruitment efforts are primarily focused on K-12 girls, retention efforts are focused on engineering students and EITs/MITs, graduates and licensed engineers, and professional development activities relate to programs offered to licensed engineers. Each of these stages will have different barriers, and therefore will require different interventions.

### 3.1 Barriers to recruitment

For the purposes of the development of SP3, “recruitment” refers to the action of bringing new women to an organization/university program/faculty/company or becoming broadly involved in engineering. Based on Engineers Canada’s 2018 survey of the 30 by 30 network, the target groups for recruitment are weighted towards the K-12 stages of the recruitment continuum. The following list of eleven barriers summarizes the barriers listed in research, by the Equitable Participation in Engineering Committee, and by the 30 by 30 network.

- Societal stereotypes and perceptions about engineering; unhelpful misperceptions include:
  - It’s a “Boys’ club”
  - Women are the subject of biases (either explicitly or unconsciously)
  - Engineering is not connected to community impact
  - Engineering is not a caring profession
  - Engineering is not seen as an esteemed profession, in the same way that medicine and law are
  - Women are not seen as technically savvy
- Parents and teachers have discouraging attitudes for girls pursuing engineering.
- Teachers have lack of understanding and comfort teaching engineering-related curriculum or don’t explicitly identify learning as engineering.
- High school councillors are not familiar with the engineering curriculum, and do not guide young women to take the high school courses towards post-secondary.
- Science and physics curriculum: are not hands on, or applicable to everyday life and society, depicts STEM as a male domain.
- Lack of awareness: young women do not have a good understanding of what engineering and technology careers entail and therefore cannot aspire to those careers.
- Lack of mentors: compared to young men, young women have fewer role models who encourage them, fewer mentors, fewer opportunities to take mathematics and science courses and to consider engineering and technology careers. Some high schools in remote areas don’t even offer the engineering requirement courses any longer.
- Engineering education does not support innovation.
- Socioeconomic barriers keep students out of engineering/STEM opportunities.
- Lack of opportunities in remote areas to learn about engineering and pursue it in post-secondary.

- Media depicts successful women as doctors, lawyers, or business women. Engineering is not depicted as a successful career for women in the media.

In addressing the reasons why girls do not enter or show interest in engineering, the *Heeding the canaries in the coal mine* report, prepared for Engineers Canada by Janice Calnan and Leo Valiquette, explains that:

“interest or participation in math and science curriculums at the high school level is seldom the issue – female participation in the maths and sciences is on par with that of male students. Rather, the dominant theme is that most young women either have little or no knowledge about what engineering or technology careers entail, or have strong negative perceptions that govern their choices for post-secondary education.”<sup>18</sup>

However, other research shows that girls self-identify out of math and sciences at a young age. According to Engendering Success in STEM (ESS) research, by age 6, North American children have implicit stereotypes associating math more strongly with boys than girls, and girls perform worse on math assessments when they are reminded of gender stereotypes.<sup>19</sup> ESS has identified math bias as a key barrier for girls participating in engineering and STEM in the K-8 stage.

Wells et al. document the under-representation of girls in the grade 12 classroom, as previously shown through the ‘leaky pipeline’ (figure 4). In examining the factors for this gender disparity, Wells et al. explain that high school girls have the same aptitude and academic standing as their male counterparts. The study lists barriers for girls as:

- Discouraging attitudes from parents and teachers for girls pursuing engineering
- Teaching content that depicts STEM as a male domain
- Science and physics curriculum that is not hands-on, or applicable to everyday life and society

The *Heeding canaries in the coal mine* report summarizes the following barriers for young women entering engineering:

- Broad cultural factors account for gender preferences in academic interests and careers.
- Young women do not have a good understanding of what engineering and technology careers entail and therefore cannot aspire to those careers.
- Young women have negative perceptions of engineering and technology occupations.
- Compared to young men, young women have fewer role models who encourage them to take mathematics and science courses and to consider engineering and technology careers.
- Too few parents encourage their daughters to study mathematics and science and to consider engineering and technology career options.

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<sup>18</sup> 2010 Calnan and Valiquette. *Heeding the canaries in the coal mine*. Engineer Canada.

<sup>19</sup> 2019 ESS. The development of implicit gender stereotypes. *Engendering Success in STEM*.

<http://successinstem.ca>

Further, through interviews with college and university engineering students who are women, OSPE captured that even women who pursue engineering explain that during high school they experience discouraging and unsupportive attitudes towards women considering a STEM education and career.<sup>20</sup>

In Engineers Canada's 2018 survey, the 30 by 30 Champions weighted the factors that have a significant influence on the recruitment of women in engineering in the following order:

1. Culture and ways of working in engineering field (ie. long hours, lack of flexibility, perceptions of a 'boys' club')
2. Stereotypes about women in engineering and unconscious biases
3. Lack of mentorship opportunities and/or role models
4. Lack of education (ie. low numbers of girls taking grade 12 physics and other prerequisites)
5. Sexist or inappropriate comments, intimidation, bullying

In addition, the survey responses highlighted the following insights:

- Public perception of engineering as highly technical, analytical, and unemotional.
- The current engineering education system is limiting, (ie. it does not allow for broader interests, such as public policy learning, or other subjects that could benefit engineers in their careers).
- Need to raise awareness of and provide outreach to internationally trained engineers who are women.

### 3.2 Barriers to retention

For the purposes of the development of SP3, "retention" refers to the action of keeping women in an organization/university program/faculty/company. Retention of women in engineering is a necessary part of improving women's participation in the profession and has a direct impact on the work to recruit more women. Young women entering the profession need mentors, supports, and visible examples of peer success in order to continue on the engineering continuum. Moreover, measures need to directly address the reasons women leave engineering at various points along the continuum (i.e., prior to degree attainment, after graduation, during their EIT programs, before obtaining their license, one to five years into their engineering career). The following list of thirteen barriers summarizes the barriers listed in research, by the Equitable Participation in Engineering Committee, and by the 30 by 30 network.

- Classroom and learning environment is not welcoming or inclusive of women.
- Workplace culture that is not welcoming (i.e. culture of engineering as a "boys' club" that does not accept women, being disrespected in the workplace).
- Working conditions that are not welcoming (i.e. too much travel, lack of advancement for women, lower salaries, parental leave is not supported, discrimination based on gender in hiring practices, gender bias in merit assessments and compensation).
- Sexist or inappropriate comments, intimidation, bullying (including comments that women are diversity hires, rather than merit hires).

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<sup>20</sup> 2018 OSPE. *Calling all STEM employers: why workplace cultures must shift to change the gender landscape.* Breaking barriers for women in STEM.

- Small number of women (i.e. students, faculty, EITs, or in the workplace) leads to isolation and gender segregation.
- Lack of mentors: compared to young men, young women have fewer role models who encourage them and mentorship opportunities to take mathematics and science courses and to consider engineering and technology careers.
- Lack of awareness of the pathway to licensure, EIT/MIT programs and key competency assessment processes.
- Lack of awareness of and resources for internationally trained engineers who are women.
- Lack of personal fit: women are dissatisfied with their engineering path, it does not meet their expectations and does not appeal to their interests.
- Lack of recognition: undervalued by managers, co-workers, contractors and/or clients in the workplace.
- Returnships: There is a lack of awareness of and resources for women who have studied engineering, were never licensed, but want to return to gain qualifications/educations/skills in order to become licensed.
- Dissatisfaction with effective use of their STEM skills (i.e. women are delegated administrative tasks).
- Hiring process turns women away (ie. job postings are written with gendered language, lack of gender diversity on interview panels).

The work to retain women in engineering is currently working to keep women in engineering programs at the post-secondary level, EIT programs, and in the workplace. For each of these three stages different barriers will exist; for example, for students, the way the engineering curriculum is taught will be a factor, whereas for professional engineers changing the workplace culture will be more important.

Barriers to retention of women in post-secondary institutions are being addressed by engineering faculties in a variety of ways, from networking opportunities for women, social events, peer mentoring and support programs, and faculty/staff advising for students who are women. The feedback from the 30 by 30 Champions and from enrolment data indicates that there is not a significant difference in attrition rates between male and female students. The focus of the barriers to retention will then focus on retaining women in the workplace, including in EIT/MIT programs.

The 2011 *Stemming the Tide: Why women leave engineering* study from the US found that roughly 40 per cent of the 3,700 engineers who are women surveyed indicated they left the field, and many who are currently working in engineering expressed their intentions to leave engineering. The key findings of the report were:

- More than two-thirds of the women who left engineering worked in another field, half of those rose to executive positions only five years after leaving engineering.
- Nearly half of women left engineering due to working conditions (ie. too much travel, lack of advancement, or low salary).
- 30 per cent left engineering due to the organizational culture.
- 25 per cent left engineering because they wanted more time with their family.

OSPE's *Breaking Barriers for women in STEM* report summarizes insights from students, educators, employers, and government on addressing barriers that contribute to the under-representation of women in STEM fields. The report lists the following top challenges for women in engineering workplaces:

- Being disrespected and undervalued by managers, co-workers, contractors and/or clients
- Lack of mentors and/or role models
- Less pay than male colleagues doing the same or lower level work
- Work culture and job demands that compete with family and/or community responsibilities
- Weak professional networks

Fouad et al. list the top reasons women leave engineering as:

- Poor and/or inequitable compensation, poor working conditions, inflexible and demanding work environment that make work-family balance difficult
- Dissatisfaction with effective use of their STEM skills
- Lack of recognition at work and adequate opportunities for advancement<sup>21</sup>

In Engineers Canada's 2018 survey, the 30 by 30 Champions identified the following factors as having a significant influence on the retention of women in engineering:

- Lack of acceptance by peers in the workplace and negative workplace culture
- Faculty who are women in engineering lack recognition and experience unsupportive culture
- Parental leave is not supported by employers and departments
- Gender bias in merit assessments and compensation
- Small number of women (ie. students, faculty, EITs, or in the workplace) leads to isolation and gender segregation

### 3.3 Barriers to professional development

For the purposes of the development of SP3, "professional development" refers to the development of competence or expertise, and career advancement of women in engineering within an organization/faculty/company. Based on Engineers Canada's 2018 survey of the 30 by 30 network, the target groups for professional development activities are weighted towards mid- and late-career professionals (84 per cent), newly licensed engineers who are women (79 per cent), and EITs and students who are women (both 68 per cent). The following list of five barriers summarizes the barriers listed in research, by the Equitable Participation in Engineering Committee, and by the 30 by 30 network.

- Workplace culture continues to be unwelcoming for professional engineers who are women, which undermines and erodes women's confidence (i.e. culture of engineering as a "boys' club" that does not accept women, being disrespected in the workplace).

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<sup>21</sup> 2017 Fouad et. al. Women's reasons for leaving the engineering field. *Frontiers in Psychology*. June 2017, Vol. 8, article 875



- Lack of mentors, sponsors and/or role models to assist women in advancing their careers and into leadership roles. Since there is a lack of women managers who support and value women's perspectives and men often mentor and council other men more easily, women are left behind.
- Lack of recognition: undervalued by managers, co-workers, contractors and/or clients in the workplace. This includes less pay for women than male colleagues doing the same or lower level of work.
- Lack of support: promotion to leadership positions and women's authority is undermined, in direct or subtle ways by various levels of a company or organization.
- Social identity threat, which is the anxiety or concern experienced in situations where one's social group is underrepresented, devalued, or stereotyped to be inferior.

OSPE's report findings relate to both the retention and professional development of women. Similar to the list above, the top challenges for women in engineering workplaces are:

- Being disrespected and undervalued by managers, co-workers, contractors and/or clients
- Lack of mentors and/or role models
- Less pay than male colleagues doing the same or lower level work
- Work culture and job demands that compete with family and/or community responsibilities
- Weak professional networks
- Experiencing discrimination
- Being underemployed and not using their STEM skills to their full capacity

The report also notes that when women are very isolated (ie. fewer than 10 per cent of women in their workplace), a significantly higher percentage report challenges compared to those who are in workplaces with more STEM women—even if they are still a minority. By contrast, when representations of women in STEM workplaces is higher than 10 per cent, a significantly higher percentage of women report that they have not faced any challenges to their career advancement.

The Engendering Success in STEM consortium supports the finding that when women feel their workplace is not gender inclusive they experience higher levels of psychological burnout and have a negative work experience. Social identity threat, which is the anxiety or concern experienced in situations where one's social group is underrepresented, devalued, or stereotyped to be inferior, has a negative impact on organizational performance and is a predictor to women choosing to leave the engineering profession.<sup>22</sup>

The Electricity Human Resource Council (EHRC) outlines the challenges to boosting women's representation within leadership roles:

- Men are not engaged in gender equity initiatives.
- There is the lack of solid, disaggregated, reliable and timely labour market data that paints a clear picture of the representation of women on boards or corporate leadership roles in the electricity sector.

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<sup>22</sup> 2017 ESS. Gender inclusive policies and practices in engineering. Engendering Success in STEM. <http://successinstem.ca/wp-content/uploads/2018/04/Gender-Inclusive-Policies-in-Engineering.pdf>

- Lack of focus of gender equity initiatives on creating a systemic culture shift.

EHRC explains that most gender initiatives focus only on “changing” women to improve their participation in the workforce (ie. giving them marketable skills, increasing their confidence, networking skills, etc.), while also looking to women alone to change the organizational practices that maintain the status quo. More interventions need to focus on changing workplace attitudes and removing biases and supporting men in becoming gender equity stewards and champions.

The topic of pay equity has been identified by many sources as a barrier to women’s professional development and retention in the profession. As mentioned in a previous section, women who graduated with undergraduate degrees in architecture or engineering had a median employment income of \$55,900. For male graduates in the same fields of study, it was \$61,000.

“Women are more educated than ever,” explains Zindzi Makinde of the Canadian Federation of University Women, in a recent article on the gender pay gap. “[Women] are more present in the workforce than ever and they are given more opportunities than ever and yet this discrimination still occurs. While it’s important that the issue of pay inequity is being recognized, it is certainly disheartening to see how little progress has occurred,” she said. “This disparity proves that there are still systemic barriers within society that don’t allow women and girls to reach their full potential.”<sup>23</sup>

According to the 2016 National Occupation Survey by Statistic Canada, the average income for women in engineering is \$80,483, and for men the average income is \$105,285.<sup>24</sup> Though there is a clear gender wage gap in the average earnings, the same census data indicated that 8.9 per cent of engineers who are women are managers, and 12.8 per cent of male engineers are managers, a relatively small difference.

Similarly, the barriers listed in the section on retention that related to lack of opportunities for advancement, and disrespect from managers and peers, directly relate to women’s professional development. Women’s career decisions are shaped by issues of inequity, whether that is in compensation, advancement opportunities, recognition of their skills, or interpersonal treatment.

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<sup>23</sup> 2018 Bieman. ‘[Gender pay gap exists among recent college and university graduates: Study](#)’. The London Free Press.

<sup>24</sup> 2016 Statistics Canada. 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016280.

## Section 4: Overview of external trends that relate to Engineers Canada's gender equity strategy

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The scope of the external environment scan has been limited to collecting information from external sources based on the following factors: similar regional regulatory context (Law Society of Ontario), similar national industry association (Electricity Human Resource Council), gender equity research (OSPE, Engendering Success in STEM, McKinsey reports) and initiatives such as Natural Resource Canada's Equal by 30, and the work being done by the NSERC Chairs. It is important to acknowledge the time constraints and subjectivity that influenced the content of the environmental scan. Given more time, the investigation into activities and research from sources outside of Engineers Canada could have included information on a broader pool of sources, such as the medical profession in Canada or the work being done by international engineering associations on equity, diversity, and inclusion. There is a breadth of research, from over 20 years, on women in STEM fields and this document attempts to capture a snapshot of that research. The following section is organized in order to capture some of the key issues and analysis of gender diversity, to facilitate discussions and development of Engineers Canada's women in engineering strategy. Continuous learning on the best practices and changing trends in equity, diversity and inclusion in engineering and STEM fields will be an important part of the work ahead.

### 4.1 Women in leadership

Research shows there is a correlation between organisations with high gender diversity in leadership and several measures of organizational success. For example, Fortune 500 companies with the most women on boards of directors outperformed companies with the least (similar results apply to Canadian companies).<sup>25</sup> The McKinsey 2010 report explained that the performance gap for companies with a higher proportion of women on their executive committees rests in the way women exercise leadership.<sup>26</sup> Some leadership behaviours, observed more often in women than men, have a positive impact on a company's performance and success, including improved governance, employee satisfaction, and innovation.

The research collected by Westcoast Women in Engineering, Science and Technology (WWEST) in 2014 indicates that gender diversity on boards can improve a firm's ability to navigate complex strategic issues, reduce conflict, and negative corporate policies. Moreover, according to a Canadian Board Diversity Council Annual Report Card from 2016, almost all Financial Post 500 directors indicated that diversity was important to them personally and to their boards.<sup>27</sup>

However, the global trend, according to McKinsey 2010, highlights the underrepresentation of women in companies' top management positions. Creating a critical mass of women is necessary to avoid

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<sup>25</sup> 2014, WWEST. *Business Case for Gender Diversity*. Westcoast Women in Engineering, Science & Technology, NSERCE Chair for Women in Science and Engineering, BC and Yukon Region. <http://wwest.ca>

<sup>26</sup> 2010, McKinsey & Company. *Women Matter 2010: Women at the top of corporations- Making it happen*.

<sup>27</sup> 2016 THE FP500. The premier ranking of Corporate Canada <http://business.financialpost.com/fp500-the-premier-ranking-for-corporate-canada>

tokenism, meaning having at least two to three women, or at least 30 per cent female representation on boards and top management positions.

In addition to improving governance, gender diversity provides other benefits to companies, including increasing the pool of new employees. Based on the 2006 Census women made up 47.4 per cent of the workforce, but only 21.9 per cent of the science and engineering workforce. Increasing gender diversity on teams has also been shown to improve the generation of new ideas and radical research, leading to innovation.

While the business case for diversity has proven a useful tool for encouraging the implementation of gender diversity in some organizations, it has been criticized as not addressing the underlying gender discrimination and gender stereotyping that are part of current business processes and practice.<sup>28</sup> If the argument is made that increasing women in leadership will lead to financial gains, the imperative for women in these positions is to prove their value by increasing a company's profits, which is both untenable and places women under more pressure than their male counterparts. Women are expected to perform at the very top of their peer group in order to be evaluated comparably to men. Another area of research focuses on the bias and stereotypes, on individuals and organizational levels, that lead to the devaluation of women's contributions in male-dominated workplaces.

## 4.2 Unconscious and implicit bias

Engendering Success in STEM (ESS) and other researchers have highlighted unconscious and implicit bias as a key limiting factor for the increased participation of women and other underrepresented groups in STEM fields. Unconscious or implicit bias refers to the assumptions or inferences we have about other peoples' behaviour—like whether someone is friendly or threatening. Usually, we are not even aware we engage in these assumptions; however, they directly influence the way we treat others and can often lead to discriminatory behaviours in the workplace and in our communities. Unconscious biases may be held by an individual, group, or institution and can impact the hiring process, particularly for women and minorities.<sup>29</sup> For example, to be seen as equally competent by reviewers, women researchers need to publish three more articles in well-known scientific journals, or 20 more articles in specialist journals than their male counterparts when applying for a medical fellowship.

It is important to note that biases, conscious or unconscious, can pertain to any aspect of an individual's identity. One's age, gender, gender identity, physical abilities, religion, sexual orientation, weight, and many other characteristics are subject to bias. Although unconscious bias and stereotypes are held by all of us, there are strategies and policies that can help reduce the impact of unconscious bias in the workplace. ESS suggests the following strategies to reduce unconscious bias:

- Education and training for hiring committees and managers on the existence and effects of unconscious bias, and assess the effectiveness of the training in changing gender inclusion

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<sup>28</sup> 2018, Colon, Kaplan. *Facing Down Backlash: What would it take to make real progress on gender equality?* Women of Influence. <https://www.womenofinfluence.ca/2018/01/07/facing-down-backlash-what-would-it-take-to-make-real-progress-on-gender-equality/#.XA6O5vZFyUk>

<sup>29</sup> 2013 WWEST. Unconscious bias. Westcoast Women in Engineering, Science and Technology. Chairs for Women in Science and Engineering. <http://successinstem.ca/wp-content/uploads/2017/02/Unconscious-Bias-Skin2.pdf>

- Increase the representation of women in top positions, seek out and hire women, and establish a goal for women across the organization.
- Adoption of anonymous hiring practices that redact applicants' names.
- Design organizational structures that hold those in leadership accountable for equity and diversity policies.
- Support outreach activities and events that inspire young girls to consider STEM.
- Use gender inclusive imagery in promotions.<sup>30</sup>

### 4.3 Electricity Human Resource Council

The Electricity Human Resource Council (EHRC) has been conducting research and supporting gender diversity programs.

According to an EHRC report, women make up 20 per cent of the overall energy industry, which is lower than women's economy-wide share in employment, which is 40 to 50 per cent according to the OECD. Some data also exists on the kinds of energy jobs women tend to hold, which are predominantly non-technical occupations (ie. in sales and administration).

EHRC conducted a series of interviews, focus groups, and online surveys of women who are working and interested in the electricity industry. The insights gained reflect the same barriers for women in engineering. The recommendations from EHRC's research highlight the need to increase awareness of the multitude of career options and opportunities for women in non-traditional roles and sectors (ie. engineering, electricity, and renewable energy sectors). "Many of the trades and occupations within the sector are performed 'behind the scenes' and the general public, by and large, does not have an idea of what these various jobs entail." This is an important insight that describes the nature of industries such as engineering as one that is not commonly in the public eye. Developing an effective intervention to bring engineering into the public eye often includes the suggestion of a multi-million-dollar marketing and advertisement campaign, however, this is far from the desired tactic given our available time and resources available. Though this is an important insight and challenge for many technical professions, the way in which it is addressed is still unclear.

Women surveyed by EHRC also indicated that skills assessment and targeted training are critical factors in career advancement and success for women. Particular focus needs to be placed on women in the early stages of their pathway to licensure, as trainees need assistance to develop and map out the career path that best suits their strengths and interests, while also helping them identify a learning path. This is something that could be easily applied to EIT/MIT and graduate retention programs. EHRC's research also indicates that further work needs to be done in promoting training programs directly to women, in partnership with post-secondary institutions, governments, and employers. "The research suggests that many females are in fact interested in trade-related occupations: however, they are unsure of where to start and how to pursue such opportunities."<sup>31</sup> This is something that relates directly to graduate recruitment and EIT/MIT retention programs in engineering. Once women receive their

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<sup>30</sup> 2018 ESS. Bias busting strategies for institutions. Engendering Success in STEM. <http://successinstem.ca/wp-content/uploads/2018/05/Bias-Busting-Strategies-Institutions.pdf>

<sup>31</sup> 2017 EHRC. Bridging the gap. Barriers, challenges and experiences. <https://electricityhr.ca/workplace-support/recruitment-retention/bridging-the-gap/findings/>

training it is vital to support their professional development in preparing them for interviews, developing their résumés, marketing their skills, and then further through the challenges they might face on the job. EHRC also reiterates the need for mentorship and sponsorship programs to successfully recruit and retain women in the profession.

#### 4.4 Law Society of Ontario

Unconscious bias training has been recommended by organizations and researchers as a tool to increase diversity and help create more welcoming workplaces. However, there are others who believe this tactic is not effective and can activate bias more than disrupt it. A 2016 report in the Harvard Business Review (HBR) looked at data from more than 800 US financial firms and interviews with hundreds of managers and executives on the success of diversity programs over a 30-year span. This report highlighted the following:

“It turns out that while people are easily taught to respond correctly to a questionnaire about bias, they soon forget the right answers. The positive effects of diversity training rarely last beyond a day or two, and a number of studies suggest that it can activate bias or spark a backlash. Nonetheless, nearly half of midsize companies use it, as do nearly all the Fortune 500.”<sup>32</sup>

The report indicates that though diversity programs have been instituted by these firms, the overall proportion of under-represented groups (ie. women, black, Hispanic, Native American) has not changed significantly. Between 1985 and 2000, white women saw the biggest gains—rising from 22 per cent to 29 per cent of managers—but their numbers have not moved since then. Over this time, financial firms have implemented a variety of diversity programs, including mandatory diversity training to reduce bias on the job, hiring tests, and performance ratings to limit it in recruitment and promotions, and grievance systems to give employees a voice. The authors of the HBR report indicate that these “tools are designed to pre-empt lawsuits...yet laboratory studies show that this kind of force-feeding can activate bias rather than stamp it out.” (2)

The report finds that while mandatory diversity training made managers reset and resist the anti-bias message, voluntary training resulted in reduced bias because the participants felt the choice was theirs and they were not being strong-armed into changing their behaviour and thinking. While 40 per cent of the companies implemented mandatory hiring tests assessing the skills of candidates for frontline jobs, the report shows that managers resist the measure and often use the tests selectively and ignore the results depending on their prejudice against the candidates. Another similar tool used to level the playing field for underrepresented groups are performance rating systems. Results show that “raters tend to lowball women and minorities in performance reviews...managers work around performance systems, the bottom line is that ratings don’t [sic] boost diversity.”(8)

The same report found a more effective approach is engaging managers in solving the problem, as opposed to relying on mandatory training modules to disrupt their bias and increasing managers on-the-job contact with women and minority workers.

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<sup>32</sup> 2016, Dobbin and Kalev. Why diversity programs fail. Harvard Business Review. July-August 2016 issue. <https://hbr.org/2016/07/why-diversity-programs-fail>

## 4.5 Natural Sciences and Engineering Research Council of Canada (NSERC)

NSERC has implemented a number of initiatives over the past decade to increase the representation of women in the natural sciences and engineering in Canada. The PromoScience program is one example that provides funding to organizations bringing science experiences to underrepresented groups and to those that promote interest in science among girls.<sup>33</sup>

The main NSERC program with the goal of increasing the participation of women in science and engineering and to provide role models for women active in and considering careers in these fields is the Chairs for Women in Science and Engineering program. This program was launched in 1996 with the establishment of five regional chairs. NSERC funding must be matched by cash contributions from corporate sponsors. The NSERC WISE Chairs are actively working to increase women's participation and access to science and engineering fields through research and other activities.

In 2017, NSERC released a statement on 'Equity, Diversity and Excellence in Natural Sciences and Engineering Research,' outlining their commitment to a Framework on Equity, Diversity and Inclusion to increase equity in all its programs, awards and research activities.<sup>34</sup> In November 2017, the Minister of Science, the Honourable Kirsty Duncan, announced changes to the Canada Research Chairs Program (CRCP) that promoted a greater diversity and revised the distribution of the federal research granting councils to address the "chronic underrepresentation of women, Indigenous peoples, visible minorities and persons with disabilities in the CRCP."<sup>35</sup>

## 4.6 Equal by 30 - NRCan

To represent a campaign by a federal department, the following summary of Natural Resources' Canada's (NRCan) Equal by 30 Campaign captures some of the work being done to promote gender equity by Canada internationally.

Launched in May 2018, NRCan's Equal by 30 campaign is an international framework that asks companies and governments to endorse principles that work towards making gender equity central to the transition to a clean energy future. This initiative attempts to address the existing inequities in the energy sector. According to the World Petroleum Council's recent report Untapped Reserves: Promoting Gender Balance in Oil and Gas, women make up a fifth of the employees in the sector, and the industry is failing to fully leverage a potentially sizable and critical pool of talent.<sup>36</sup> NRCan's campaign has a strong focus on promoting equal pay, opportunity, and leadership to women as a foundation of the clean energy sector. This is an excellent example of a gender lens and principles of equity and inclusion being applied to the development and organization of the energy sector. Signatories include Italy, Finland, and Sweden, and industry signatories are being sought to help validate the campaign in each country.<sup>37</sup>

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<sup>33</sup> 2010 NSERC. Women in science and engineering in Canada. Corporate Planning and Policy Directorate, Natural Sciences and Engineering Research Council of Canada (NSERC). Nov. 2010

<sup>34</sup> 2017 NSERC. NSERC Statement on Equity, Diversity and Excellence in Natural Sciences and Engineering Research. [http://www.nserc-crsng.gc.ca/NSERC-CRSNG/Policies-Politiques/Wpolicy-Fpolitique\\_eng.asp](http://www.nserc-crsng.gc.ca/NSERC-CRSNG/Policies-Politiques/Wpolicy-Fpolitique_eng.asp)

<sup>35</sup> 2017 CRC. Government of Canada takes action to increase equity, diversity in research. Nov. 2, 2017. Ottawa [http://www.chairs-chaires.gc.ca/media-medias/releases-communications/2017/tier\\_1-niveau\\_1-eng.aspx](http://www.chairs-chaires.gc.ca/media-medias/releases-communications/2017/tier_1-niveau_1-eng.aspx)

<sup>36</sup> 2018 BCG. Untapped Reserves: Promoting gender balance in oil and gas. <https://www.bcg.com/en-us/publications/2017/energy-environment-people-organization-untapped-reserves.aspx>

<sup>37</sup> 2018 NRCan. The equal by 30 campaign. <https://www.nrcan.gc.ca/21638>

Further investigations could provide more information on the national, international, and regional initiatives working to increase women’s participation in engineering. For the purpose of this environmental scan, it is important to note that these initiatives exist and can contribute to existing and new interventions through strategic partnerships. Provincial and territorial initiatives can serve to amplify and support the work to address barriers to women in engineering.



## Section 5: The role of Engineers Canada

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### 5.1 Internal environment

Engineers Canada's primary role is to collaborate with and advocate for the 12 provincial and territorial engineering regulators on the creation of the SP3 actions plans and the implementation of the expanded mandate. Given the history of Engineers Canada and of the women in engineering working groups and task force (see section 1.1) there is a precedent for Engineers Canada supporting the work towards improving gender equality in the profession through collaboration.

One challenge for Engineers Canada is effectively engaging multiple stakeholders along the engineering continuum, who are increasingly connected and interdependent but remain organized into silos of influence (ie. K-12 education, regulators, government, employers, and post-secondary institutions).

In addition to the engineering regulators, who are the primary customers in Engineers Canada's work, Engineers Canada connects with the HEIs as contributors on the work towards 30 by 30, as they play a vital role in the recruitment of girls (primarily grade 9 to 12) through their engineering outreach programs. In addition, Engineers Canada has and will continue collaborating with other contributors, including:

- educational organizations, such as the NCDEAS
- engineering organizations, such as the Canadian Federation of Engineering Students, Canadian Academy of Engineering, and OSPE
- outreach organizations, such as ACTUA and Girl Guides Canada
- industry associations, such as Association of Consulting Engineering Companies- Canada
- engineering companies

Some of these contributors are members of the 30 by 30 network and other contributors who are not 30 by 30 Champions might to be further engaged when a strategy for SP3 and action plans are produced.

Engineers Canada also plays an important role as a source of information. Engineers Canada provides research services to support and advance the engineering profession and to inform decision-making for Engineers Canada and other stakeholders. Its research services identify trends in:

- the labour market
- engineering enrolment
- engineering employment
- engineering education
- the gender of practising engineers
- membership of the provincial and territorial engineering regulatory bodies
- the career plans of soon-to-be engineering graduates

In the production of reports on national engineering membership, and enrolment and graduation, Engineers Canada is viewed as a source for current and historic data on women's participation in engineering. However, there are gaps in this information, as the previous sections indicated (e.g.

number of years between graduation and licensure, inconsistent reporting from some engineering programs on enrolment and graduation data).

Engineers Canada also acts as a central point for government advocacy in the areas of equity, diversity, and inclusion in the engineering profession. Working with other associations, organizations and researchers, Engineers Canada participates in consultations and provides testimonies to government on gender equity issues. Engineers Canada's government relations activities and advocacy statements address the needs of women in the profession and continue to raise the issue of increasing women in engineering.

## Section 6: Analysis and recommendations

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The intention of this environmental scan is to present a history of the work leading up to 30 by 30, alongside information on the current programs and tactics being used by the 30 by 30 network, and statistics on women's participation along the engineering continuum. Reviewing the information above we hope to provide a strong foundation for development of Engineers Canada's SP3 strategy. We do not want to duplicate efforts or attempt to reinvent the wheel, instead we intend to build a strategy that supports the existing work of the 30 by 30 Champions network, identifies gaps in existing interventions, and proposes tactics that are effective and actionable.

Taking the historic and statistical information on women in engineering in Canada, the following are recommended interventions that attempt to address the barriers related to each of the three focus areas, as well as recommendations for Engineers Canada.

### 6.1 Engineers Canada

Engineers Canada's role in increasing women's participation in engineering must be based on the organization's capacity (ie. resources, strengths, partnerships, etc.) and purpose (to serve the regulators, and to promote and maintain the interests, honour, and integrity of the Canadian engineering profession). To contribute towards the substantive change in the engineering profession, Engineers Canada should:

- Continue to act as a backbone organization, fostering collaboration with engineering regulators, and other engineering stakeholders, to work collectively and share authority, decision-making, and accountability to influence the challenge of 30 by 30. The backbone organization facilitates the work of the network, their full participation in the effort, managing tensions, supporting solutions to challenges, and creating a dynamic environment for new ideas.
- Improve 30 by 30 network structure to facilitate increased collaboration and actionable steps taken by the Champions. Organizing the network into working groups would help break the network into topic specific groups, with more focused discussions, and the potential for workplans and increased accountability. Working groups would include: K-12, Post-secondary, Early Career, and Professional Development.
- Map out tactics to address the cohort of women who are expected to be licensed in 2030. Given Engineers Canada's Strategic Plan 2019-2021, the strategy and tactics need to address what is achievable within the next two years, as well as what can be achieved by 2030. The goal of 30 per cent newly licensed engineers who are women by 2030 needs to remain a focus, while addressing the barriers to retaining the women who are already working in the profession. For example, the women who will obtain their licence in 2030 are expected to be in the engineering graduation classes of 2025-2026, and they are currently in grades 9 to 12. This could mean a set of tactics in 2019-2021 that focus on girls in high school, then later programs that support these women through their post-secondary education and into their EIT/MIT programs. While it is important to support engineering outreach that speaks to all ages, in order to achieve 30 by 30, a timely and targeted approach will have the greatest impact.

- Review gaps in research and data on women in engineering. For example, a study that tracks the 2030 cohort of newly licensed engineers who are women would be an effective way to record the progress and the experiences of young women in engineering, or data on the professional development of women in engineering workplaces through an employer survey. Research studies can be cost-prohibitive for one organization; however, investigations into potential private sector and academic partners would be a good first step. Statistics Canada has recently launched a diversity office and might be interested in this topic; moreover, they are an important source for data on the engineering profession.
- Conduct regular assessments of the progress of the 30 by 30 network towards the 30 by 30 goal to ensure continued accountability and momentum. Engineers Canada is well positioned to facilitate the gathering of this information via a survey and analysis, which can be presented to the 30 by 30 network as well as the Engineers Canada's Board as an annual 30 by 30 report. Each 30 by 30 Champion will be required to track the progress of their programs and provide input through an annual survey.
- Create an expansion plan for 30 by 30, to include strategic engagement with the remaining higher education institutions that have not endorsed the 30 by 30 goal and engineering employers. The 30 by 30 survey should be expanded to reach more employers in order to fully understand the current state of gender equity programs that exist in the workplace.
- Support the increased use of gender analysis tools that already exist. A simple intervention, such as promotion of the federal government's Gender Based Analysis Plus training tool, which is a free two-hour online course, could help address the lack of gender analysis being used by the 30 by 30 Champions and their organizations (44 per cent of 30 by 30 survey respondents never used gender analysis tools)
- Leverage existing partnerships to facilitate continued capacity building for the 30 by 30 network (e.g. providing training through partnership with EngiQueers on diversity and inclusion, endorsement of 30 by 30 by engineering companies, Electricity Human Resources Canada's Leadership Accord for Gender Equity).
- Highlight the need for men to play a significant part in changing the engineering culture. Engineers Canada must work with the 30 by 30 Champions to ensure male allyship is developed and encouraged throughout the SP3 action plans.
- Foster collaboration and partnerships, particularly with employers, to facilitate the culture shift in the workplace that is needed to make engineering a more welcoming place for women.
- Continue to advocate for welcoming workplaces, and policies and regulations that support women in engineering with the federal government.
- Investigate the development of a guideline from the Qualifications Board that addresses the need for more inclusive workplaces as part of the work to institutionalize gender equity.
- Improve programs by implementing evaluation frameworks, applies across all programs and action plans.

## 6.2 Recruitment

Recruitment efforts need to address the barriers listed above. Here are some suggested interventions that address specific challenges to recruitment of women in engineering.

- Revitalize K-12 classroom programs to increase accessibility to engineering principles and support girls' participation in grade 12 physics and other engineering prerequisites.
- Publicly celebrate engineers who are women as role models.
- Recruit more girls into grades 9 to 12 science, math, and physics (engineering pre-requisites) through existing targeted outreach programs.
  - Go ENG Girl expansion (five more schools in 2019)
  - Girl Guides of Canada engineering program and engineering crest
  - Mentorship programs such as Cybermentor at the University of Calgary
  - Partnership with ACTUA, leveraging their existing expertise and network of STEM outreach practitioners
- Outreach to parents and guardians (resource: 'Why STEM for Parents and Guardians' [ESS pamphlet](#)).
- Tools and training for teachers on engineering concepts and principles.
- Engineers in Schools are great volunteer opportunities for engineers and connect students with role models. Adequate training and resources need to be provided to ensure engineers present age-appropriate content and have a level of cultural competency.
- Outreach to internationally trained engineers who are women.
- Increase post-secondary female engineering student enrolment.

## 6.3 Retention

Retention efforts need to address the barriers listed above. Here are some suggested interventions that address specific challenges to recruitment of women in engineering.

- Review licensure procedures using a gender lens (ie. time windows for re-licensing, returnship for members, scope of practice—to support women on leave and internationally trained women).
- Commitments and action by engineering employers to create welcoming workplaces.
- Though work-life benefits might exist in a workplace, the work culture may discourage employees from using them. Clear communication from leaders support use of work-life benefits and assurance that career penalties will not be imposed for using work-life benefits is necessary.
- Appraise and monitor pay equity practices.
- Training and supports that assist young women through the EIT/MIT program and assist them in finding the career path and professional development learning that best suits their needs.
- Provide parental leave for men and women, and ensure the workplace culture is supportive of the use of these benefits.
- Implement a transition plan for employees while on and when returning from leave to ensure there are no negative consequences for the employee's career due to taking leave—see [Managing Transitions](#).

- Providing flexible work schedules, creating more part-time opportunities, allowing employees to work remotely in order to facilitate the success of engineers with care-giving responsibilities.
- Managers and HR leaders need to send a clear message against harassment and discrimination in the workplace, in addition to putting in place the appropriate policies.
- Implement gender-blind hiring practices and remove implicit biases. For instance, first names can be removed on cover letters so that the gender of an applicant is not obvious.
- Training for all supervisors on diversity and inclusion and unconscious bias.
- Training for all supervisors on providing positive feedback and encouragement to their employees.
- Managers and supervisors need to show leadership in normalizing gender-equal treatment of their employees.
- Employers support employees in volunteering with community organizations.
- Increase the number of women graduating through retention efforts by post-secondary institutions.
- Conduct a survey of engineering students who are women who have left engineering: Why did they leave? What other field of study are they in now? Did they leave university altogether?

#### 6.4 Professional development

- In order to address the barriers listed above, interventions can include the following actions: Commitments and action by engineering employers to create welcoming workplaces.
- Engineering employers providing career development opportunities for women.
- As part of gender equity policies, conduct a regulator gender equity survey of employees to assess the implementation of programs and policies.
- Create mechanisms within existing professional structures to promote women (ie. count service work, which women do a lot of, towards career advancement and promotion).
- Gender inclusive policies that reduce social identity threat, such as reinforced cultural norms and values that support positive working relations between genders, company-sponsored diversity awareness training, implementation of a formal workplace harassment policy and training, physical working conditions (ie. equipment, clothing, facilities) appropriate for men and women, advertisements and marketing materials that showcase gender diversity, training and mentorship programs that support equal professional advancement for men and women (from [ESS' Gender inclusive policies and practices in engineering](#))