

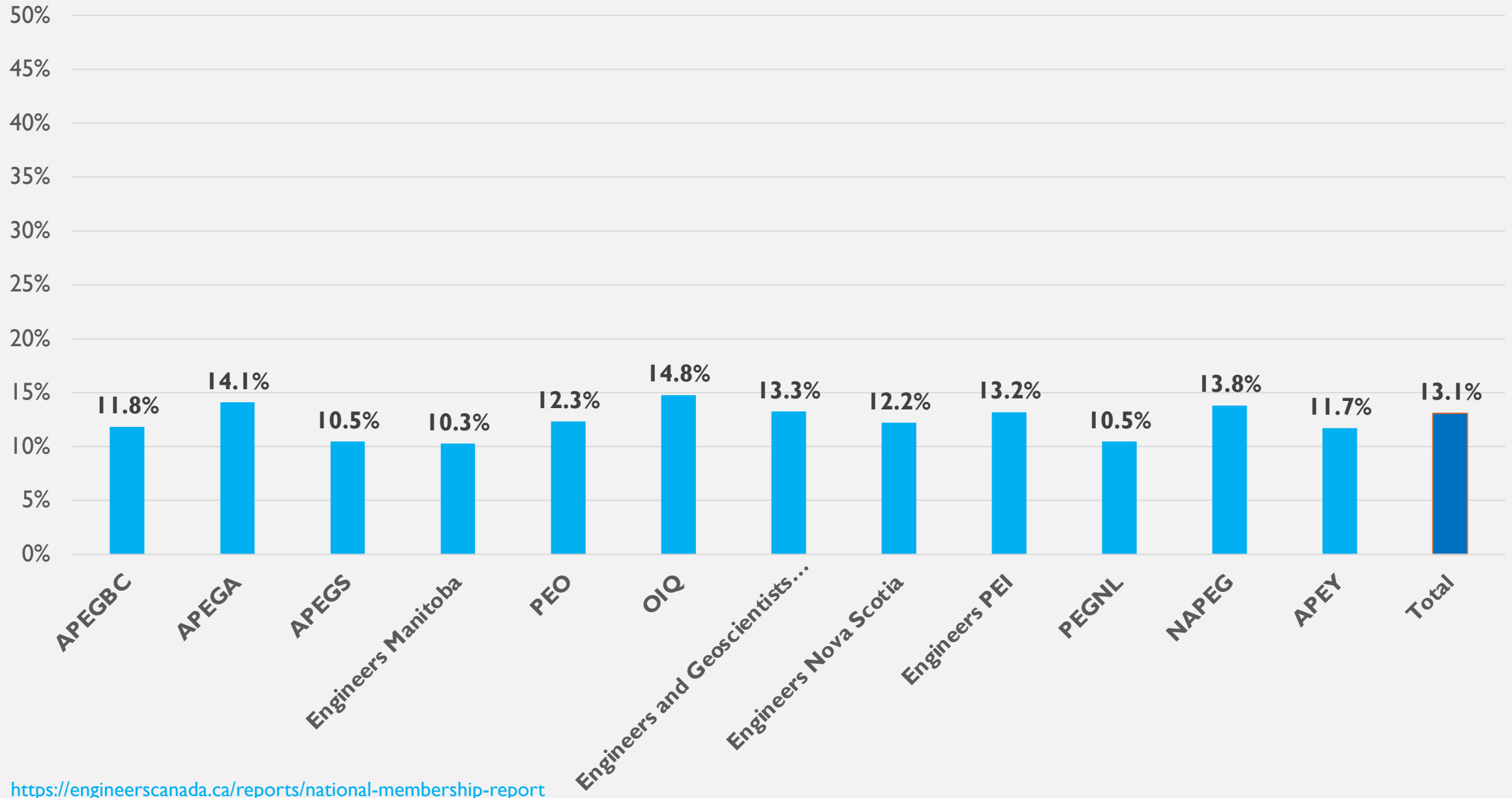
DIVERSITY AT WORK

Women in Engineering

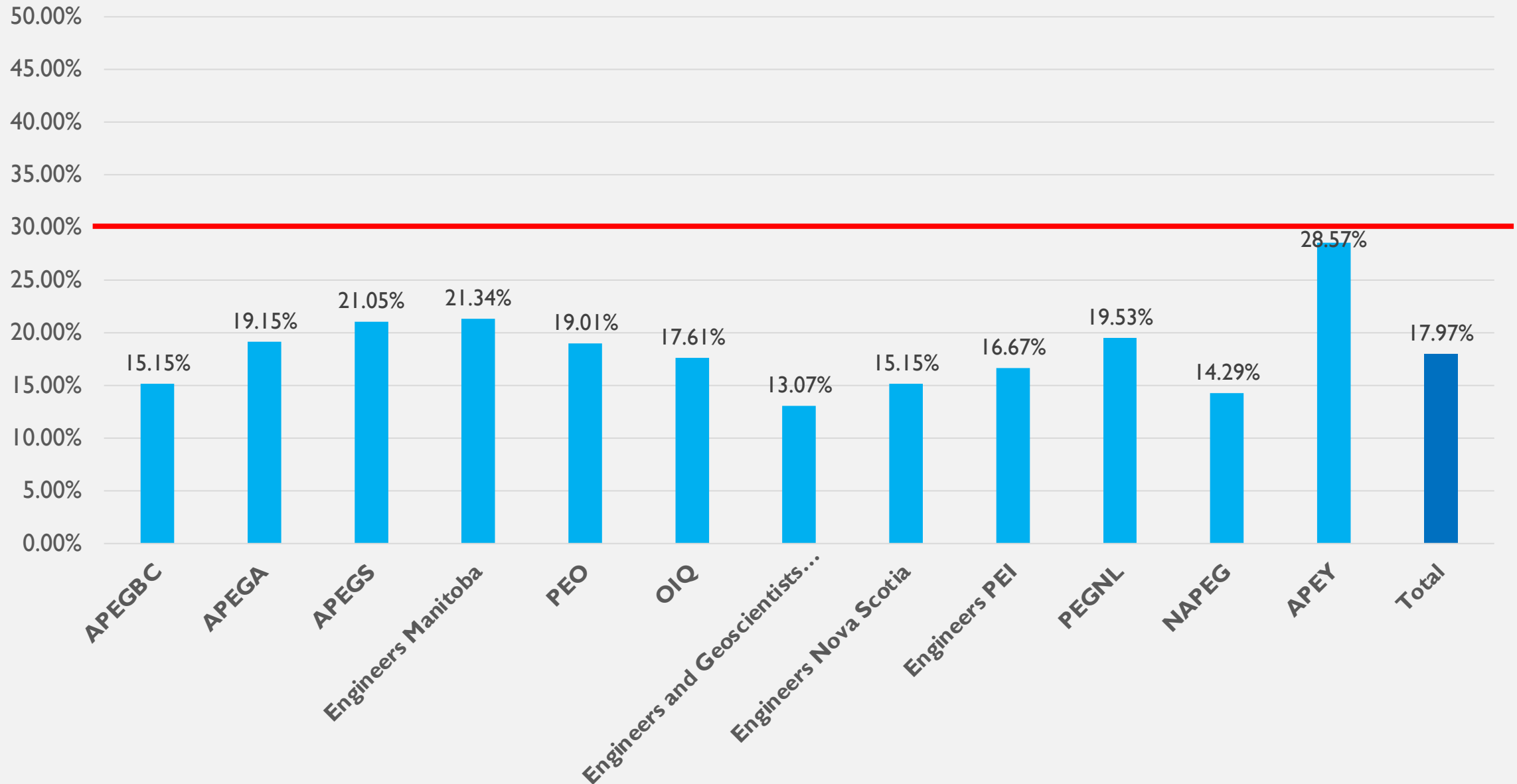
ENGINEERING PROFESSIONS

- Critical case study for gender segregation
- Described as a 'leaky pipeline'
 - [Women who perform well in math in HS are less likely than high performing men to enter STEM](#)
 - [Women who choose to enter the major are less likely to stay](#)
 - [Women who complete the degree are less likely to become practicing engineers and exit more frequently](#)
- Concerted effort to attract and retain women in the profession by provincial regulators and Engineers Canada

Practising P.Eng.'s (% Female), 2017



Newly Licensed Engineers (% Female), 2017



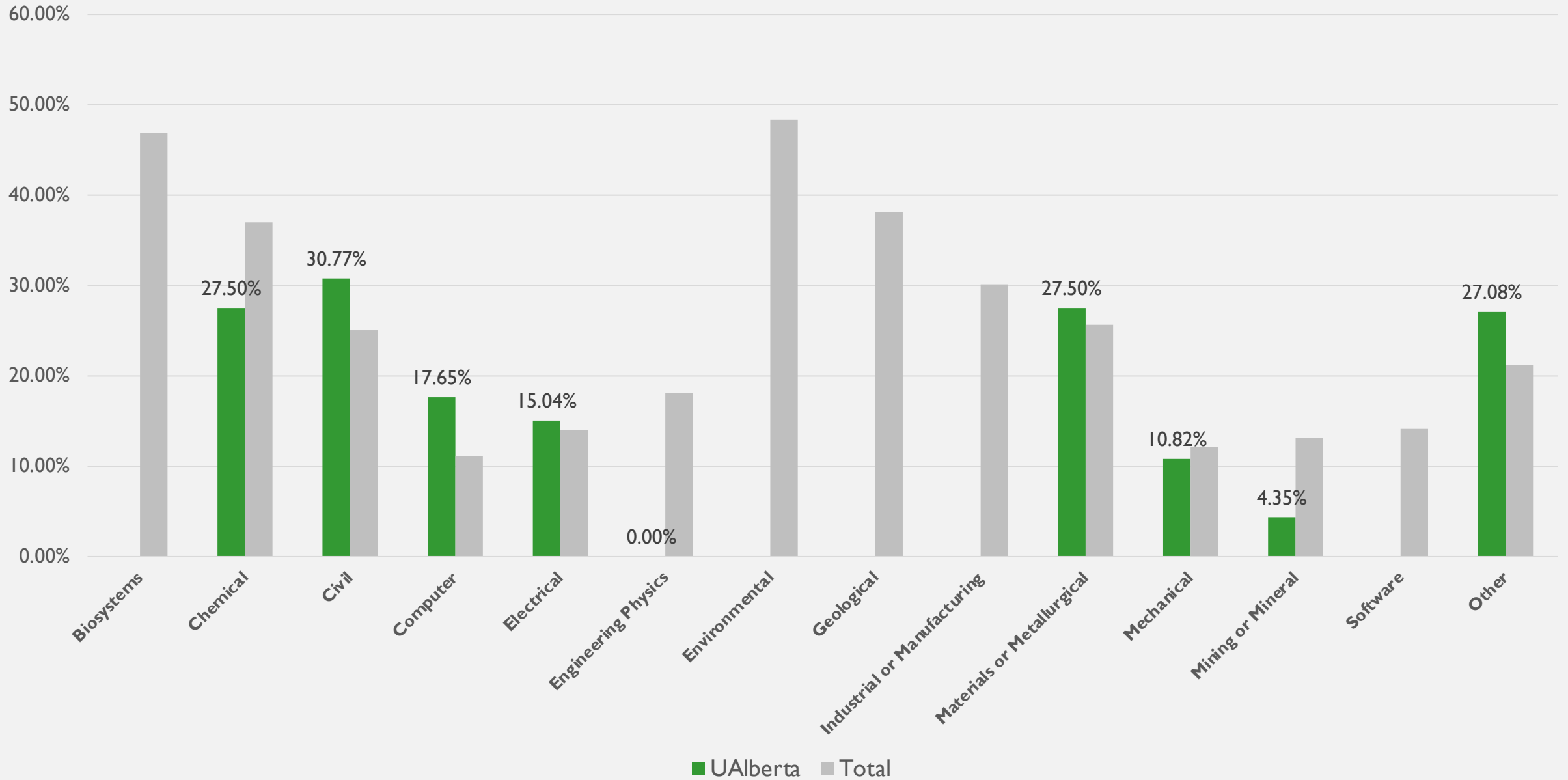
30 by 30

Engineers Canada has long fostered collaboration with engineering regulators and other engineering stakeholders to work collectively and share authority, decision-making, and accountability to reach 30 by 30. Engineers Canada facilitates the work of the 30 by 30 Champions network, facilitates data collection and distribution on the composition of the profession, and advocates to the federal government on issues relevant to women in engineering.

Engineers Canada is working to increase the representation of women within engineering through its 30 by 30 initiative. This initiative has a goal of raising the percentage of newly licensed engineers who are women to 30 per cent by the year 2030. Thirty per cent is universally held as the tipping point for sustainable change—reaching 30 by 30 will help drive the shift in the overall membership of the engineering profession as more and more women continue to enter the profession.

30 by 30 has received national support across all provinces and territories. Engineers Canada collaborates with engineering regulators and other stakeholders to facilitate a national vision on this issue.

Degree Recipients %Female by Discipline, 2017



WHAT IS ENGINEERING CULTURE?

“practice of engineering” means...

(i) reporting on, advising on, evaluating, designing, preparing plans and specifications for or directing the construction, technical inspection, maintenance or operation of any structure, work or process

- (A) that is aimed at the discovery, development or utilization of matter, materials or energy or in any other way designed for the use and convenience of humans, and
- (B) that requires in that reporting, advising, evaluating, designing, preparation or direction the professional application of the principles of mathematics, chemistry, physics or any related applied subject, or

(ii) teaching engineering at a university;

Source: http://www.qp.alberta.ca/1266.cfm?page=E11.cfm&leg_type=Acts&isbncln=9780779785131

CASE STUDY

- Cech, Seron, Silbey, Rubineau [2011](#), [2016](#)
- Longitudinal study of engineering program entry cohorts at:
 - Massachusetts Institute of Technology
 - University of Massachusetts at Amherst
 - Franklin W. Olin College of Engineering
 - Smith College
- Two studies
 - Statistical analysis of correlates of persistence through undergraduate
 - Interview and diary data on socialization into fit

STUDY I

- Question: What drives gender differences in persistence?
 - Confidence in math abilities
 - Long-term family concerns
 - Professional role fit
- Key findings
 - Math self-assessment and family plans do not explain gender differences in persistence
 - Professional role confidence significantly predicts persistence; gender differences in role confidence help explain segregation

Key Independent Variables

Importance of Family Plans (alpha = .721)

Importance to me (0 = very unimportant to 3 = very important):
Building a satisfying, long-term intimate relationship
Building a family

Math Self-Assessment

Rate your math ability compared to an average person your age (1 = lowest 10%, 2 = below average, 3 = average, 4 = above average, 5 = highest 10%)

Professional Role Confidence: Expertise

Confidence (alpha = .809)
As a result of my engineering courses (1 = not confident at all to 4 = very confident):
Developing useful skills
Advancing to the next level in engineering
My ability to be successful in my career

Professional Role Confidence: Career-Fit

Confidence (alpha = .751)
As a result of my engineering courses (1 = not confident at all to 4 = very confident):
Engineering is the right profession for me
Selecting the right field of engineering for me
Finding a satisfying job
My commitment to engineering

Behavioral Persistence (DV)

Persisted as an engineering major = 0 (Year 1 to 4)
Left engineering for another STEM major = 1 (Year 1 to 4)
Left engineering for a non-STEM major = 2 (Year 1 to 4)

Intentional Persistence (DV)

"How likely is it that you will be an engineer in 5 years?" (1 = very unlikely to 4 = very likely)

Institutional Variables

Attends Smith College (1 = yes)
Attends Olin College (1 = yes)
Attends UMass (1 = yes)
MIT is the comparison category

Individual-Level Control Variables

Gender (women = 1)
Hispanic or Latino (yes = 1)
African American (yes = 1)
Asian or Asian American (yes = 1)
Cumulative GPA (Year 4)
Mother's education (3 = some elementary or grammar school; 10 = graduate degree)
Father's education (3 = some elementary or grammar school; 10 = graduate degree)
SAT math score (self-reported)
SAT verbal score (self-reported)
Writing self-assessment
Rate your writing ability compared to an average person your age (1 = lowest 10%, 2 = below average, 3 = average, 4 = above average, 5 = highest 10%)

STUDY 2

- Key Question: Does professional socialization contribute to gender differences in perceived fit in the profession?
 - Entry and orientation into the program
 - Initiation rituals
 - Anticipatory Socialization
- Method
 - 100 in-depth interviews with students
 - Bi-monthly diaries of 40 students over their 4 years

FINDINGS: ENTRY

	Events	Women's experiences	Women's interpretations	Men's experiences	Men's interpretations
Entry	College major in engineering	High achievement in math and science in elementary and high school	Confidence in math and science skills, looking for secure career with advancement and opportunities to help people	High achievement in math and science in elementary and high school	Confidence in math and science skills, looking for secure career with advancement and opportunities to solve problems

Last night while writing up my [engineering course] assignment, I all of a sudden realized that I loved chemical engineering. It was like an epiphany! Before, I had the attitude of “well, I like chemistry, and engineering seems neat, so I’ll do chemical engineering. And besides, I don’t know what else I would do.” Now, my attitude has changed ... to one of “I wouldn’t want to do anything else(!)” It was amazing; I was just writing along, minding my own business and it hit me like a sack of flour. It made me feel very good about chemical engineering, and it made me more confident in my decision to pursue a degree in chemical engineering hereA moment of self-confirmation, if you will. Beautiful, absolutely beautiful. (Brian)

FINDINGS: INITIATION RITUALS

	Events	Women's experiences	Women's interpretations	Men's experiences	Men's interpretations
Initiation rituals	Membership in a cohort	Discovering a pecking order among initiates, no longer top of the class, uncertainty	Coping with pecking order. Seek validation from teachers and grades but don't question the circumstances	Discovering a pecking order among initiates, no longer top of the class, uncertainty	Coping with pecking order. Explain position by pointing to external factors
	Collaboration in engineering teams	Experiencing exclusion, relegated to helping role in design teams, can be managerial/leaders	Begin to question expertise, question whether engineering is meritocratic, some gender segregation	Applying math and science expertise to real-world problem, feed off group interactions and "show their stuff"	Begin to envision self as engineer

FINDINGS: INITIATION RITUALS

...in our design class, two girls in a group had been working on the robot we were building in that class for hours, and the guys in their group came in and within minutes had sentenced them to doing menial tasks while the guys went and had all the fun in the machine shop. We heard the girls complaining about it—in fact, one of them ended up on the group who was doing the project with me, which was cool. (Kimberly)

We set about coupling our 7.2 volt cordless drill motor to the dynamometer to determine its no-load speed, stall torque, and its current draw at different torques. From this data we were able to create a rough torque-speed curve and determine what size sprockets we would need to build for our chain-and-sprocket transmission We obtained precision-ground rods for our axles, more acrylic, and ball bearings (which we eventually did not use). We actually did use the large machine shops once on Friday to have them fabricate acrylic wheels for us on the laser cutter, and this was a wise move, for the wheels were of impeccable quality. Over the weekend, after I took my math test on Saturday, the home stretch of car building lasted through 2 a.m. in the mini shop on Sunday, at which time I had visualized, sketched, and built an adjustable angle solar canopy structure within just a few hours. The chassis, bearings, and axles were complete, and I attached my canopy before catching four hours of sleep. (Eric)

FINDINGS: ANTICIPATORY SOCIALIZATION

	Events	Women's experiences	Women's interpretations	Men's experiences	Men's interpretations
Anticipatory socialization	Internships	Fewer opportunities to practice, assigned supporting roles, coworkers assume lack of expertise, also experience some confirmation of expertise	Begin to question the attraction of the job, and culture of engineering; the awkwardness of engineers. See work as mundane; lacking meaning; Problem solving for own sake consequences. Being a cog in a wheel. Some experience synergy/expertise and future work as engineer	Continuation of collaborative experience, confidence from previous experience that they bring, not alien but familiar	Confirmation of achieved skills, anticipation of career as an engineer. Experienced as supportive turning point

So I'm two weeks into my research position and for the first time in my "working career" I'm really enjoying what I'm doing. The last two summers I've been working in an engineering internship position at X, the military defense government contractor The environment was creepy, with older weirdo man engineers hitting on me all the time and a sexist infrastructure was in place that kept female interns shuffling papers while their oftentimes less experienced male counterparts had legitimate "engineering" assignments. (Aurora)