

BME Careers: An Overview

A Mix of Engineering and Biology

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BME Careers
Some Perspectives
And Reality Checks
Lots of Data for Engineers
BME Data – not so much

Simple Observations

- The field has exploded
- Huge Opportunity for All of Society -- Globally
- Involves all forms of engineering and biology
- Huge challenge for academics, employers, students, professionals

Curricula

We are Preparing Students for

”MED TECH”

(devices)

“BTECH”

Molecular, pharma, tissue, ...

“BINFFORMATICS

Genomic data

”BSYSTEMS”

Analysis of complex systems

BioE Job Market (BS/MS Level)

- Growing percentage-wise very quickly
- Smaller than other engineering fields especially CS
- Growing need for cross trained in BioE & Other Engineering
 - design, quality control, software, manufacturing ...
- There are also good jobs in: clinical engineering, marketing, field support, business operations, ...
- Think about Law, MBA, regulatory (FDA)
- Traditional engineering majors with biology minors
 - Compete with BME majors
- Biologists – especially molecular
 - Compete with some molecular oriented BME majors
- Helps to have a strength in a more engineering traditional area
- MS helps significantly

BME Enrollment and Employment

Source: AIMBE <http://navigate.aimbe.org>

Good News

- 20,100 BME jobs in US (estimates up to 27,000)
- 7% growth rate to 2026
- \$92,970 annual salary average (Bureau of Labor Statistics)
- 1008 PhDs in 2017

BME Enrollment and Employment

Sources: American Institute of Medical and Biological Engineering <http://navigate.aimbe.org>,
Bureau of Labor Statistics, American Society for Engineering Education

Good News

- 20,100 BME jobs in US (AIMBE: 21,300 in 2016; others up to 27,000)
- 7% growth rate to 2026
- \$92,970 annual salary average (Bureau of Labor Statistics)
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Not So Good News (ASEE and Bureau Labor Statistics)

- 6,725 grads/yr = 33% of current total BME job market
- 34,060 current BME BS students = 70% greater than total BME job market
- 4,025 current BME MS students = 20% of total BME job market
- 6,730 current BME PhD students = 33% of total BME job market

Not So Good News:

Ratios:

Total USA Jobs Current BS Grads

Notes:

- Job totals for all who are working, not new openings;
- BS grads are those graduating in 2017

| Engr Field | 2012 | 2017 |
|-------------|-------|-------|
| ■ AgE | 3.0 | 1.3 |
| ■ BME | 4.5 | 3.0 |
| ■ ChemE | 4.6 | 3.1 |
| ■ MechE | 12.7 | 9.7 |
| ■ Materials | 18.9 | 13.4 |
| ■ Aero | 19.5 | 16.2 |
| ■ EE | 23.5 | 17.0 |
| ■ Petroleum | 34.8 | 18.3 |
| ■ Mining | 33.9 | 20.9 |
| ■ Environ. | 32.0 | 22.8 |
| ■ Civil | 21.3 | 25.1 |
| ■ Nuclear | 29.0 | 29.5 |
| ■ CS | 256.0 | 133.0 |

Enrollments are increasing faster than jobs

STEM recruitment in middle/high school increases number of BS grads

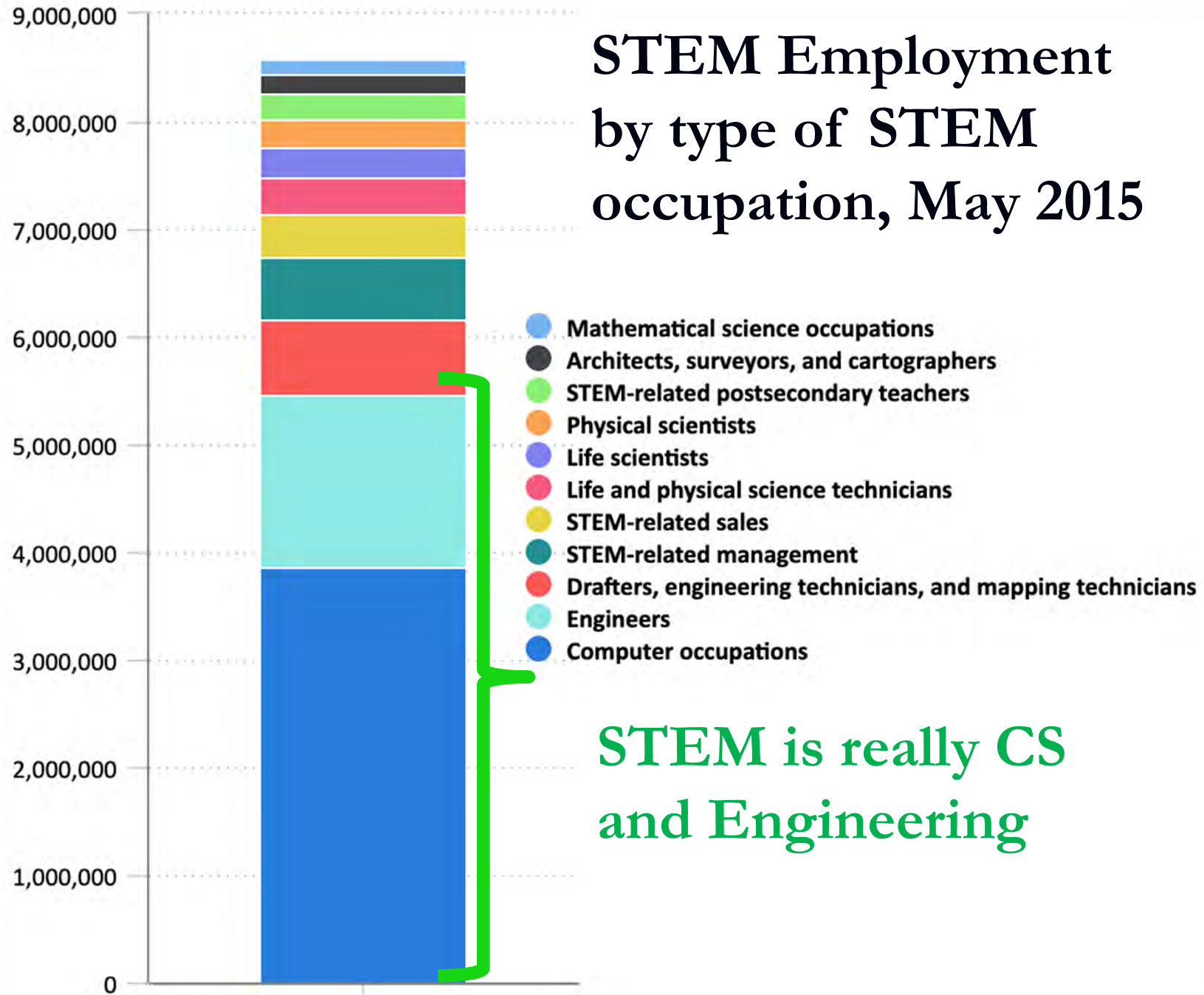
Sources: 2017, 2012 ASEE <https://www.asee.org/documents/papers-and-publications/publications/college-profiles/2017-Engineering-by-Numbers-Engineering-Statistics.pdf> 2017, 2013 Bureau of Labor Statistics http://www.bls.gov/oes/current/oes_nat.htm#15-0000

Limits of *STEM* – it's Really *TE*

- 2013 starting salary data for BS grads:
 - English majors - \$32k
 - *TE*: Engineering/CS - \$50k
 - *S*: Biology - \$25k
 - *S*: Chemistry – a little better than English majors
 - *M*: Math – between Chem and Engineering
- Associate's Level
 - Bio and Chem majors ~ barista
 - Eng / CS tech – twice as much
- NIH recognizes oversupply of biology PhD's
 - (still happening today)

References: 1. M. Schneider. (2013). Why the S in STEM is overrated. *The Atlantic*. [Online]. Available: <http://www.theatlantic.com/business/archive/2013/09/why-the-s-in-stem-is-overrated/279931/>. 2. B. Alberts, M. W. Kirschner, S. Tilghman, and H. Varmus. Rescuing U.S. biomedical research from its systemic flaws. *Proc. Nat. Acad. Sci. United States Amer.* [Online]. Available: www.pnas.org/cgi/doi/10.1073/pnas.1404402111. 3. U.S. National Institutes of Health, “Biomedical Research Workforce Working Group Report,” Bethesda, MD, 2012.

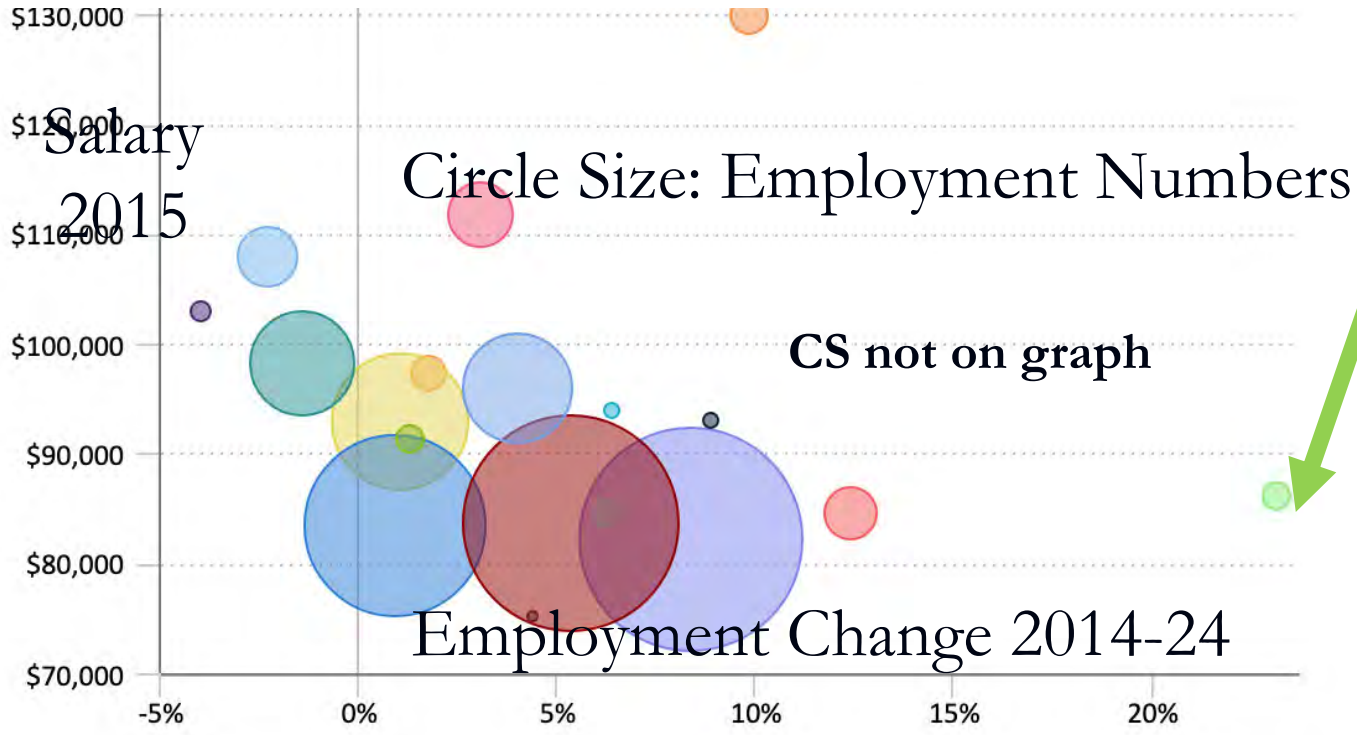
STEM Employment by type of STEM occupation, May 2015



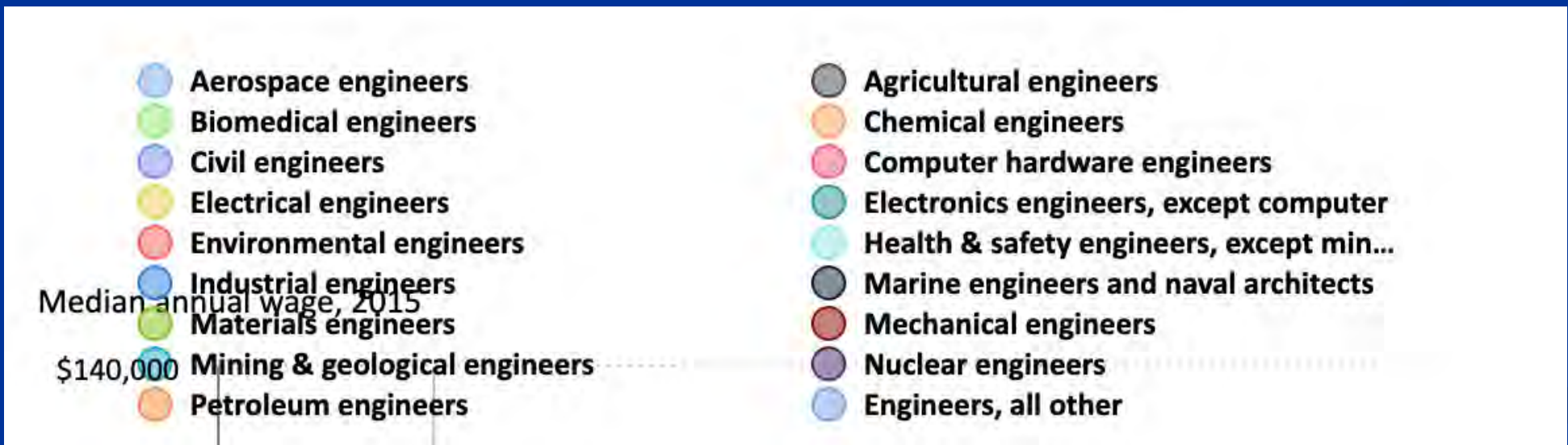
Important Data Points

Unemployment among BS Engineering Grads is lowest of all major employment groups

2013: Engineers: 2.9% vs All BS degrees: 4.3%
(2013 was not a good year)



Biomedical Engineers
By far the fastest growing engineering field



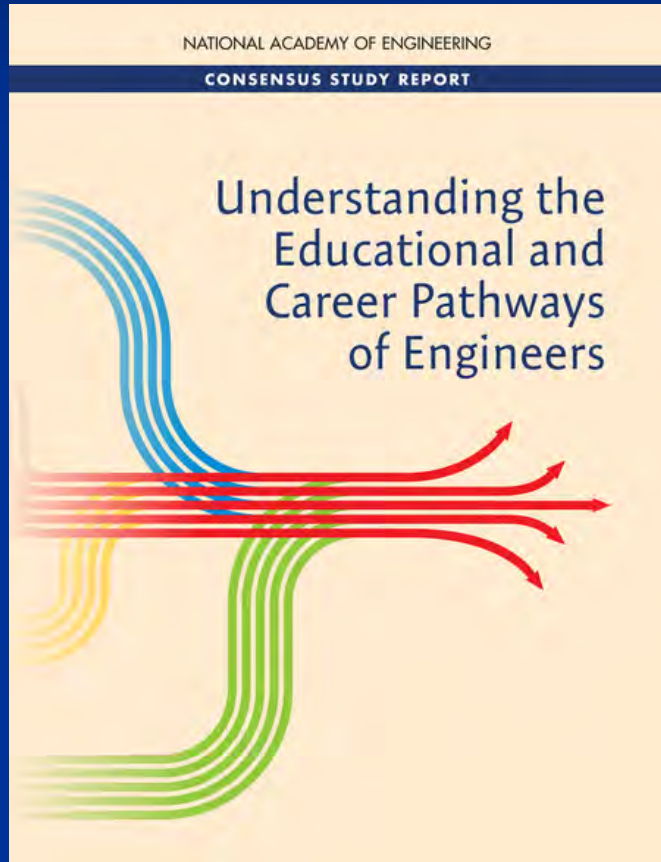
BME in Between Engineering and Biology

- The more like an engineer ...
 - Higher pay, more jobs, but ... is it as interesting?
- The more like a biologist ...
 - Lower pay, fewer jobs, but ... is it as interesting?
- But ... *the Big But* ...
- Life is more than calculating odds for getting a job
- The exciting stuff is “right down the middle” --
both bio and engineering
- Where are you going to bet your life?

Caveat

**There exist ZERO Reliable
Statistics on Employment
Of BME Majors**

ENGINEERING JOB DEMOGRAPHICS



Principal Source:

National Academy of Engineering
2018. *Understanding the Educational
and Career Pathways of Engineers.*
Washington, DC: The National
Academies Press.

<https://doi.org/10.17226/25284>.

TABLE I-1 Number of college-educated people employed in NSF engineering occupations, 2015.

| NSF categories used for engineering occupations | Number employed |
|---|------------------|
| Aeronautical/aerospace/astronautical engineers | 96,000 |
| Agricultural engineers | 7,000 |
| Bioengineers/biomedical engineers | 26,000 |
| Chemical engineers | 80,000 |
| Civil, including architectural/sanitary engineers | 251,000 |
| Computer engineers – hardware ^a | 70,000 |
| Electrical and electronics engineers | 290,000 |
| Environmental engineers | 66,000 |
| Industrial engineers | 82,000 |
| Marine engineers and naval architects | 12,000 |
| Materials and metallurgical engineers | 31,000 |
| Mechanical engineers | 337,000 |
| Mining and geological engineers | 5,000 |
| Nuclear engineers | 25,000 |
| Petroleum engineers | 19,000 |
| Sales engineers ^b | 90,000 |
| Engineers – all others ^c | 178,000 |
| Postsecondary teachers: Engineering | 53,000 |
| Total | 1,718,000 |

1.5%

Computer
Science
Not Included

BS Graduates 2000-2013

Rapid Growth After Recession

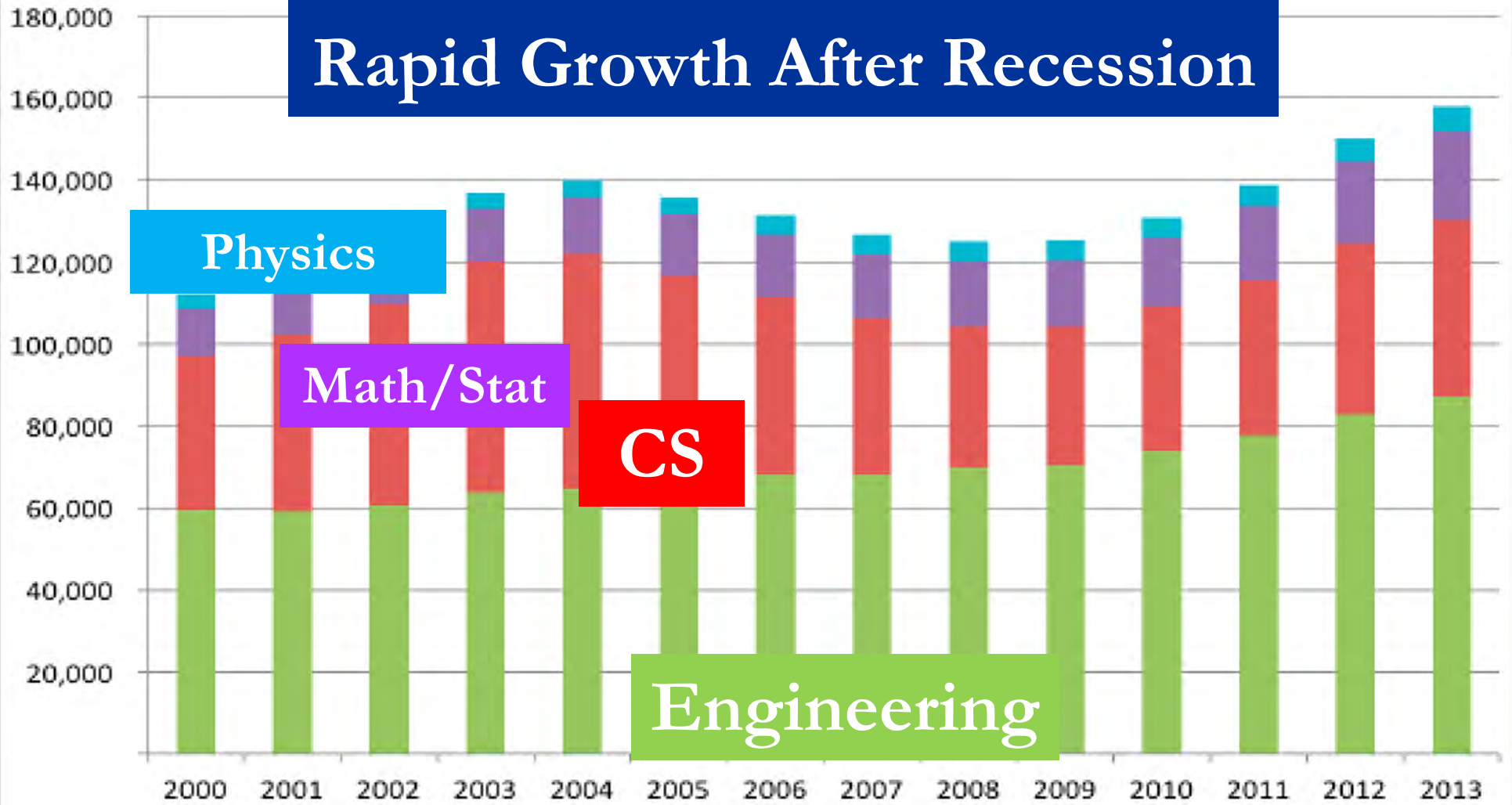


FIGURE 1-B1 Number of bachelor's degrees awarded annually in engineering and related fields, 2000–2013.
 Source: IPEDS Completion Survey 2000–2013.

Rapid Growth in All Engineering Degrees

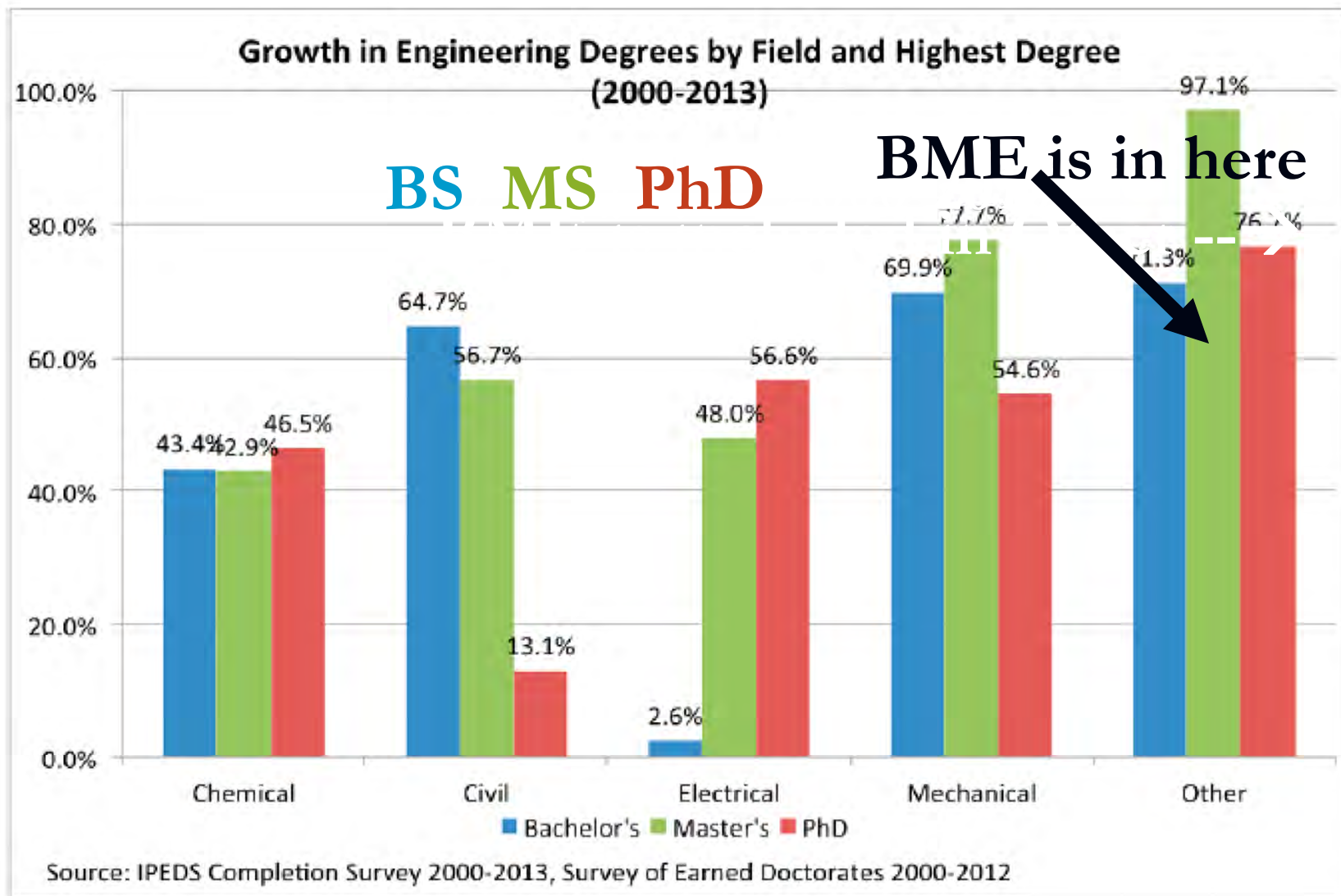
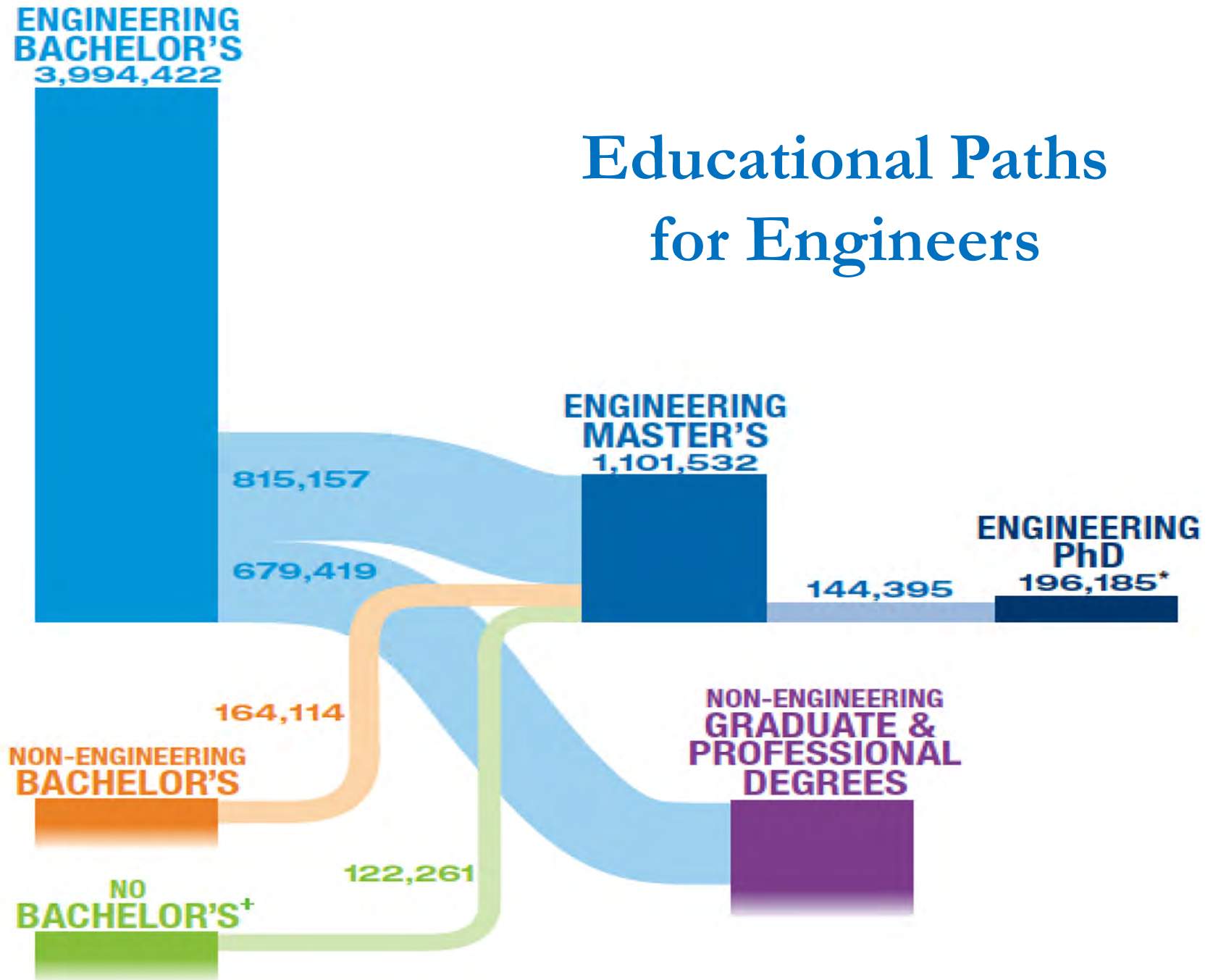


Figure A-3 Growth in Bachelor's, Master's and PhD Degrees in Engineering 2000-2012.
 Source: Bachelor's & Master's—IPEDS Completion Survey; PhD—Survey of Earned Doctorates.

Educational Paths for Engineers



Career Paths for BS Engineers

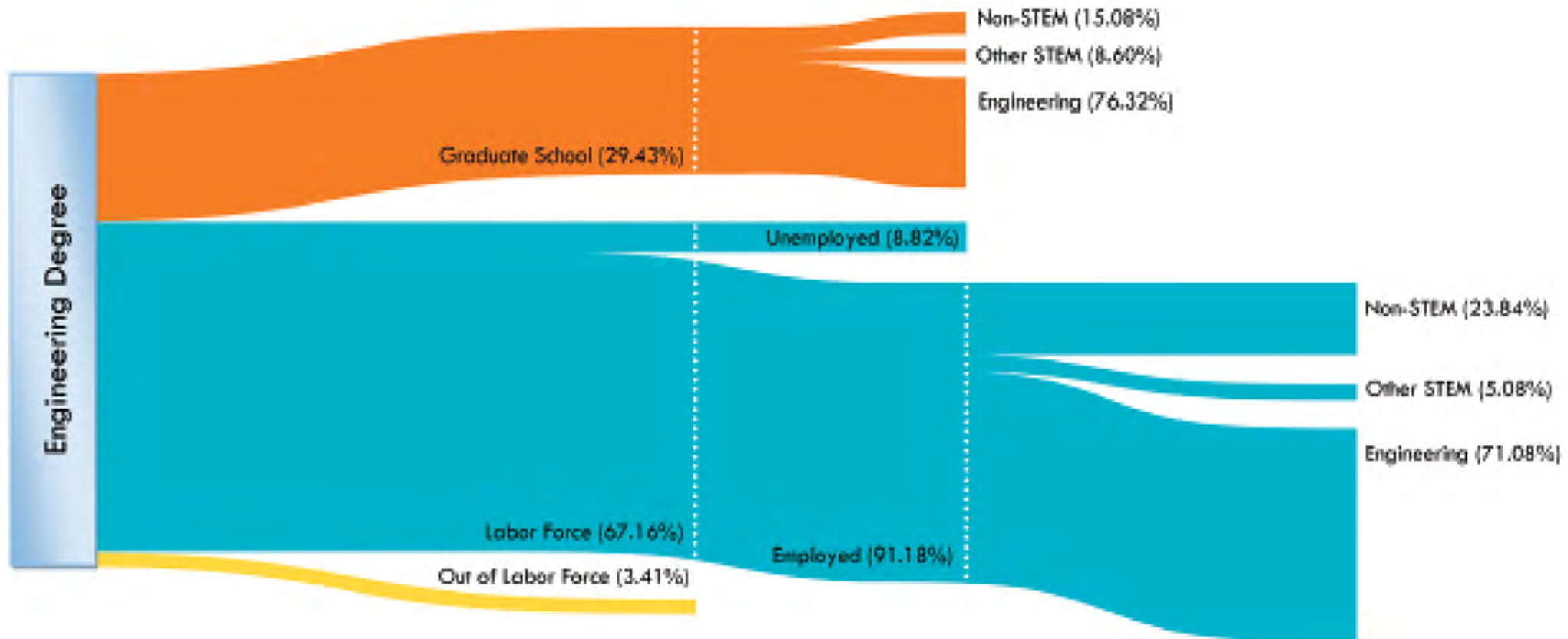


FIGURE C-17 Post-College Pathways of Engineering Degree Holders (N=1,956)
Source: 2011 Post-baccalaureate Survey, Higher Education Research Institute, UCLA.

Many engineers move to other areas but they don't come back

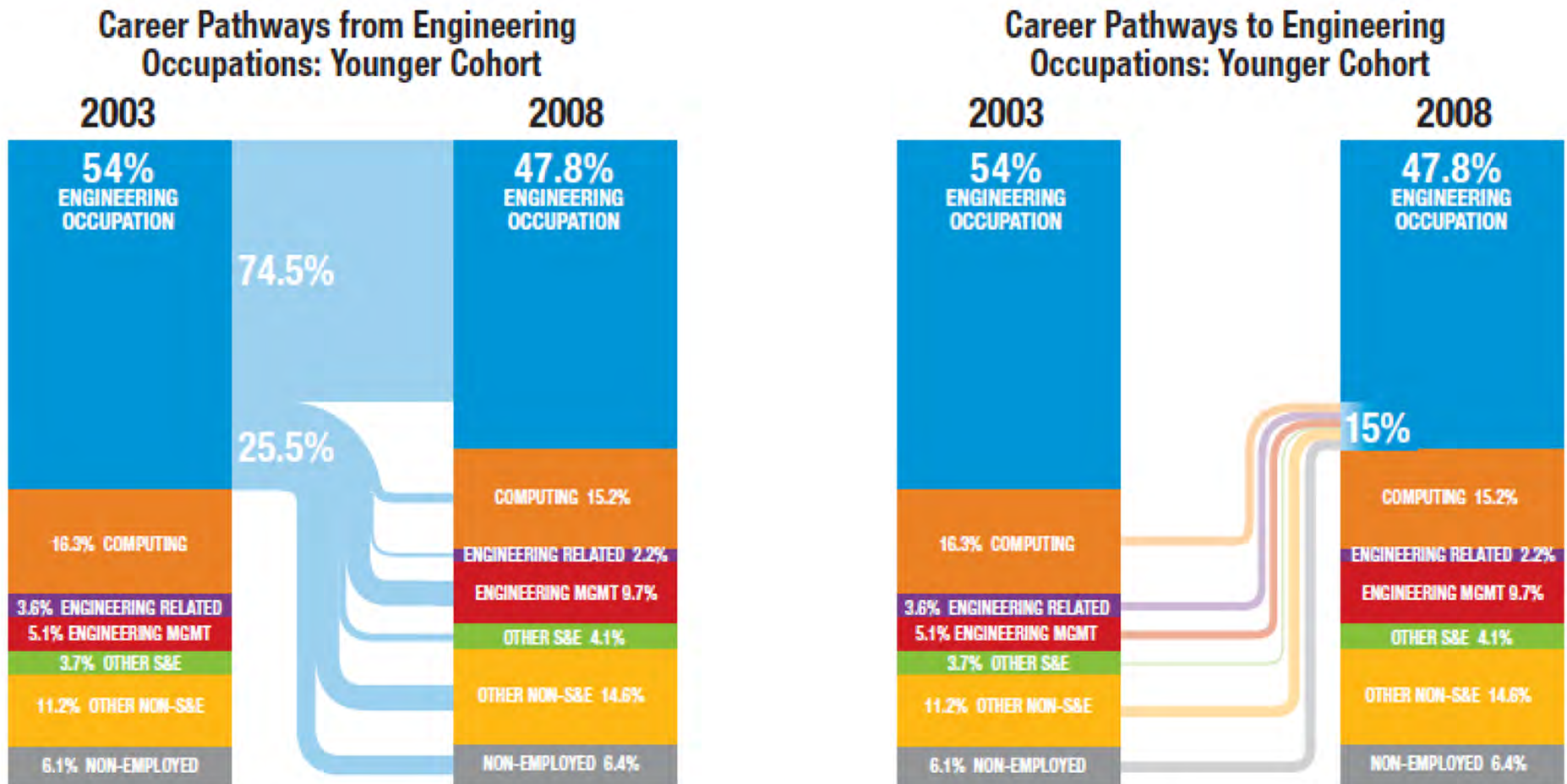


FIGURE I-13 Pathways of engineering graduates with a bachelor's or master's degree (earned in 1996–2002), showing those moving from and to engineering occupations between 2003 and 2008. Mgmt = management; S&E = science and engineering. Source: NSCG 2013.

Engineering Careers Pay Well

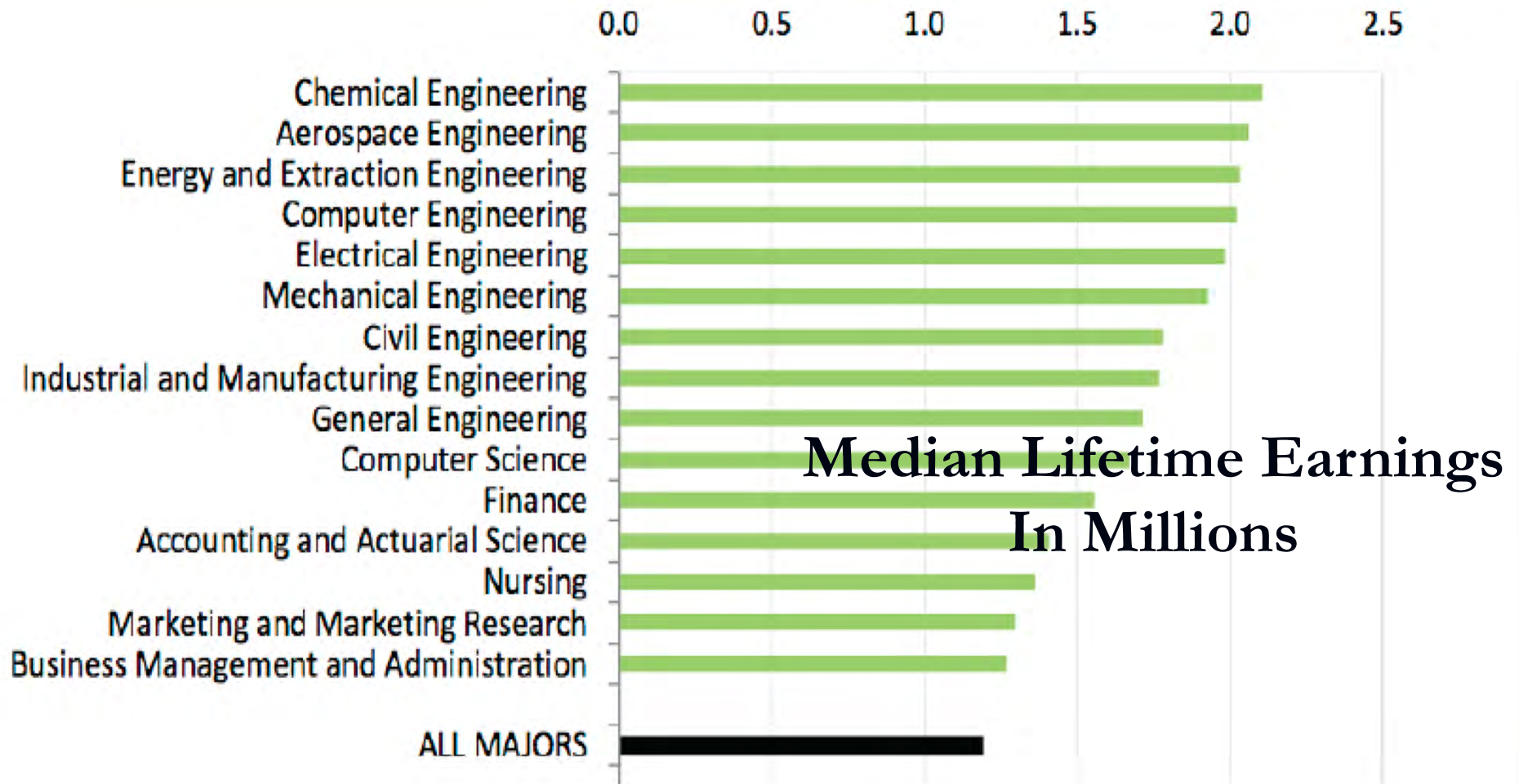


FIGURE I-18 Median lifetime earnings for the top-paying 15 majors, in millions of dollars, 2014.

Source: Hershbein and Kearney 2014, complete chart is available at www.hamiltonproject.org/assets/legacy/files/downloads_and_links/MajorDecisions-Figure_2a.pdf.

A. Annual Average Earnings for Bachelor's Degrees by Field & Years of Experience, NSCG 2013

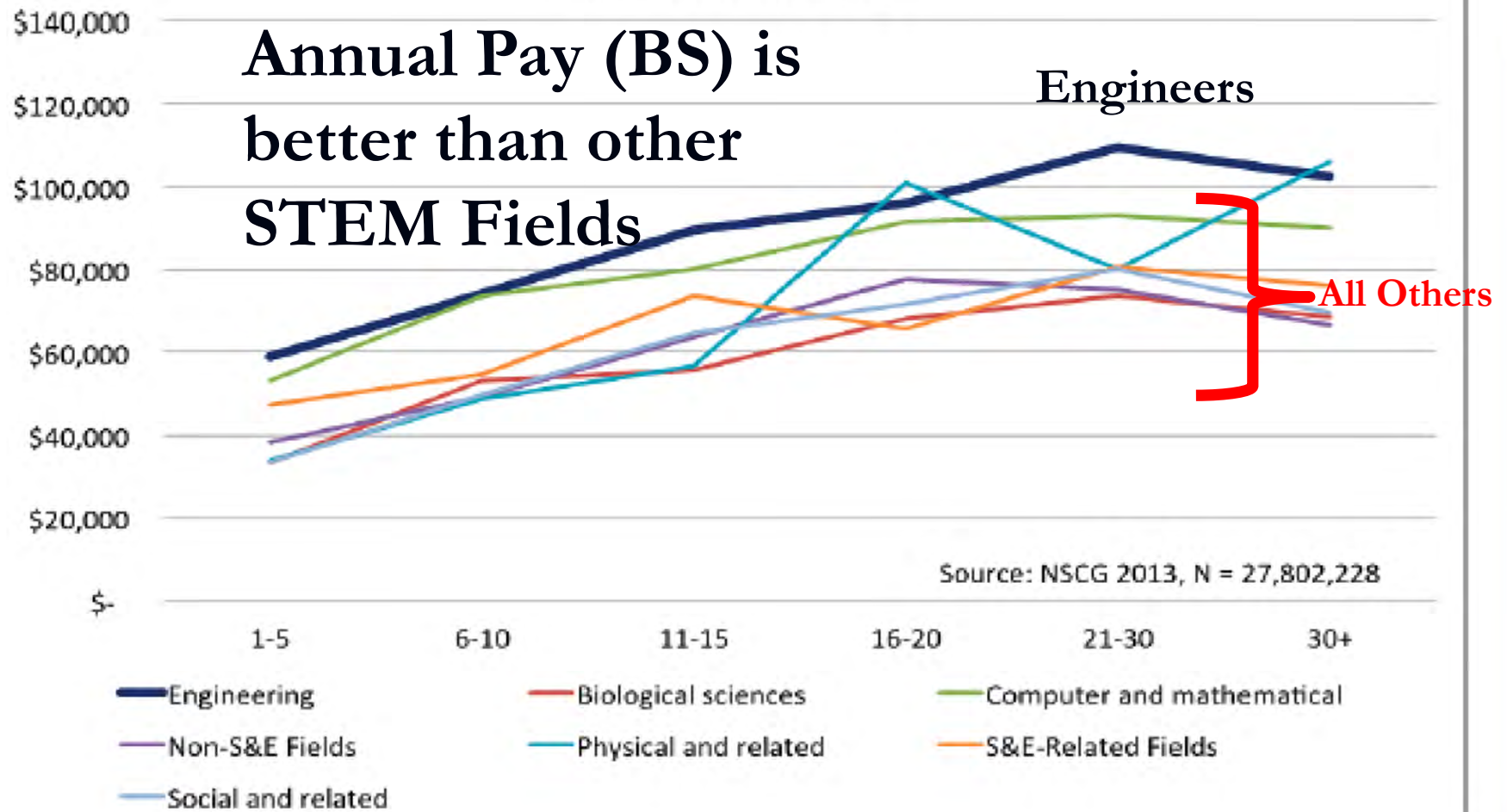


Figure A-15A Annual Average Earnings for Bachelor's Degrees by Field and Years of Experience.
 Source: 2013 National Survey of College Graduates. N = 27,802,228 Bachelor's.

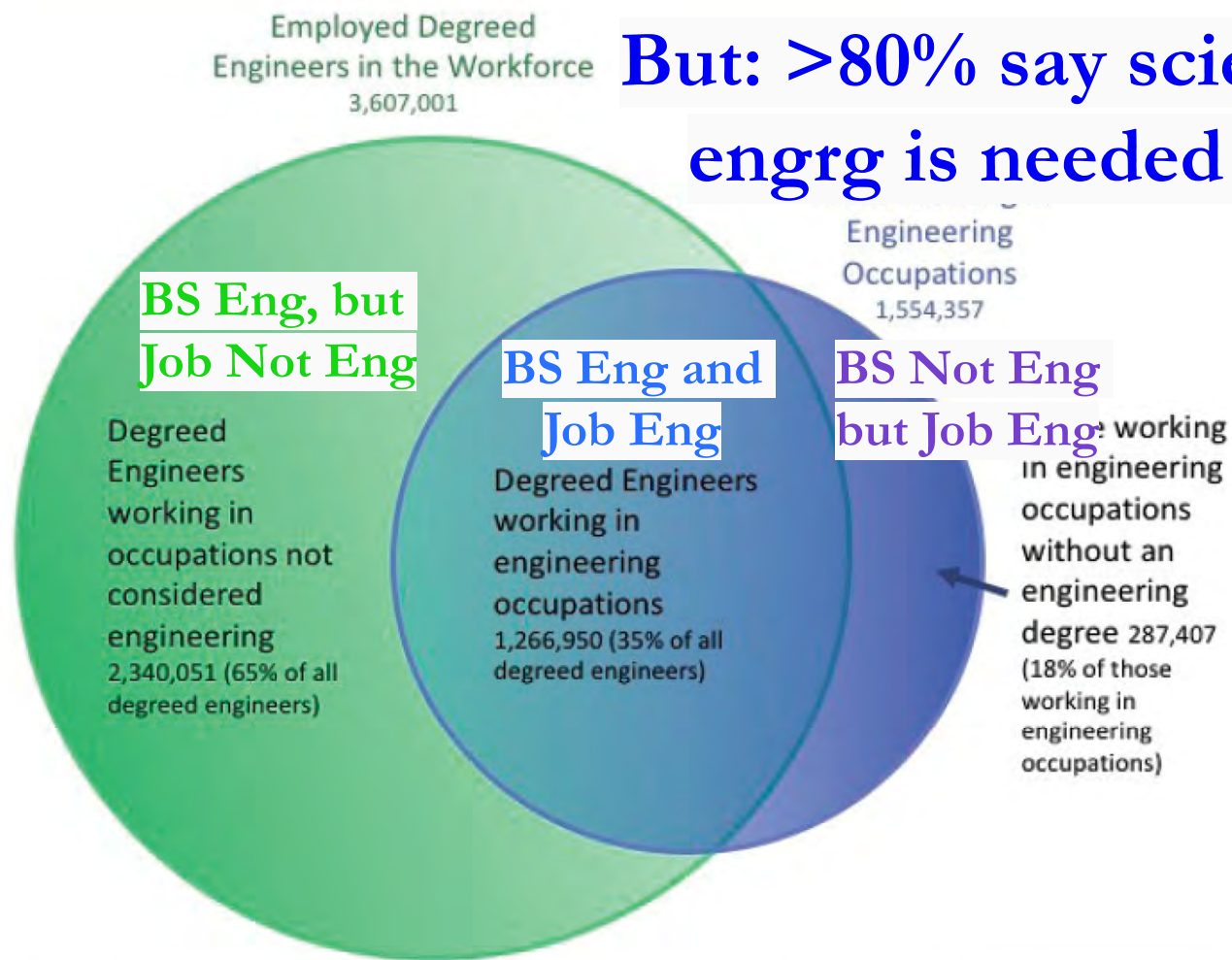
2019 Starting and Mean Salaries for Engineers

| | Starting | Mean |
|-------------------|----------|--------|
| ■ BME: | \$61k | \$95k |
| ■ Aero: | \$ | \$115k |
| ■ AgE: | \$ | \$77k |
| ■ Civil: | \$56k | \$93k |
| ■ CompE hardware: | \$71k | \$118k |
| ■ CompE software: | \$68k | \$114k |
| ■ ChemE: | \$65k | \$114k |
| ■ EE: | \$65k | \$101k |
| ■ Environmental: | \$56k | \$92k |
| ■ Geo/Mining: | \$62k | \$98k |
| ■ Materials: | \$66k | \$97k |
| ■ MechE: | \$62k | \$93k |
| ■ Petroleum: | \$ | \$137k |

Source: Michigan Tech: <https://www.mtu.edu/engineering/outreach/welcome/salary/>
Referencing mostly Bureau Labor Stats: <https://www.bls.gov/oes/current/oes172031.htm>

Will You Use
Your Major?

Twice as Many Engineers Work
Outside Engineering than Within



But: >80% say science or
engrg is needed for job

FIGURE 1-11 The engineering workforce in 2013: Degreed engineers in engineering and non-engineering occupations, and workers without an engineering degree in engineering occupations.
Source: NSCG 2013.

20% Chance You Will Become a Manager Independent of Degree

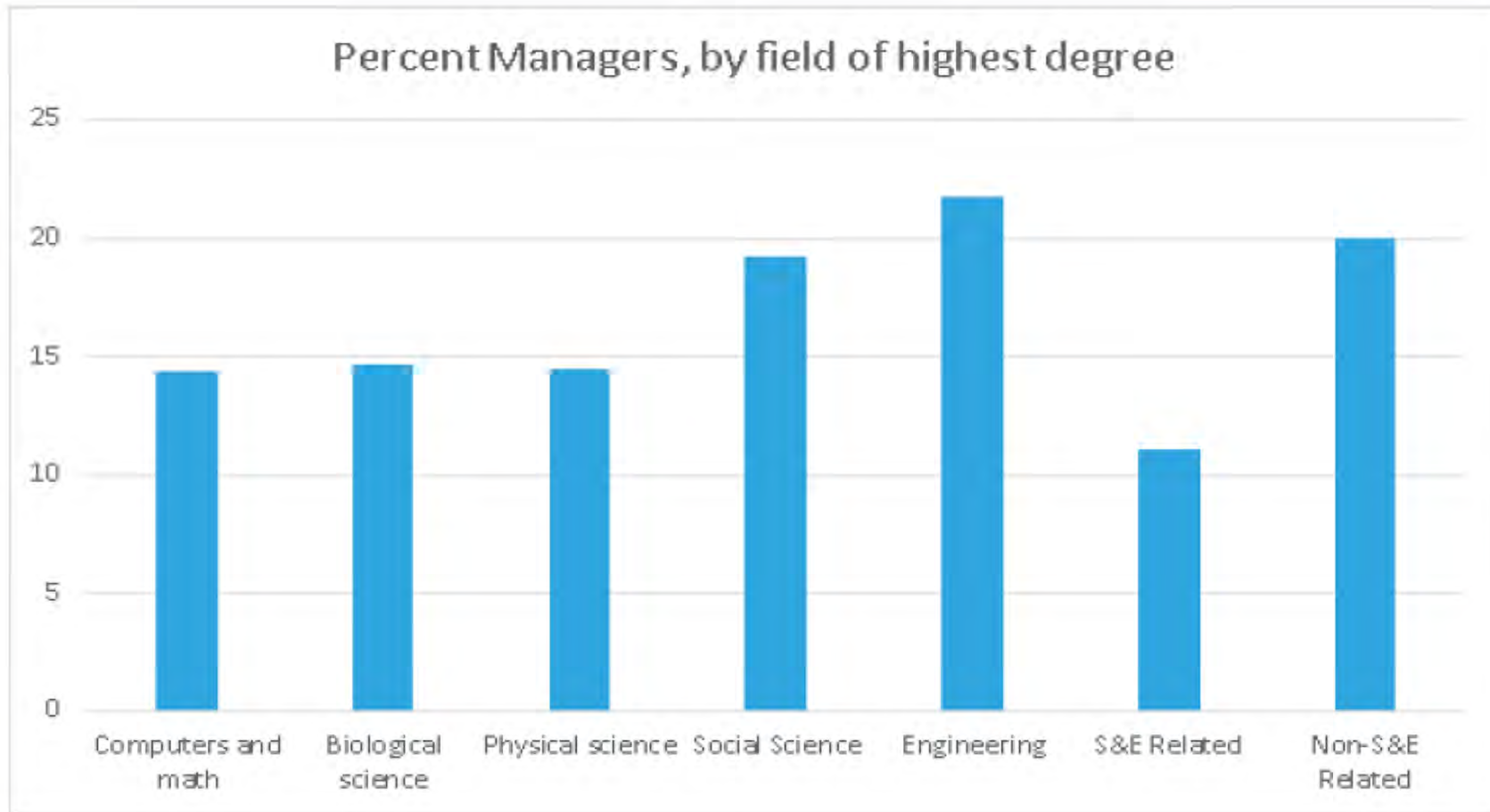
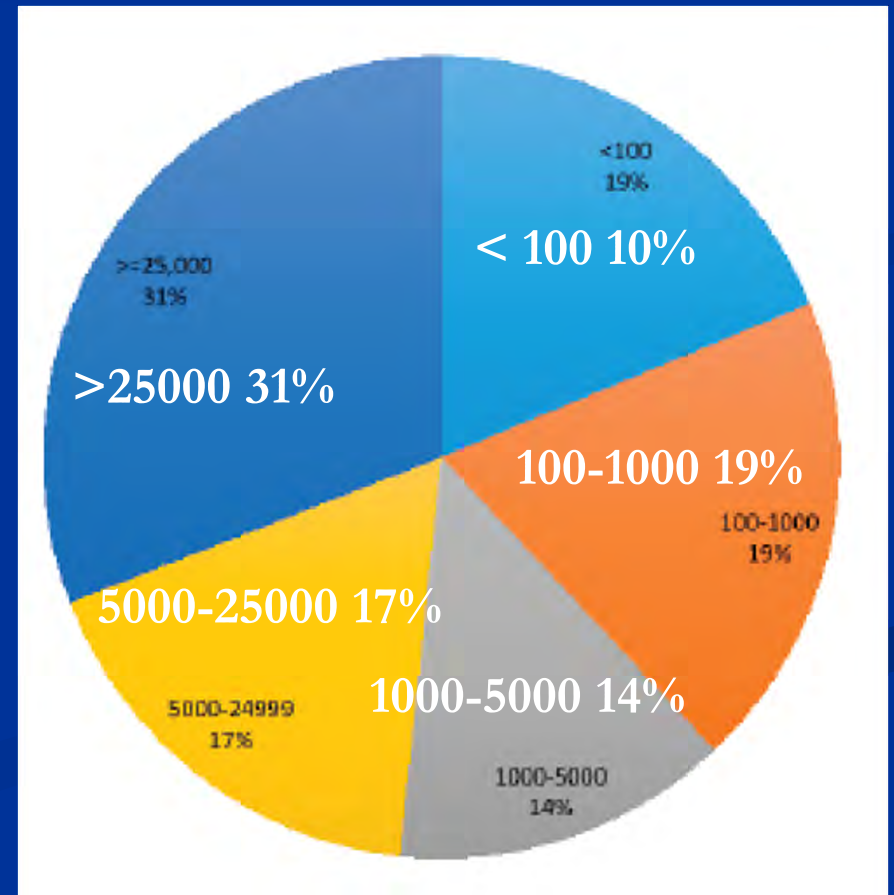
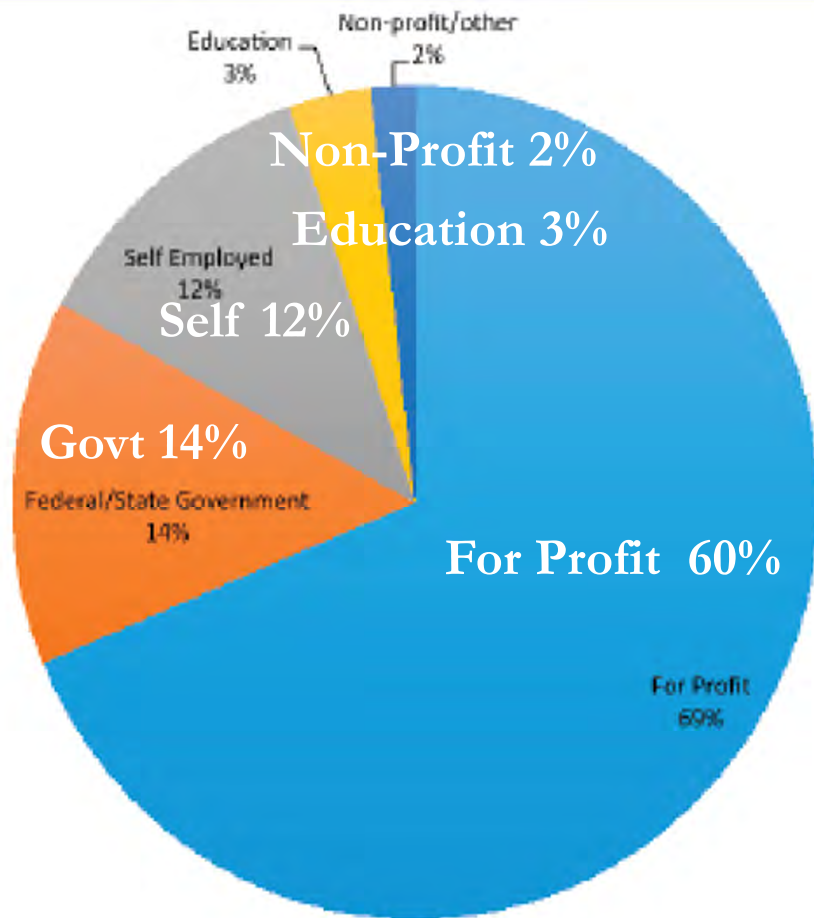


Figure A-12 Likelihood of holding a management job (for those with highest degree a bachelor's or master's), by field of highest degree.

Source: 2013 National Survey of College Graduates.

You will likely work for a For-Profit Company that has at least 1000 employees



Can you choose a great job in an idyllic place that you can afford?

Engineers as a Percentage of Total Employment by State, 2013

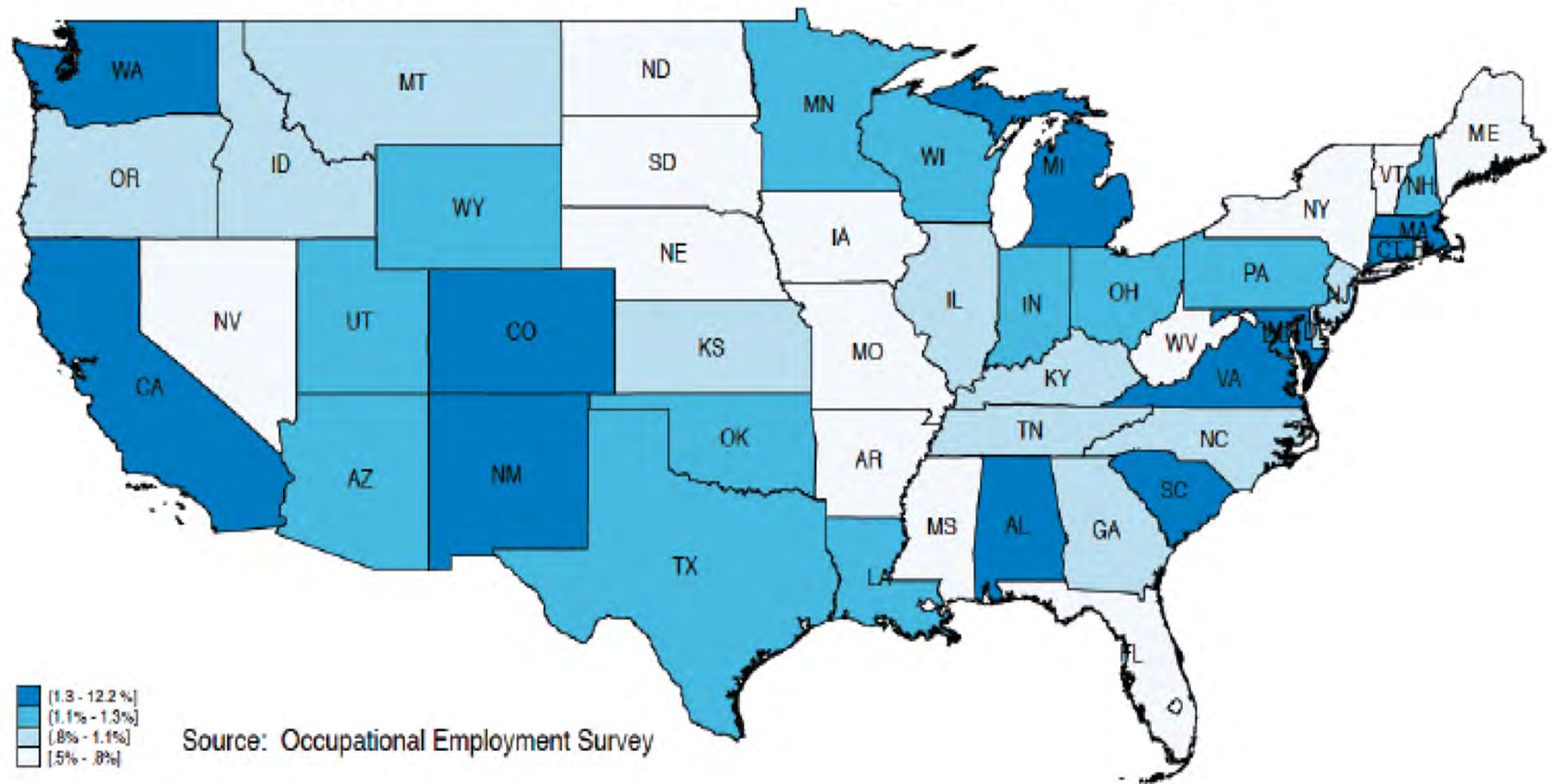


Figure A-8 Engineering as a Percentage of Total Employment 2013.
Source: Occupational Employment Statistics.

Entrepreneurship as a Career

- Rapid Increase in Engineering Curricula
- 6% of BS Engineers work in new company (< 5 yrs)

Conclusion: Entrepreneurship lessons are more often used for promoting ideas within companies

Diversity

Statistics haven't changed a lot in 15 years

BS/MS/PhD Engineering

- Women: ~20% (**BME: ~44%** -- this stat has increased)
- Under-represented minorities: ~10%
- Foreign Born fractions of degrees granted
 - 10% BS, 40% MS, 55% PhD
- Differences in promotion/stress/pay persist
- **You can create change!**

- **Biology: >50% women PhDs for ?30 years?**
- **MD Grads: >50% women for ?15 years?**

Reasons Engineers Leave Engineering

- Job in engineering field not available (44%)
- Change in interests (13%)
- Promotion or pay increase (4%)
- Location (women: 12%; men 2%)
- Working conditions (4%)
- Family (3%)
- Other (20%)

Men/Women the same except location

Satisfaction is high

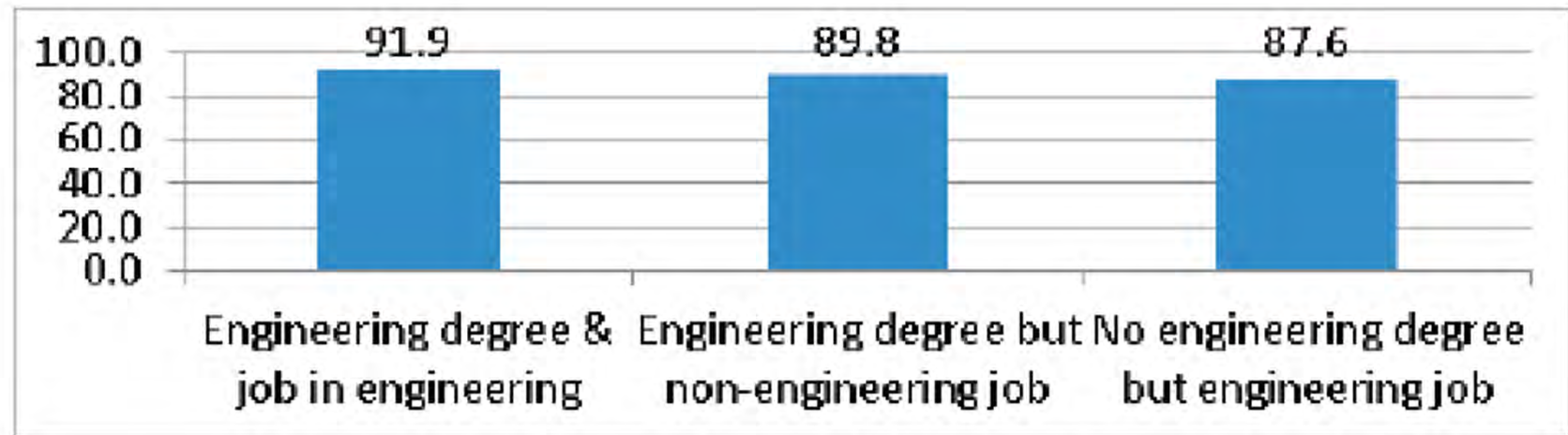


FIGURE 3-2 Percent somewhat or very satisfied with their job by engineering degree and occupation. (N=15,189)
Source: SESTAT 2010.

Unemployment is Low

Lowest of all major employment groups

Summary

- Engineering is a Great Career – lots of choices
- Biology is a Great Career – not so many choice
- Bioengineering is in between biology and engineering

- Next up – more on Bioengineering