# Engineering Advisory Council

April 26, 2024

College of Engineering & Applied Science
UNIVERSITY OF COLORADO **BOULDER**

# Engineering Advisory Council

**Purpose:**

- Advise the college on programs and policies
- Encourage and advocate for resource development
- Develop and guide education, outreach, and research programs
- Recognize achievements of alumni and other supporters in publicity and public relations

**Meeting Expectations:**

- Provide candid assessment to help us improve
- Speak and listen for understanding

# Since Our Last EAC Meeting

- Measuring Engineering Connections and Lattice Scholars impacts
- Advancing Business + Engineering collaboration
- Advancing Industry Partnership Framework
- Meaningful progress on MS programs

# Current State of U.S. Higher Education

- Enrollment cliff
- Increasing cost of attendance
- Erosion of public confidence
- Attack on DEI programs
- Gen Z decision making
- Impact of AI

# Agenda

- State of the college
  - *Break*
- Strategic planning metrics
- Lattice + Engineering Connections
- COO Pat O’Rourke
- Lunch with students and senior staff
- Biomedical + Robotics programs
  - *Break*
- Business + Engineering
- EAC executive session

# EAC Membership Updates: Departures

Our sincere thanks to:

- **Cliff Pearson** (CivEngr & Hist’82)
- **John Scarano**
- **Herb Vogel** (MechEngr’82)
- **Faran Nouri** (ElEngr'82, MS'84)

Terms of service for these members ends June 30, 2024.

Cliff Pearson

Herb Vogel

Faran Nouri

John Scarano

# EAC Membership Updates: New Members for Fall

Welcome to our new members:

- **Karen Furlani** (Worley)
- **Terry Hogan** CompSci'94 (NCWIT)
- **Jiong Ma** PhDElEngr'96 (Chavant Capital)
- **Mina McCullom** MArchEngr'09 (SynEnergy)
- **Dennis Pretti** ElEngr'95 (Micron)
- **Steven Smith** MAeroEngr'95 (BAE System and Mission Systems)

Karen Furlani

Terry Hogan

Jiong Ma

Mina McCullom

Dennis Pretti

Steven Smith

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# College Leadership Updates

## Departures

- **Fernando Rosario-Ortiz**
  AD for Faculty Advancement
- **Charles Musgrave**
  AD for Graduate Education
- **Will Medlin**
  Chair, ChBE
- **Dan Schwartz**
  Director, EVEN
- **Jeni Blacklock**
  Director, CU-WCU Partnership

## Additions

**Ryan Hayward**
Chair, Chemical & Biological Eng

**Mike Hannigan**
Director, Environmental Engineering

## Incoming

- AD for Faculty Advancement
  *(2 finalists)*
- AD for Graduate Education
  *(3 finalists)*
- AD for Innovation & Entrepreneurship
  *(3 finalists)*

# State of the College

College of Engineering & Applied Science
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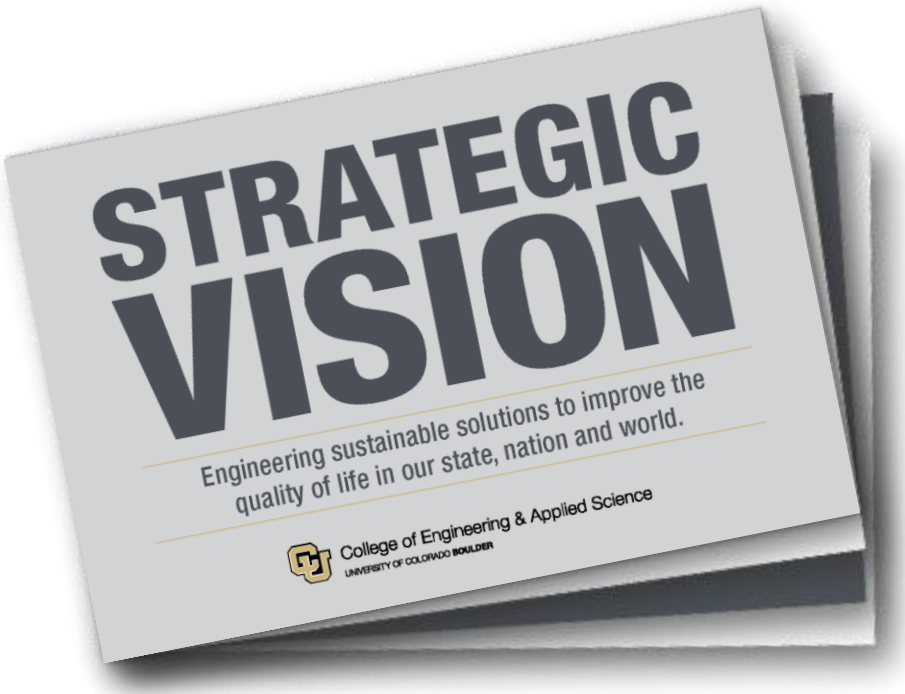
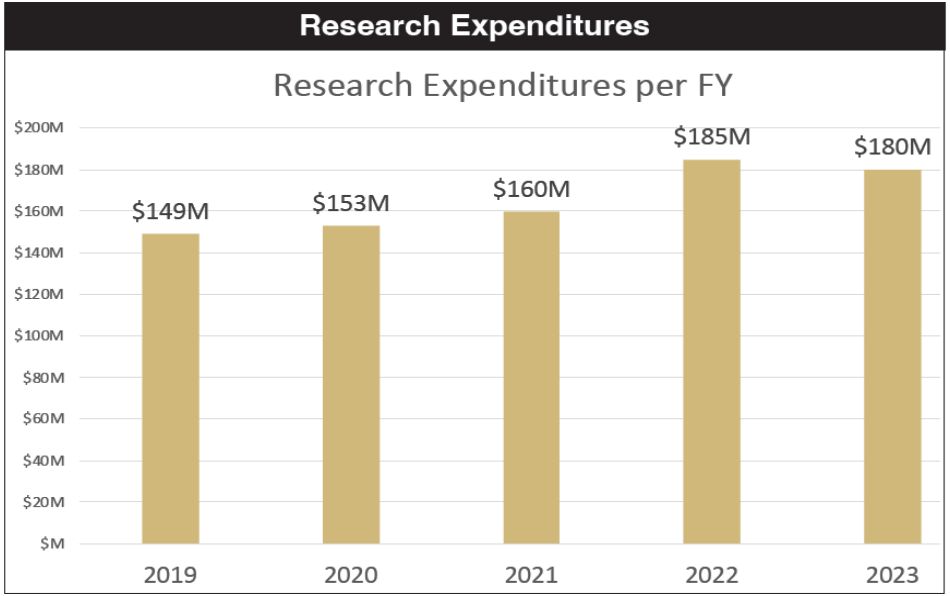

STRATEGIC
VISION
Engineering sustainable solutions to improve the quality of life in our state, nation and world.
College of Engineering & Applied Science
UNIVERSITY OF COLORADO BOULDER

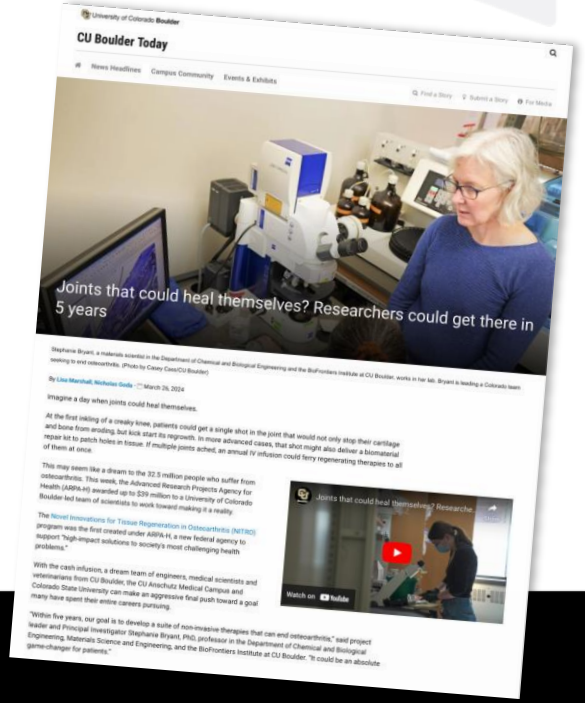

STRATEGIC
VISION
Engineering sustainable solutions to improve the quality of life in our state, nation and world.
Research & Innovation
We shape the world through research that generates fundamental knowledge and translates innovations to impact.
Education
We inspire tomorrow's leaders through engineering education that cultivates curiosity, care and community.
Inclusion
We grow stronger by embracing and cultivating the unique contributions of all community members.
Through this vision and our strategic actions, the college will be recognized as a top 10 undergraduate and graduate institution.
colorado.edu/engineering/vision
College of Engineering & Applied Science
UNIVERSITY OF COLORADO BOULDER
STRATEGIC
ACTIONS
Translate Innovations to Impact
» Invest in interdisciplinary research initiatives across campus and with our external partners.
» Cultivate an environment to inspire faculty and student entrepreneurial work.
» Position faculty to shape local, state and national research and policy agendas.
Shape Tomorrow's Leaders
» Provide access for all students and strive for gender parity in our first-year class.
» Improve student retention rates across all student demographics and close equity gaps.
» Grow the size, diversity and support of our Doctoral student cohort.
Embrace the Unique Contributions of All
» Recruit and retain diverse students, faculty and staff to enrich our community.
» Improve and celebrate inclusive policies and practices affecting students, staff and faculty.
» Invest, resource and build collaborative relationships that support inclusion.
colorado.edu/engineering/vision

# CEAS Research Performance



# New Advanced Research Projects Agency for Health $49M grant – *Can joints heal themselves?*

- Novel Innovations for Tissue Regeneration in Osteoarthritis (NITRO)
- **Goal:** develop non-invasive therapies that can end osteoarthritis in 5 years
- Success story of AB Nexus effort
- **PI:** Stephanie Bryant (ChBE, Materials)



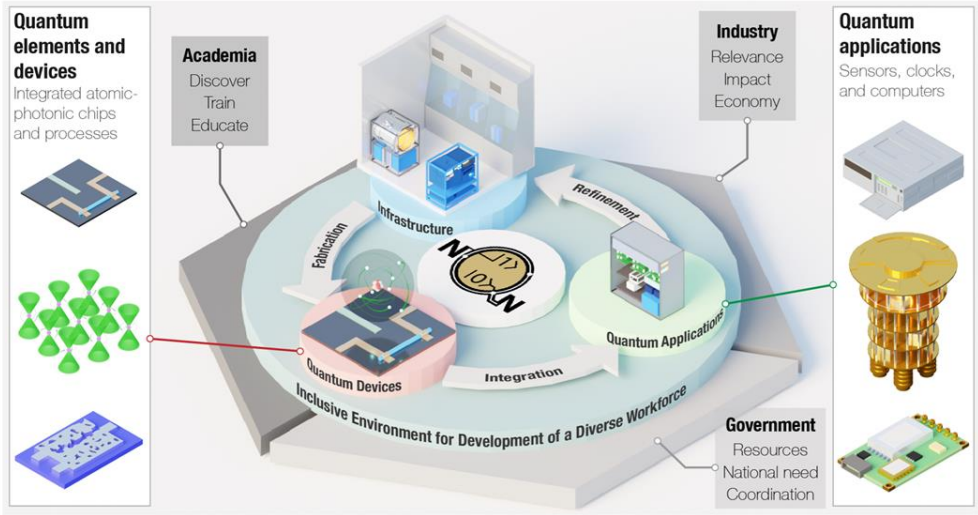
# $20M NSF National Quantum Nanofab

Leverage Boulder's ….

- Best-in-world expertise in quantum science with photons, atoms and ions
- Unique combination of academia, industry and government
- Entrepreneurial quantum environment

for impact by …

- Rapid cycling "from lab to fab"
- Attracting and training the next generation diverse quantum workforce
- Accelerating innovation that is critical to our national and economic security



# $20M NSF National Quantum Nanofab

# Next Steps in Enabling Research Goals

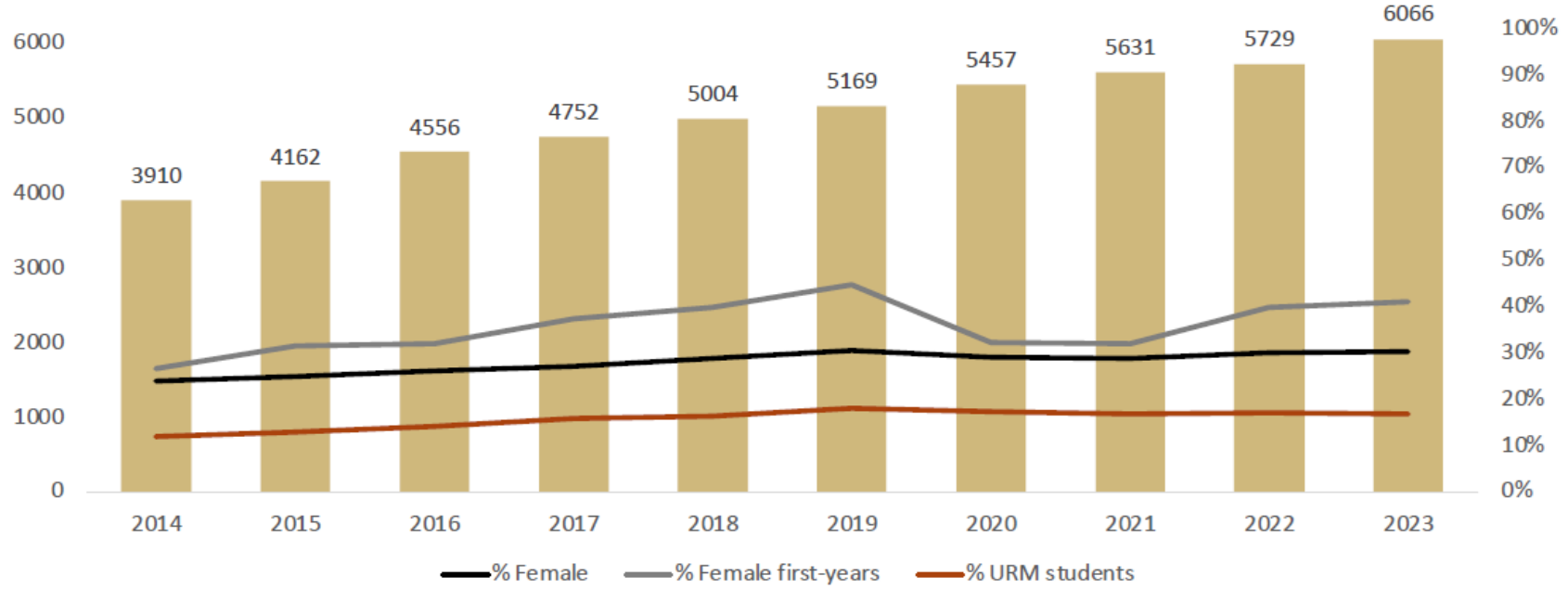
**Invest in interdisciplinary research initiatives across campus and with our external partners**

- Cross-campus New Frontiers research initiative requires collaborators from 2 colleges + 1 research institute to define new campus strengths
- New cross-campus Sustainability Research Initiative seeks to initiate new impactful collaborations from basic, applied, and societal research themes
- Advance Strategic Corporate Partnerships

# CEAS Strategic Corporate Partners

| | Activity | Recruiting | Education | Research | Inclusion |
|---|---|---|---|---|---|
| **Recruiting** | Campus visits for recruiting | • | | | |
| | — Independent tabling | • | | | |
| | — Career fairs | • | | | |
| **Education & Inclusion** | Capstone project support | • | • | | |
| | Workforce development | • | • | | |
| | — Internships | • | • | | |
| | — Programmatic development | • | • | | |
| | Scholarships and enrichment | • | • | | |
| **Research & Innovation** | Research project support | | | • | |
| | — Single project contract | | | • | |
| | — Master research agreements | | | • | |
| | — Third party funding collaborations | | | • | |
| | Faculty fellowships | | | • | |
| **Signature Partnership** | CU Engineering Advisory Council | • | • | • | • |
| | CEAS center and dept. engagement | • | • | • | • |
| | Endowments | • | • | • | • |
| | — Faculty | • | • | • | • |
| | — Facilities | • | • | • | • |

## Undergrad Enrollment (by Year)



# Leadership in Gender Parity

Daily Camera

Saturday, April 20, 2024

dailycamera.com

UNIVERSITY OF COLORADO

## Schwartz hired as new Boulder chancellor

By Olivia Dean

Schwartz

CU BOULDER

## 'MORE WOMEN IN THE ROOM'

University of Colorado Boulder Aerospace Engineering major Ada Forcner poses for a portrait in Boulder on Friday.

## University nearly doubles number of female engineering students

By Olivia Dean

CLIMBING

## Colorado's 14ers just had their elevations changed

New research measured all 58 mountain peaks to within fractions of feet

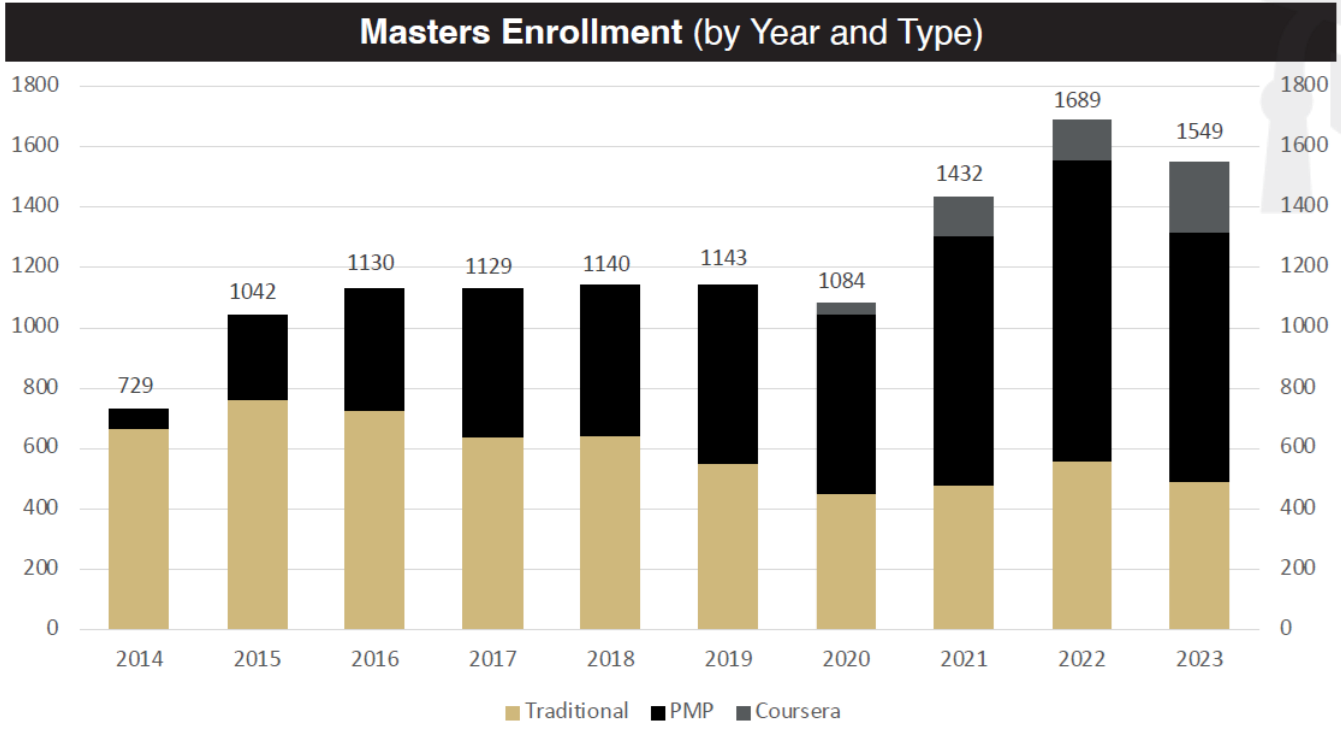
By John Meyer


Denver7: CU Boulder becoming a top destination for women in engineering

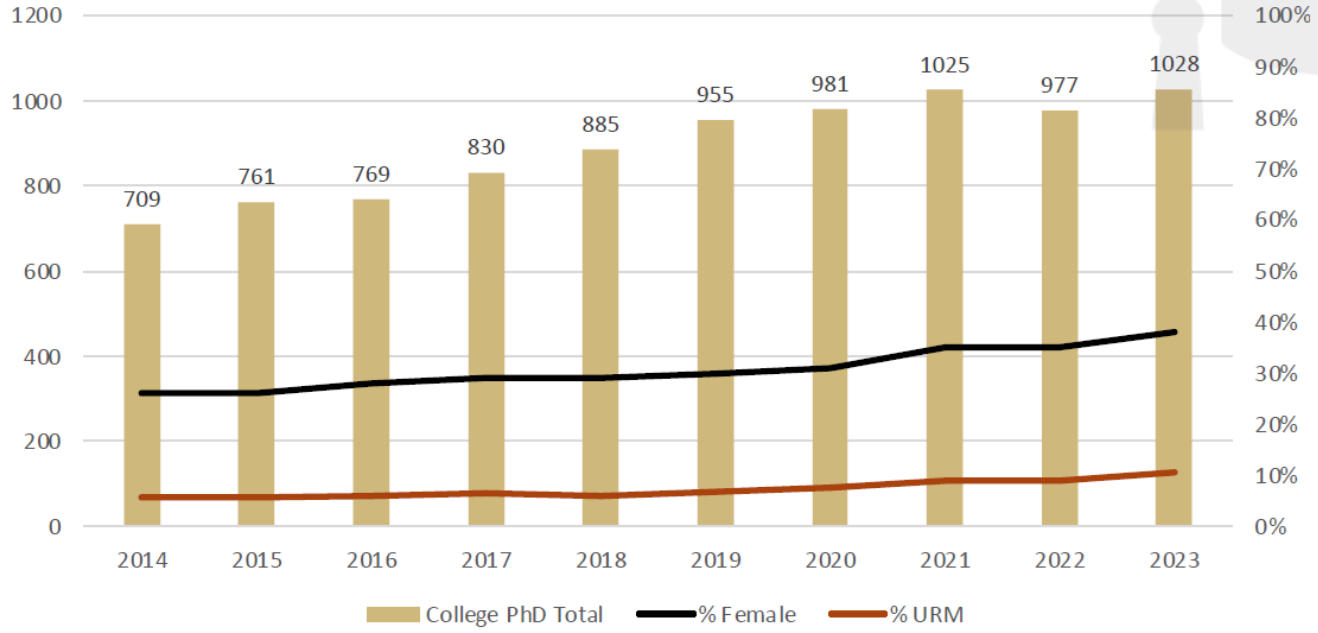
# Undergraduate Retention Initiatives

## Engineering Connections

## Lattice Scholars


Masters Enrollment (by Year and Type)
1800
1600
1400
1200
1000
800
600
400
200
0
729
1042
1130
1129
1140
1143
1084
1432
1689
1549
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Traditional
PMP
Coursera

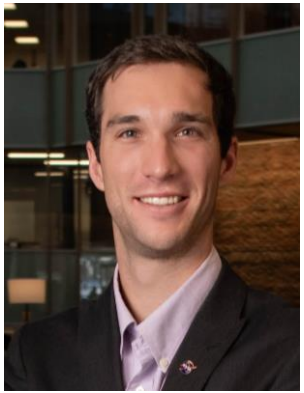
## PhD Enrollment (by Year)



# Graduate Initiatives


# Turning air pollution into a useable product: *Student startup transforms CO2 into carbon fiber components*

- **Company:** Mach Electric Aerospace, LLC
- **Goal:** create 3-D printed carbon fiber components from industrial carbon dioxide waste
- Won **Lab Venture Challenge**, 2nd place in **New Venture Challenge**, receiving $125,000 in startup funding.
- **Founder and VP:** Spencer Dansereau, PhD student in aerospace engineering






Story link

# College DEI Organization

**Dean**
College of Engineering & Applied Science

**Assistant Dean,**
Strategic Initiatives

| Students | Faculty | Staff |
|---|---|---|
| **Associate Dean** for Students | **Associate Dean** Faculty Advancement | **Assistant Dean** Organizational Development, Culture, Equity |
| **BOLD Center, Student Committees** | **Faculty Governance Committee** | **Engineering Staff Council** |

**Inclusive Culture Council**

**Department JEDI Committees**

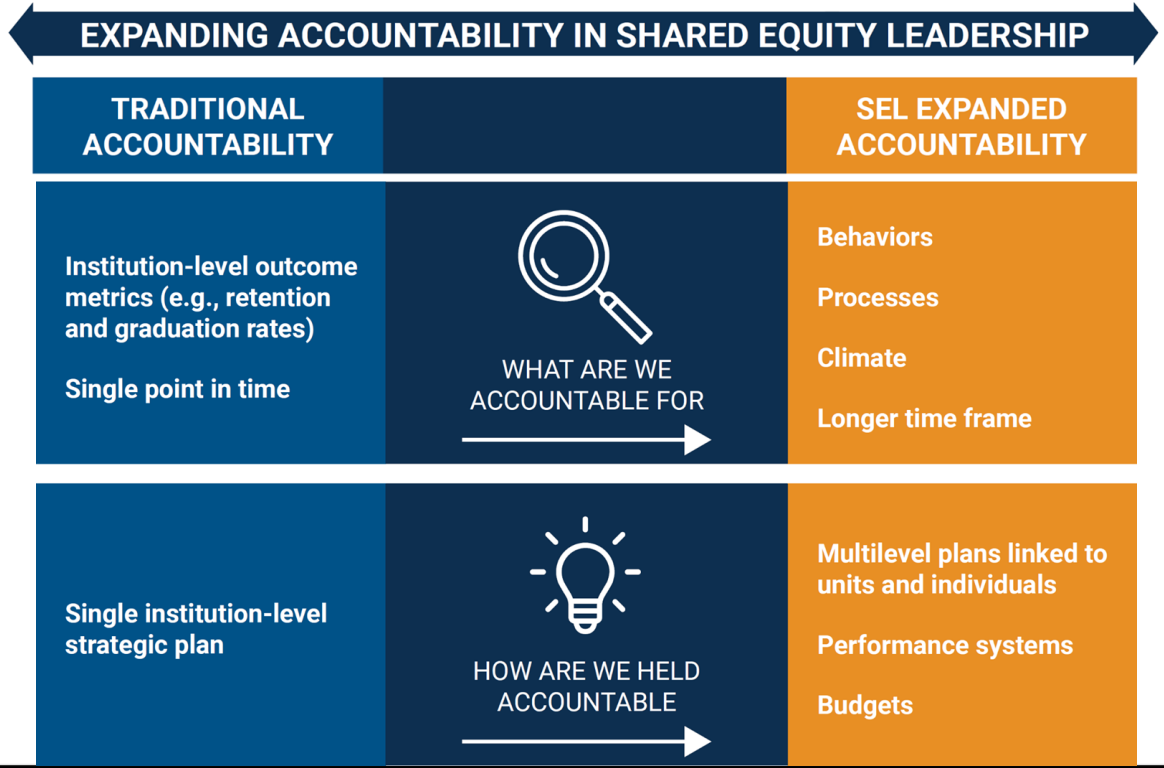
# Shared Equity Leadership Model

Is a framework for:

- A **critical mass** of people who are committed to undertaking a **personal journey** toward critical consciousness
- Who share **equity-focused values** and
- Enact **specific practices** to promote more just and equitable outcomes.

# Shared Equity Leadership Model

# Shared Equity Leadership Model



# Creating New K-12 Pathways

- Campos Foundation Initiative
- Creating STEM Alliance
  - Goal is to coalesce our many K-12 outreach efforts and partnerships

# Creating New Transfer Pathways


- Streamlined process with 13 community colleges across multiple degree paths
- $11M DoD Denver-Metro Engineering Consortium with focus on historically underrepresented students

# Agenda

- State of the College
  - *Break*
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- COO Pat O’Rourke
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  - *Break*
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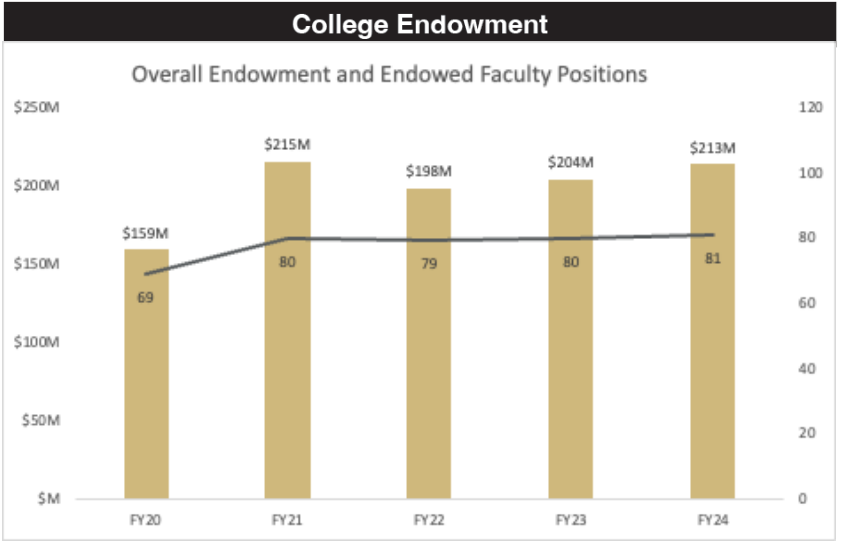
# Strategic Planning Metrics

How can we most effectively measure what we value?

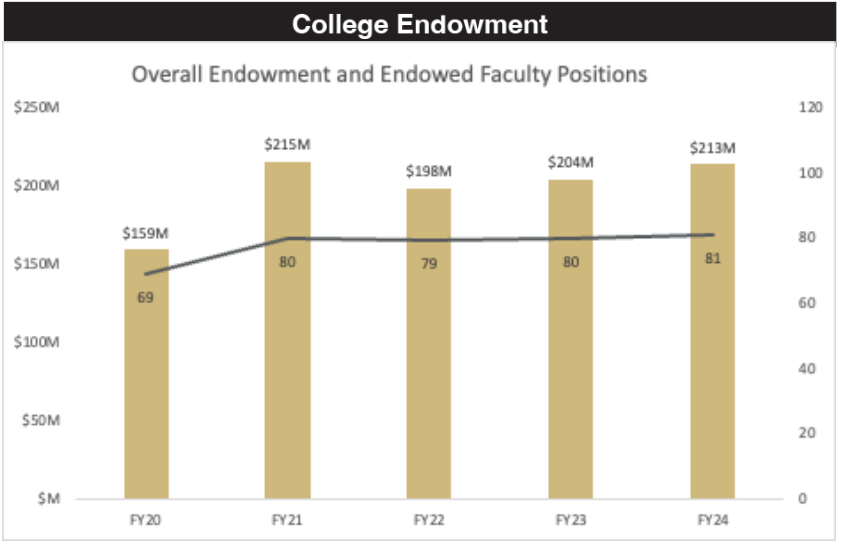
- Research & Innovation
- Education
- Inclusion



# Strategic Planning Metrics

## Breakout questions

- Strengths and weakness of proposed high-level metrics?
- What sub-metrics would you propose in these areas?



# Engineering Connections and Lattice Scholars Update

College of Engineering & Applied Science
UNIVERSITY OF COLORADO **BOULDER**

# Engineering Connections Overview

- Ending year one of Engineering Connections!
- 1,000 students living in Will Vill East, Will Vill North and Stearns East
- Centralized services and programming efforts across all three buildings
- Focus on retention, engagement and belonging

# Engineering Connections: What we know so far

## Retention

- Fall ’22 Cohort
  - 1st Spring any College CU: 96%
  - 1st Spring Engineering: 93%
- Fall ’23 cohort
  - 1st Spring any College CU: 98%
  - 1st Spring Engineering: 92%
- Will know First to Second-year retention later this summer

# Engineering Connections: What we know so far

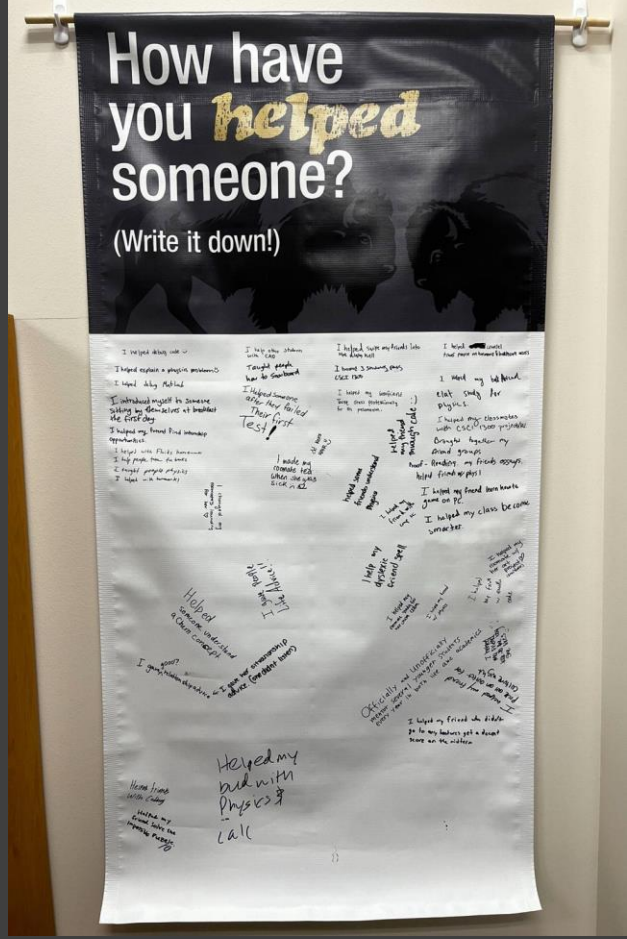
## Engagement

- 1,470 unique participants in an Engineering Connections event
- An average of approximately 3 events attended per student
- Participant demographic data aligns with the makeup of the college overall

# Engineering Connections: What we know so far

## Belonging

- At beginning of the year, belonging was very high for Engineering students (Fall Welcome Survey)
- 77% of Engineering Connections students agreed that they belong at CU vs 70% of first-year students overall
- According to OIEC's fall survey assessing belonging, more Engineering students in residential communities overall indicated that they felt supported, were treated like they belong, and felt faculty were invested in their success when compared with 2021 survey results



Spring retreat, 2024

# Lattice Scholars Overview

- 55 current Lattice Scholars
- Robust programming
  - Spring retreat
  - Seminars (financial wellness and academic focused)
  - Mentorship program
  - Financial aid support (including budgeting for next year)
  - Academic coaching and holistic student support
- Focus on retention, engagement, belonging, and financial wellness

# Lattice Scholars: What we know so far

| Lattice Scholarship Student Numbers | # of Scholars |
|---|---|
| Students offered Lattice in summer 2023 | 63 |
| Enrolled in Engineering at fall census | 59 |
| Enrolled in Engineering at present | 55 |

| Lattice Scholarship Costs | Costs to CEAS |
|---|---|
| Lattice Program First Gen Scholarship | $550,000 |
| Additional CEAS funds awarded to Lattice Scholars (incl. BOLD, donor funds, need-based) | $160,000 |

# Lattice Scholars: What we know so far

## Persistence and Performance

- Average Lattice GPA = 2.60
  - CEAS first-year, first-gen AVG GPA = 2.66
  - CEAS first-year AVG GPA = 2.95
  - Expectation of increased retention based on program support

## Engagement

- ~90% participation in retreat and monthly seminars

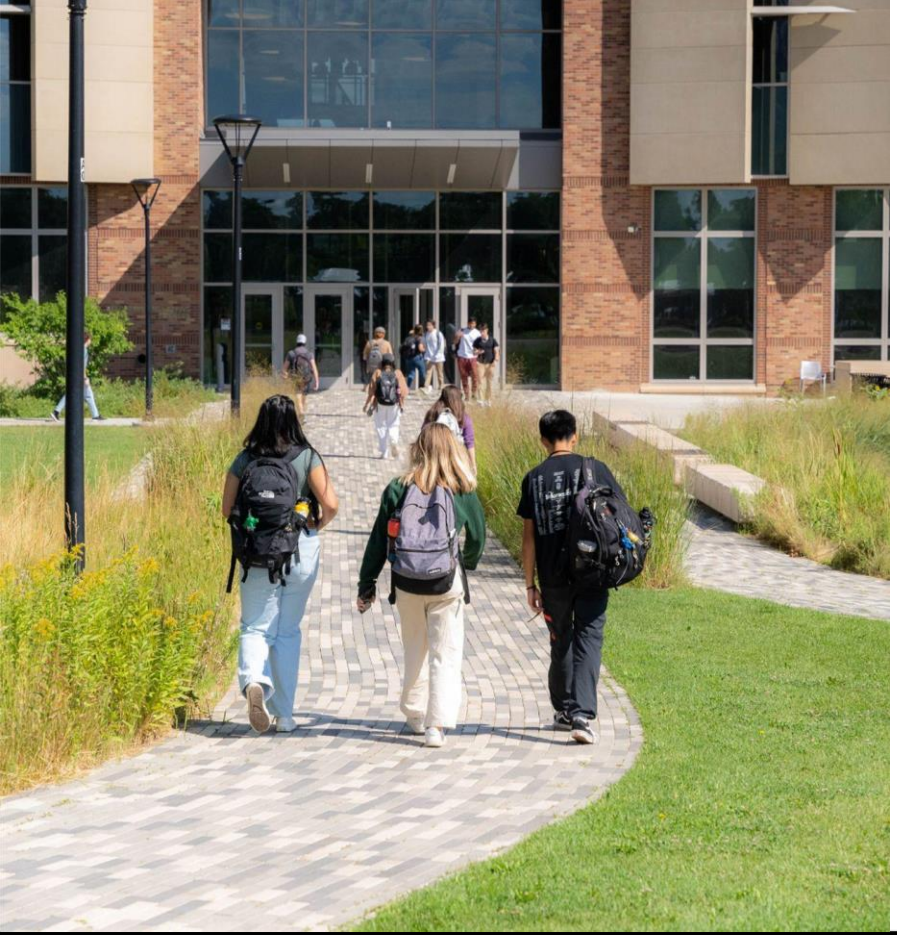
## Feedback from surveys and focus groups

- Benefits of open dialogue about money
- The retreat helped students build deeper relationships with their peers in Lattice and that helped them feel a greater sense of community and less isolated within CEAS
- Activities and workshop helped students refocus and gain more clarity about their motivation and strategies that they can use in their studies

# Future information we are gathering

**Retention**

- First- to Second-Year Retention Rates
- Data around knowledge and use of resources for support and academic success
- Comparison of data related to academic success course rates



# Future information we are gathering

**Engagement**

- Continued collection of participation data and analysis of various demographics, types of engagement, etc.
- Student satisfaction surveys regarding event types, availability, etc.

# Future information we are gathering

**Belonging**

- End of First-Year Survey results to compare sense of belonging over the course of the year
- Engineering Connections surveys asking students to indicate if/how they have supported others in the community

# Future information we are gathering

**Lattice Scholars Year-End Survey, to measure:**

- Impact on skills and confidence for managing financial resources and wellness
- Impact on students' academic success and overall well-being
- Which types of support are most valuable to students
- Areas for improvement

# Pat O’Rourke

Operating Officer, CU Boulder

College of Engineering & Applied Science

UNIVERSITY OF COLORADO **BOULDER**

# Agenda

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# Engineering Advancement Overview

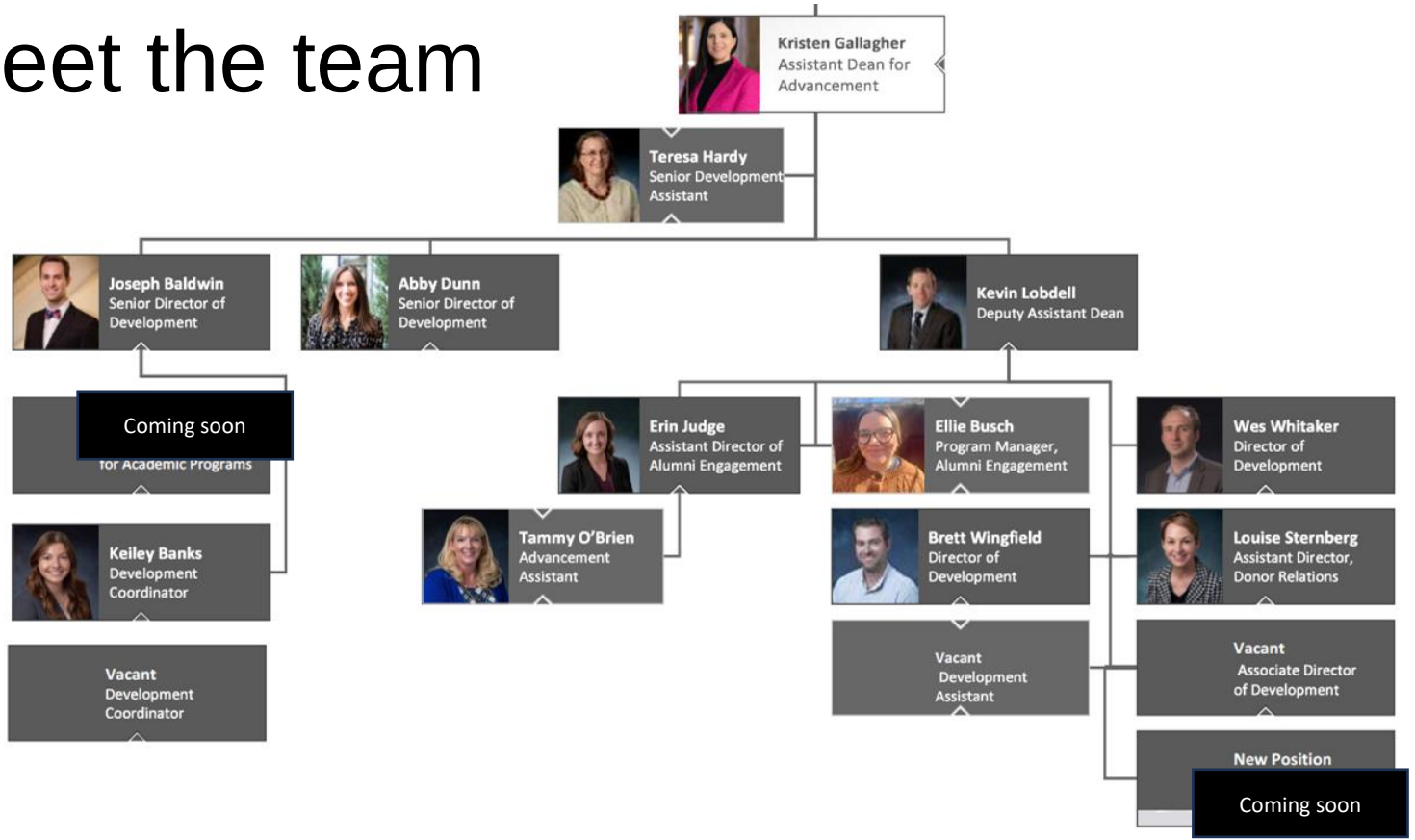
Kristen Snyder Gallagher
*Assistant Dean for Advancement*
*College of Engineering and Applied Science*
University of Colorado Boulder

# Meet Kristen

- Started as Assistant Dean of Advancement for CEAS in November 2023
- Oversight of all alumni relations, fundraising, and development strategy for the college
- Executive Director of Development at Missouri University of Science and Technology for 9 years prior to CU
- Served in roles in Alumni Relations and Annual Fund at the Harvard Kennedy School
- Worked in undergraduate Student Affairs and Leadership Programs at Kutztown University, Neumann University, and Goldey-Beacom College
- MS in Education from Neumann University
- Originally from Wilmington, DE

Two cute kiddos, Charles and Angelina

# Meet the team



# Fundraising Progress

## As of April 22, 2024

- To date philanthropy to CEAS has reached $38,732,000
- Our largest fundraising year was $40,825,000
- We are on track to exceed that amount

## Notable new gifts in FY24

| | |
|---|---|
| • Bishop Family Endowed Scholarship | **$400K** BOLD scholars |
| • Department Unrestricted Fund | **$500K** Civil/Arch Engineering |
| • Giarratano Endowed Scholarship | **$500K** 1st gen students |
| • Gittinger Endowed Scholarship | **$1M** Electrical/Computer Engineering |
| • *Anonymous* Endowed Professorship | **$1M** Environmental Engineering |
| • *Anonymous* Lattice Scholarships | **$1M** Lattice Scholars |
| • Stebbins Endowed Professorship | **$1.5M** AI, Computer Science |
| • Kliss Endowed Professorship | **$1.5M** Aerospace Engineering |
| • *Anonymous* Lattice Scholarships | **$2M** Lattice Scholars |
| • Kiewit Scholarships | **$2.5M** Design-Build Scholars |

# College Fundraising Priorities

*We aim to create a permanent margin of excellence through philanthropy and engagement*

## A preview…

- Increase number of endowed faculty from 81 to 150
- Create sustainable funding for Lattice Scholars and SWE scholarships
- Academic department naming gifts
- Dual degree in business and engineering
- STEM Alliance (K-12 outreach)
- Innovation Campus
- Support for programs including biomedical engineering, materials science, environmental engineering, and robotics
- BOLD Center

# Maximize Team Efforts for Audacious Goals

- **CEAS will need to be a leader in the upcoming CU Boulder comprehensive campaign**
- Will develop a robust annual giving program reimagining donor recognition and strategic efforts toward department- and college-level giving
- Will realign current fundraising staffing to focus more on principal and major gifts
- Will add new positions in fundraising, alumni relations, and advancement support

# EAC Support

- Each member to give $2,500 annually, with $1,000 minimum going to Dean's Fund
- As of April 22, we are at 39% overall EAC giving.  Goal is 100%!
- Gifts can be made until June 30 to count in this year's giving

**Thank you to all you who've made your gift for this year!**

- Is CU in your estate plans?  Do we have documentation of your wishes?

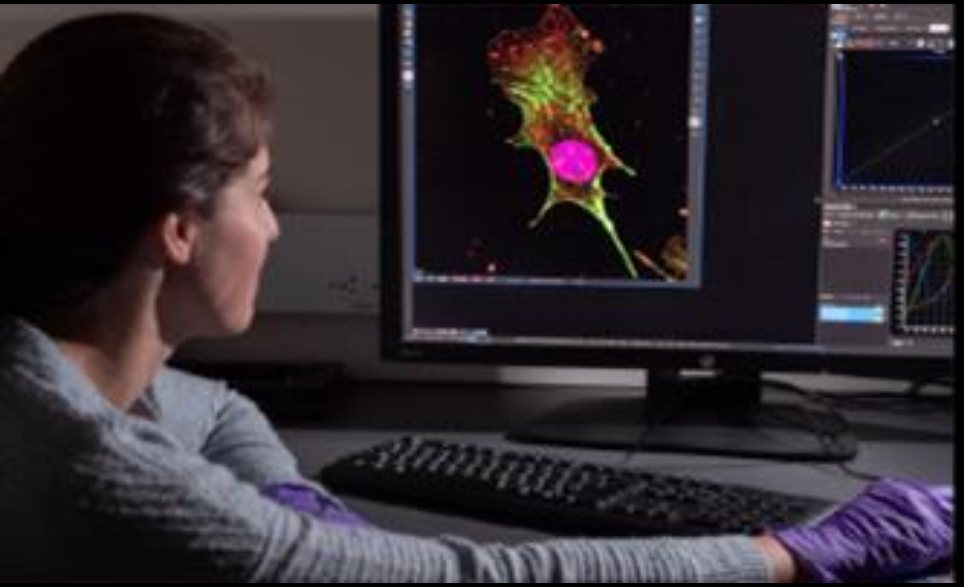
# Discussion

How can EAC help support the college's fundraising priorities?

What do you think are some of the unique opportunities for CEAS?

# Questions?

# Biomedical Engineering Program



# BME Program

**Launched:** **January 2020**

**Vision:** BME at CU Boulder is a multidisciplinary program dedicated to disseminate high-impact research, engage in societal healthcare challenges, and create bench-to-bedside technology through translation and entrepreneurship.


## Pioneering research, improving human health.

We lead the development of interdisciplinary technology solutions to improve human health and quality of life.

» Be a biomedical hub in Colorado, with international reach to improve human health

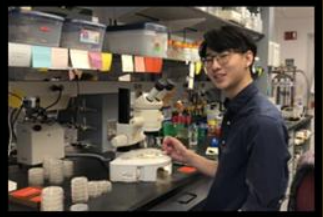
## Research Strengths

Biomechanics & Mechanobiology | Medical Devices
Imaging & Diagnostics | Therapeutics

# BME Program Faculty

**BME Teaching Faculty (2)**

**Biochemistry (1)**



**Aerospace Engineering (2)**

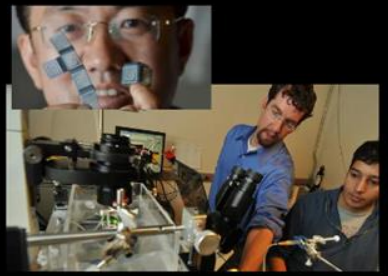
**Civil and Environmental Engineering (1)**

**Electrical, Computer, and Energy Engineering (7)**

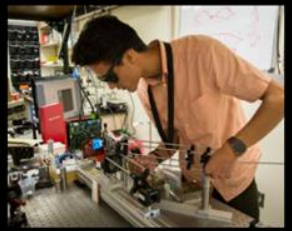
**Chemical and Biological Engineering (7)**

**Computer Science (3)**

**Mechanical Engineering (15)**



**CU Anschutz Affiliate**
**Bioengineering (2)**
**School of Dental Medicine(1)**



**CU Colorado Springs Affiliate**
**Mechanical and Aerospace Engineering (1)**


## Real-world, experiential learning in biomedical engineering.

We prepare students to be innovators and leaders in biomedical engineering addressing major societal healthcare challenges.

» **Be known for experiential learning with real-world impact that is integrated with the life sciences and healthcare industries**

## Degree Programs

Undergrad Minor | BS | MS | BAM | PhD

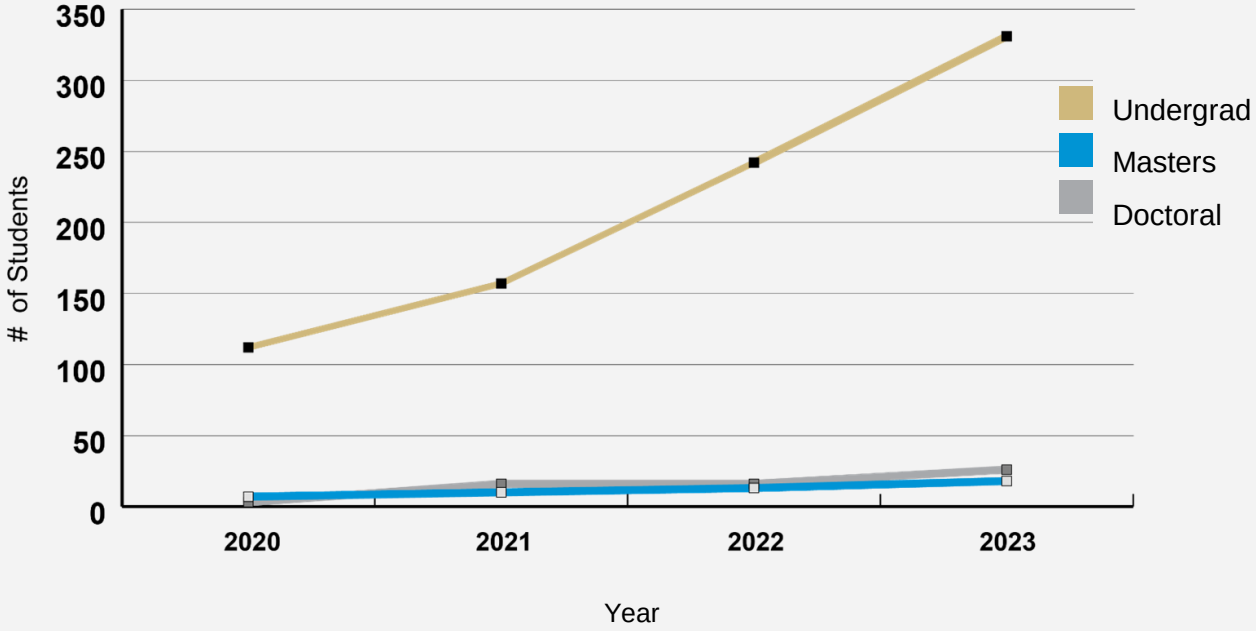
# Biomedical Engineering

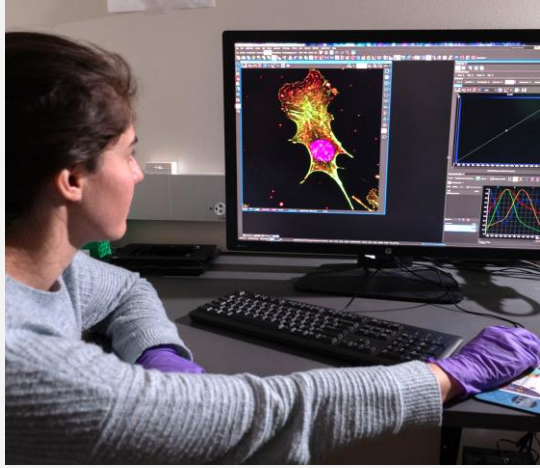
- 2023 – first graduated class
- 98 freshman (2023)
- 38 program faculty and growing

# National Trends

- ~55-60% graduates hired by industry

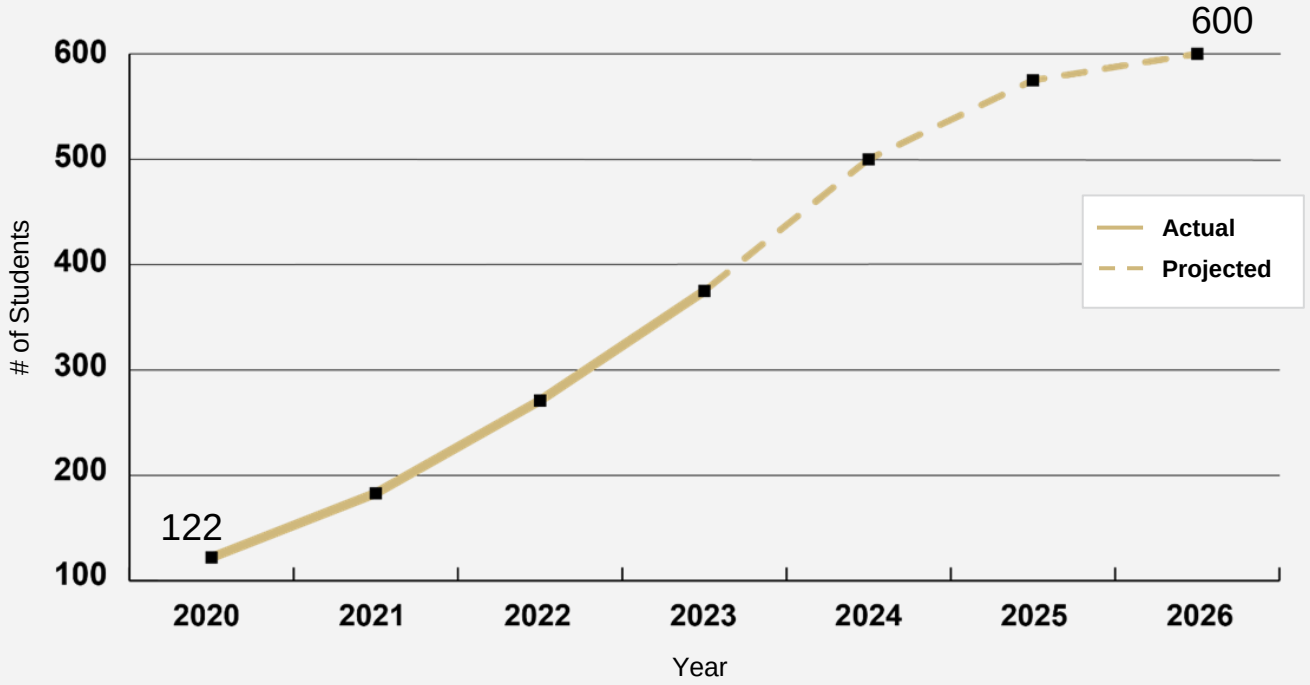
# Biomedical Engineering Fall Enrollment

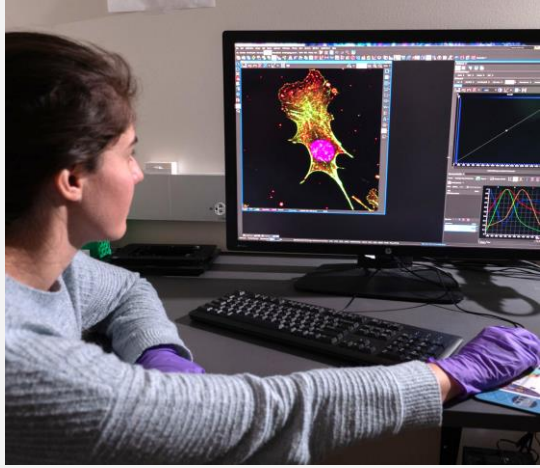


# Biomedical Engineering Fall Enrollment

Includes undergrad, master's and doctoral students



# BME Capstone Projects

3 → 13

*(AY22-23)* *(AY23-24)*

Medtronic

TERUMO

AlloSource®

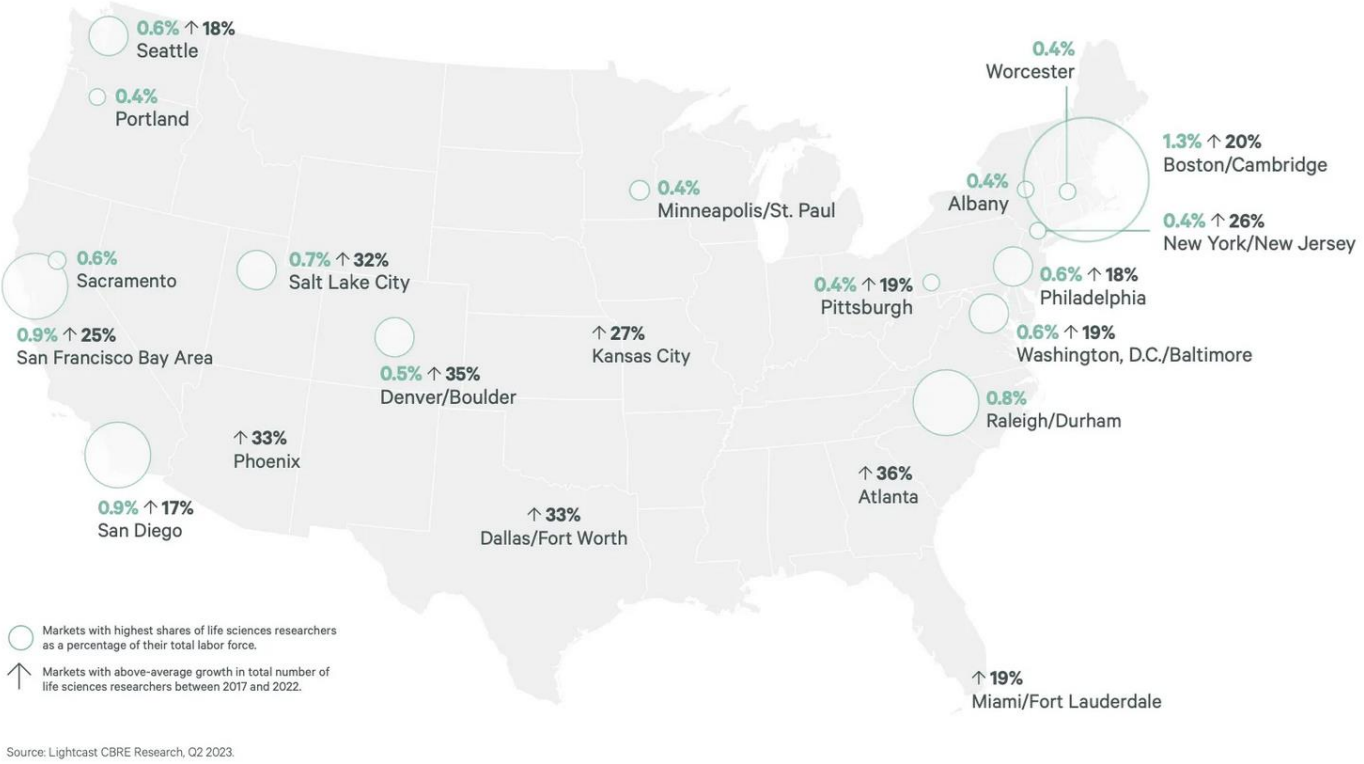

## Diversity leading to emergent innovations in biomedical research and education.

We embrace diversity leading to emergent behavior, including innovations in biomedical research and education.

# Positioned for Success

## Boulder-Denver top 10 national biotech market

CBRE Research, 2023



# Positioned for Success

- How is BME shaping your industry?
- What are you looking for in future BME student hires?
- How do you see the BME industry evolving over the next 3-5 years?
- What generalist (non-specialist) advice would you suggest to position CU BME as a global leader?

Forbes

2 of 16 Phillip Spears/Getty Images

**No. 1: Biomedical Engineering**

# Graduate Degree Programs in Robotics

# CU Robotics Degree Tracks

**MS Degree (non-thesis)**

- 30 credit hours (5000+ level courses)
- Minimum GPA 3.00
- 18 credit hours in ROBO courses
- One core course required: ROBO 5xxx: Intro to Robotics
- Candidacy: C or better in all 5000+ level courses

**MS Degree (Thesis)**

- 30 credit hours (5000+ level courses)
- 4-6 thesis credit hours
- Minimum GPA 3.00
- 18 credit hours in ROBO courses
- One core course required: ROBO 5xxx: Intro to Robotics
- Candidacy: C or better in all 5000+ level courses

**PhD Degree**

- 30 credit hours (5000+ level courses)
- 30 dissertation credit hours
- Minimum GPA 3.00
- 18 credit hours in ROBO courses
- One core course required: ROBO 5xxx: Intro to Robotics
- Candidacy: B- or better in all 5000+ level courses

# Robotics Curriculum: Breadth and Depth

## Dynamics and Mechatronics (16)

Modeling and design of robots Hardware/software integration

### Breadth

- ASEN 5050: Space Flight Dynamics
- ASEN 5067: Microavionics
- CSCI 5302: Advanced Robotics
- ECEN 5613: Embedded Systems Design
- MCEN 5115: Mechatronics and Robotics
- MCEN 5173: Finite Element Analysis
- MCEN 5195: Bioinspired Robotics
- MCEN 5228: Advanced Dynamics

### Depth

- ASEN 6010: Advanced Spacecraft Dyn & Ctrl
- ECEN 5623: Real-Time Embedded Systems
- MCEN 5157: Modeling of Human Movement
- MCEN 5228: Automated Mechanical Design
- MCEN 5293: Mechanics of Soft Matter
- MCEN 5636: Micro-Electro-Mechanical Systems
- MCEN 5228: Mechatronics 2
- CHEN 5836: Nanomaterials

## Perception and Control (19)

Use feedback to estimate the state of a system and achieve a desirable behavior.

### Breadth

- ASEN 5044: Statistical Estimation for Dynamical Systems
- ASEN 5014: Linear Control Systems
- ASEN 6024: Nonlinear Systems
- CSCI 5722: Computer Vision
- ECEN/MCEN 5138: Control Systems Analysis
- ECEN 5448/MCEN 5228: Advanced Linear Systems
- ECEN 5738: Theory of Nonlinear Systems

### Depth

- ASEN 5245: Radar and Remote Sensing
- ASEN 6044: Advanced State Estimation
- ASEN 6412: Uncertainty Quantification
- ASEN 6519: Hybrid Systems
- ASEN 6519: Verifiable Control of Stochastic Systems
- ASEN 6519: System Identification for Control
- ECEN 5028: Constrained Control
- ECEN 5458: Sampled-Data and Digital Control Systems
- ECEN 5638: Control Systems Laboratory
- ECEN 5678: Coordinated Control of Multi-Agent Systems
- MCEN 5228: Industrial Automation
- MCEN 6228: Robust Multivariable Control

## Cognition and Interaction (14)

Algorithmically describe and solve complex decision-making or machine learning problems.

### Breadth

- ASEN 5254: Algorithmic Motion Planning
- ASEN 5264: Decision Making Under Uncertainty
- CSCI 5254: Convex Optimization and Its Applications
- CSCI 5302: Advanced Robotics
- CSCI 5322: Algorithmic Human Robot Interaction
- CSCI 5622: Machine Learning
- CSCI 5854: Theoretical Foundations of Autonomous Systems
- CSCI 5922: Neural Networks and Deep Learning
- CSCI 7000: Deep Reinforcement Learning and Robotics
- ECEN 5478: Online Convex Optimization and Learning

### Depth

- ASEN 6216: Human Operation of Aerospace Vehicles
- CSCI/ATLS 5616: Introduction to Virtual Reality
- CSCI 7000: Physical Human-Robot Interaction
- ECEN 5712: Machine Learning for Engineers

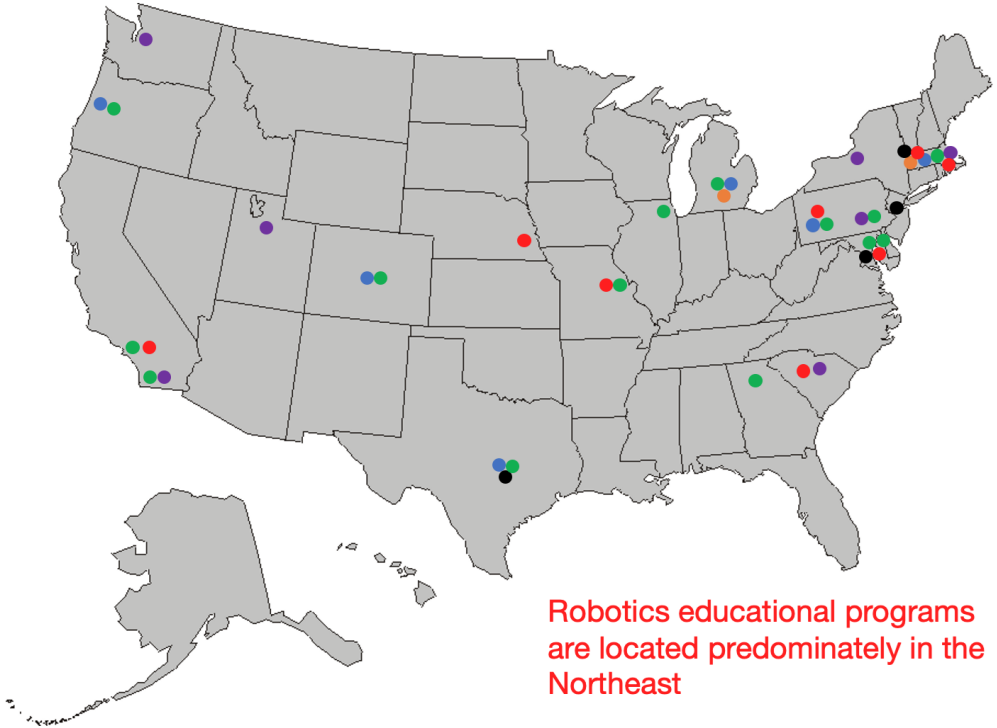
# Robotics Program Highlights

- **Research**: 3rd Place ($500K Prize), DARPA Subterranean Challenge (top U.S. team)
- **Education**: 85 PhD and 73 MS graduate applications in first year
- **Outreach**: Hosted several K-12 STEM events, including the VEX Robotics Competition
- **Future Plans**: Undergraduate major in robotics, certificate in AI




# National Distribution of Robotics Education Programs

**PhD, MS, BS, PhD/MS Focus Area, UG Minor, Certificate**



Robotics educational programs are located predominately in the Northeast

PhD Degrees (8)
- CU Boulder, Oregon State, CMU, Michigan, Georgia Tech, WPI, UT Austin, CO Mines

MS/MEng Degrees (15)
- CU Boulder, Oregon State, CMU, Michigan, UCSD, GT, UPenn, Maryland, USC, Johns Hopkins, WPI, UT Austin, Mines, Northwestern, Washington (St. Louis)

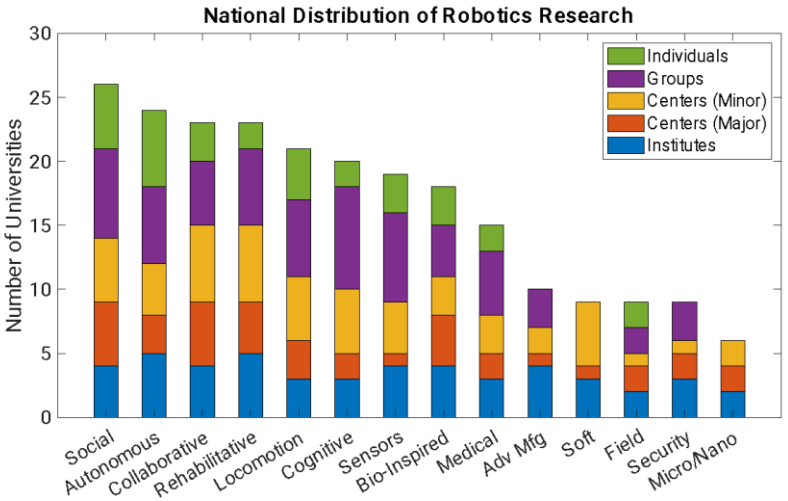
BS Degrees (2)
- Michigan, WPI

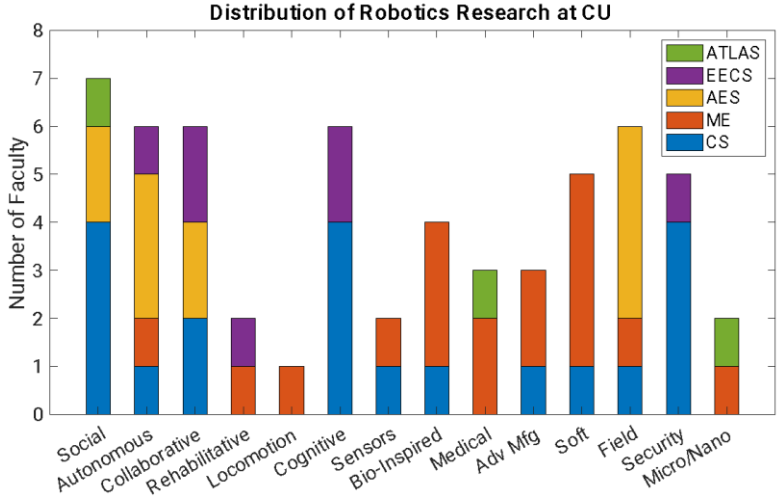
MS/PhD Graduate Focus Area/Track/Concentration (7)
- UCSD, UPenn, Utah, MIT, Cornell, UW, Duke

Undergraduate Focus Area / Track / Minor (8)
- CMU, USC, Johns Hopkins, MIT, WPI, Duke, Washington (St. Louis), Nebraska

Certificate (4)
- Maryland (G), UT Austin (G), WPI (G), Princeton (UG)

# Why CU Robotics?

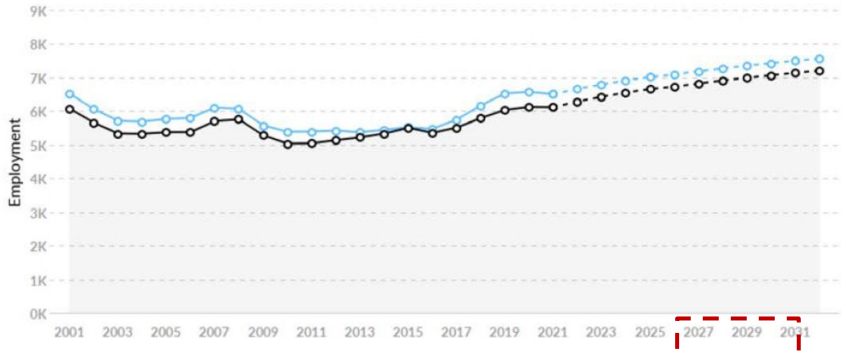



- CEAS hosts 40+ faculty that are actively engaged in robotics research
- CEAS leadership has made investments in two Interdisciplinary Research Themes (IRTs): Autonomous Systems (ASIRT) and Multifunctional Materials (MFM)
- Center for National Security Initiatives (NSI) was launched 2 years ago to expand the engagement of CU in the national security sector

# Robotics Workforce and Research Outlook

## Expected Robotics Job Growth




| Region | 2001 Jobs | 2032 Jobs | Change | % Change |
|---|---|---|---|---|
| Colorado | 6,074 | 7,204 | 1,130 | 18.6% |
| National Average | 6,520 | 7,562 | 1,042 | 16.0% |

## NSF Investment Roadmap

National Science Foundation
Directorate for Technology, Innovation and Partnerships

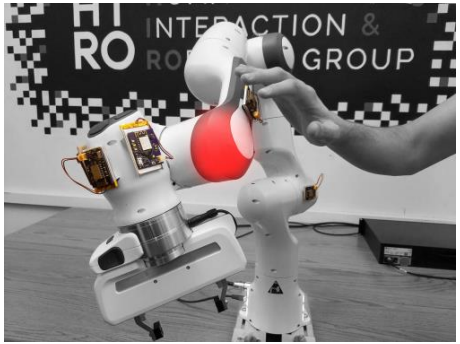
Critical technology focus areas

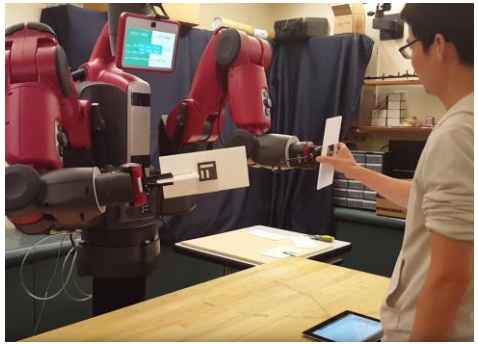
1. Artificial intelligence, machine learning, autonomy and related advances.
2. High-performance computing, semiconductors, and advanced computer hardware and software.
3. Quantum information science and technology.
4. Robotics, automation and advanced manufacturing.
5. Natural and anthropogenic disaster prevention or mitigation.
6. Advanced communications technology and immersive technology.
7. Biotechnology, medical technology, genomics and synthetic biology.
8. Data storage, data management, distributed ledger technologies and cybersecurity, including biometrics.
9. Advanced energy and industrial efficiency technologies, such as batteries and advanced nuclear technologies, including but not limited to for the purposes of electric generation.
10. Advanced materials science, including composite 2D materials, other next-generation materials and related manufacturing technologies.

CU Robotics Program

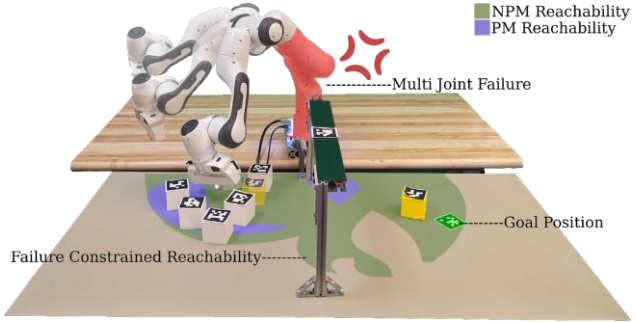
# Areas of Collaboration

Autonomous Systems

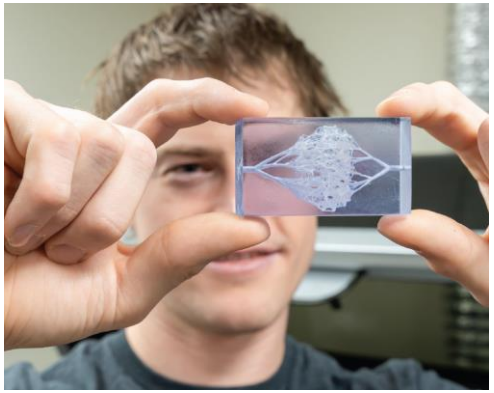


Human-Robot Interaction, Human-AI Teaming



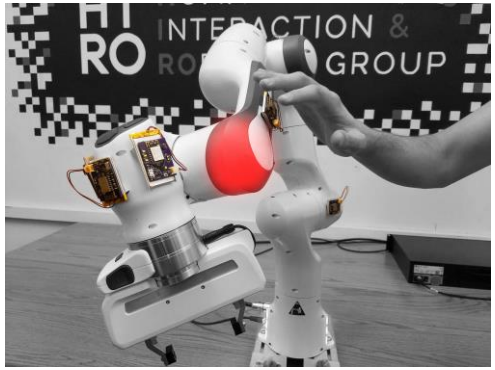

Machine Learning and Generative AI

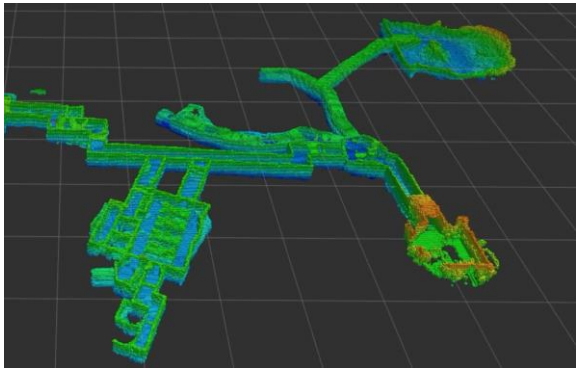


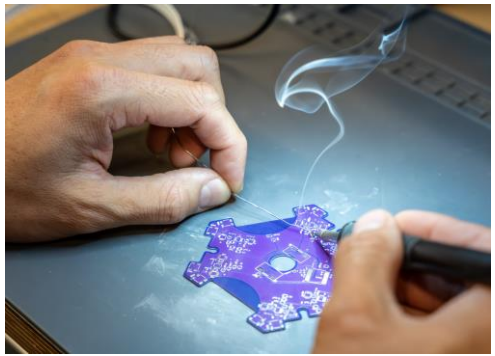
Advanced Materials, Fabrication and Manufacturing

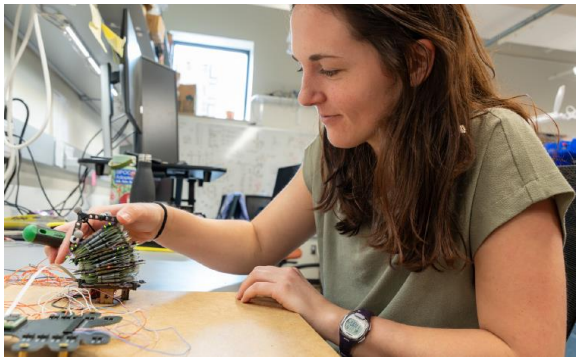
# Discussion

- How is robotics shaping your industry?
- What are you looking for in future robotics student hires?
- How are you trying to advance robotics in your company?







# Agenda

- State of the College
  - *Break*
- Strategic Planning Metrics
- Lattice + Engineering Connections
- COO, Pat O’Rourke
- Lunch with Students and Senior Staff
- Biomedical + Robotics Programs
  - *Break*
- Business + Engineering
- EAC Executive Session


# Business + Engineering Alumni Networking Night

CU Boulder's Leeds School of Business and College of Engineering & Applied Science first-ever collaborative alumni networking night!

**Thursday, May 30, 2024**
6 – 8 p.m.

**Number Thirty Eight**
3560 Chestnut Place
Denver, CO 80216

# Business + Engineering Initiatives

| Degrees | Experiential Opportunities |
| --- | --- |
| BS in Integrated Business + Engineering | Center for Digital Intelligence |
| Portfolio of MS degrees in Sustainability | Mortenson Center in Global Engineering & Resilience<br><br>Center for Ethics and Social Responsibility |

**Dean Vijay Khatri**

Leeds School of Business

# Integrated Business + Engineering Undergraduate Degree

| Degrees | Experiential Opportunities |
| --- | --- |
| BS in Integrated Business + Engineering | Center for Digital Intelligence |
| Portfolio of MS degrees in Sustainability | Mortenson Center in Global Engineering & Resilience<br>Center for Ethics and Social Responsibility |

# IBE: Common Program Structures

- Mix of fundamental courses in business and engineering
- Concentration in one business and one engineering area
- Experiential learning: project courses, internships, co-op programs
- Dual degree* (accredited by AACSB and ABET) or single degree (often AACSB-accredited)

LEHIGH UNIVERSITY

IBE Honors Program*

Berkeley M.E.T.
Management, Entrepreneurship, & Technology

Management, Entrepreneurship & Technology*

MICHIGAN ROSS

BBA Dual Degree*

PURDUE UNIVERSITY

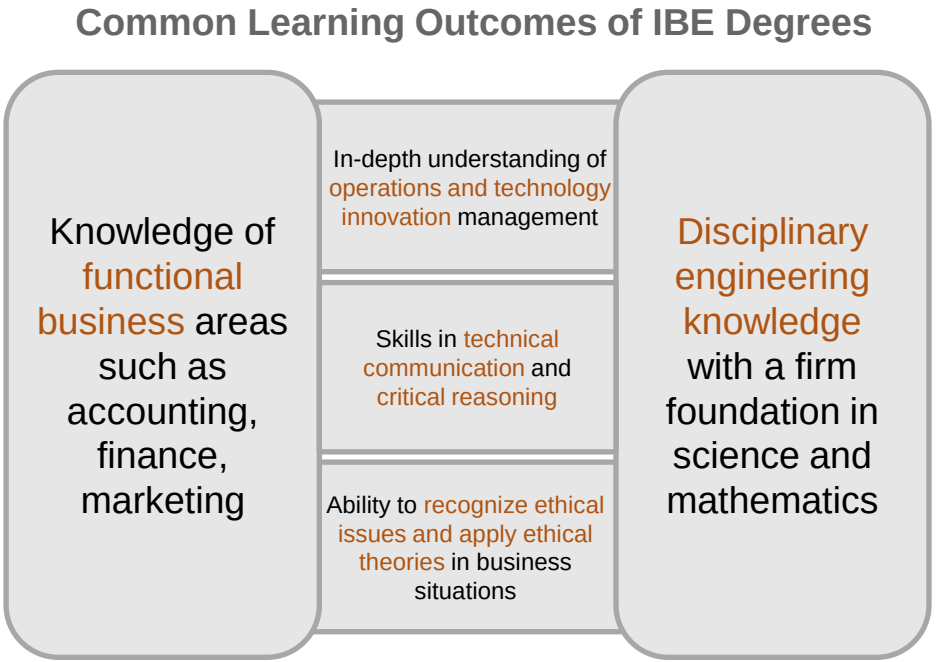
PennState

20 IBE degrees in U.S. and Canada identified

# IBE: Program and Common Learning Outcome

Main program outcome of IBE degrees:

- Prepare graduates to make business decisions grounded in technology, engineering, science and math.



# IBE at CU: Potential opportunities

**Front Range Startup Ecosystem**
Tech Entrepreneurship

**Campus Initiative on Sustainability**
Various Engineering Programs

**Colorado AeroSpace Industry**
Top-ranked Aerospace Engineering

## Alternative Business & Engineering degree programs at CU

- Engineering Major with Business Minor (2023: 321 students enrolled)
- Engineering Major with Engineering Management Minor (2023: 168 students enrolled)
- BS in Business Administration with a specialization in computer science (2023: 63 students enrolled)

# Portfolio of MS degrees in sustainability

| Degrees | Experiential Opportunities |
| --- | --- |
| BS in Integrated Business + Engineering | Center for Digital Intelligence |
| Portfolio of MS degrees in Sustainability | Mortenson Center in Global Engineering & Resilience<br>Center for Ethics and Social Responsibility |

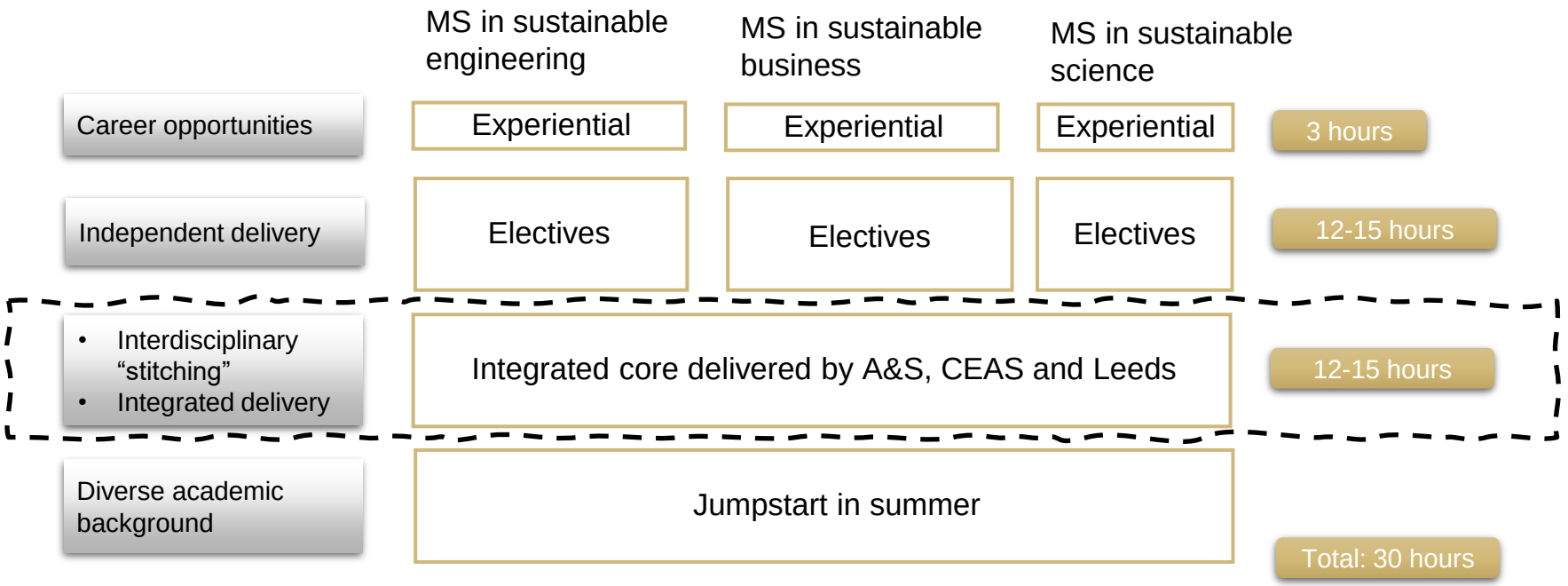
# MS in Sustainability Degrees in the U.S.

- **Demand for sustainability careers has been steadily increasing**
  - In the U.S., jobs in the renewable energy and environment sectors grew by 237% over the last five years (Source: 2023 Fast Company)
- **Green General Skill Index** that identifies four main types of interdisciplinary skills that are sought after in green occupations: **Engineering and technical skills; Science-based skills; Operational management skills; Monitoring skills** (Source: 2022 Harvard Business Review)
- Many different foci, for example,
  - ASU's Master's in Sustainable Food Systems
  - Johns Hopkins' Master of Science in Environmental Sciences and Policy
  - University of Michigan's Master of Science in Environment and Sustainability
  - Harvard's Sustainability Science Program

# Goals of the portfolio of MS Degrees in Sustainability

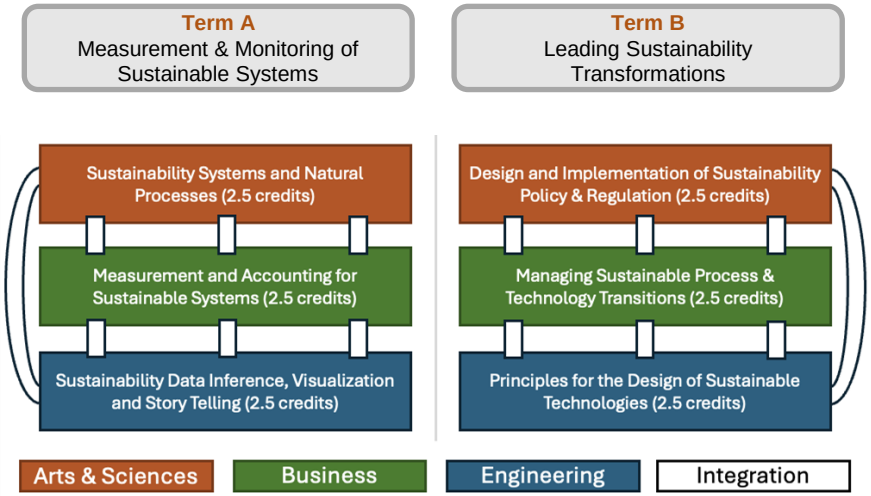
- Provide graduates educated in sustainability in demand by industry and government
- Differentiate from other MS in sustainability by having students educated across a common core in business, engineering and science
- Students learn by engaging with interdisciplinary faculty and cohort
- Fosters innovation by having students working in diverse teams
- Capstone and common core provide experience of working in teams across disciplines on real-world problems
- Leverage existing courses and programs across three schools and colleges

# MS in Sustainability in Business, Engineering and Science



# Proposed Common Core

| Common Competencies to Develop | Term A | Term B |
|---|---|---|
| **Long-term value assessment:** Carbon GHG (Green House Gas) accounting and environmental/social impact assessment. This should include identification of emission sources, calculation of emissions, verification and assurance, setting reduction targets and strategies, and offsetting and mitigation. After building a foundation in impact assessment through GHG, this foundation should be extended to additional natural systems (e.g., water and food systems) and to social impacts such as poverty alleviation and social justice. | ✓ ✓ | ✓ ✓ |
| **Project management** that focuses on environmental impact, social implications, and economic viability of projects over their entire lifecycle, from conception through to decommissioning, sustainable procurement, lifecycle assessment (LCA). | | ✓ ✓ |
| **Knowledge of environmental regulatory frameworks & policies**, for example, Environmental Regulations (Emissions and Air Quality, Water Quality, Waste Management, Chemical and Hazardous Materials), Social Responsibility and Labor Laws (Labor Standards, Health and Safety, Equal Opportunity and Non-Discrimination), Corporate Governance and Financial Disclosure (Transparency and Reporting, Anti-Corruption and Bribery), Product and Service Standards (Quality and Safety Standards, Environmental Labeling and Claims), Sector-Specific Regulations (e.g., energy, agriculture, construction, and manufacturing), International Standards and Agreements (e.g., ISO 14001 for environmental management, ISO 26000 for social responsibility) | | ✓ |
| **Data analysis and quantitative analysis** that focuses on, for example, summarizing historical data to understand changes over time, geospatial analysis, lifecycle assessment, carbon footprint analysis, material flow analysis for the circular economy | ✓ ✓ ✓ | |
| **Writing, communication and presentation** that focuses on, for example, explaining complex sustainability concepts and data without jargon, engaging narratives, visual story telling, building logical, evidence-based arguments to persuade stakeholders of the need for sustainable practices, cross cultural engagement and communication, digital communication such as use of social media and online collaboration. Ability to produce clear and precise reports, policy documents, and proposals that meet professional standards | ✓ ✓ | ✓ ✓ |




**Notable Features**

- Schedule: Each class would meet twice per week, for 1.5 hours
- Integration: Three times per term, all sections will participate in scheduled, 7.5-hour integration days involving professors and topics from each course (e.g., workshops, tournaments, guest speakers and judges, etc.)
- Load: For each section, faculty will receive credit for teaching a 3-hour course

# Center for Digital Intelligence

| Degrees | Experiential Opportunities |
| --- | --- |
| BS in Integrated Business + Engineering | Center for Digital Intelligence |
| Portfolio of MS degrees in Sustainability | Mortenson Center in Global Engineering & Resilience<br>Center for Ethics and Social Responsibility |

# Center for Digital Intelligence

Digital intelligence centers around user interaction with technology, akin to how emotional intelligence pertains to how an individual interacts with other individuals.

- Driving Technologies:
  - Artificial Intelligence (Generative AI)
  - Cloud Computing
  - 6G Networks
  - Virtual/Augmented Reality
- Amara’s Law: "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run”

# Center for Digital Intelligence: Goals and sample initiatives

## Goals

- Prepare our students to thrive in the new era that will be shaped by these technologies.
- Modernize education by embracing new technologies to expand the reach of the digital classroom.
- Bring highly innovative thinkers from engineering and business together under a single center.
- Develop cutting edge solutions that are responsive to the needs of industry, government and the society at large.

## Sample Initiatives

### Joint Engineering + Business Innovation Challenge Competitions

- Students will work together on problems posed by our partner companies.
- **Goal**: Innovative technology that serves the needs of the industry and society at large.

### Augmented/Virtual Reality Based Innovation

- Pilot project involving Engineering + Business.
- Rethinking digital education and research with AR/VR technologies.
- Both units have committed funds towards pilot projects that will run during AY 2025.
- **Goal**: Leadership in development and application of AR/VR technologies for education and research.

# Business + Engineering Initiatives

## BS in Integrated B+E

1. What are employment and career growth opportunities for students with an integrated degree?
2. What (unique) experiential learning opportunities for students with an integrated degree exist and should be integrated into the curriculum?
3. As an employer, what level of knowledge and skills would you like to see in students with an integrated degree (i.e., depth vs. breadth)?

## MS in Sustainability

1. How does sustainability fit into your business model and how does that inform the areas of sustainability that would benefit your industry?
2. What do you see as the key skill set(s) for an engineer being trained in a Sustainable Engineering graduate degree program?
3. Do you have ideas for sustainability challenge/problem topics in your industry that could be used as capstone design projects for the graduate program?

## Digital Intelligence

1. What are the technologies that you would categorize under the umbrella term “digital intelligence”?
2. What are the threats and opportunities for your opportunity related to the emergence of “digital intelligence”?
3. What sort of research questions would you propose to advance your organization’s future digital intelligence needs?

# Agenda

- State of the College
- Strategic Planning Metrics
- Lattice + Engineering Connections
- COO Pat O’Rourke
- Lunch with Students and Senior Staff
- Biomedical + Robotics Programs
- Business + Engineering
- EAC Executive Session

**Next Meetings**

- Oct. 25, 2024 - Growing Stronger Together
- April 25, 2025

# Engineering Advisory Council

April 26, 2024

College of Engineering & Applied Science
UNIVERSITY OF COLORADO **BOULDER**