

College of Engineering Annual Report 2023 – 2024



Introduction

The College of Engineering welcomed its new Dean, Jim Pfaendtner, at the end of July 2023. Over the course of the academic year, Dean Pfaendtner met with students, faculty, staff, alumni and donors to continue to learn more about the traditions and programs that have made the College so successful, while also shaping his vision for the future. Priorities for the academic year included assessing and implementing actions to manage the College's expansion, launching an Applied AI in Engineering and Computer Science initiative, growing research, and continuing to ensure the wellbeing and success of our students.

Across our measures of success – philanthropic giving, research awards, enrollment and graduation rates – we experienced growth. Demand for our graduates continues to grow, with all of our graduating students having successfully moved to their next phase within six months of graduation.

Significant time and effort were invested in building an effective leadership team in the College. The Associate Dean for Research & Infrastructure, the Associate Dean for Graduate Programs & Postdoctoral Affairs, and the Department Head of Electrical and Computer Engineering positions were filled. As Departmental and Administrative Unit leadership teams continued to be built out, the foundation for growth has been laid.

Key Initiatives

Engineering Expansion

In 2021, the General Assembly established Engineering NC's Future and created a goal for the College to increase enrollment by 4,000 undergraduate and graduate students. The College had an enrollment of 11,888 in 2023-24, year two of expansion. This is a 14% increase over the baseline of 10,461 students. To keep pace with the growth in the number of students, we have increased total faculty by 64 new tenure track and professional faculty members over the 2017-21 baseline, ensuring favorable student to faculty ratios are maintained.

A continued focus on student success and wellness is critical as the College expands. COE Academic Affairs added staff in critical advising, teaching, administrative support and recruiting roles and developed plans to expand resources to grow vital programs and experiences for students. Investments were also made in programs and staff members in the Office for Access, Wellbeing and Engagement to expand the College's ability to promote a sense of belonging and wellbeing for all students, faculty and staff.

In addition to providing funding for additional faculty and staff to support expansion efforts, the General Assembly allocated \$30M for repair and renovation to engineering buildings and a \$200M investment in a new

engineering classroom building that is planned for Centennial Campus. During the 2023-23 academic year, \$1.7M was used to outfit a new engineering online classroom, CSC research space, CCEE teaching lab enhancements, and ECE Undergraduate and Graduate research center renovations. Mann Hall renovations are underway which will result in new spaces for engineering student counseling, hands-on teaching/experiential labs, a new classroom and additional faculty and staff office space.

Applied AI in Engineering and Computer Science

As artificial intelligence transforms countless aspects of society, it will fundamentally impact all areas of engineering and computer science. Faculty, students, and graduates of all engineering and computer science disciplines must be able to understand and harness AI's potential to remain competitive and contribute to the advancement of their fields. Launched in the spring semester, the College's Applied AI in Engineering and Computer Science initiative will infuse Applied AI across our curriculum and research.

The Applied AI faculty advisory group formed in the spring semester has representatives from each COE department, including affiliate programs. Members of the advisory group are working across parallel workstreams to create a strategic plan that is informing curriculum and teaching, research and faculty, facilities and infrastructure, and external relationships. The Applied AI initiative is also informing the College's approach to expansion: new research labs will provide an opportunity to bring cross disciplinary teams of researchers together to explore the application of AI to engineering problems, classrooms will be designed to bring in more experiential learning and the use of new AI technologies, and expansion faculty hiring bring additional depth in AI teaching and research. In September 2024, the College is hosting an Applied AI in Engineering and Computer Science Day to share the vision with all faculty and build community engagement.

Operational Excellence

Meeting expansion goals in a planful way requires a renewed focus on operational excellence in the College. With a mandate from the Dean to explore more effective delivery of services across the College, a review of the College, Departmental and Administrative Communications teams and processes was completed. Based on the learnings of the review, the College Communications team is being restructured, and a resource sharing model for departmental communications is being piloted. To continue momentum in operational excellence, a team is now in place, led by a new Director of Special Projects, Planning & Strategic Initiatives to drive added improvements and evolve operational models. The administrative budgeting process, new employee onboarding

and college event management processes have been identified as early opportunities to improve college operations.

Highlighted College Accomplishments

Empower students for a lifetime of success and impact.

Undergraduate enrollment and student success continues to be very strong in the College of Engineering. The demand for enrollment continues to grow with over 12,000 applications for Fall 2024. First year first time cohorts have grown from 1571 in Fall 2021 to more than 1800 anticipated students in Fall 2024, an increase of approximately 16% over two years. Transfer students continue to be strong through our community college, 4-year 2+2, dual degree partnerships and C3 admissions. In spring 2024, 860 new transfer students enrolled in engineering from these sources. In Fall 2024 we expect approximately 400 new transfer students, a 28% increase in new transfer students compared to Fall 2023.

Retention and graduation rates continue to improve. Data for the last available year shows first year retention remaining consistent at around 94% and 4-year and 6-year graduation rates at 56% and 86.2% respectively.

The net result is that first year, and external transfer, student profiles have increased in quality both in terms of academic achievement and promise.

The College of Engineering strongly encourages High Impact Experiences, many of which are provided through Engineer Your Experience investment in Student Success. These include opportunities for students to attend conferences, compete in national and international design competitions as well as immersive Study Abroad and Alternative Service Break (ASB) experiences. During the 2023-2024 academic year, we provided funding for 1305 students, a 25% increase over the last academic year, to participate across various high impact programs.

The Wolfpack Engineering Unleashed (WEU) Program offers a comprehensive framework to establish and expand engineering education initiatives, both within the COE and across campus. The purpose is to enhance student learning experiences and academic excellence by advocating for the integration of the 6C's (Curiosity, Connections, Creating Value, Communication, Collaboration, and Character) within educational practices and research environments to instill a student's entrepreneurial mindset. As a member of the Kern Entrepreneurial Engineering Network (KEEN), we will provide every student with an opportunity to develop this skillset.

Ensure preeminence in research, scholarship, innovation and collaboration.

The College of Engineering had a record-breaking year in research, submitting 1084 proposals valued at \$1,169,240,323. This is a 12% increase in the number of proposals and a 108% increase in the value of the proposals over 2022 - 23. The College represented 50% of the total number of proposals submitted for the University. The number and value of awards also increased. In FY 23-24, the College received 674 awards, an increase of 18% over FY 22-23, valued at \$186,725,524, a year over year increase of 65%.

Two new research centers were established during 2024 FY and continuation funding was received for two existing research centers.

Commercial Leap Ahead for Wide Bandgap Semiconductors (CLAWS) – over \$50M to date

The regional hub, Commercial Leap Ahead for Wide Bandgap Semiconductors or CLAWS, led by North Carolina State University, includes one university partner, N.C. A&T State University, as well as six industry partners: MACOM, Coherent Corp., General Electric, Bluglass, Adroit Materials and Kyma Technologies, Inc. The funding is part of \$238 million invested through the CHIPS and Science Act for the [establishment of eight Microelectronics Commons regional innovation hubs](#) spread across the United States.

Wide bandgap semiconductors offer higher voltage and temperature capacity than traditional silicon chips. They are used in power electronics, but also in RF and wireless devices for communications and radars, as well as photonic devices for sensing, communications, artificial intelligence, and future quantum technology applications. The hub will also explore next-generation ultra-wide bandgap materials with even greater voltage and temperature capabilities, including diamond and gallium oxide electronics. The focus areas of the new center include Silicon Carbide Electronics, III-N RF Electronics, III-N Photonics, III-N Power Electronics and Ultrawide Bandgap Electronics

Bezos Center for Sustainable Protein - \$30M

The Center includes partners from academia and industry to research, create and commercialize new technologies for manufacturing various protein products. Efforts will focus on three areas:

The *Research and Development team* aims to improve the palette of materials used to extract proteins or to use as raw materials for fermentation and cell cultivation; make manufacturing processes for sustainable protein products more efficient and less costly, using advanced biotechnology and manufacturing methods; and train the center's faculty and students on innovation and intellectual property as well as commercialization models, tools and strategies to facilitate new technology transfer to industry.

The *Workforce Development team* aims to set standards for educating and training students and personnel in advanced food technologies; ensure that curricula span all age and grade levels as well as professional training; and implement programs that extend NC State's Biomanufacturing Training and Education Center's groundwork in pharmaceuticals to advanced food technologies.

The *Capacity Building team* aims to reach out to community stakeholders – consumers, farmers and chefs, for example – to understand their perceptions, preferences and expectations of sustainable protein foods and use the results to inform outreach strategies. It will also conduct workshops with industry members and regulators to understand policy and regulatory trends, drivers, barriers and enablers.

Expand and advance our engagement with and service to North Carolina and beyond, defining the standard for a 21st century land-grant university.

K-20 Engineering Outreach

The Engineering Place (TEP) program, the College of Engineering's K-20 education and resource headquarters is a national leader in engineering and engineering education outreach, continuing to introduce, inspire and increase K-20 students' knowledge and interest about engineering, engineering design thinking, engineering habits of mind, and career possibilities. These programs assist in building the K-8 learning ecosystem necessary to recruit high school students to the college with focused programming to increase underserved and underrepresented population participation. Undergraduate engineering students (Engineering Ambassadors and Engineering Lab Assistants) are provided with training and hands-on experiences in both leadership and best practices in teaching and communicating engineering concepts to younger students, their college peers, and the general public, strengthening their communication skills in preparation for engineering careers.

The TEP team, along with the Engineering Ambassador Workforce and summer camp graduate and undergraduate staff, continues to provide outstanding engineering programming for the state. In 2023-24, TEP provided 66 events, reaching 3590 K-12 students and 176 K-12 teachers.

Summer Engineering Camps

K-12 Students: Summer camps engage students from kindergarten through high school juniors and seniors participating in residential camps. The Raleigh camp attendance has grown to 955 students while our eight partner camps reach rural communities. During the summer of 2023, we ran twenty-seven camps.

Educator Professional Learning: K-12 teachers receive in-depth experience in engineering education as Summer Camp Team Leads. Teachers receive a full day workshop and spend the summer implementing engineering challenges, learning how to effectively implement the engineering design challenge, and emphasizing the engineering habits of mind. This year, 29 educators supported the camps and increased their confidence in teaching engineering in the classroom.

NC State Partner Camps

In collaboration with 8 partner camps, we provided engineering programs across the state. Elizabeth City, Charlotte, Spindale, Pembroke, Jacksonville, Hickory, Havelock and Wilson all held summer camps. Providing an all-day camp training session at Charlotte for the Western Camps and one in Raleigh for Eastern Camps, provided engineering content and challenges for camp staff, enabling them to implement the knowledge and teaching strategies into their camps. We continued our ongoing partnerships with Wake and Johnston County Indian Education Programs, increasing the number of indigenous students attending camp.

Rural Works

The COE Academic Affairs and Industry Expansion Solutions (IES) offices continued strong advocacy and support of the Rural Works Internship program. Rural Works provides summer engineering internships in Tier 1 and 2 counties (all engineering/cs disciplines), most of which are in small-to-medium manufacturers where students gain valuable operations, design, project management and/or supply chain experiences. Summer 2024 was the largest ever cohort of internships, with a total of 147 students working in 39 counties in North Carolina and working at 83 companies. This is a 60% increase from summer 2023. For summer 2023, 91 summer internships had been arranged, growing from 60 in 2022, 45 in 2021 and 19 in 2019.

An important aspect of the program is the minimum eight hours of community service that are required of the students, designed to increase student awareness of the breadth of experiences and opportunities for them when they graduate, including in rural communities. Additionally, the community component expands students' knowledge of the challenges and barriers faced by rural communities. The program is also built with strong company mentoring and student career development programming components.

Champion a culture of equity, diversity, inclusion, belonging and well-being in all we do.

The College of Engineering continues its focus on creating an inclusive and welcoming college culture for all. The College of Engineering office of Access, Wellbeing and Engagement worked throughout the year to provide

access to programs and events that promoted a sense of belonging for all students and provided support for student and faculty wellbeing.

Cultural Showcase

A new signature event for the Office of Diversity, Equity, and Inclusion was the inaugural COE Cultural Showcase, hosted during the fall semester. This event celebrated the rich diversity of the college community, providing a platform for students and employees alike to share their cultures and talents. Representatives from countries spanning the globe converged to showcase a dazzling array of performances, exhibits, and culinary delights, totaling 35 contributors and featuring cuisines from 14 different countries and regions. The Cultural Showcase not only captivated audiences with its artistic presentations but also fostered an atmosphere of cross-cultural understanding and appreciation. The success of the Cultural Showcase ensured it will be a perennial event on the college calendar, promising to continue to enrich campus life and celebrate the global identities that help define NC State University and the College of Engineering.

Active Minds Student Organization

Following a challenging academic year marked by significant losses, we recognized the urgent need for a comprehensive supportive response. Simultaneously, there were students across the college who wanted to be part of increasing mental health awareness, sharing resources, and supporting their peers. Research revealed a significant opportunity gap in the absence of an Active Minds chapter on campus, and our staff collaborated closely with COE seniors Savannah Powers and Abigail Wucherer, who established and led the new NC State chapter.

Under the guidance of the Office for Diversity, Equity, and Inclusion, the new student organization achieved remarkable milestones. One of the most impactful initiatives was the Student ID Campaign, where Active Minds collaborated with university administration to redesign student IDs for new incoming students to include crucial on-campus support numbers and national suicide/crisis prevention contacts. Over 1,000 stickers were placed on existing IDs during update drives organized by Active Minds, the COE Safety Pin crew, and other campus partners.

Active Minds also hosted a variety of successful events throughout the year, including embedded counselors meet and greet, finals prep snack and self-care stations, and student/faculty departmental lunches, fostering connections beyond the classroom.

UNC System Wellness and Wellbeing Grant

The College of Engineering, along with Wellness and Recreation, secured a grant aimed at enhancing student mental health resiliency through the existing Engineer Your Wellness (E-Well) program. This comprehensive initiative focuses on preparing engineering students to navigate life's challenges and avoid lasting mental health impacts. Key components of the program include monthly wellness programming on topics such as growth mindset and coping strategies, wellness coaching and access to the BetterYou app, and workshops designed to promote healthy habits and lifestyle skills.

The overarching goal is to improve self-efficacy, resilience, and well-being, ultimately connecting students with university resources to support their holistic success. This initiative also includes preventative efforts to equip students with the skills needed to manage mental health concerns proactively, reducing the reliance on emergency services. The program also supports staff and faculty.

Gaming with the Dean

As part of our commitment to fostering connections within the college, the final Wellness Day of the academic year featured an interactive event where students and staff engaged with the Dean in a friendly gaming competition. Held in the newly opened Hunt Library E-Sports Lab, the event allowed for over three hours of connection and relaxation, during which the Dean engaged in meaningful conversation with participants and shared his personal experiences with mental health.

LDOC Fest

For the second consecutive year, the Office for DEI organized the immensely popular Last Day of Class Festival: Stress Reliever Field Day. This year, attendance surged by nearly 30%, with more than 1,300 participants from the student body and staff celebrating the successful academic year. This event serves as a joyful culmination of the semester, reinforcing community bonds and promoting well-being.

Improve university effectiveness through transformative technologies, cutting-edge processes and actionable data.

Communications

A comprehensive assessment of College, Departmental, and Administrative communications was completed with the support of an external consultant specializing in higher education communications. Recommendations

on a new communications team structure and new communications activities were provided at the end of the academic year. The implementation of recommended actions over the next academic year will result in more effective and efficient delivery of communications for the entire College of Engineering community.

Research Administration

The COE Research Committee completed an assessment on the state of research administration in the College with a focus on departmental processes and experiences with pre- and post-award operations. The committee provided insight on differences between departments and challenges with the current operations. Additional assessment and improvement of Research Administration processes will be completed in 2024-25.

Engineering Online

The ITECS team released a new registration system for the Engineering Online program. This new system allows program administrators to get real-time data from registration and records associated with new and current students which previously required logging into a different system to access the relevant data. It also has a proctoring system built to help create efficiencies in administrative tasks.

Lead in developing innovative partnerships, entrepreneurial thinking and applied problem solving.

Engineering Grand Challenges Scholars Program

The Engineering Grand Challenges Scholars Program (GCSP) at NC State continues to maintain a global reputation for excellence, leadership, and model for facilitating intellectual property and technology transfer in engineering education. In the past three years, the number of undergraduate scholars addressing the NAE's fourteen grand challenges has steadily increased. In 2021, we accepted 10 new scholars, in 2022 and 2023 we accepted 35 new scholars each year. For 2024, we accepted 89 new scholars. In the past three years, the majority of the new scholars participated in one or both of the GCSP symposiums held in the Fall and Spring semesters. Both symposiums were well attended by an average of 75 first-year engineering students who were eager to learn about the program, internal and external university partners, current scholars, and research faculty mentors.

Currently, the program has 127 active scholars (47 sophomores, 59 juniors, 21 seniors). We have consistently graduated an average of 20 scholars per year, bringing the total number of graduates since the inception of the

program to 115 alumni, representing 15 of the 18 engineering disciplines. A third year of paid undergraduate research experience was also offered to 15 Grand Challenges scholars for summer 2024.

Engineering Education

The Engineering Education program, which represents a strategic partnership between the College of Engineering and the College of Education, enrolled their first students into the certificate and master's programs. Two students have graduated with Certificates in Engineering Education.

Co-directed by faculty in both colleges, a total of six classes now exist under the EED prefix and are being taught in fall, spring, and summer. Two of those courses, EED509 Field Experiences in Engineering Education and EED511 Ethics in Engineering Education, served as the basis for the four-week student abroad in Rwanda. Both Engineering and Education students participated in the study abroad. A strategic partnership has been formed with the University of Rwanda and INES University. Engineering, mathematics, and technology students from INES served as translators and partnered with NC State students to go into secondary schools to do engineering activities with more than 900 Rwandan students.

Elevate the national and global reputation and visibility of NC State.

Rankings

The College of Engineering's Aerospace, Biological/Agriculture, Computer, Materials and Mechanical Engineering graduate programs realized increases in their US News & World Report rankings. Nuclear Engineering maintained its position as the #3 Graduate Program in US News & World Report.

Fundraising

The College of Engineering raised \$40,413,266, inclusive of the Bezos Earth Fund Grant, against a goal of \$21,500,000. This represents a 77% growth in fundraising over the previous year.