

Annual Report 2021-2022
College of Engineering
North Carolina State University

Overview

NC State's College of Engineering (COE) is the flagship engineering school in the state of North Carolina and one of the leading public colleges of engineering in the United States. The College continues to have a major impact on the state by providing its students with a very high-quality education that affords them significant career opportunities. NC State Engineering is a major driver of the North Carolina economy through its research and innovation. The COE also plays an integral role in building a highly skilled workforce for North Carolina, thus supporting existing industry as well as assisting and spearheading the development of new businesses, products and services that have led to significant investment and job creation in our state.

The College, in keeping with goals set forth in its most recent Strategic Plan, works to provide a premier educational experience for its students and a world-class environment for its faculty that allows them to thrive and become global leaders in discovery, learning and innovation. Of equal, if not greater, importance is that the College be able to carry this out within a culture that promotes diversity, equity and inclusion throughout so that all of our students and faculty members can thrive and prosper in their endeavors. Our vision and long-term goal, which is to be the leading public college of engineering in the country and one of the preeminent colleges of engineering in the world, can only be achieved if we are true to the last commitment.

Underlying this mission and vision is a sustained effort to engage and invest in vital areas of research growth and educational needs. It involves, first and foremost, making strategic investments in faculty and infrastructure in areas of significant societal need and impact that also provide the greatest potential for attracting external funding and best serve the needs of our country and state. At the core of the COE's mission and vision is enhancing student success through the integration of research and education, recruiting and retaining outstanding faculty members and students and providing opportunities for interdisciplinary research at both graduate and undergraduate levels.

With more than 10,000 students, the COE ranks in the top 10 nationally in the number of annual engineering and computer science bachelor's degrees awarded and top 15 nationally in master's and Ph.D. graduates. The College is also recognized nationally for the high quality of its undergraduate and graduate programs. In the most recent *U.S. News & World Report* rankings of the top graduate engineering programs in the country, NC State's COE was ranked 26th overall and 12th among public institutions. The College has been in or near the top 10 nationally in research expenditures for several years, according to data from the American Society for Engineering Education. In particular, federal research expenditures have grown significantly over the last decade.

Changes in the Service Environment

As noted in last year's report, announcements made by Apple, Google, Fujifilm Diosynth, Pratt-Whitney, and numerous other major companies to locate new or expand existing facilities in North Carolina highlighted the critical need and urgency to grow and expand COE engineering and computer science programs in order to meet the human resource, workforce and technical demands of these new investments in North Carolina. Concurrently with the need for enrollment growth, we also noted the importance of increasing the COE faculty size, not just to support the COE strategic plan, but more importantly NC State's goals and aspirations to be a premier university and a major engine of growth for the economic development of North Carolina. With this in mind, we are pleased to emphasize that the most significant development in 2021-2022 for COE was that the North Carolina legislature has both heard and acted upon these needs with investments that are aimed at catalyzing both COE enrollment growth and concurrent growth in faculty size.

Engineering North Carolina's Future as funded by the NC legislature represents an initial investment of \$20 million to catalyze what would eventually be an increase of 4,000 engineering and computer science students at NC State together with an increase of more than 175 additional faculty and staff members. This investment also includes \$30 million in capital funding for initial additional space needs for this student, faculty and staff growth. Even when significant additional recurring and capital funding will be needed to achieve these enrollment and faculty and staff growth goals over a five-to-seven-year horizon, this legislative action has kick-started a number of actions and initiatives, both within COE and across the University, that have already played a significant role in the both the scope and scale of activities carried out by COE in 2021-2022. The impact and challenges motivated by this initiative on future COE enrollment and faculty and staff levels will be commented on in the final section of this report.

In addition to this Engineering Expansion initiative, it is important to note that the biggest impact of the COVID-19 pandemic over the last two years was a decline in graduate enrollment due to the inability of international graduate students to travel. We are pleased to note, however, that based on COE graduate program numbers, academic year 2021-22 was a year of remarkable recovery from the global pandemic. Graduate applications and admissions were strong due to pent up demand as well as aggressive recruiting by our directors of graduate programs and the strong reputation of the College. Combined with a steady increase in undergraduate applications and enrollment, we are now seeing very strong new enrollments for fall 2022, in some cases just shy of all-time highs.

Major Research Initiatives and Highlights:

Over the last ten years, NC State University has been recognized as one of the nation's leaders in the increase of federal research expenditures per year, rising more than 65 percent in that period. The COE represents half of that growth. In fact, the COE federal research expenditures grew 105 percent in the 10-year period, placing the college as one of the top two colleges in the country, and far above the national average growth of 35 percent in engineering.

This has been driven by the COE's success starting and sustaining large federal research centers and institutes. In particular, this year we are celebrating the awarding of the STEPS National Science Foundation (NSF) Science and Technology Center (STC) focused on phosphorus sustainability; STEPS is the first STC ever led by NC State. NSF also awarded major funding for a new AI Learning Institute led by faculty members in the Department of Computer Science, which builds on years of research in the department on artificial intelligence in education. This success also includes the FREEDM and ASSIST NSF Engineering Research Centers (ERC), the Power America National Manufacturing Innovation Institute, the CNEC and CASL Department of Energy research centers and NC State's role in the NIIMBL. This is also reflected in the large increase in doctoral graduates in the COE, which is now in the top 10 in the United States, just three graduates per year behind UC Berkeley.

The Hub Site Portal for the IBM Quantum Computing in North America now has four new and sustained industry members. There was also a very successful ASSIST 10th-year review and the PowerAmerica critical sixth-year performance renewal. Aim Bio, a bio pharma manufacturing research and training effort led by the Biotechnology and Training and Education Center (BTEC) with funding from the Novo Nordisk Foundation, has begun operations and programs, in hybrid mode, between Denmark and North Carolina. These new ventures and renewals alone generate in excess of \$20M in annual research expenditures translating into almost \$8M in annual F&A revenue for NC State.

One NSF ERC full proposal (OneWASH) was submitted and selected for an NSF reverse site visit. The final outcome of this ERC proposal is still pending. The COE has also been a driver of the two prestigious NIH T32 training grants to be awarded to NC State. The COE is also a university leader in the Army Futures command areas of wearable sensors, additive manufacturing and power electronics. The FREEDM Center was also awarded a large grant for development of new fast charging electronics.

Other research highlights include:

- Total research expenditures for the year were estimated in mid-June to be \$205,031,605.
- New research awards for 2021-22 were estimated at \$119,759,816.
- Based on estimates, the College saw an increase of six percent in research expenditures year over year, while F&A generated increased by 12 percent over 2020-21.

- Thirty-five faculty members have received research awards of more than \$1M this year and nine above \$2M.

- Five faculty members received NSF CAREER Awards.

- Bradley Reaves, assistant professor in the Department of Computer Science, will receive \$606,848 over five years for his project “Increasing Trust and Reducing Abuse in Telephone Networks.”

- Ashly Cabas, assistant professor in the Department of Civil, Construction, and Environmental Engineering, will receive \$606,848 over five years for her project “Multiscale Probabilistic Characterization of Seismic Site Response in Highly Uncertain Environments.”

- Albert Keung, assistant professor in the Department of Chemical and Biomolecular Engineering, will receive \$825,816 over five years for his project “A Synthetic Biology Platform to Map and Engineer the Diverse Epigenetic Space.”

- Spyridon Pavlidis, assistant professor in the Department of Electrical and Computer Engineering (ECE), will receive \$500,000 over five years for his project “Engineering Ultra-Wide Bandgap III-Nitride Devices for Highly Efficient and Robust Electronics.”

- Wenyuan Tang, assistant professor in ECE, will receive \$500,000 over five years for his project, “Pricing Non-convexities Toward Transparency in Electricity Markets.”

New Initiatives

The College worked with the College of Education to continue the establishment of our new Engineering Education program. Four masters’ level classes were submitted to registration and records under our new EED prefix. These classes have now all been taught for multiple years. Proposals for a certificate in Engineering Education and an M.S. in Engineering Education are currently being considered. The Engineering Education program is serving as a convener for multiple proposal submissions across departments in the College of Engineering and across multiple Colleges, including a large proposal that includes Engineering, Education, CHASS and Management. To date, three faculty members from the College of Education and three from the College of Engineering have been the core group working on creating this program.

The COE Academic Affairs and Industry Expansion Solutions (IES) offices continued strong advocacy and support of the RuralWorks! Internship program. For summer 2022, 60 summer internships are filled, growing from 45 in 2021 and 19 in 2019. The lower number in 2019 was due to the Covid pandemic and many were completed virtually. For the 60 students in summer 2022, there are 51 in Tier 1 or 2 counties in NC and the remaining nine students are with employers located in Tier 3 counties. RuralWorks! continues to be a valuable experience for engineering students to gain work experience and provides an opportunity for them to consider employment in rural counties and learn about rural social and community issues.

Diversity, Equity and Inclusion

The College emerged from the challenges of COVID-19 stronger. The work done by our staff and faculty over the previous year paid off as we returned to campus and to the classroom. As an enhancement to the University Climate survey done just prior to the pandemic, we completed a climate survey of all of our students, undergraduate and graduate, to get more actionable information. We have begun efforts to disseminate the survey findings to department heads and make recommendations for action plans.

We continue to have great success recruiting and hiring female faculty members. Since 2006, the College has tripled the number of women and doubled the number of underrepresented faculty members. For the 2021-22 year, the COE hired 20 new tenure-track and tenured and professional faculty members. Of the 20 COE hires, half are women to include one African American and two Hispanic/White. This year's cohort also included an African American male and a Native American male. A noteworthy accomplishment is that for the first time in the history of the University/College, three of the COE department heads are women, these being Julie Swann, head of the Fitts Department of Industrial and Systems Engineering; Sindee Simon, head of the Department of Chemical and Biomolecular Engineering; and Jackie Gibson, incoming head of the Department of Civil, Construction, and Environmental Engineering, who will start her appointment on August 15, 2022.

While the College has made good progress, increasing the number of diverse faculty members is a high priority. We continue to focus on the hiring and retention of faculty and staff members who are members of groups that are historically underrepresented in engineering (URM), realizing that the opportunity for staff members to advance and equitable pay both need to be addressed. The special advisor to the dean and the interim associate dean of faculty advancement have collaborated on strategies to locate and recruit diverse faculty members.

Where the College has made excellent progress is in recruiting female undergraduate students. Our fall 2021 first-year engineering class was 32.8 percent female, and fall 2022 is anticipated to be 28.6 percent female, which sets the College well above the national average of 19 percent. Our fall 2021, first-year engineering class was 14.9 percent URM, and for fall 2022 the percentage is expected to be 16.2 percent. This year, we yielded 39.5 percent (297/752) of the URM students admitted for fall 2022.

The special advisor to the dean for diversity, equity and inclusion initiatives and the Broadening Participation and Inclusion (BPI) Steering Committee developed the guiding principles for the College of Engineering Diversity, Equity and Inclusion Strategic Plan. The committee has been working to fully draft the plan and will deliver the first draft to the dean this year.

Approval for the inaugural assistant dean for student, faculty and staff equity and inclusion was granted. The position will provide college-wide leadership in this critical area. This position will report to the dean of engineering starting August 1, 2022, and will be a critical member of the COE Executive Committee and COE leadership team.

Educational Program Advances

Undergraduate enrollment and student success continue to be very strong in COE. The demand for enrollment continues to grow, with more than 10,000 applications for slots in 2022. First-year, first-time cohorts have grown from 1,496 and 1,571 in fall 2020 and fall 2021, to an anticipated 1,825 students in fall 2022, an increase of 329 additional slots over two years. Transfer student numbers continue to be strong through our community college, four-year 2+2 and dual degree partnerships. In fall 2022 we expect approximately 290 new transfer students.

The Engineering Enhancement fee has allowed the COE to continue to scale our Research Experiences for Undergraduates (REU) and Grand Challenges Scholars programs; strongly encourage high-impact experiences, such as work, international, research, service, and entrepreneurship activities; and add a number of new special initiatives that are enhancing the quality of the undergraduate experience in the COE and improving retention.

The expansion of community college articulation efforts and creation of new 3+2 pathways have also been facilitated by COE investments and in many cases are assisting with the recruitment of greater numbers of underrepresented students. Bridge programs for new students were offered in live format in 2022. Engineering summer camps were mixed, with some in live format and others online with supply kits mailed to students' homes. The camps were able to maintain overall enrollments and continue to increase the diversity of our student population.

Extension and Outreach

The Engineering Place for K-20 Outreach (TEP):

The Engineering Place (TEP) program, the College'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, design thinking, engineering habits of mind and career possibilities with a focus on serving underserved, underrepresented and under resourced populations, all while promoting engineering research at NC State. These programs assist in building the K-8 learning ecosystem necessary in order to recruit high-school students to the College with focused programming to increase underserved and underrepresented population participation. Undergraduate engineering students are provided with training and hands-on experiences in both leadership and best practices in teaching and communicating engineering concepts to younger students and the general public, strengthening their communication skills in preparation for engineering careers. Presentations at several different teacher conferences promoted the teaching of engineering in the K-12 classroom and highlighted the resources available to North Carolina teachers. TEP is always a requested presenter at several of these conferences.

Following on the 2020 The Engineering Place (TEP) Virtual Summer Engineering Camp successes, we increased summer camp offerings in 2021. Forty-nine K-12 camps were offered with 624 campers attending, a 7.5-percent camper increase from the previous summer. Over 750 kits were mailed to all campers and staff, with over 3,200 activities packed. With our

support, three partner camps were able to offer camps during summer 2021: Charlotte, Hickory and Wilson and three all-day camp training sessions were provided for partner camps for the upcoming 2022 camps.

While we began transitioning into in-person programming, spring programming became challenging as program cancellations occurred due to rising Covid cases. Regardless of these challenges, TEP continued to provide outstanding engineering outreach programming and served a large number of students. TEP partnerships span a wide range of community groups, prioritizing on underserved and underrepresented groups.

Industry Expansion Solutions (IES):

Over the past year, IES has continued to adjust to the transitions of the pandemic and our need to serve industrial extension clients. This year saw an increased level of opportunities to engage businesses on-site, although the number of virtual training solutions to clients remained substantial. IES field agents realized greater success in developing opportunities in the rural areas of the state including client commitments to receive engineering students into the RuralWorks! internship program. For summer 2021, sponsor and student participation was again very strong, with 45 students participating all across Tier 1 and 2 counties. RuralWorks! recruitment by IES for summer 2022 provided opportunities for 55 engineering interns working across 37 rural manufacturers.

The National Institute of Standards and Technology (NIST)-sponsored Manufacturing Extension Partnership program and its recurring federal funds administered by IES continue to grow as new requirements for client engagement are included and new directions are set to include a focus on introducing advanced manufacturing technology into smaller companies and addressing manufacturing supply chain challenges. In May, IES led the partnership through a successful sixth North Carolina Manufacturing Conference (mfgCON 2022) held at the Durham Convention Center after a 2 1/2-year pandemic-related hiatus. The IES extension focus on military and defense programs continued to grow this year when, in August 2021, the Department of Defense's (DoD) Office of Local Defense Community Cooperation, following a competitive selection process, announced that the state of North Carolina was selected to receive the designation as one of five Defense Manufacturing Communities nationwide. On September 22, 2021, DoD awarded a \$5 million grant to IES to strengthen defense advanced textiles manufacturing capabilities through an industrial production ecosystem in support of warfighter health and performance.

Biomanufacturing Training and Education Center (BTEC):

BTEC continued to focus on its primary mission of providing educational opportunities to develop skilled professionals for the biomanufacturing industry. Undergraduate and graduate enrollment in BTEC classes was at an all-time high of 985 students in 2021-2022. Further, BTEC continues to boast a nearly 100-percent placement rate for students enrolled in our academic programs, most of whom find outstanding opportunities in the local biopharmaceutical industry. BTEC's professional development (i.e., short course) program continued to attract professionals from North Carolina, throughout the U.S. and around the world and had an all-

time-high enrollment of 868 participants in 2021-2022. The last two years have seen particularly high enrollment largely driven by enhanced online course options. The addition of numerous online learning options to what was a mainly in-person program prior to COVID has enabled BTEC to extend its educational outreach to professionals who may not be in a position to travel to BTEC.

BTEC also continued to seek opportunities to provide contract services to industry and academia and to undertake projects with external stakeholders. The bioprocess and analytical services program completed 15 projects for industry clients, similar to last year. BTEC was a lead or partner in four projects funded by the National Institute for Innovation in Biopharmaceutical Manufacturing (NIIMBL). One of these projects aims to design highly optimized processes for production of mRNA, a new and critically important vaccine modality. In addition, BTEC continued its efforts on the Accelerated Innovation in Manufacturing Biologics (AIM-Bio) program, in collaboration with the Technical University of Denmark (DTU) and funded by a grant from the Novo Nordisk Foundation. This program has seen much success in both research and development/delivery of new courses, all on topics of great import to biopharmaceutical manufacturing. The program is at its halfway point – 2.5 years into a 5-year program – and a decision on whether or not to move forward with Phase 2 of the grant (January 1, 2023-December 31, 2024) is expected from the Foundation by December 31, 2022.

Faculty

The COE added 20 new faculty members who started in fall 2021. Twelve were tenured or tenure-track, six were professional teaching members and two were professional research members. The College has also hired an additional 35 new tenured or tenure-track faculty members who are scheduled to start in fall 2022.

The College's Faculty Advancement (EFA) office continues to be led by Joel Ducoste, associate dean for faculty advancement and professor in the Department of Civil, Construction, and Environmental Engineering, who has accepted the position on a permanent basis after serving in an interim capacity. Ducoste and his team continue to lead faculty professional development initiatives connecting COE faculty members with each other as well as faculty members in other NC State colleges. In COE, our goal is to develop faculty members at all levels to be research and educational leaders who provide strong mentoring of our graduate students and peers.

Our faculty continues to be acknowledged for its outstanding scholarship. In 2021, six faculty members were selected as University Faculty Scholars and nine were recipients of Goodnight Early Career Innovator Scholar awards.

Faculty Highlights

- Michael Dickey, Camille and Henry Dreyfus Professor in the Department of Chemical and Biomolecular Engineering (CBE), received the R.J. Reynolds Tobacco Company Award for Excellence in Teaching, Research and Extension from the COE.

- Lisa Bullard, teaching professor in CBE, received the inaugural Provost Award for Excellence in Teaching, NC State's most prestigious award for exceptional teaching given to professional full-time faculty members.

- Lilian Hsiao, an assistant professor in CBE, was awarded a 2022 Sloan Research Fellowship in Chemistry.

- James Lester III, Distinguished University Professor in the Department of Computer Science; Veena Misra, Distinguished Professor in ECE; and Richard Spontak, Distinguished Professor in CBE, received the Alexander Quarles Holladay Medal for Excellence, the highest honor bestowed by NC State and the University's Board of Trustees.

- Amay J. Bhandodkar, assistant professor in ECE with an affiliation to the ASSIST Center and the Joint Department of Biomedical Engineering (BME), was named to *Newsweek's* inaugural America's 50 Greatest Disruptors list.

- Iqbal Husain, professor in ECE and director of the FREEDM Systems Center, and Michael Kudenov, associate professor in ECE, received the 2022 Alcoa Foundation Engineering Research Awards.

- Three College of Engineering faculty members — Yevgeny Brudno, assistant professor in BME; James Tuck, professor in ECE; and Huiyang Zhou, professor in ECE — were named recipients of the Outstanding Teacher Award for 2021-22.

- Leda Lunardi, professor in ECE, and Steven S. Welton, teaching professor in the Department of Civil, Construction, and Environmental Engineering (CCEE), were recognized with the 2022 Blesis Outstanding Undergraduate Advisor Award from the College of Engineering for their outstanding commitment to ensuring students are academically and personally supported.

- CCEE professor and University Faculty Scholar Joseph DeCarolis was confirmed by the Senate to serve as administrator of the Energy Information Administration at the Department of Energy.

- Lilian Hsiao, assistant professor in CBE, received the Camille Dreyfus Teacher-Scholar Award from the Camille and Henry Dreyfus Foundation, Inc.

- Christopher Frey, Glenn E. Futrell Distinguished University Professor in CCEE, was confirmed by the U.S. Senate to serve as assistant administrator for the Office and Research and Development at the Environmental Protection Agency.

- Ayman Hawari, Distinguished Professor in the Department of Nuclear Engineering (NE) and director of the Nuclear Reactor Program, was appointed to the Nuclear Data Subcommittee of the National Science Advisory Committee.

- Jerome Lavelle, the College's associate dean of academic affairs, received the National Engineering Economy Teaching Excellence Award from the American Society for Engineering Education.

- Seven faculty members were named as Professors of Distinction

- Tiffany Barnes was named a Distinguished Professor in the Department of Computer Science.

- Francis de los Reyes was named a Glenn E. and Phyliss J. Futrell Professor in the Department of Civil, Construction, and Environmental Engineering.

- Robert Heath was named a Lampe Distinguished Professor in the Department of Electrical and Computer Engineering.

- Jacob Jones was named a Kobe Steel Distinguished Professor in the Department of Materials Science and Engineering (MSE).

- Roger Narayan was named a Distinguished Professor in the UNC/NC State Joint Department of Biomedical Engineering.

- Kara Peters was named a Distinguished Professor in the Department of Mechanical and Aerospace Engineering.

- Yaroslava Yingling was named a Distinguished Professor in MSE.

- Six faculty members were named Fellows of professional organizations.

- Louis Martin-Vega, dean of the College, was named as a Fellow of the American Society for Engineering Education.

- Fred Kish, M.C. Dean Distinguished Professor in the Department of Electrical and Computer Engineering, was named as a Fellow of the National Academy of Inventors.

- Morton Barlaz, Distinguished University Professor and head of the Department of Civil, Construction, and Environmental Engineering, was named a Fellow of American Association for the Advancement of Science (AAAS).

- Ayman Hawari, Distinguished University Professor of Nuclear Engineering and director of the nuclear reactor program, was named a Fellow of AAAS.

- Roger Narayan, Distinguished Professor in the UNC/NC State Joint Department of Biomedical Engineering, has been elected a Fellow of the Materials Research Society.

- John Gilligan, Distinguished University Professor of Nuclear Engineering and the College of Engineering's executive associate dean, was named an ANS Fellow of the American Nuclear Society.

Students

Undergraduate student enrollment Undergraduate enrollment for fall 2021 was 7,339 (1,555 new first-year, 281 new transfer, 216 first year, 948 sophomores, 1,635 juniors and 2,704 seniors). The undergraduate cohort is 27.9 percent women and 11.7 of the undergraduate populations is made up of members of groups that are historically underrepresented in engineering.

Graduate student enrollment Graduate student enrollment for fall 2021 was 3,228 (1,892 master's students and 1,336 Ph.D. students). That compares to 2,874 (1,588 master's students and 1,286 Ph.D. students) in fall 2020. The graduate student population is 28 percent women and is 50.7 percent international students.

Undergraduate degrees awarded During 2021-22, 1,651 undergraduate engineering degrees were awarded. That compares to 1,685 bachelor's degrees in engineering awarded in 2020-21.

Graduate degrees awarded The number of graduate degrees awarded in 2021-22 was 825 (622 master's degrees and 203 doctoral degrees. That compares to 1,278 degrees (1,078 master's degrees and 200 doctoral degrees) awarded in 2020-21.

Undergraduate recruiting During fall 2021, Engineering Academic Affairs hosted four recruiting events for prospective fall 2022 applicants. The College hosted three fall recruiting days, all of which were specifically targeted toward women and underrepresented minorities in engineering. Two of the events were offered virtually and one was offered in-person/on-campus. The College also hosted a virtual faculty speaker recruitment event specifically for students in their senior year at the North Carolina School of Science and Math.

COE participated in the University's Open House, held in person for the first time since fall 2019 and hosted two "VIP" dean's receptions aimed at recruiting and yielding special populations that are typically recruited and yielded at lower rates. One reception welcomed students from the North Carolina School of Science and Math while the other welcomed African American/Black male-identifying students.

During spring 2022, COE participated in five of the Office of Undergraduate Admissions' Experience NC State events (in person), welcoming admitted students to campus to gather more information. Engineering Academic Affairs also offered three additional virtual yield events for students accepted for fall 2022. The College hosted an event for Park Scholarship finalists during Finalists Weekend and participated in interview weekend college fairs for both first-year and transfer finalists in the Goodnight Scholarship Program.

Four spring yield events were hosted specifically for women and underrepresented minorities in order to highlight both the MEP and WIE, with one specifically designed for African American/Black male-identifying students. The College hosted Engineering Open House in person for the first time since March 2019. Engineering Academic Affairs again hosted two “VIP” receptions, both for African American/Black male-identifying students.

Graduate student recruiting COE graduate students were well supported this year with a total of 1,080 RAs, TAs, or RA/TAs, having a total stipend value of \$30.6M and an average annual stipend of \$28,387. For comparison, in fall 2020 there were 1,041 RAs, TAs, and RA/TAs, with a total stipend value of \$28.3M and an average annual stipend of \$27,243. Additional RA/TA positions that were made available either from the Provost’s office, the COE engineering enhancement fee and other COE sources have been critical in helping the COE continue to be competitive in recruiting top graduate students nationally.

This year, COE graduate students held four GAANN fellowships, 22 NSF fellowships, 13 NIH fellowships, 10 Fitts fellowships, 30 Provost fellowships, 10 Dean’s Doctoral fellowships, two GEM fellowships, six Dissertation Completion fellowships, three Diversity grants, 73 graduate merit awards, two Hassan Family fellowships, one Hood fellowship, one NASA fellowship, six Engineering Management fellowships, 26 Mentored Teaching fellowships, two GFINE fellowships, seven NEUP fellowships, six SEAS fellowships, 31 University Graduate fellowships, 100 Summer Graduate fellowships and 31 other distinguished fellowships. For the first time, COE awarded 30 Diversity Enhancement fellowships that provided URM students with a supplemental stipend of \$2,700. The total number of COE fellowships was 416 as compared to 301 in 2020-21. The total stipend award for all fellows combined was \$4M as compared to \$3.8M in 2020-21. To promote planned COE graduate program enrollment growth, 50 additional one-time doctoral assistantships were offered to incoming F22 Ph.D. students. engineering expansion funds were used to support these assistantships.

Ducoste continues to mentor our NSF-sponsored Bridge to the Doctorate (BTD) students. The NSF BTD program promotes the participation of underrepresented students in science, technology, engineering or mathematics (STEM) disciplines. One-on-one meetings were held with each BTD student to discuss their progress and professional development using the Individual Development plan (IDP) model. BTD students shared their career goals, accomplishments over the past year and what they hope to accomplish in the next academic year.

Over the next academic year, Ducoste will work with the Minority Engineering Program (MEP) director and staff to determine the possibility of shared spaces that would allow for peer interaction among underrepresented undergraduate and graduate students. Such spaces could lead to improved climate on the NC State campus and meet the goals of NC State University strategic plan goal 4: Champion a culture of equity, diversity, inclusion, belonging and well-being in all we do.

Brandon McConnell, military and veteran liaison, continues to improve our recruiting of active-

duty and veteran students into COE Graduate Programs. The 2021–22 COE military and veteran strategy was to expand and replicate initial successes from 2018–2021 in the OR and ISE programs with the US Army. Although the enrollment numbers are low, data show that active duty and veteran COE graduate applications have grown by more than seven percent for each of the past two years – demonstrating some success.

Distance Engineering Education Programs

The College offers a broad and diverse set of distance engineering education courses and degree programs for students in NC, across the United States and in other countries. Two new online degree programs, the Master of Engineering Management and Master of Operations Research, were added this year to the list of graduate program offerings, bringing a total of 18 online master’s degree programs available for professional engineers and computer scientists. The number of graduates from these programs has grown in the last two years from 138 in 2020-21 academic year to 152 in the current year. All of the degree programs had graduates. The M.S. in mechanical engineering had 26 percent of the College’s distance education graduates followed by the M.S. in chemical engineering, M.S. in computer science and M.S. in civil engineering, each at 15 percent. Women represented 26 percent of all graduates.

The College also offers 15 online graduate certificate programs and an undergraduate computer programming certificate program. In partnership with sister institutions in Asheville and Wilmington and Craven Community College in Havelock, the College has three 2+2 undergraduate site-based programs and two four-year site-based degree programs. Both the Mechatronics Engineering program in Asheville and the Mechanical Systems Engineering program are ABET-accredited as distance programs and have had an increase in enrollments and in graduation rates.

US News & World Report ranked the graduate engineering online programs as number seven in 2022; this is the fourth straight year in which the program ranked in the top 10.

Women and Minority Engineering Programs

Women and Minority Engineering Programs (WMEP) at NC State continues to be known as a national leader in recruitment, retention, graduation and job placement of outstanding engineers and computer scientists.

This year, the program hosted VIP recruitment receptions for students attending the North Carolina School of Science and Mathematics (NCSSM) and for Black males. These receptions were well attended and allowed participants to learn about the engineering departments and the support offered for women and historically underrepresented groups.

In 2021/22, the College has continued the momentum toward a fully inclusive and diverse student body. In summer 2021, WMEP held one of the few University-approved in-person events on campus in the form of the summer bridge program. WMEP combined programs that had previously been hosted separately for women and historically underrepresented students into

one program that hosted 100 rising first-year students on campus for a week. The diversity and enthusiasm of the Summer Exploration Experience (SEE) program was wildly successful, and the College partnered with GE, John Deere and NASA. During the academic year, WMEP held more than 19 in-person programs for students, some in partnership with the Career Development Center and the Women in Science and Engineering (WISE) Village. In addition, WMEP collaborated with the director of recruiting for the College to hold five specialized programs targeting historically underrepresented students for recruiting.

Engineering Career Fair

The Engineering Career Fair transitioned to a virtual format during the Covid-19 pandemic, with great success. Partnering with Career Fair Plus, the College was able to replace the in-person event traditionally held in the McKimmon Center with a robust online option. The two-day fall 2021 event in September saw participation from 182 employers who scheduled 9,200 virtual meetings with 2,243 job candidates.

During the one-day spring 2022 fair in February, 182 participating employers were able to schedule 5,480 meetings with 1,545 job/internship/co-op candidates.

The ECF team is planning a hybrid two-day event in September 2022 with an opportunity to attend in person in the McKimmon Center and an option for virtual meetings. A one-day virtual fair is planned for the spring 2023 semester.

Fundraising and Development

COE is proud to celebrate surpassing its \$230M campaign goal with a final result of \$276M as of December 31, 2021. We marked the occasion of this historic campaign with our College's own Celebration of Philanthropy and Service, an in-person donor and recognition event in April 2022. A major event this year was the dedication of Fitts Woolard Hall (FWH) in October 2021, marking the culmination of almost a decade-long effort to bring the fourth building of the engineering complex on Centennial Campus to fruition.

This past year marked an increase (and in some cases a return to) in-person activities. The NC State Engineering Foundation held hybrid on-campus board meeting, to include the election of new president Debbie Young, and a two-day, in-person executive committee retreat. Under Debbie's leadership, with contributions from newly elected vice president Scott Stabler, the Foundation has nearly completed its next strategic plan. For the first time ever, DEI plays a significant role with its own strategic pillar and focus. The board remains focused on its advocacy roots and is organizing itself to be effective advocates for the engineering expansion. The fall board meeting was held in conjunction with the FWH building dedication. While we plan to continue encouraging gifts to FWH, the College is reassessing this fundraising priority within the broader context of future needs.

As of the writing of this report, the College anticipates closing FY22 with over \$22M in philanthropic gifts and pledges. Fundraising goals of this magnitude are a team effort, with our College-based team serving as the nexus among University and department-led development

activities. A fundraising highlight of the year was the Goodnight Family Foundation gift to establish the Louie Martin-Vega Dean's Chair Endowment. At the other end of the giving spectrum, our 4th Day of Giving suggests that we have settled into a steady rhythm of volunteer-led giving and department competitions. Our Foundation board finished 3rd out of 26 campus boards for giving participation, and the College raised \$1.5M in gifts and pledges.

Administration

- After serving in an interim role, Joel Ducoste accepted the role of associate dean for faculty advancement on a permanent basis.
- Mechelle Belvin was named as the executive assistant to Dean Louis Martin-Vega. She succeeded Wendy Silver, who retired from the University.
- Jackie MacDonald Gibson was appointed as the head of the Department of Civil, Construction, and Environmental Engineering. She succeeds Mort Barlaz.
- Shawn Dunning was named as the College's director of technology. He replaces Keith Boswell, who retired from the University.
- Paul Dayton was named as chair of the UNC/NC State Joint Department of Biomedical Engineering on a permanent basis. Dayton had served as department chair on an interim basis after Nancy Allbritton left for the University of Washington.
- Maria Mayorga, professor in the Fitts Department of Industrial and Systems Engineering, was named as interim director of the College's Operations Research program.

Recommendations and Concerns for the Future

Engineering North Carolina's Future represents a generational opportunity to magnify the impact of NC State University on the State of North Carolina. This will be accomplished by significantly increasing the enrollment and awarded degrees in the engineering and computer science disciplines by 40 percent over a five- to seven-year period. The new, talented graduates will support the explosive economic growth of the state in the high-tech areas exemplified by Apple, Google, Fujifilm, VinFast, Toyota Battery, Novozymes and others.

About 30 percent of the time of COE leadership has been dedicated to planning and implementing the student, faculty and staff growth projected to occur as part of the Engineering Expansion. A task force has been assembled and meets on a regular basis to address the growth issues. Some of the guiding principles for the growth have been that 2/3 of the enrollment increase would be undergraduate students and 1/3 graduate students. Also, not all departments would grow at the same percentages. Given the current focus of industry growth and expansion, we anticipate Computer Science (CSC), Electrical and Computer Engineering (ECE), Mechanical and Aerospace Engineering (MAE) and Chemical and Biomolecular Engineering (CBE) seeing the largest growth.

In order to maintain and increase research productivity concurrent with such a significant enrollment growth, tenure/tenure (T/TT) track faculty will be needed to accommodate the graduate student and research roles at a ratio of about 10 to one, graduate students to faculty. Teaching faculty will be needed to accommodate the larger number of service courses,

especially in Computer Science. Staff will be needed in many support roles such as advising, financial, HR, contracts and grants, IT, etc.

A critical need for the engineering growth will be the additional teaching, research and office space required to hire the nearly 200 more faculty and staff members. As an example, the new Fitts Woolard Hall accommodates approximately 67 T/TT faculty members whereas the Engineering Expansion anticipates an additional 100 T/TT faculty members. The Smith Group has been engaged by the University Architects office to conduct a space needs study of current and projected space for the COE. This report should be available by Fall 2022. The COE has been working with the Architects office, University Real Estate and University Planning/Facilities to identify new space for 2022-2023 primarily in Research Building IV. The space identified should be sufficient in the first year to accommodate the immediate growth needs. The COE has grown in enrollment by nearly 20 percent over the last decade but space has only increased by four percent (including Fitts Woolard Hall). Likewise, research output has increased by nearly 100 percent with only modest increases in faculty size.

With support from the provost, the College continues to pay the Keystone building lease which provides the FREEDM Center with sustained laboratory and facilities support for three more years. As the COE continued its commitment to grow in strategic areas, significant rental obligations, in excess of \$2M annually, were required to support other major centers, faculty offices, cluster hires and laboratories. In addition, this year COE assumed the debt payment on approximately \$8M for FWH and for the first time had to incur an annual payment for all risk insurance. The latter two items amount to about \$1M per year annually.