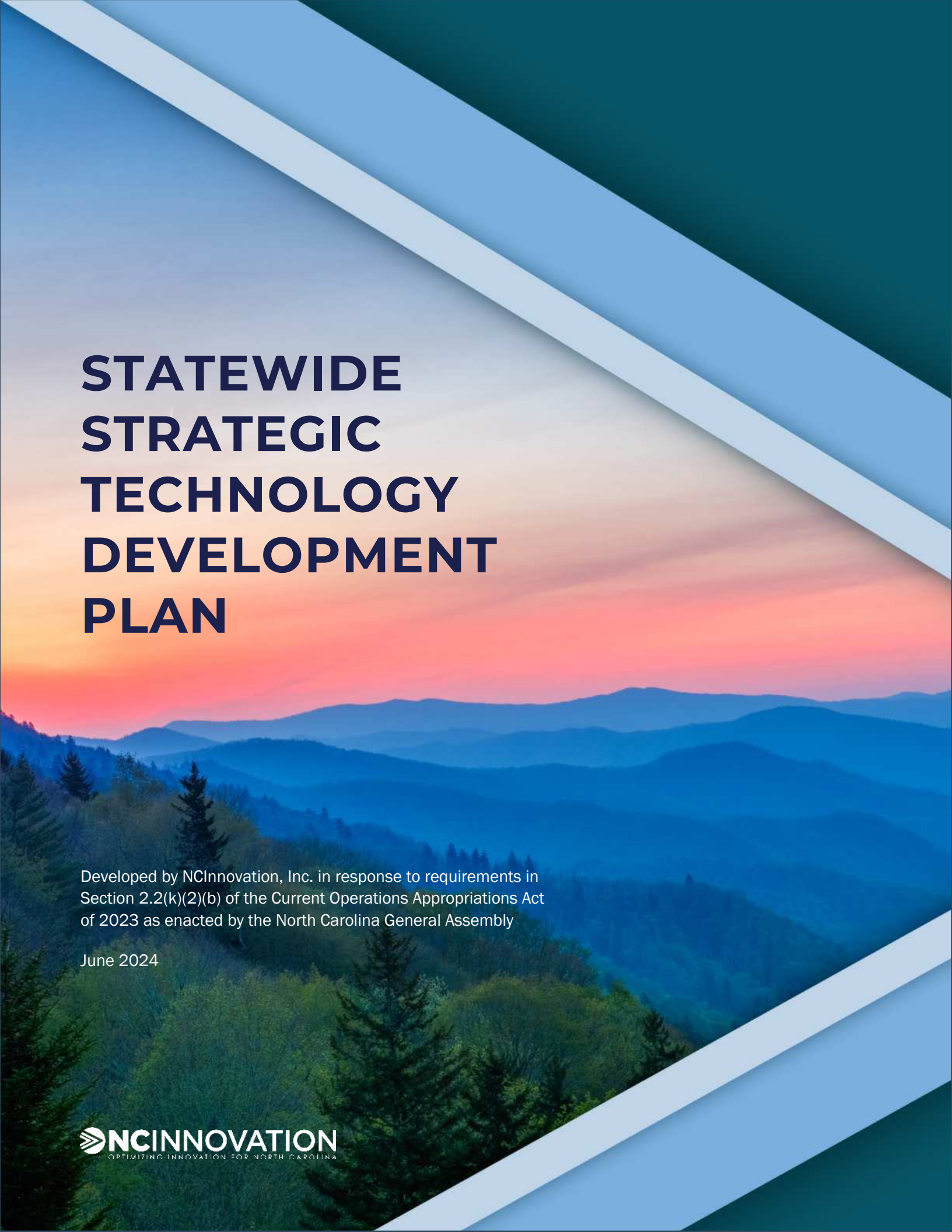

STATEWIDE STRATEGIC TECHNOLOGY DEVELOPMENT PLAN

Developed by NCInnovation, Inc. in response to requirements in Section 2.2(k)(2)(b) of the Current Operations Appropriations Act of 2023 as enacted by the North Carolina General Assembly

June 2024

NCINNOVATION
OPTIMIZING INNOVATION FOR NORTH CAROLINA

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LETTER FROM THE CEO AND CIO

TO OUR FELLOW NORTH CAROLINIANS:

With the best public university system in America, North Carolina holds incredible potential for transformative technology-based economic development in all parts of the state, not just the Triangle. But our innovation performance falls short compared to the size of our research base even though UNC System institutions are home to incredible faculty working on cutting-edge research.

Replicating the Triangle's economy elsewhere in the state is not possible and probably not desirable; what's more, that is not something any government-funded initiative should attempt. But it is possible, and it is desirable, to promote economic development across all of North Carolina by helping regions build their capacity for innovation anchored by public university research. Indeed, though strategy and tactics may have changed over time, this exact goal has driven American growth and technological dominance for nearly a century.

What's more, technological innovation is not itself an economic sector. Rather, it drives growth in all sectors. Agriculture, energy generation, power electronics, defense - competition within all these segments of the economy depends on new technologies.

Innovation, the process of translating research into commercially viable enterprises, is a key driver of economic growth. NCInnovation helps North Carolina's public universities realize the full technological innovation potential of their applied research portfolios. In this way, discoveries that may never have been born for lack of research and development (R&D) support can advance to later phases of readiness, attracting private investment or leading to spinoff companies.

North Carolinians have been laying the groundwork for innovation-based growth for years, both through the continued progress of our university system and thoughtful analysis and planning efforts across the state. In 2020, RTI International (RTI) released *A Blueprint for Building an Innovation Corridor*,[1] which proposed a plan for expanding the technology capacity of the Triangle eastward and westward and identified four technology focus areas in which North Carolina was poised for growth: AgTech, Biohealth, Power Electronics for Transportation, and Defense Innovation.

Building on this work, in October of 2022, NCInnovation released a report prepared by TEConomy Partners[2] that incorporated findings from the *Blueprint* and identified four key challenges that North Carolina faces in its efforts to commercialize university research: 1) uneven success outside of larger metro areas; 2) lack of

applied research that addresses marketplace problems; 3) an underdeveloped capital landscape that does not sufficiently fund university innovation; and 4) a lack of regional innovation networks that would allow effective collaboration among universities, industry, and capital formation organizations.

TOP-DOWN PLANNING cannot direct economic growth. The American system of private initiative and risk-taking, which created the most dynamic economy the world has ever known, proves the point. Policymakers, though, can and should be aware of the strengths and weaknesses of the market. Such data informs government action on everything from fiscal policy to regulatory strategy to bureaucratic organization. And where government funding and the private sector naturally intersect – public university research, for example – insights like those contained in this report can prove invaluable. North Carolina truly does have world-class university researchers spread throughout the state; government and industry both have a deep interest in aligning publicly funded research with market demands.

Based on these new insights, NCInnovation undertook a deeper, statewide analysis of North Carolina's innovation assets in close partnership with RTI. Funded entirely by private dollars and initiated before NCInnovation received a legislative appropriation, this statewide study has thoroughly validated the TEConomy Partners findings through extensive quantitative and qualitative data collection and analysis. Through numerous interviews (over 140 individuals across 130 organizations) and comprehensive data analysis, the study validated the TEConomy model and expanded those original four technology focus areas from the *Blueprint* into six, adding Advanced Manufacturing and Computing & Informatics. It also broadened the original Power Electronics category to Energy Transition & Electrification.

Though the speed of technology development requires an ongoing evaluation of North Carolina's technology strengths and development opportunities, this report represents a current snapshot of capabilities within regions across the state, points to some areas of existing strength, and suggests some concrete ways in which North Carolina and its innovation ecosystem can continue to support universities in advancing technology-based economic development. Strengthening the innovation capacity within our universities, increasing collaboration among our universities, and improving university engagement with industry will have far-reaching economic benefits for North Carolina through job creation, business growth, economic opportunity, and economic resilience. The North Carolina General Assembly's foresight and investment in this work will be felt for generations as North Carolina sets an example for the nation in university-centered technological innovation.

Sincerely,

DR. J. BENNET WATERS
President & Chief Executive Officer

MS. MICHELLE BOLAS
Executive Vice President & Chief Innovation Officer

ACKNOWLEDGEMENTS

NCInnovation would like to thank the North Carolina General Assembly for its commitment to North Carolinians and for its forward-thinking approach to supporting technology and innovation as an economic engine for North Carolina. We also thank our private donors who saw the value in NCInnovation's approach to economic development and have committed over $25 million to support overhead and administrative expenses so that state dollars can be used to support NCInnovation's grant programs and regional hubs.

NCInnovation would like to thank RTI International for working tirelessly for almost a year to gather and analyze the data that made this report possible. The RTI team's deep expertise and unwavering commitment to this work has played a key role in helping NCInnovation take a thoughtful, data-based approach to its programs and plans. We also thank our industry partners who have generously contributed their time and expertise to make this analysis possible.

Finally, we offer our deep appreciation to North Carolina's exceptional public university system and the UNC System Office. We feel profoundly honored to be entrusted with this important work, and we thank each chancellor, administrator, faculty member, and staff member who has committed to this work and shared their valuable time and energy to make NCInnovation's progress possible.

INTRODUCTION AND PURPOSE

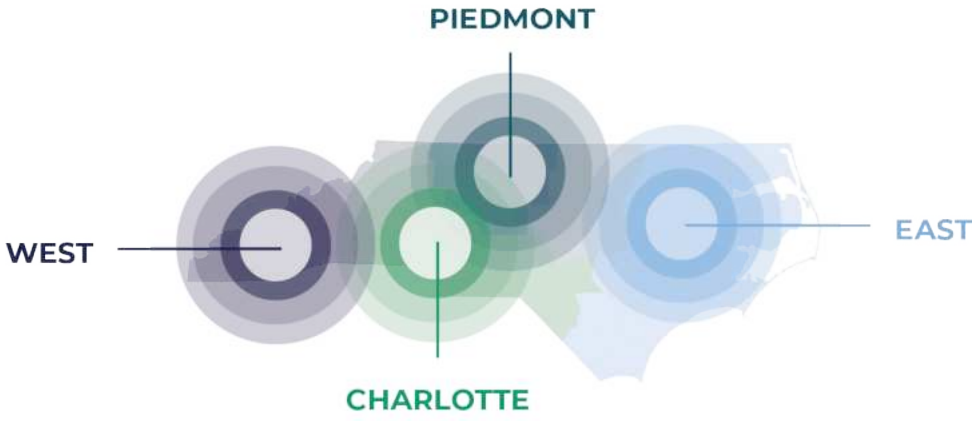
About NCInnovation

MISSION: NCInnovation is a nonprofit public-private partnership that unlocks the innovative potential of North Carolina's world-class public universities by providing grant funding and support services to public university applied researchers working on discoveries that have commercial promise, accelerating those discoveries toward commercialization.

MODEL: NCInnovation provides fiscally responsible commercialization support by funding non-dilutive grants from an endowment capitalized with state reserves that earn interest and low-risk investment income to fund the organization's programs. The endowment model eliminates the need for annual taxpayer allocations. Private contributions cover administrative costs ensuring earnings from state funds go directly to NCInnovation's authorized programs.

Programs

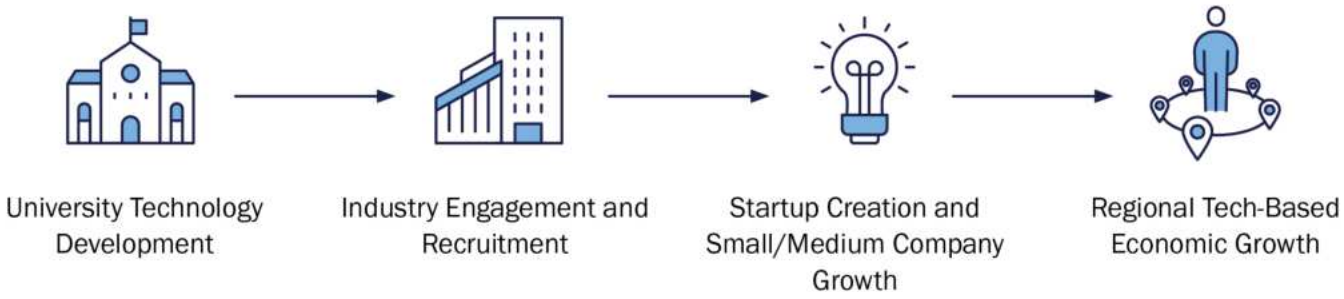
REGIONAL INNOVATION NETWORKS[3]: NCInnovation focuses on public university-based applied research across North Carolina. Through a statewide footprint, NCInnovation's Regional Innovation Network Directors connect university researchers with university collaborators, industry partners, private sector knowledge, and support services to accelerate effective commercialization strategies across North Carolina.



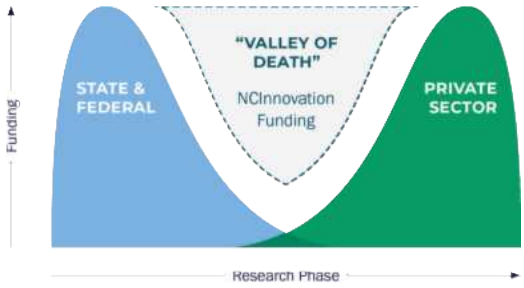
NCInnovation operates four regional innovation networks anchored by hub universities.

GRANTS: NCInnovation's merit-based grant program supports public university-based applied research that has commercial promise. NCInnovation provides funding at a critical inflection point of the R&D process. NCInnovation grants only support North Carolina public university researchers. NCInnovation does not fund private companies, nor does it take equity positions in exchange for grant funding.

NCInnovation investment in university technology development and commercialization infrastructure leads to...



NCInnovation's grant programs fund the crucial R&D stage between proof of concept and market readiness, often called the "valley of death." Alongside funding, NCInnovation's four Regional Innovation Networks connect public university researchers with industry partners, private sector knowledge, and support services to facilitate the commercialization of applied research. These core programs accelerate research breakthroughs to the point of commercialization to drive job creation and economic growth statewide.



Universities can (and often do) serve as regional innovation engines. A brief walk around NC State University's Centennial Campus, replete with labs and buildings showcasing industry partnerships, reveals the potential of a fully mature university-to-industry pipeline. Companies turn to research universities to scout new technologies to buy or license; faculty disrupt industries with their own businesses; corporations sponsor research at university labs – all of it supports regional economic development.

NC State University has of course been building its research portfolio and industry network for many decades, and few universities in the country will reach that sort of scale. But that does not mean other universities cannot anchor regional growth. They certainly can, especially in industries particular to that region, much like the economics concept of "comparative advantage."

To realize that potential, though, regional universities require a foundation from which they can advance promising research initiatives through the R&D sequence, when handoffs to industry generally occur. NCInnovation support for university technology development and commercialization infrastructure provides just that foundation to:

- Increase applied research, IP generation, and talent development;
- Attract industry investment, engagement, and recruitment;
- Generate startup creation and small/medium sized company growth; and
- Grow regional technology-based economies through technology commercialization, company growth, and job creation.

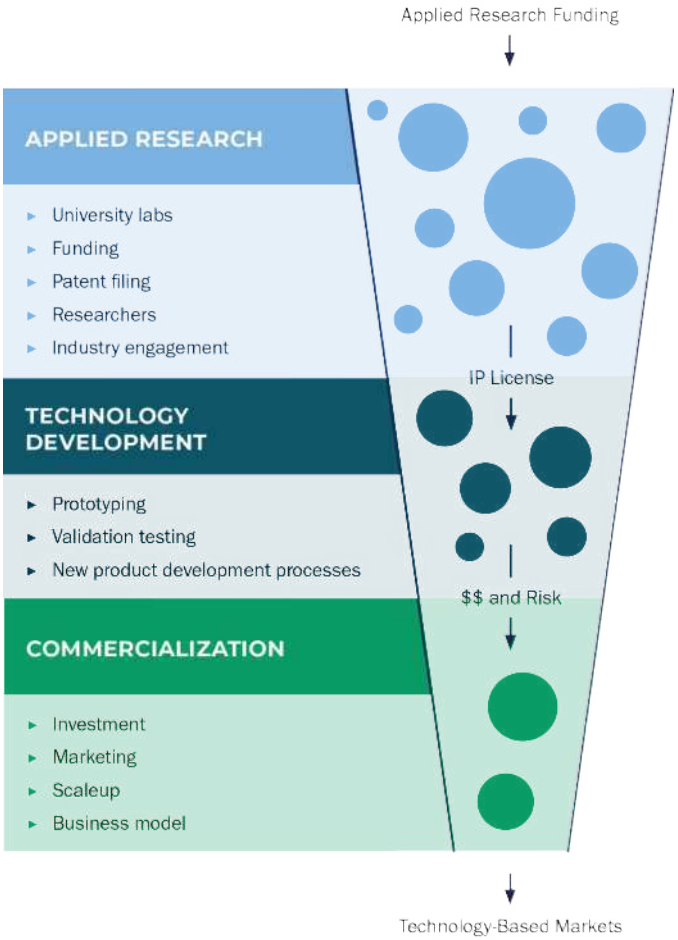
WHY A STATEWIDE STRATEGIC TECHNOLOGY DEVELOPMENT PLAN?

BACKGROUND AND CONTEXT

In September 2023, the North Carolina General Assembly adopted the 2023-2025 biennium budget that authorized NCInnovation and appropriated $500 million to create an endowment to support regional innovation commercialization across the state. Following a ten-day waiting period, the bill became law on October 3, 2023. Among the requirements for multi-year funding, the North Carolina General Assembly charged NCInnovation with developing a **STATEWIDE STRATEGIC TECHNOLOGY DEVELOPMENT PLAN** grounded in research, technology, and innovation studies.

Less than twenty-four hours later, NCInnovation announced the hiring of four Regional Innovation Network Directors. Since then, these regional directors have been imbedded at hubs within each region, scouting potential projects and building relationships with academic institutions and industry in their respective regions. These efforts were designed, in part, to build on privately funded work NCInnovation began in July 2023 (prior to the adoption of the budget) to analyze and catalogue regional innovation assets, technology focus areas, and opportunities for regional innovation capacity building.

Different parts of North Carolina of course have different economies. With military bases concentrated in the east, for example, the defense industry is more prominent there than in the west. That's why NCInnovation divided its operations into four regions, with one "hub" university anchoring each: East (East Carolina University), West (Western Carolina University), Charlotte (UNC Charlotte), and Piedmont (NC A&T State University).



NCINNOVATION
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Led by RTI, a global research firm based in Research Triangle Park, this ongoing study has continued to bear fruit for nearly a year. The research team has methodically investigated R&D strengths across the state and analyzed market demand to orient university research portfolios to existing industry needs and commercial opportunities. This report represents a summary of findings and provides data to inform statewide efforts to accelerate innovation commercialization across multiple sectors.

In publishing this report, NCInnovation is fulfilling its statutory mandate to conduct the above-referenced data analysis and provide the Statewide Strategic Technology Development Plan. In doing so, NCInnovation recognizes the myriad stakeholders involved in innovation, entrepreneurship, and applied research commercialization and in no way presupposes how each might choose to use the findings presented herein. By the same token, NCInnovation was purpose-built to address the widening gap in North Carolina's incoming research and development dollars and the commercialization of successful applied research. Using a similar methodology in framing this report, NCInnovation recognizes its place as a conduit of data, analysis, and information without being prescriptive about how other organizations might use those outputs.

Simply put, NCInnovation was charged with developing a strategic roadmap that might inform North Carolina research commercialization activities. However, NCInnovation was not (nor should it be) authorized to direct the tactics or implementation plans of other entities. To this end, NCInnovation offers the following strategic technology development objectives for others' consideration. This report will describe the following objectives more fully and provide an overview of the evidence used to generate them.

Limitations

As with any study of this scope, the research team encountered some limitations. Differences in organizational structures and in the maturity of innovation processes at various North Carolina public universities led to a more customized data collection approach than initially predicted. Balancing the analysis of hub universities with the broader region was also a challenge, particularly for the larger regions. Under NCInnovation's guidance, RTI has already begun a deeper analysis of additional non-hub universities to help expand regional knowledge. Understanding and developing NCInnovation's role in the broader North Carolina innovation ecosystem was an important part of this work, as NCInnovation sought to further strengthen relationships with partners and avoid duplicating effort of others across the state.

Due to the pace of innovation and technology development, this report will become rapidly obsolete. NCInnovation will conduct ongoing analysis in its hub regions as it further develops its programs. Over time, NCInnovation will continue to mature its capability to monitor technology development across the hub regions and will release periodic updates.

This report is responsive to language in Section 2.2(k)(2)(b) of the Current Operations Appropriations Act of 2023 (S.L. 2023-134) and is scoped accordingly. Therefore, it does not include an exhaustive study of all aspects of technology-based economic development, such as workforce/talent development and retention, suggestions for encouraging venture capital investment in the state, specific initiatives aimed at recruiting high tech companies to the state, or specific initiatives and programs that may be advisable for individual universities to consider.

Statutory Requirements

As noted above, NCInnovation's authorizing language imposes several reporting obligations on the organization. Among them, Section 2.2(k)(2)(b) of the Current Operations Appropriations Act of 2023 (S.L. 2023-134) ties NCInnovation's second-year funding to five requirements, including the following:

- NCInnovation has completed (i) research, technology, and innovation studies of the four regional innovation hubs to maximize local educational efforts and the commercialization of those efforts to meet regional needs and (ii) a statewide strategic technology development plan.

Second, N.C. General Statute §143-728 (d)(3)(a) requires NCInnovation to perform several duties, one of which is to establish and support a network of regional innovation hubs. In the performance of this duty the law outlines seven items that NCInnovation should perform, which include:

- Conducting analysis of research activities, capacities, and capabilities of each higher education research institution in each university research hub in light of commercial innovation needs in the hub, including (i) identifying specific strengths and gaps that could benefit from regional collaboration, (ii) identifying existing patents and research and, where applicable, how the patents or research might have commercial application for industry needs, and (iii) creating a strategic plan to guide future investments and identify resources or infrastructure required to implement and apply patents and research into commercialized innovation.
- Providing the results of, and associated guidance concerning, conducted analyses to assist connecting hub-specific capabilities with regional commercial needs and to ensure applied research investments are aligned with regional strengths, capabilities, and commercial opportunities.

This report is responsive to the statutory obligation that NCInnovation complete the **STATEWIDE STRATEGIC TECHNOLOGY DEVELOPMENT PLAN** called for by Section 2.2(k)(2)(b) of the Current Operations Appropriations Act of 2023. It is informed by NCInnovation's research, technology, and innovation studies of the four regional innovation hubs, together with analysis of research activities, capacities, and capabilities of each higher education research institution as they relate to regional commercial innovation needs.

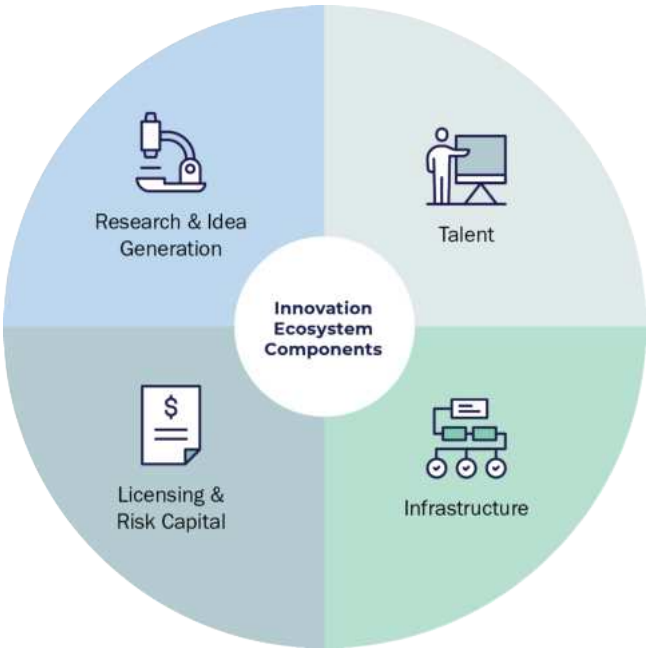
This report outlines the specific university R&D strengths that may offer commercial applications for regional industry, as well as opportunities for collaboration to advance regional capabilities. It also provides strategic recommendations – with more research commercialization as an end goal – to guide university research activity and infrastructure across the state.

ABOUT THIS REPORT

METHODS

RTI performed an extensive assessment to identify technology areas of strength and assess their alignment with industry needs. The team evaluated regional innovation assets and sought industry input to guide recommendations to support forward-looking industry cluster growth in North Carolina. RTI considered both *capability push* and *market pull*. Capability push refers to the development of innovative technologies, products, or services driven by internal capabilities and expertise. Market pull refers to the development of innovative technologies, products, or services driven by external market demands and needs.

First, RTI analyzed existing capabilities and infrastructure within NCInnovation's four regional innovation networks according to four categories that comprise the "innovation ecosystem framework" (see Innovation Ecosystem Components figure right). From this analysis, RTI developed recommendations for university-centered innovation focused on: 1) industry engagement; 2) applied research; and 3) entrepreneurial activity and commercialization. Second, RTI assessed market needs. The team sought to understand technical challenges of six state-wide strategic technology focus areas. NCInnovation's four hub universities gave feedback on their technology portfolios to inform RTI's market-driven technology development recommendations for NCInnovation research grant support.



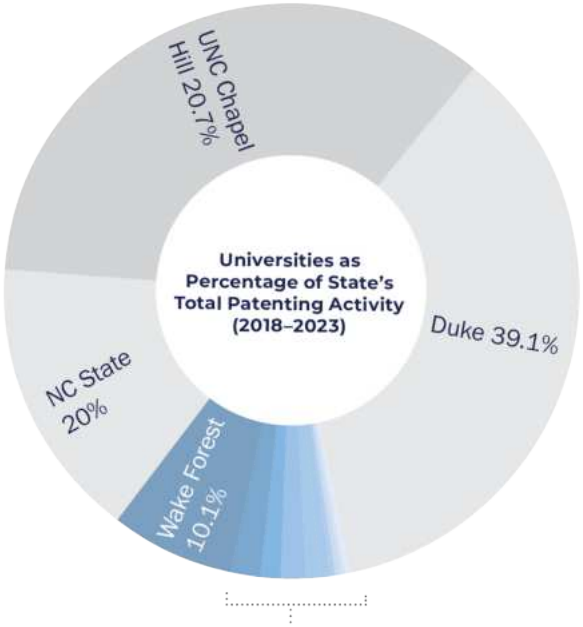
RTI's innovation ecosystem framework details four critical components to consider when understanding the assets of an ecosystem.

RTI's approach included both quantitative and qualitative data. Quantitative analysis of the universities' capabilities and assets include these sources the National Science Foundation (NSF) Higher Education R&D Survey, US Department of Education IPEDS, Association of University Technology Managers, US Patent and Trademark Office, Innography, and Patsnap. Quantitative data sources regarding regional assets included the US Bureau of Economic Analysis, US Bureau of Labor Statistics, IdeaGist, Pitchbook, SBIR/STTR, and USPTO.

The quantitative data was supplemented and contextualized through qualitative data drawn from site visits to the innovation hubs and regional interviews. Site visits included conversations with university stakeholders, including tech transfer personnel, faculty, and other university leadership to understand existing industry collaborations, research strengths, and commercialization activity. To understand regional assets, RTI conducted regional interviews with stakeholders, including entrepreneurial support and economic development organizations.

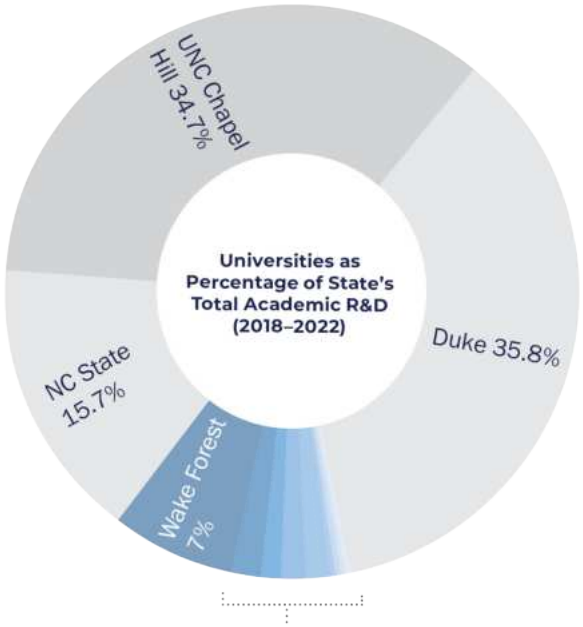
NCInnovation serves the entire state, and its statewide grant program will be open to all regions of North Carolina. NCInnovation's early focus has been on regions outside the Triangle so that resources are initially directed toward the areas with less developed innovation ecosystems. The Triangle contains three research universities comprising 87% of all academic R&D expenditures in the state. Because of the uneven distribution of innovation infrastructure, this report focuses primarily on the regions outside the Triangle.

Three research universities in the Triangle comprise nearly 80% of NC's total patenting activity.



UNC Charlotte 4.3% | ECU 1.5% | NC A&T 1.5% | NC A&T 1.5% | UNC Greensboro 1.0% | Appalachian State 0.2% | UNC Wilmington 0.2% | Fayetteville State 0.2% | Winston-Salem State 0.1% | NC Central 0.1% | WCU 0.1% | Johnson C. Smith 0.0% | Davidson 0.0% | Elon 0.0% | Elizabeth City State 0.0% | UNC Asheville 0.0%

Three research universities in the Triangle comprise more than 85% of NC's total academic R&D.



ECU 1.5% | UNC Charlotte 1.3% | NC A&T 1.2% | UNC Greensboro 0.9% | UNC Wilmington 0.5% | NC Central 0.4% | Winston-Salem State 0.2% | UNC Asheville 0.1% | Appalachian State 0.1% | UNC Gen Adm 0.1% | Fayetteville State 0.1% | WCU 0.1% | Johnson C. Smith 0.1% | Davidson 0.1% | Elon 0.1% | Elizabeth City State <0.1%

Although NCInnovation focuses on the entire state, the Triangle region has a majority of the R&D investment; thus, our analysis explored the assets of the four other regions.

Six Strategically Important Technology Focus Areas

RTI analyzed technology focus areas to determine the areas where the state is best positioned to excel globally to drive innovation and national competitiveness for economic growth. Though NCInnovation remains technology agnostic, identifying technology focus areas will help guide NCInnovation's investments into areas most primed for growth, and thus generate an ROI to the state. This Statewide Strategic Technology Development Plan builds upon a foundation established by RTI's prior work on *A Blueprint for Building an Innovation Corridor*.[4] The authors of that report analyzed a corridor of North Carolina that included Greensboro–Winston- Salem–High Point, Raleigh–Durham–Chapel Hill, Rocky Mount–Wilson–Roanoke Rapids, and Greenville–Washington. They identified four technology focus areas of strategic importance, including AgTech, Biohealth, Power Electronics for Transportation, and Defense Innovation.

The current RTI study expands that analysis statewide and refines the recommended technology development areas, taking a particularly close look at NCInnovation's regional hub universities. The findings supported refining several of the previously identified technology focus areas plus adding two more, as described below.

ADVANCED MANUFACTURING captures innovations in automation, robotics, data analytics, machine learning (ML) and artificial intelligence (AI), and additive manufacturing that enable improvements in efficiency and quality of manufacturing as well as enable new manufacturing processes and on-demand manufacturing. This category includes automation & robotics adoption, integration of data analytics, the Internet of Things, and additive manufacturing.

AGTECH covers life sciences, food science, digital technologies, machine learning, and other forms of technology that can improve or disrupt the global agricultural sector. These technologies typically focus on enhancing the productivity, efficiency, sustainability, climate impacts, and/or profitability of the global agriculture industry. AgTech includes crop protection, precision agriculture, climate/sustainability, genetically modified crops/animals, and automation.

BIOHEALTH encompasses the discovery, development, and manufacture of medical devices, pharmaceuticals, biomaterials, and other applications of biotechnology, engineering, and health technology to solve biological or medical problems related to human health. Biohealth excludes hospitals, clinics, health care systems, service providers, and payers, although they are related. It includes digital technology & analytics, biomaterial & other biologics, platform technologies, and specialty & personalized medicine.

COMPUTING & INFORMATICS captures the research and development into hardware, software, and computer science advances that enable improved computational performance, access, and networking capabilities. Artificial intelligence (AI), cybersecurity, edge computing, and addressing the need for enhanced data centers are included.

DEFENSE INNOVATION includes the design, development, and commercialization of soldier-centric technology solutions for advanced autonomous systems, secure data & knowledge management (i.e., cybersecurity), improved human performance, advanced materials, and power in the context of enabling a strong, modern national security. Defense Innovation includes advanced materials, energy generation/storage, microelectronics, manufacturing & supply chain, and trusted AI and autonomy.

ENERGY TRANSITION & ELECTRIFICATION includes new developments in semiconductors (including wide band gap materials for power electronics), systems engineering, grid-connected technologies, and other areas that enable advancements in cleantech or climate tech driving the transition to renewable energy and an electrified nation. This category includes distributed power source management, decarbonization, power electronics integration, and energy storage/deployment.

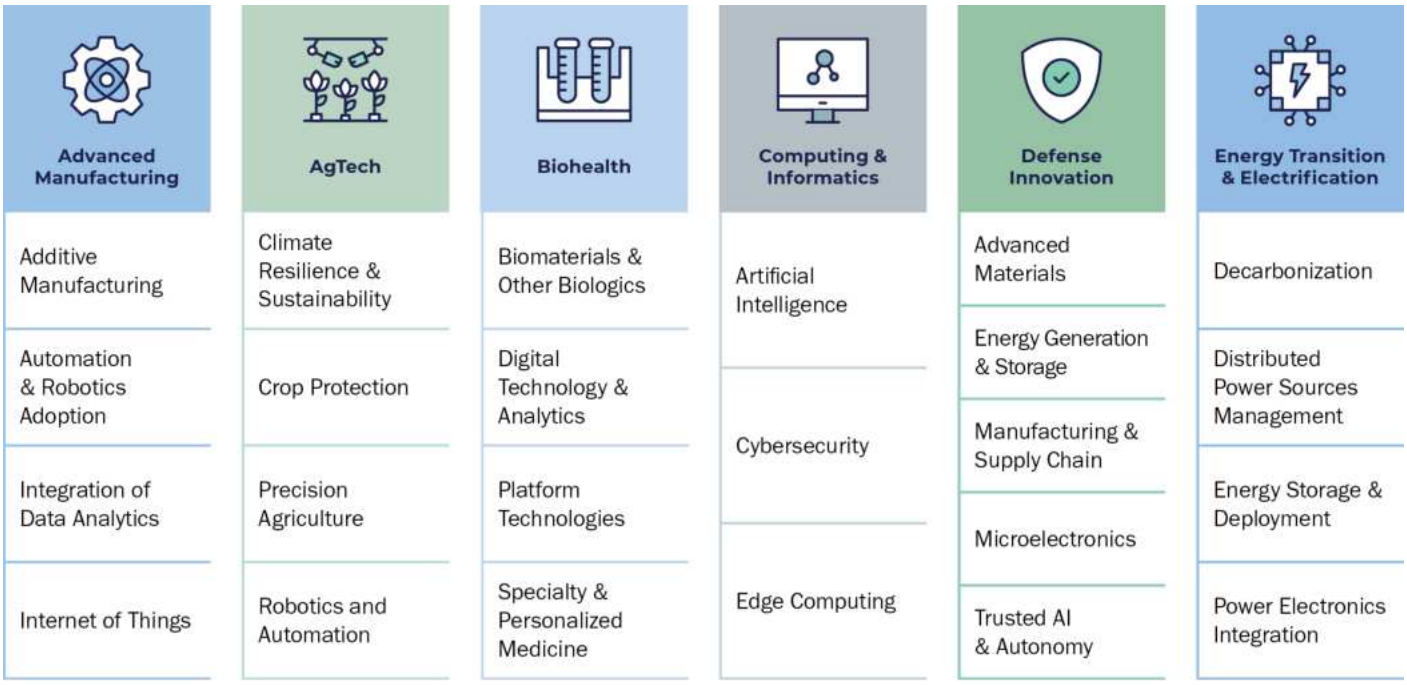
Analysis and Recommendations

The analysis contained in this report has potential implications for the entire state, and NCInnovation does not have the statutory authority, nor the scope and capacity, to address a full suite of statewide recommendations. However, NCInnovation includes the full set here and defers to state and local policymakers and colleagues in economic development organizations, innovation ecosystem organizations, the UNC System Office, and the UNC System institutions to apply these recommendations within their own domains. The statewide strategic technology development recommendations in this report sit at the intersection of regional technology strengths and market needs. These recommendations identify specific opportunity areas for technology development and growth in North Carolina that will help focus energy and resources. A combined understanding of the technical challenges in a specific industry and the regional technology strengths is crucial for assessing investment opportunities in applied research and technology commercialization. This combined understanding helps align technology-driven innovation with market needs, thereby enhancing the probability of successful commercialization.

To develop this understanding, RTI used a comprehensive approach to assess both the market needs of the six technology focus areas and the technology strengths of each region. They conducted in-depth interviews with key experts in each of the six technology focus areas. Through these interviews, they heard first-hand the technical challenges and market needs specific to each technology focus area. Each of these needs and challenges represent opportunities that universities and partners could consider addressing via applied research, technology development, and commercialization. Additionally, RTI conducted a thorough assessment of the existing assets and capabilities within each technology focus area, considering factors such as patenting and publication activity, regional companies, industry partnerships, and venture funding. By combining these insights, they were able to define the intersection of regional technology strengths and market needs, pinpointing specific opportunity areas for technology development in North Carolina.

EXISTING REGIONAL STRENGTHS BY TECHNOLOGY FOCUS AREAS

For each technology focus area, RTI evaluated innovation assets and areas of technology strength in each North Carolina region. Note that this report makes a distinction between regional technology strengths and regional economic/industry strengths. These two areas of strength may not always align in all regions. The analysis in this section helps to illustrate possible areas for collaboration across the state and indicates ways in which each region may contribute to economic growth related to each technology focus area.



Advanced Manufacturing

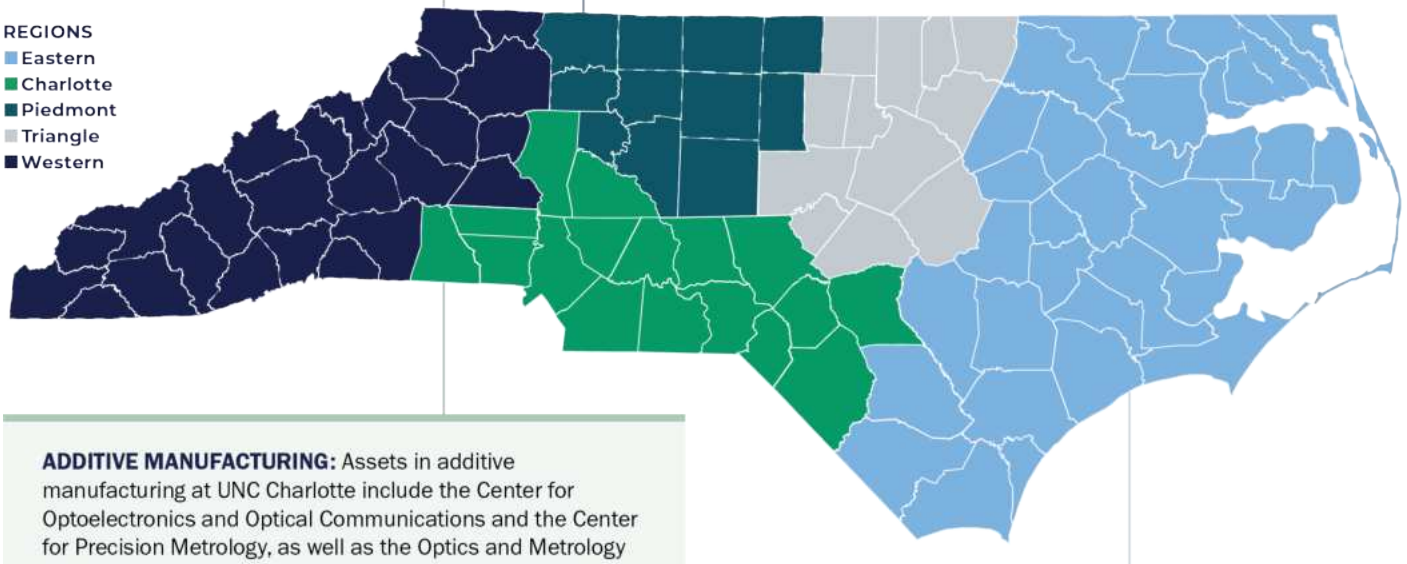
AUTOMATION AND ROBOTICS ADOPTION AND ADDITIVE MANUFACTURING: WCU's Rapid Center, a state-of-the-art prototyping facility, has automation and robotics capabilities and additive manufacturing.

ADDITIVE MANUFACTURING: NC A&T has a Center of Excellence in Product Design and Advanced Manufacturing, which has additive manufacturing labs. The Nussbaum Center for Entrepreneurship is developing The Steelhouse, an urban manufacturing innovation center in Greensboro.

AUTOMATION AND ROBOTICS ADOPTION: NC A&T has research strengths in autonomy and systems controls engineering, and is a partner institution on NSF's Engineering Research Center (ERC), Hybrid Autonomous Manufacturing, Moving from Evolution to Revolution (HAMMER). This region has a diversity of manufacturers across aerospace, automotive, and life sciences industries that would benefit from advances in this area.

INTEGRATION OF DATA ANALYTICS: NC A&T has research strengths in software and advanced manufacturing that can be leveraged to support integration of data analytics.

INTERNET OF THINGS: NC A&T has research strengths in systems controls engineering and autonomy. Sensory Analytics, a global company headquartered in Greensboro, has developed real-time non-contact sensing of coating thicknesses.



ADDITIVE MANUFACTURING: Assets in additive manufacturing at UNC Charlotte include the Center for Optoelectronics and Optical Communications and the Center for Precision Metrology, as well as the Optics and Metrology U.S. Economic Development Administration (EDA) Tech Hubs Development Award. In 2022, Siemens opened a new technology hub in Charlotte to accelerate implementation of additive manufacturing.

AUTOMATION AND ROBOTICS ADOPTION: UNC Charlotte's Battery Complexity, Autonomous Vehicle and Electrification Research Center (BATT CAVE) has strengths in robotics and automation. Regional companies like Muratec and Ellison Technologies are developing automation solutions.

INTEGRATION OF DATA ANALYTICS: UNC Charlotte has research strengths in computing, visualization, and informatics, as well as emerging strength in AI/data science.

INTERNET OF THINGS: UNC Charlotte has research strengths in computing and cybersecurity, as well as emerging strength in artificial intelligence (AI)/data science. Key research centers include the Center for Precision Metrology.

AUTOMATION AND ROBOTICS ADOPTION: ECU's Advanced Manufacturing Lab is focused on robotics, additive manufacturing, and warehousing technologies. Several companies in the region are developing advanced technologies and automation for warehouses and logistics, including Cummins, Wilmington Machinery, and Hyster-Yale.

AgTech

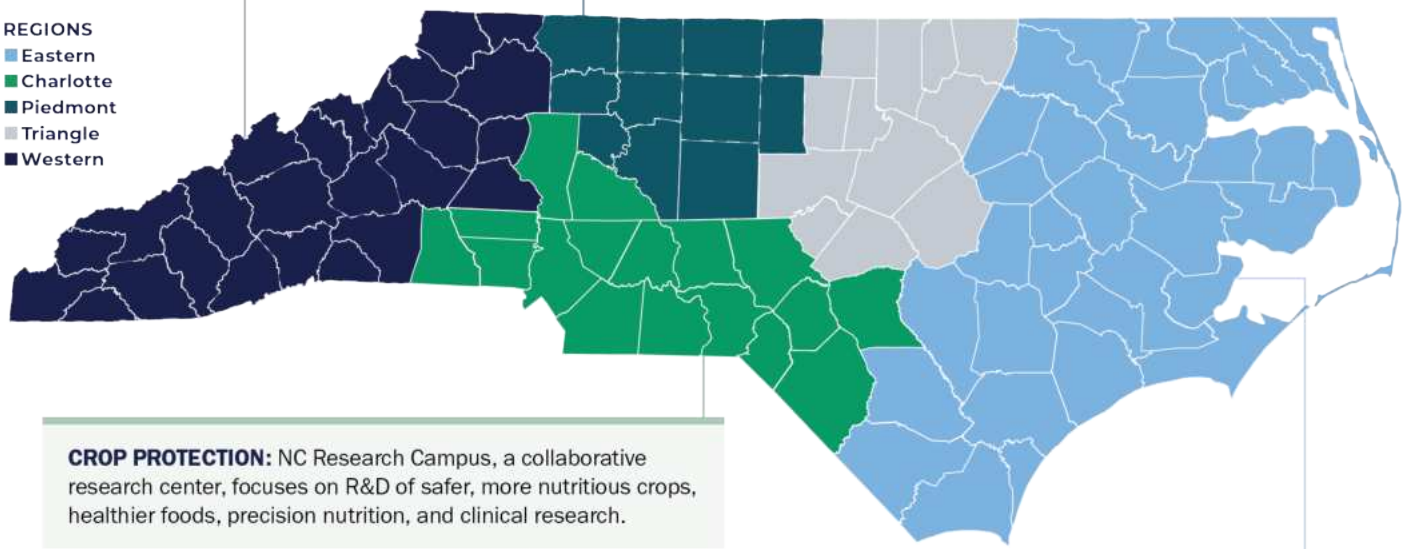
CLIMATE RESILIENCE AND SUSTAINABILITY: NC A&T has research centers in post-harvest technologies, environmental farming systems, and a small farms resource and innovation center. NC A&T, collaborating with ECU and research universities in the Triangle, recently won an NSF Engines development award called CROPS to build an AgTech innovation corridor that supports research on plant response to climate change.

CROP PROTECTION: Syngenta has formulation and product safety R&D centers in Greensboro and is developing its Crop Protection headquarters in the region.

PRECISION AGRICULTURE: NC A&T has research strengths in agriculture, software, autonomy, and systems controls engineering that can be leveraged to support precision agriculture. They also have a new partnership with NC State and SAS for digital agriculture solutions.

ROBOTICS AND AUTOMATION: NC A&T has research strengths in agriculture, software, autonomy, and systems controls engineering.

CLIMATE RESILIENCE AND SUSTAINABILITY: The National Oceanic and Atmospheric Administration's (NOAA's) National Climatic Data Center is based in Asheville.



CROP PROTECTION: NC Research Campus, a collaborative research center, focuses on R&D of safer, more nutritious crops, healthier foods, precision nutrition, and clinical research.

CLIMATE RESILIENCE AND SUSTAINABILITY: UNC Wilmington is the lead institution on an NSF Engines strategy award focused on aquaculture and coastal infrastructure. Additionally, ECU is connected to NC A&T's NSF Engines strategy award – CROPS.

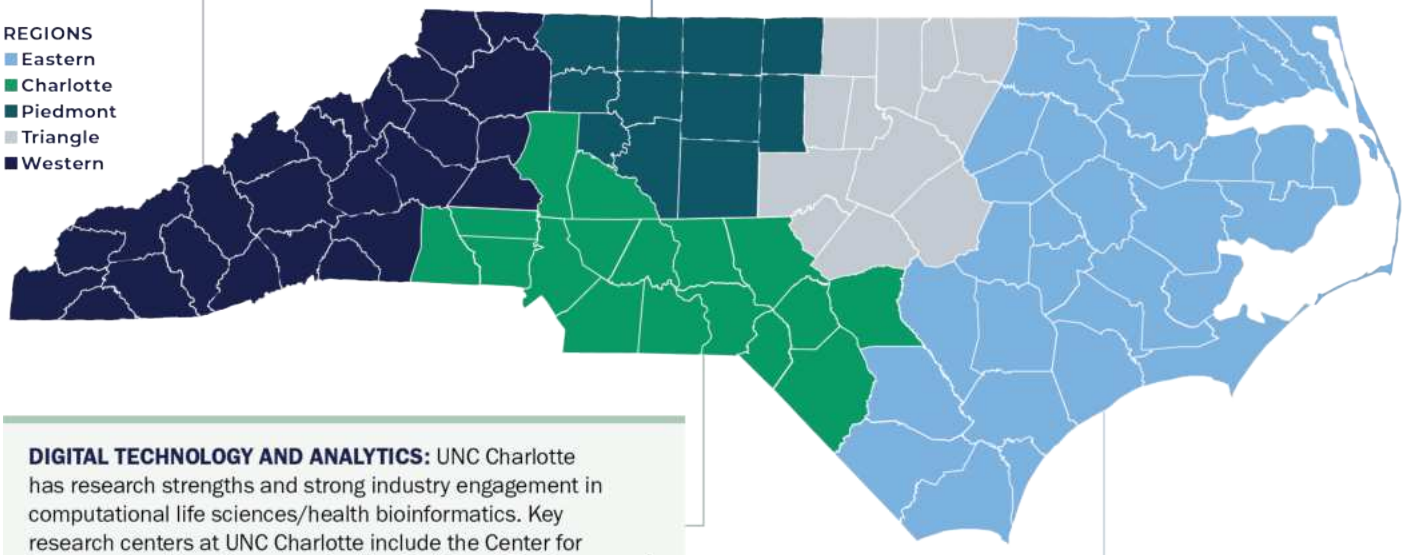
Biohealth

DIGITAL TECHNOLOGY AND ANALYTICS AND SPECIALTY AND PERSONALIZED MEDICINE: Regional universities have emerging strengths in these areas. For example, WCU is researching the assessment of mosquito-borne diseases.

BIOMATERIALS AND OTHER BIOLOGICS: NC A&T has research strengths in agriculture, nanoscience, and biomaterials.

PLATFORM TECHNOLOGIES: In April, NC A&T and Merck launched the Merck Biotechnology Learning Center at the Gateway Research Center. This center will provide workforce development and training opportunities for NC A&T students in biotechnology. Additionally, ProKidney Corp. is building a new biomanufacturing facility in Greensboro.

SPECIALTY AND PERSONALIZED MEDICINE: Wake Forest and Winston-Salem have significant assets in regenerative medicine, including RegeneratOR, Institute for Regenerative Medicine, RegenMed Hub, and an NSF Engines award.



DIGITAL TECHNOLOGY AND ANALYTICS: UNC Charlotte has research strengths and strong industry engagement in computational life sciences/health bioinformatics. Key research centers at UNC Charlotte include the Center for Computational Intelligence to Predict Health and Environmental Risks (CIPHER) and the AI Institute for Human Digital Twin and Computational Health.

BIOMATERIALS AND OTHER BIOLOGICS: The BioPharma Crescent is a five-county region primarily in eastern NC with more than a dozen companies (e.g., Catalent, ThermoFisher, CMP Pharma) that employ 10,000 people in the pharma industry.

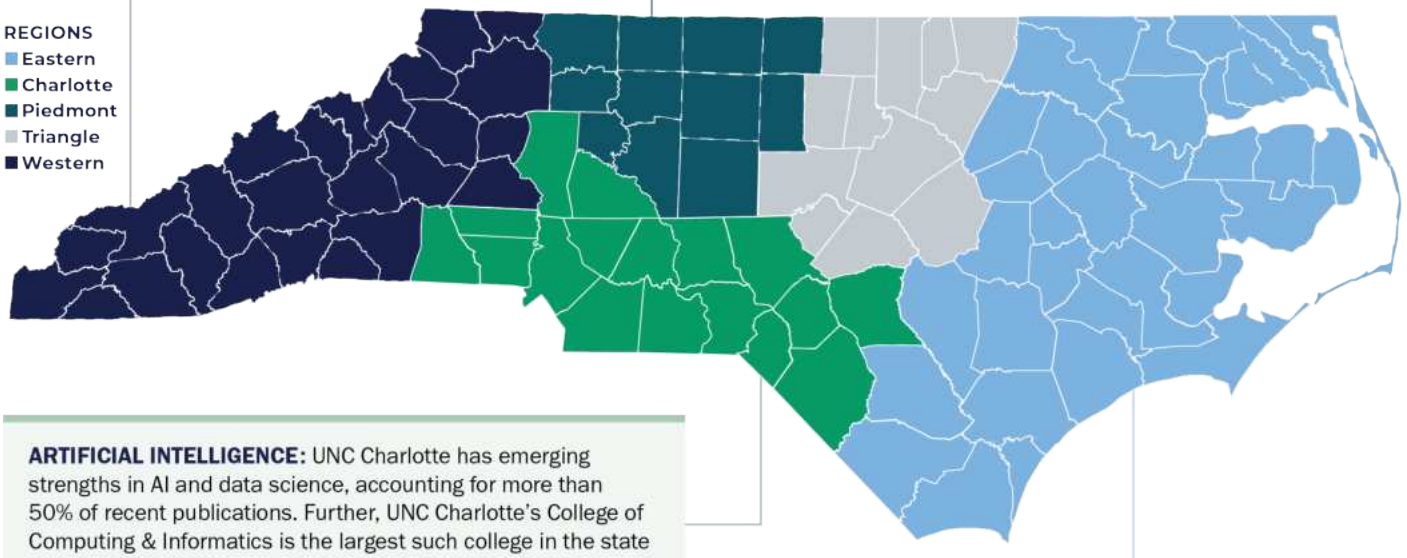
ECU and the Golden Leaf Foundation supported the founding of the Eastern Region Biopharma Center. The center at ECU has partnerships with 15 regional pharmaceutical companies and 5 eastern community colleges.

Computing & Informatics

ARTIFICIAL INTELLIGENCE AND EDGE COMPUTING: The private sector is relatively active in this space across the region, accounting for $10M in private venture deals including funding for Ecobot. Further, established companies like Cattron are developing automation solutions leveraging advances in networking and data analysis to support the manufacturing sector—the largest industry in the region.

ARTIFICIAL INTELLIGENCE: NC A&T has key research centers in this area including the Autonomous Control and Information Technology Institute and the Center for Trustworthy AI (CTA).

CYBERSECURITY: NC A&T's cybersecurity programs are designated a National Center of Academic Excellence in Cyber Defense Education and Cyber Defense Research. Key research and education centers at the university include the Center of Excellence in Cybersecurity Research, Education, and Outreach (CREO) and the Center for Cyber Defense.



ARTIFICIAL INTELLIGENCE: UNC Charlotte has emerging strengths in AI and data science, accounting for more than 50% of recent publications. Further, UNC Charlotte's College of Computing & Informatics is the largest such college in the state by number of graduates.

CYBERSECURITY: UNC Charlotte's cybersecurity programs are nationally recognized as a Center of Academic Excellence in Cyber Defense and Education by the U.S. National Security Agency (NSA) and the U.S. Department of Homeland Security (DHS). Further, UNC Charlotte and regional partners are working together to launch the North Tryon Tech Hub to further establish the region as a computational and informatics technology center of excellence.

CYBERSECURITY: ECU's Information and Computer Technology program is designated as a National Center of Academic Excellence in Cyber Defense Education. Additionally, the number of graduates from ECU in computer science and related fields rank second behind the medical and dental schools.

Defense Innovation

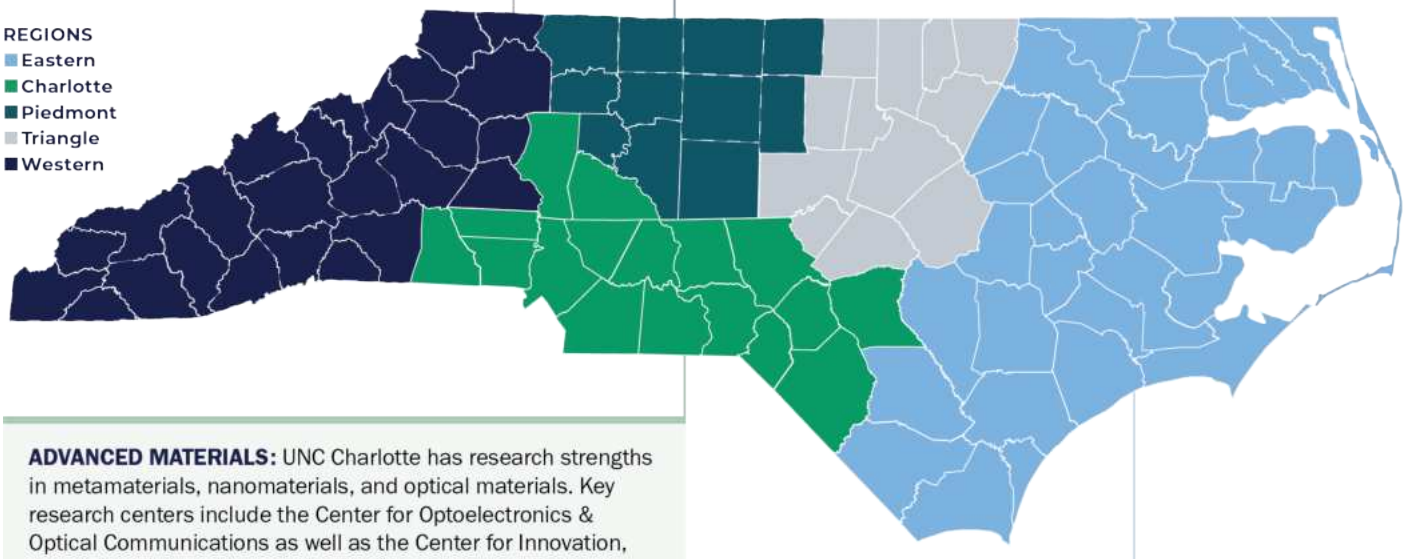
MANUFACTURING AND SUPPLY CHAIN: WCU's faculty and staff are experienced in working on defense-related projects through Capstone engagements and the Rapid Center state-of-the-art prototyping facility. Aviation and defense companies in the region include GE Aerospace (previously GE Aviation), Pratt & Whitney (Raytheon), and Kearfott.

ADVANCED MATERIALS: NC A&T has research strengths in nanoscience, composites, and other materials. Key research centers include the Center for Advanced Materials and Smart Structures and the Center for Composite Materials Research.

ENERGY GENERATION AND STORAGE AND MICROELECTRONICS: NC A&T has research strengths in nanoscience, power electronics, and advanced materials.

MANUFACTURING AND SUPPLY CHAIN: NC A&T has research strengths in software, autonomy, and systems controls engineering. The region is home to several aviation and defense companies including General Dynamics, Lockheed Martin, Textron, and Collins.

TRUSTED AI AND AUTONOMY: NC A&T's cybersecurity programs are designated National Center of Academic Excellence in Cyber Defense Education and Research by NSA. Key research centers in the Center for Excellence in Cybersecurity Research, Education and Outreach, and the Center for Trustworthy AI.



ADVANCED MATERIALS: UNC Charlotte has research strengths in metamaterials, nanomaterials, and optical materials. Key research centers include the Center for Optoelectronics & Optical Communications as well as the Center for Innovation, Translational Research and Applications of Nanostructured Systems.

ENERGY GENERATION AND STORAGE: UNC Charlotte has research strengths and industry engagement in energy and power grid technologies. Key research centers include the BATT CAVE, Energy Production and Infrastructure Center (EPIC), and Center for Advanced Power Engineering Research (CAPER).

MANUFACTURING AND SUPPLY CHAIN AND MICROELECTRONICS: UNC Charlotte has research strengths in optics, optical communications, and precision metrology.

TRUSTED AI AND AUTONOMY: UNC Charlotte's cybersecurity programs are designated National Center of Academic Excellence in Cyber Defense Education and Research by NSA. The Emerging Technology Institute is a regional asset that works with Fort Liberty to test drone and AI technology.

ADVANCED MATERIALS: Spirit AeroSystems Composite Center of Excellence is based in the region.

MANUFACTURING AND SUPPLY CHAIN: This region is home to multiple military locations with manufacturing needs, notably MRO at the Navy's Fleet Readiness Center East (FRC East) at Marine Corps Air Station Cherry Point and MRO at Global TransPark.

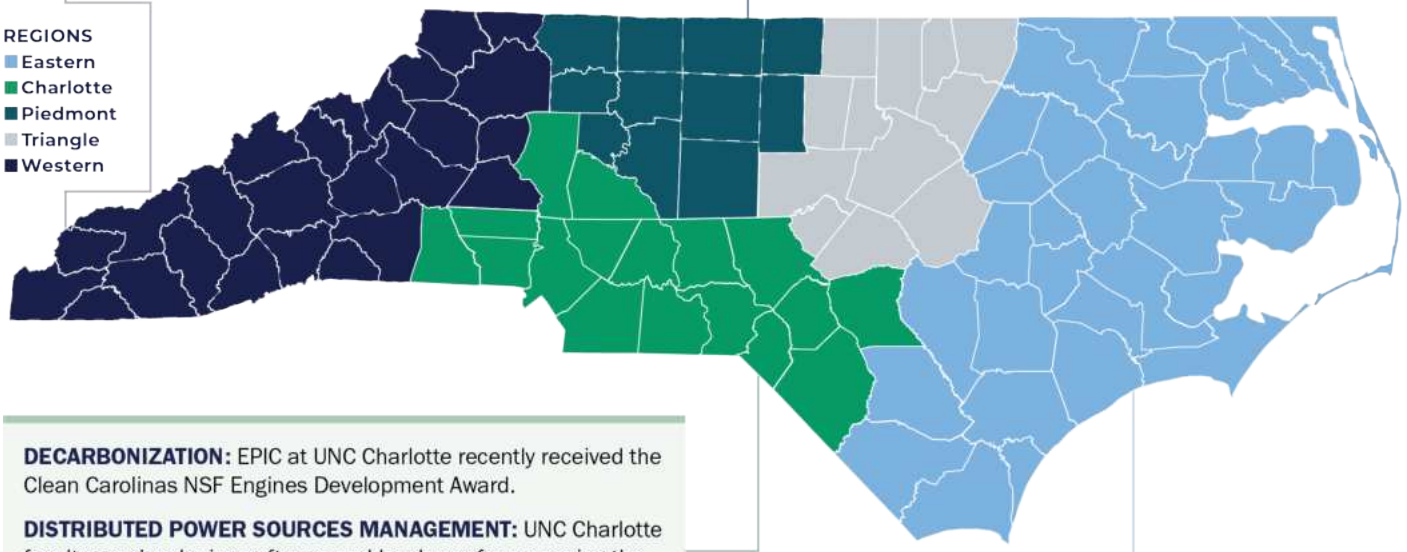
TRUSTED AI AND AUTONOMY: ECU's cybersecurity programs are designated National Center of Academic Excellence in Cyber Defense Education by NSA.

Energy Transition & Electrification

DISTRIBUTED POWER SOURCES MANAGEMENT AND ENERGY STORAGE & DEPLOYMENT: Capstone projects through WCU's Rapid Center are connecting power systems clients to the university.

ENERGY STORAGE & DEPLOYMENT: Regional universities (e.g., NC A&T and UNC Greensboro) have become leaders in battery technology development from new chemistries and architectures to novel lithium refining techniques to enable improved manufacturing techniques. The region is host to battery startups (e.g., Soelect), established companies (e.g., Toyota Batteries, Energizer Holdings, and Kriesel Electric) and workforce development programs (Carolina Battery Institute).

POWER ELECTRONICS INTEGRATION: NC A&T has established strengths in materials science and recently engaged in a partnership with Wolfspeed to create a joint R&D facility for advanced semiconductors for power electronics.



DECARBONIZATION: EPIC at UNC Charlotte recently received the Clean Carolinas NSF Engines Development Award.

DISTRIBUTED POWER SOURCES MANAGEMENT: UNC Charlotte faculty are developing software and hardware for managing the next-generation electrical grid. The university's partnership with Duke Energy enables testing of the inventions at Duke's Mount Holly Technology and Innovation Center. Much of this work is supported through UNC Charlotte's EPIC. Electronics Power Research Institute's (EPRI) Charlotte lab and testing facilities work on expanding transmission line capacity and other related research.

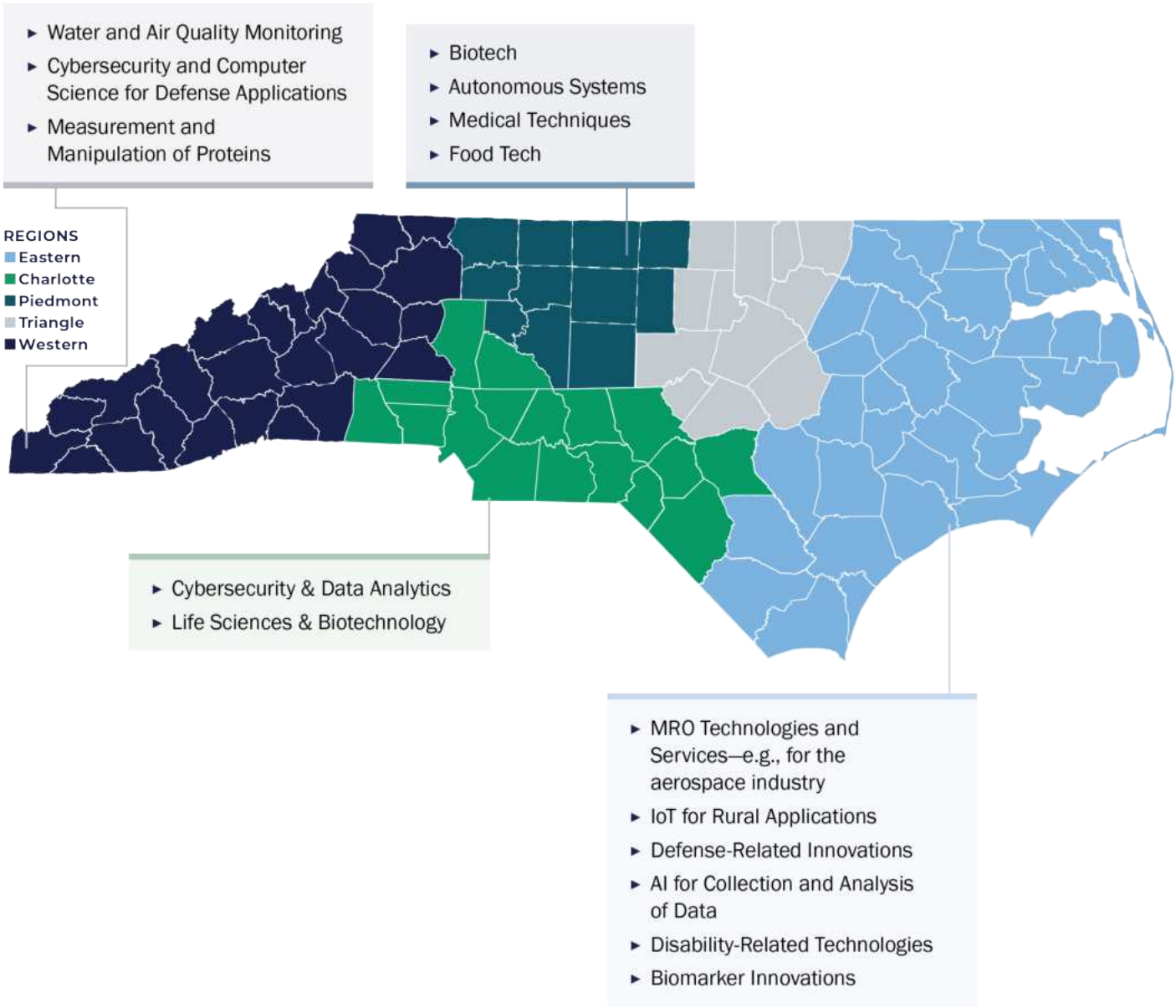
ENERGY STORAGE & DEPLOYMENT: The BATT CAVE is a hub of innovation and research related to this market need.

POWER ELECTRONICS INTEGRATION: UNC Charlotte's CAPER supports research in this area.

DECARBONIZATION: Headquartered in Wilmington, GE Hitachi Nuclear Energy is a nuclear power leader, developing small modular reactors (SMRs).

ENERGY STORAGE & DEPLOYMENT: Epsilon Advanced Materials has announced a new battery anode manufacturing facility in Wilmington.

Several emerging areas of expertise and research at the four hub universities were identified during discussions between RTI and the universities.



OPPORTUNITIES FOR GROWTH BY TECHNOLOGY FOCUS AREA

As illustrated above, North Carolina has a wealth of technology-oriented strengths that can contribute to development of technologies in the six focus areas. These recommendations, in alphabetic order by technology focus area, represent opportunities for North Carolina public universities and regional partners to come together to solve large, pressing needs expressed by industry.

Advanced Manufacturing

Advanced Manufacturing is a critical sector in North Carolina due to its significant role in driving economic growth and innovation across multiple industries. Major industries like aerospace, automotive, biotechnology, and machinery production brought manufacturing to the state and are reliant on future advancements in manufacturing to stay competitive. North Carolina's legacy of manufacturing started with tobacco, textiles, and furniture. Today, North Carolina's economy boasts the largest Advanced Manufacturing workforce in the Southeast.[5] The state is home to global manufacturing leaders as well as a network of innovative small and midsized firms driving advances in areas like precision machining, microelectronics, and materials. Specific areas of need identified by industry that are relevant to North Carolina include:

1. **ADDITIVE MANUFACTURING:** Address technology needs of additive manufacturing, such as process monitoring and new material creation.
2. **AUTOMATION AND ROBOTICS:** Create technologies to better enable manufacturers to adopt automation and robotics so they can increase manufacturing efficiency, reduce costs, and mitigate labor shortages.
3. **INTEGRATION OF DATA ANALYTICS:** Develop data analytics tools to provide improved forecasting capabilities and abilities to proactively identify supply shortages, ensuring these issues are addressed before they disrupt the manufacturing line.
4. **INTERNET OF THINGS (IOT):** Align research to support the development of IoT technologies that collect and analyze data from sensors on equipment and the factory floor to improve efficiency and reduce both maintenance and product irregularities.

AgTech

Agriculture is North Carolina's #1 industry, contributing over $100 billion to the state's economy.[6] Across the four regions of study, there are at least 90 tech-based agriculture companies developing patents in AgTech, including BASF Agricultural Solutions Seed US LLC, Syngenta Participations AG, and Believer Meats. North Carolina startups have benefited from at least $48M in recent private investment and venture deals, as well as attracted SBIR awards from the U.S. Department of Agriculture (USDA). From an R&D perspective, North Carolina public universities have programs and infrastructure to support AgTech innovation, including collaborative efforts like the NC Agromedicine Institute, the Climate-Responsive Opportunities in Plant Science (CROPS) NSF Innovation Engine (NSF Engines) award, and the NCSU Extension Program. Specific areas of need identified by industry that are relevant to North Carolina include:

1. **CLIMATE RESILIENCE AND SUSTAINABILITY PRACTICES FOR AGTECH:** Develop climate resilient and sustainable technologies across the AgTech supply chain, spanning needs such as climate resilient seeds, waste reduction, upcycling agricultural byproducts, water treatment for forever chemicals, and sustainable packaging.
2. **CROP PROTECTION:** Create biological solutions to accelerate shift away from synthetic chemistry to biologics to better control and target specific pests and diseases without chemicals.
3. **PRECISION AGRICULTURE:** Demonstrate and encourage adoption of precision agriculture advancements (sensors, AI, drones, other technologies) beyond large commercial farms to increase efficient agriculture production.
4. **ROBOTICS AND AUTOMATION:** Develop robotics and automation technologies to provide solutions for labor-intensive, repetitive, and physically demanding agricultural tasks.

Biohealth

North Carolina has emerged as a leader in Biohealth, cultivating an innovation ecosystem, research, and cutting-edge advancements. With more than 830 life sciences companies driving transformative change, particularly in pharma/biopharma manufacturing, gene and cell therapy, and contract research, the North Carolina life science industry employs “more than 75,000 people, generates $88B in annual economic impact, and brings in $2.4B in state and local government tax revenue every year” (Haskins & Parilla, 2024).[7] Specific areas of need identified by industry that are relevant to North Carolina include:

1. **BIOMATERIALS AND OTHER BIOLOGICS:** Leverage statewide institutional and regional strengths in biopharma to develop novel biological-based (vs chemistry-based) medicines and therapeutics, as well as novel production and processing methods. New methods will also require the development of specially trained talent pools.
2. **PLATFORM TECHNOLOGIES:** Seek opportunities to leverage Biohealth and AgTech expertise in development of advancements in platform technologies like fermentation (i.e., processes and methods that enable the creation of multiple other technologies). New platform technologies will be needed to enable further innovation across Biohealth.
3. **SPECIALTY AND PERSONALIZED MEDICINE:** Combine expertise in pharma, biotech, and computational capabilities to tackle development of precision medicines that take into account an individual’s genetics, environment, and lifestyle for increased effectiveness.

4. **DIGITAL TECHNOLOGY AND ANALYTICS:** Support the development of new systems and methods (including data analysis, sensors, compliance measures) for transforming the vast amount of data being generated in Biohealth fields and manufacturing into actionable information.

Note that both biomaterials and platform technology development could enable opportunities to explore greater collaboration with industry on solving/co-developing specialized manufacturing processes and specially trained talent pools to enable commercialization and implementation of new methods.

Computing & Informatics

Computing & Informatics is a critical technology space, especially considering the wide array of industries that can benefit from Computing & Informatics advancements including multiple key sectors in North Carolina. Solutions that can provide improved computational performance, cybersecurity protection, visualization and manipulation of large datasets, or improved networking capabilities should be considered highly valuable across many industries, but specifically manufacturing, which is a top-three industry in all four North Carolina regions of interest. In pursuit of this, in North Carolina, more than $680M in private venture deals has been executed to support startups in sectors related to Computing & Informatics outside of the Triangle region. Further, the state's universities reported more than $80M in R&D expenditures in computer and information sciences. In the four regions of study, nearly 250 tech-based companies are producing IP in this area, including Bank of America, Wells Fargo, IBM, Cattron, and ECR Software. Specific areas of need identified by industry that are relevant to North Carolina include:

1. **ARTIFICIAL INTELLIGENCE (AI):** Develop data and computer science technologies that enhance AI capabilities to meet the accelerating demand for AI-based systems and tools within a framework of responsible AI deployment.
2. **CYBERSECURITY:** Create solutions to improve and ensure data security that are growing increasingly important across all sectors and industries as cloud-based computing is becoming ubiquitous.
3. **EDGE COMPUTING:** Support advances in connectivity and internet of things (IoT) technologies that are required to meet the needs of rural or remote locations requiring edge computing infrastructure, especially in manufacturing facilities.

Defense Innovation

North Carolina has a long history and strong connections to the nation's military, with a significant military presence in the state plus companies of all sizes developing defense-related technologies. Within the four regions examined in this study there are at least 299 tech-based companies with patents in Defense Innovation. North Carolina defense-related startups have benefited from more than $100M in recent private investment and venture deals, including more than $70M in defense-related SBIR awards. From an R&D perspective, North Carolina universities have programs and infrastructure to support Defense Innovation, including expertise in advanced materials, cybersecurity, and energy storage. The state can lean into

opportunities to foster regional and statewide collaboration to (1) increase Defense Innovation R&D that leads to development and commercialization of new technologies, and (2) develop and scale manufacturing technologies that can address the growing need for domestic manufacturing of key defense materials and technologies. Specific areas of need identified by industry that are relevant to North Carolina include:

1. **ADVANCED MATERIALS:** Develop advanced materials that demonstrate properties such as lightweighting, high refraction, stealth, hardness, corrosion resistance, or high thermal change.
2. **MANUFACTURING AND SUPPLY CHAIN:** Support the development of technologies for reliable and scalable domestic manufacturing, supply chain infrastructure, and maintenance, repair, and overhaul (MRO) applications, such as environmentally friendly corrosion-resistant coatings, characterizing material properties of metal powders used for additive manufacturing, and digital tracking solutions for tools.
3. **ENERGY GENERATION AND STORAGE:** Create energy generation and storage technologies that enhance energy efficiency and have diverse energy sources to enable greater mobility, resilience, and flexibility for both permanent and mobile operations.
4. **MICROELECTRONICS:** Develop technologies that would enable the domestic manufacturing of semiconductors, such as cost-efficient production, digital twinning, and new materials.
5. **TRUSTED AI AND AUTONOMY:** Support technologies and innovation in automation, including those that maintain trust in automated systems and improve underlying computing infrastructure.

Energy Transition & Electrification

Universities and companies across the state are investing in the development of technologies related to Energy Transition & Electrification. In the Triangle, Wolfspeed leads the world in the development of silicon carbide (SiC)–based power electronics. In the other regions, battery firms are developing new chemistries to lead the energy transition, and universities are producing grid technologies to enable a next-generation energy grid. Across the four regions of study, there are nearly 270 tech-based companies that have patents in areas related to Energy Transition & Electrification, including the Electronic Power Research Institute (EPRI), Siemens Energy, Qorvo, CommScope, and Corning Inc. Meanwhile, startups in North Carolina have received more than $200M in private venture funding to support their technology development. Specific areas of need identified by industry that are relevant to North Carolina include:

1. **DECARBONIZATION:** Create new technologies from basic science through to devices that enable further adoption of electrified tech (e.g., EVs) and renewable energy sources, including small-scale nuclear power supporting the drive to eliminate greenhouse gas emissions.
2. **DISTRIBUTED POWER SOURCES MANAGEMENT:** Develop new technologies enabling advanced power management systems and improved capabilities of controlling grid-connected assets including software, data, algorithms, and hardware to enable the next generation electrical grid.
3. **ENERGY STORAGE & DEPLOYMENT:** Develop technologies (hardware and software) to efficiently store generated power on large scales and deploy it as needed to meet the varying demands of the grid that accompanies a transition to decarbonized, intermittent energy sources.
4. **POWER ELECTRONICS INTEGRATION:** Enable collaborative efforts to connect fundamental science advancements in power electronics semiconductors to those developing systems capable of utilizing the enhanced speed and capabilities and integration with legacy systems (e.g., existing grid assets).

OPPORTUNITIES TO SUPPORT COMMERCIALIZATION INFRASTRUCTURE

RTI identified challenges impeding research commercialization, as well as opportunities to shore up regional capabilities. These challenges and opportunities are described below in groups corresponding to the three categories of university-centered innovation in RTI's study framework.

Industry Engagement

- Universities historically focused on undergraduate education often have industry partnerships that reflect this workforce development focus. It can be challenging to reposition those relationships to also include research and technology development partnerships.
- Many of North Carolina's public universities do not have sufficient industry engagement support staff. In many cases, industry engagement functions are separate from research functions, reducing alignment between the goals of these organizational units.
- To develop their messaging strategy related to industry outreach, universities must be equipped with knowledge about the alignment of their research strengths to market needs.

Applied Research

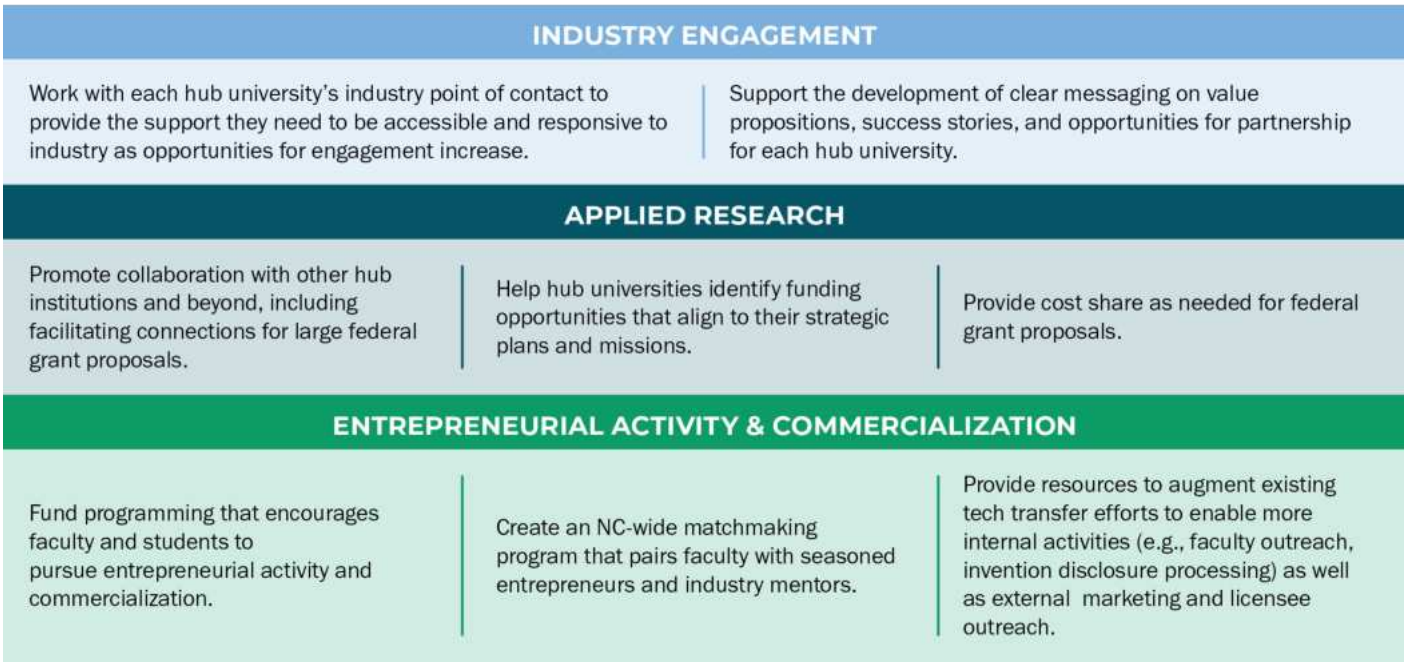
- Universities that have not historically engaged in applied research and technology commercialization often lack the staffing, expertise, and infrastructure to support faculty. Ways to better support faculty would include recruiting adjunct faculty to provide lighter teaching loads when faculty are engaged in applied research/innovation, more consistently rewarding technology commercialization activities in tenure consideration, and providing entrepreneurship support/education.
- Difficulty hiring skilled lab technicians and postdoctoral researchers can put extra strain on faculty to carry a higher load and maintain momentum on technology commercialization projects.
- Demand for staff in offices of sponsored research is high, especially for pre- and post-award administrators. Smaller universities have difficulty competing with larger universities to hire knowledgeable staff, and turnover tends to be high due to constraints on salaries.
- At smaller universities in particular, university leadership may not have a view of the full portfolio of faculty research. Budget constraints and cultural norms that do not emphasize research at all levels of the university from students to the administration can slow or prevent information sharing at the university-wide level.

Entrepreneurial Activity and Commercialization

- Many UNC System institutions have limited staffing, infrastructure, and knowledge of technology transfer functions, and some universities lack these functions altogether. For universities that are growing their applied research functions, this will become a barrier to commercialization as NCInnovation invests in more research in these universities.
- Faculty may not know if their technologies can or should be protected and may be unaware of the pathway for advancing their technology to increasing levels of market readiness without education and outreach from technology transfer staff. They may need guidance in applying research to commercial problems and protecting the IP they generate.
- Some UNC System institutions do not have access to nearby prototyping facilities and other technology development infrastructure such as well-equipped laboratories, specialized equipment, research administration staffing, commercialization support functions, and other necessary supports.

Recommendations for Capabilities and Infrastructure

Universities need specialized infrastructure and support capabilities to successfully commercialize their technologies. Faculty inventors need access to funding, educational resources, mentors, appropriate university staffing and expertise, and other supportive programs and resources. RTI identified a set of cross-cutting recommendations that North Carolina could implement to better support universities statewide. Those recommendations are shown in the graphic below.



Regional research universities require support in industry engagement, applied research, and commercialization, based on common university needs and best practices.

POTENTIAL IMPLICATIONS FOR NORTH CAROLINA INNOVATION ECOSYSTEM STAKEHOLDERS

This report fulfills NCInnovation's statutory mandate to conduct a systematic data analysis and provide a Statewide Strategic Technology Development Plan. The role of NCInnovation is to serve as a conduit of data, analysis, and information without being prescriptive about how other organizations might use those outputs. NCInnovation recognizes that a multitude of North Carolina organizations and individuals are involved in innovation, entrepreneurship, and applied research commercialization, and this report is not intended to prescribe how these stakeholders might choose to use the findings presented herein.

Taken together, the regional research, technology, and innovation studies required by law provide the basis for the following strategic technology development opportunities for others' consideration:

1. **BE GUIDED BY DATA.** The best way for North Carolina to target its research resources is to be guided by data. In assembling this report, NCInnovation and RTI have collected, synthesized, and analyzed terabytes of data to identify statewide applied research strengths and opportunities. While careful to avoid being prescriptive in its recommendations, NCInnovation offers the consolidated data as a critical component that might guide future research investments and incentives. Ongoing analysis of statewide technology and innovation strengths and opportunities will allow for strengthening North Carolina's innovation ecosystem and improving connectivity among ecosystem entities.
2. **ORGANIZE AND OPERATE REGIONALLY.** As federal and industry R&D funding increasingly rewards states organized and collaborating on regional bases, it will be important for North Carolina to do likewise. Some areas to consider include providing entrepreneurial training programs, connecting universities and other ecosystem actors, and providing commercialization support services.

3. **STRENGTHEN PARTNERSHIPS BETWEEN INDUSTRY AND ACADEMIA.** Following decades of success in which industry and academia partner to leverage our nation's best and brightest minds to solve specific industry needs, North Carolina should embrace the opportunity to leverage all of its research capabilities and create statewide partnerships to maximize its capacity for commercialized innovation. Types of support to consider may include assisting universities in developing effective messaging for outreach to industry and providing programmatic support to facilitate interactions between university faculty and industry organizations.
4. **INCENTIVIZE APPLIED RESEARCH TARGETED TO COMMERCIAL NEEDS.** While foundational science will always be the building block of research, applied and translational research that has direct application to existing or emerging market needs is the lifeblood of an innovation economy. North Carolina should continue to incentivize those researchers focused on such opportunities, and particularly in rural parts of the state that are already conducting meaningful applied research. The state can also consider assisting with capacity building within universities to help build the infrastructure for technology commercialization.
5. **PROVIDE FUNDING AND ONGOING SUPPORT SERVICES TO QUALIFIED RESEARCH UNIVERSITIES.** The reality of the "valley of death" is well chronicled, and its implications for regional research institutions in North Carolina are profound. To compete nationally, North Carolina must invest in the ecosystems and support services that enable proofs-of-concept to successfully cross the valley and position themselves for private funding, commercialization, and scale.

Based on the quantified data, analysis, and findings described in this report, and in alignment with NCInnovation's statutory authorities, NCInnovation will continue to work with its Board of Directors, university partners, and innovation stakeholders across North Carolina to develop regional capabilities and provide support to North Carolina research universities.

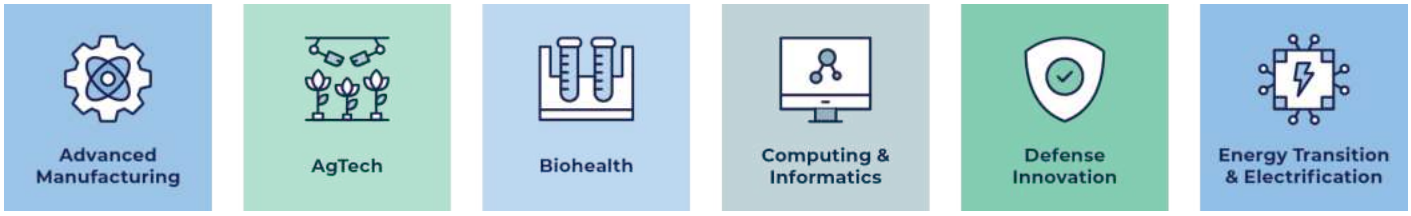
CONCLUSION

Backed by more than seven years of research, policy analysis, and an understanding of applied research commercialization rates that lag the state's competitors, the North Carolina General Assembly enacted authorizing language and a $500 million appropriation to create the NCInnovation Endowment as part of the Current Operations Appropriations Act of 2023. This forward-thinking approach leverages state reserves to create investment income that will, in turn, fund regional innovation networks and provide nondilutive grant funding and support services to research universities across the state.

In keeping with its data-driven approach, the North Carolina General Assembly charged NCInnovation with: a) conducting regional reviews of research, technology, and innovation assets to maximize local educational research efforts and the commercialization of those efforts to meet regional needs; and b) developing a strategic technology development plan that might inform future applied research.

Having completed the required reviews, the data revealed specific areas of strength and opportunity within various regions of the state. The data strongly suggests North Carolina research universities can serve as regional innovation engines, but data-driven strategic investments are needed to enable them to create intellectual property (IP) and bolster the infrastructure required to translate that IP into regional economic growth.

This report has identified six technology focus areas that represent the alignment between North Carolina's R&D strengths and market needs:



While these technology focus areas represent areas of opportunity for North Carolina, NCInnovation will remain flexible in its funding model to accommodate the rapidly changing technology landscape. This report also highlights the strength and diversity of applied research capabilities across North Carolina and points to areas of emerging strength that will help inform future data gathering and analysis efforts.

For each technology focus area, and consistent with the requirements of Section 2.2(k)(2)(b) of the 2023 Appropriations Act (Session Law 2023-134), RTI evaluated research, technology, and innovation assets and areas of technology strength in each North Carolina region. The analysis identified possible areas for collaboration across the state and indicated ways in which each region may contribute to economic growth related to each technology focus area.

In turn, these regional proof points were used to develop a set of statewide technology development recommendations that identify specific opportunity areas for technology development to focus energy and resources. RTI also identified challenges impeding research commercialization, as well as opportunities to shore up regional capabilities.

Finally, this report identified the following strategic technology development opportunities for consideration by technology-based economic development stakeholders across the state:

The data confirm North Carolina's investment in public university technology development and commercialization infrastructure will lead to improved university commercialization output, industry engagement and recruitment, startup creation and small & medium-sized business growth, and regional technology-based economic growth. Working in concert with innovation ecosystem stakeholders across North Carolina, NCInnovation will fulfill its statutory responsibilities to advance university technologies. This will be accomplished through targeted grants and support services to assist the state's research universities in becoming regional industry anchors by connecting hubs and surrounding regions to private sector commercial needs. By enhancing statewide technology-based economic development capacity within universities, between universities, and between universities and industry, North Carolina will position itself to lead the nation in commercialized applied research, making us THE innovation state.

ENDNOTES

[1] Lawrence, S., Hogan, M. Q., VanLear, S., & Rieth, K. T. (2020). *A blueprint for building an innovation corridor*. RTI International.

[2] TEConomy Partners, LLC. (2022). *Optimizing North Carolina's Innovation Ecosystem: Recommendations to Accelerate Commercialization of University-Based Innovations through Public-Private Partnerships*. Prepared for NCInnovation.

[3] NCInnovation's regions are dynamic and are evolving based on identified data and efforts to align research capabilities with industry and commercial opportunities. Data in this report are presented based on July 2023 regional definitions.

[4] Lawrence, S., Hogan, M. Q., VanLear, S., & Rieth, K. T. (2020). *A blueprint for building an innovation corridor*. RTI International.

[5] EDPNC. (n.d.). Advanced manufacturing. Economic Development Partnership of North Carolina. Retrieved June 18, 2024, from https://edpnc.com/industries/advanced-manufacturing/

[6] North Carolina Department of Agriculture and Consumer Services. (n.d.). Home page. Retrieved June 18, 2024, from https://www.ncagr.gov/

[7] Haskins, G., & Parilla, J. (2024, May 21). Accelerating equitable growth in North Carolina's life sciences cluster. Brookings Institution.