North Carolina Innovation Index 2024

TRACKING INNOVATION

NC DEPARTMENT of COMMERCE
SCIENCE, TECHNOLOGY & INNOVATION

NORTH CAROLINA DEPARTMENT OF COMMERCE
OFFICE OF SCIENCE, TECHNOLOGY & INNOVATION

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July 10, 2024

To the People of North Carolina,

It is our pleasure to share with you the 2024 *Tracking Innovation* report, produced by the North Carolina Board of Science, Technology & Innovation and the North Carolina Department of Commerce. This periodic report tracks North Carolina's performance in the innovation economy across 42 measures and compares them to national trends. We are pleased to announce that the state maintains a strong position and is improving on a majority of the report's measures.

Innovation is a critical force multiplier that raises the standard of living of North Carolinians. It is also an accelerator that helps create new industries, keep existing ones globally competitive, advance national security, and drive future economic growth and well-being. Innovative regions are better equipped to resist and recover from economic shocks or downturns, such as those caused by supply chain disruptions or military conflicts overseas. North Carolina's ability to thrive in an increasingly dynamic, global economy depends, fundamentally, on how much it infuses innovation throughout our citizenry and this great state.

A detailed analysis of the data in previous *Tracking Innovation* reports found that leading states for output and compensation are strongly linked to high levels of the following three key innovation-related factors:

- Post-secondary educational attainment,
- Proportion of workers in science, engineering and technology establishments, and
- Proportion of workers in science and engineering occupations across the economy.

On each of these factors, North Carolina has advanced to exceed the national average, as it has on other factors such as Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding, university technology license income, and gender and ethnic diversity in knowledge- and technology-intensive industries. It must continue to boost these factors to further drive its future economic gains and prosperity. As shown in this latest report, North Carolina has the raw materials to continue to do just that.

As proof of its resilience, North Carolina has grown to be the 11th largest economy in the United States and the 22nd largest in the world. One of our strongest sources of innovation is our universities, which excel at research & development, generate significant intellectual capital, facilitate the creation of startup companies, and produce a well-educated and well-trained science & engineering workforce. North Carolina also has one of the fastest growing populations in the country, and the average years of education of its newest residents is well above the U.S. average. Moreover, its science, engineering, and technology enterprises are doing well, increasing in employment, and have wages well above the U.S. average for all establishments.

These strengths are not enough, however. To continue to increase the level of prosperity throughout the state, a larger share of the state's economy must transition to embrace and drive innovation. As this report illustrates, the state's innovation strengths are concentrated in a small number of regions. A broader cross section of the state's population must gain the education, training, resources, and infrastructure needed to start, grow, attract, participate in, and sustain companies and organizations that are innovative, entrepreneurial, and able to compete with the best in the world.

This report is, therefore, a call to action. North Carolina is known around the world for the farsighted investments that it has made in the past in support of its innovation-based future. We must continue to be vigilant and proactive about our investments in the innovation economy. Our future success will be determined by what we do now—the quality of our vision, how we invest, how we prioritize, and how we respond to the challenges of an evolving economy.

This report highlights key trends and themes that should be considered when undertaking these efforts, with the goal of generating informed decision making among North Carolina's policymakers, industries, academic institutions, and citizens.

We invite you to read the report and join in efforts to advance our state's innovation-based economy.

Machelle Baker Sanders
Secretary, N.C. Department of Commerce
Member, N.C. Board of Science, Technology & Innovation

Janet Cowell
Chair, N.C. Board of Science, Technology & Innovation

Executive Summary

OVERVIEW

Innovation fuels the knowledge-based economy. A force multiplier, it creates new industries, makes existing ones globally competitive, sustains economic growth, and advances national security. With this report, the ninth in a series of innovation indexes that began with *Tracking Innovation* 2000,[1] North Carolina is one of a handful of states that regularly monitor innovation assets, activities, and trends within their borders.

This 2024 report, the most extensive since the series' inception, measures the health of North Carolina's innovation economy. It tracks North Carolina's performance across 42 innovation measures weighed against that of the United States overall and six key comparison states (California, Massachusetts, Georgia, Virginia, Colorado, Washington). These measures provide insights into the links between innovation, resources, and economic results in the North Carolina economy.

STATEWIDE SUMMARY FINDINGS

During the most recent time period for which data are available across the report's 42 measures, North Carolina's average rank among the 50 U.S. states is 20th based on these measures **[Statewide Summary Chart, *page iii*]**.[2,3] However, with this edition of the report, we're introducing an additional metric that provides insight on how states compare on an absolute basis to one another, using the other states' average rank across all measures. Using this score-based benchmark, North Carolina's rank among states is 11th.[4] When compared to other states, North Carolina's highest single rank on a measure is 5th; its lowest single rank is 49th;[5] its most common rank is 18th. Additionally, on 20 of the 42 measures, North Carolina's "Percent of U.S. Average Value" is equal to or better than average, meaning the state matches or outperforms the nation as a whole on those measures.

Since the early 2000s, North Carolina's innovation economy has, on balance, advanced—on 31 measures it improved, on eight it declined, and on three it stayed the same or could not be measured over time. During that same period, the U.S. innovation economy, on balance, also advanced—on 34 measures it improved, on six it declined, and on two it stayed the same or could not be measured over time.[6] Overall, North Carolina's statewide innovation ecosystem is healthy, has improved since the early 2000s, and at a rate comparable to the U.S as a whole.[7]

FINDINGS BY CATEGORY

- **Economic Well-Being:** North Carolina has one of the fastest-growing populations in the nation, but the productive capacity of its economy and the wages and incomes of its citizens are below and not keeping pace with the national average. North Carolina's unemployment rate is consistent with the national average, and its poverty rate is above the national average.
- **Research & Development (R&D):** North Carolina excels at academic R&D, with a level well above the national average, while the total level of the state's R&D, particularly that performed by business, is slightly below the national average. Both academic and business R&D have grown faster than the national average since 2000, providing a strong foundation to fuel and sustain economic growth.
- **Commercialization:** North Carolina organizations, particularly its academic institutions, generate significant intellectual property. University academic license income (running royalties) and start-up company activity have improved to levels above the national average, but other innovation commercialization activities remain below average and must be stronger to realize the full economic and social benefits of that intellectual property.

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[1] The NC Board of Science, Technology & Innovation has produced seven innovation indexes during the last 21 years, in 2000, 2003, 2008, 2013, 2015, 2017, and 2019.

[2] In the 2021 version of the report, North Carolina's average rank was also 20th; in the 2019 version of this report, North Carolina's average rank was 21st; in the 2017 and 2015 versions, North Carolina's average rank was 23rd; in the 2013 version North Carolina's average rank was 24th. Some measures have changed in this version of the report, so caution should be taken when making comparisons to previous reports; due to changes in methodology, change in ranks cannot be positively attributed to changes in the economic conditions or structure of a state's economy. The rankings are for the state *overall*; for more detail on performance by NC county, which varies considerably across counties, see page iv of the Executive Summary and individual measures in the body of the report. All measures are expressed as *ratios or percentages*, which "normalizes" the data by controlling for "size" factors such as state population and Gross Domestic Product (GDP), thus enabling an "apples to apples" comparison. See the "Interpreting the Data" section of this report for additional insights on understanding the various values, rankings, and averages in the report.

[3] On a nominal basis, not adjusting measures for size or any other factor, North Carolina ranks 10th out of all 50 states, which is consistent with its population (9th largest) and GDP (11th).

[4] This is a score-based benchmark, which incorporates the magnitude of differences between the states on each measure, instead of merely their ordinal rank from 1 to 50 based on all measures combined. As such, it provides a more distinct rank of North Carolina's performance relative to other states. To facilitate comparison across various years of the *Tracking Innovation* report, North Carolina's average rank across all the measures is reported in this Executive Summary above, consistent with the practice in previous reports. This 2024 *Tracking Innovation* report and future releases of the report will incorporate both North Carolina's average rank across all measures and North Carolina's state rank based on scores. See Appendix B for a description of the score-based rankings.

[5] North Carolina's highest rank is on Appropriations of State Tax Funds for Higher Education as a Percentage of State GDP; its lowest rank is on Elementary & Secondary Public School Expenditures as a Percentage of State GDP.

[6] Historical data are unavailable for two of the 42 measures.

[7] While the U.S. improved on more measures than did North Caolina, the extent of improvement is sufficiently small that that the difference in performance between the U.S. and North Carolina is negligible.

Executive Summary

OVERVIEW

- **Innovative Organizations:** North Carolina has a higher-than-average concentration of knowledge- and technology-intensive (KTI) industries, which are increasing in employment and have wages that are above the national average for all industries. The state also has well above-average gender and ethnic diversity in KTI industries, but levels of entrepreneurial activity are below average.
- **Education & Workforce:** North Carolina has a well-educated and well-trained science & engineering workforce, including at the more-advanced educational levels, similar to the national average, but its universities are graduating a lower proportion of science and engineering students. The overall educational attainment level of its residents is at the national average, and the in-migration rate of college-educated adults is higher than the national average.
- **Environment & Infrastructure:** North Carolina funding for higher education expenses ranks well above average, but state funding for elementary and secondary public schools remains well below the U.S. average. Levels of broadband access are also below the U.S. average but are rising faster than the U.S. average, albeit with considerable variations in access levels across the state. The state's favorable cost of living positions it well to continue to diversify its industry mix, including maintaining its strong position in manufacturing and growing its KTI manufacturing industries.

Across the state, these findings vary considerably by locale, with urban areas performing well above the U.S. average and having the greatest share of the assets and activities vital to creating, commercializing, and utilizing innovations. As in other states, rural areas fare less well and have the greatest need for improving their economic well-being and quality of life though the benefits of innovation. Efforts to extend the benefits of innovation throughout the state should continue.

Executive Summary

STATEWIDE SUMMARY OF MEASURES

Statewide Summary Chart

MEASURE	N.C. RANK	N.C. % OF U.S. AVERAGE VALUE	PERFORMANCE OVER TIME[1] N.C.	PERFORMANCE OVER TIME[1] U.S.
Section 1: Economic Well-Being & Quality of Life	**29**	0% 20% 40% 60% 80% 100% 120% 140% 160% 180% 200%		
Per Capita Gross Domestic Product, 2022	32	86%	↑	↑
Per Capita Income, 2022	36	88%	↑	↑
Median Household Income, 2022	36	90%	↑	↑
Average Annual Wage, 2022	23	90%	↑	↑
Unemployment Rate, 2022	31	104%	–	↓
Percentage of Citizens in Poverty, 2022	35	102%	↓	↓
Population Growth, 2000-2022	9	179%	↑	↑
Section 2: Research & Development	**13**	0% 20% 40% 60% 80% 100% 120% 140% 160% 180% 200%		
Total R&D Expenditures as a Percentage of GDP, 2020	14	90%	↑	↑
Business-Performed R&D as a Percentage of Private-Industry Output, 2021	10	93%	↑	↑
Academic Science & Engineering R&D per $1,000 of State GDP, 2021	6	140%	↑	↑
Federal R&D Obligations per Employed Worker, 2022	18	63%	↑	↑
Academic S&E Article Output per 1,000 SEH Doctorate Holders in Academia, 2021	16	101%	↑	↑
Section 3: Commercialization	**13**	0% 20% 40% 60% 80% 100% 120% 140% 160% 180% 200%		
Average Annual SBIR & STTR Funding per $1 Million of GDP, 2020-2022	14	129%	↑	↑
Academic Patents Awarded per 1,000 S&E Doctorate Holders in Academia, 2021	18	80%	↑	↑
Patents Awarded per 1,000 Individuals in S&E Occupations, 2020	24	71%	↑	↑
Venture Capital Dispersed per $1 Million of GDP, 2022	12	70%	↑	↑
Venture Capital Dispersed per Venture Capital Deal, 2022	9	91%	↑	↑
Academic License Inc. (Gross) as a Percentage of Academic R&D Expend., 2020-2021	11	96%	N/A	N/A
Academic License Inc. (Running) as a Percentage of Acad. S&E R&D Expend., 2020-2022	9	108%	↓	↓
Avg. Number of University Startups Formed per $1M of Academic S&E R&D Expenditures, 2020-2022	8	146%	↑	↑
Section 4: Innovative Organizations	**22**	0% 20% 40% 60% 80% 100% 120% 140% 160% 180% 200%		
KTI Employment Establishments as Percentage of All Business Establishments, 2022	18	115%	↑	↑
Net KTI Employment Business Formations as a Percentage of All Business Establishments, 2022	20	159%	↑	↑
Employment in KTI Employment Establishments as a Percentage of Total Employment, 2022	20	101%	↓	↓
Average Monthly Number of Entrepreneurs per 100,000 People, 2019-2021	25	73%	↑	↑
Average Opportunity Share of New Entrepreneurs, 2019-2021	30	99%	↓	↑
Exports as a Percentage of GDP, 2022	28	70%	↑	↑
Gender Diversity in KTI Industries, 2022	7	109%	↓	↓
Ethnic Diversity in KTI Industries, 2022	30	114%	↓	↑
Section 5: Education & Workforce	**21**	0% 20% 40% 60% 80% 100% 120% 140% 160% 180% 200%		
Individuals in S&E Occupations as a Percentage of the Workforce, 2020	16	101%	↑	↑
Employed SEH Doctorate Holders as a Percentage of the Workforce, 2021	15	105%	↑	↑
Engineers as a Percentage of All Occupations, 2020	27	87%	↑	↑
Bachelor's Degrees in S&E Conferred per 1,000 Individuals 18–24 Years Old, 2021	28	93%	↑	↑
Science & Engineering Degrees as a Percentage of Higher Education Degrees Conferred, 2022	18	102%	↑	↑
Educational Attainment of Residents Aged 25 and Over (Composite Score), 2022	21	101%	↑	↑
Average Years of Education Among In-Migrants, 2021	23	101%	↑	↑
In-Migration of College Educated Adults as a Percentage of Total State Population, 2021	22	122%	↑	↑
Section 6: Environment & Infrastructure	**23**	0% 20% 40% 60% 80% 100% 120% 140% 160% 180% 200%		
Elementary & Secondary Public School Current Expend. as a Percentage of State GDP, 2021	49	77%	↓	↓
Approp. of State Tax Funds for Higher Education as a Percentage of State GDP, 2022	5	175%	↓	↓
Percentage of Homes with an Internet Accessible Device, 2022	31	99%	↑	↑
Percentage of Homes with a Broadband Subscription, 2022	32	99%	↑	↑
Cost of Living Index, 2023	11	95%	N/A	N/A
Manufacturing GDP a Percentage of State GDP, 2022	12	134%	↓	↓
AVERAGE N.C. RANK ACROSS ALL MEASURES	**20[2]**			

↑ Improving ↓ Worsening[3]

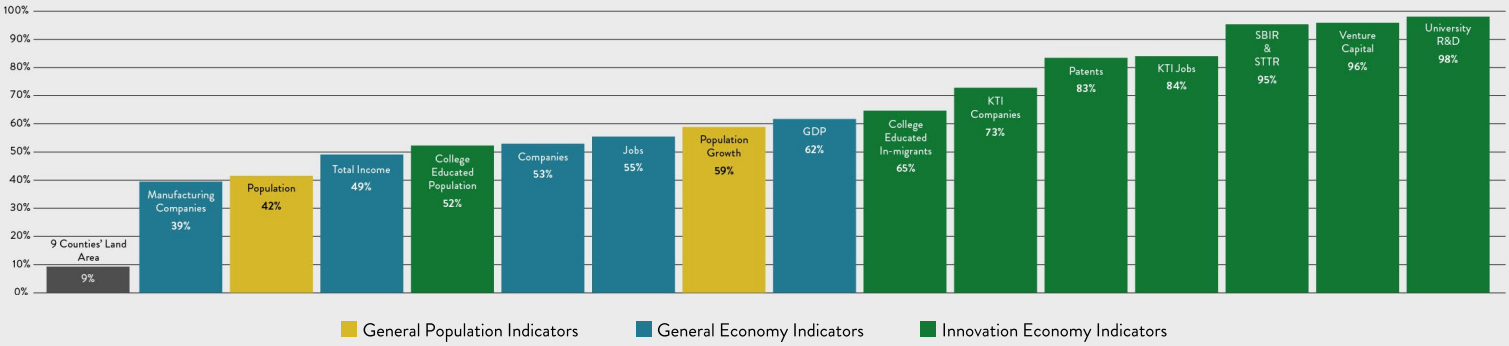
[1] For most measures, "over time" refers to the period between the year 2000 and the year listed to the right of the measure. In the rare cases when data were not available starting in 2000 for a measue, the starting year is typically few years after 2000.

[2] Assumes measures are weighted equally.

[3] For the Unemployment Rate and Percentage of Citizens in Poverty, increases represent worsening, while decreases represent improving.

COUNTY-LEVEL SUMMARY OF KEY MEASURES

County Summary Key Measures



9 North Carolina Counties (Mecklenburg, Wake, Guilford, Forsyth, Durham, Buncombe, New Hanover, Orange, and Iredelle) represent 9% of the state's land area but disproportionately larger shares of state's population, economy, and innovation assets and activities.

COUNTY-LEVEL SUMMARY FINDINGS

At the county level, 15 key measures reveal differences important for further understanding North Carolina's overall performance and by local levels within the state **[County Summary Chart]**.[8] Specifically, among North Carolina's 100 counties, 9 that are highly populated and/or are home to major research universities (Wake, Mecklenburg, Guilford, Forsyth, Durham, Buncombe, New Hanover, Iredell, and Orange) represent just 9 percent of the state's land area but account for disproportionally larger shares of the state's population, economy, and innovation assets and activities.[9]

In terms of General Population, those 9 counties represent 42 percent of the state's current population and 59 percent of the state's population growth between 2000 and 2022.[10] In terms of the General Economy, those 9 counties represent larger shares—they hold 39 percent of the state's manufacturing companies, 53 percent of the state's companies, 49 percent of the state's total income, 55 percent of its jobs, and 62 percent of its GDP. And in terms of the Innovation Economy, those 9 counties represent even larger shares—52 percent of the state's college educated population, 65 percent of its college educated in-migrants, 73 percent of the state's KTI companies, 83 percent of the state's patents, 84 percent of the state's KTI jobs, 95 percent of the state's SBIR/STTR grants, 96 percent of the state's venture capital, and 98 percent of the state's university R&D.

County Share of Key Measures[11]

County	Mfg. Co.s	Pop.	Total Income	College-Ed. Pop.	Co.s	Jobs	Pop. Growth	GDP	College-Ed. In-migrants	KTI Co.s	Patents	KTI Jobs	SBIR & STTR $	Venture Capital	Univ. R&D	NC Total Share	NC Cumulative Share
Wake	8%	11%	14%	16%	15%	14%	21%	16%	19%	29%	39%	27%	23%	53%	15%	21%	21%
Mecklenburg	10%	11%	14%	14%	15%	17%	17%	21%	19%	19%	12%	19%	3%	11%	1%	14%	35%
Durham	2%	3%	3%	4%	3%	5%	4%	7%	7%	7%	10%	21%	30%	21%	36%	11%	46%
Orange	1%	1%	2%	2%	2%	2%	1%	2%	3%	3%	7%	1%	24%	6%	35%	6%	52%
Guilford	6%	5%	5%	5%	5%	6%	5%	6%	4%	4%	5%	6%	1%	1%	2%	5%	56%
Forsyth	3%	4%	4%	3%	3%	4%	3%	4%	3%	3%	5%	3%	2%	1%	7%	4%	60%
Buncombe	4%	3%	3%	3%	4%	3%	3%	3%	4%	3%	2%	3%	0%	0%	0%	2%	62%
New Hanover	2%	2%	2%	3%	3%	3%	3%	3%	3%	3%	2%	3%	1%	1%	1%	2%	65%
Iredelle	3%	2%	2%	2%	2%	2%	3%	2%	2%	2%	2%	1%	11%	1%	0%	2%	67%
Total	**39%**	**42%**	**49%**	**52%**	**53%**	**55%**	**59%**	**62%**	**65%**	**73%**	**83%**	**84%**	**95%**	**96%**	**98%**		

General Population Measures General Economy Measures Innovation Economy Measures

[8] Not all of the report's 42 measures are available at the county level. The 15 key measures presented here are the ones that are both available at the county level and are most relevant to the state's General Population, General Economy, or Innovation Economy. Detailed descriptions of each measure are available in the body of the report. See the Table of Contents for each measure's location in the report. Dates of source data for these measures: Mfg. Co.s (2022), Pop. (2022), Co.s (2022), Total Income (2022), Jobs (2022), College-Ed. Pop. (2018-2022, five-year estimates), Pop. Growth (2000-2022), GDP (2022, chained 2017 dollars), College-Ed. In-migrants (2017-2021, five-year estimates), KTI Co.s (2022), Patents (2020-2022 average), KTI Jobs (2022), SBIR & STTR $ (2020-2022 average), Venture Capital (2020-2022 average), Univ. R&D (2022).

[9] Averaging across the 15 measures, each of the 9 counties accounts for at least 2 percent of the state total value on those measures within the state. Each of the counties beyond those 9 accounts for less than 2 percent of the state's total value on those measures, with the majority of counties representing far less than 1 percent. The value of 2 percent was used as a breakpoint to determine which counties to include because 2 percent is twice the 1 percent share that each county represents among the total number (100) of counties in the state.

[10] Between 2000 and 2030, the 9 counties combined are expected to represent as much as 54 percent of the state's population growth, suggesting the disproportionate findings by locale will continue and possibly increase over time.

[11] This table provides a county-level breakout of the 9 counties whose aggregated values are presented in the County Summary of Key Measures chart above.

COUNTY-LEVEL SUMMARY OF KEY MEASURES

More specifically, 3 counties in the Research Triangle region (Wake, Durham, and Orange counties) account for an average of 46 percent of North Carolina's totals across all 15 key measures, and Wake is the only county with more than 5 percent share in each measure **[County Share of Key Measures Chart, *previous page*]**. This region is notable for the high number of research universities, as indicated by academic R&D expenditures and federal funding for science and technology small businesses, many of which are university spinouts. Despite higher levels of academic R&D in Durham and Orange counties, more science and technology businesses are located in Wake County, where venture capital investments are highly concentrated (53 percent of state total) along with patenting activity (42 percent). Mecklenburg County maintains large shares of science and engineering firms, jobs, patent activity, venture capital, and the highest share of the state's economic activity, but has much less academic R&D and federal funding for commercialization of innovative technologies.

Relative to their populations, the Piedmont-Triad counties (Guilford and Forsyth), Buncombe County, and New Hanover County maintain high shares of KTI establishments and employment, intellectual property generation, and an educated workforce. At the same time, these areas have less SBIR/STTR funding, venture capital investments, and academic research activities (with the notable exception of Wake Forest University in Forsyth County). The foundation exists in these emerging counties outside the Triangle to grow significant innovative, entrepreneurial ecosystems, however, and a focused, sustained effort to marshal their assets and address gaps has strong potential to broaden North Carolina's innovation strengths beyond the Research Triangle region.

When county performance is measured not solely by its share of the state total, but instead relative to the U.S. average, a larger number of counties show strengths **[N.C. Counties with At Least 2 Measures Above the U.S. Average]**.[12]

N.C. Counties with At Least 2 Measures Above the U.S. Average

County	College-Ed. In-migrants / Total Pop.	College-Ed. Pop. / Total Pop.	KTI Emp. Establishments / Total Establishments	Median Household Income	University R&D / GDP	Patents / GDP	SBIR-STTR / GDP	Per Capita GDP	Venture Capital / GDP	KTI Emp. / Total Emp.	Total Measures
Wake	■	■	■	▒	▒	■	■	▒	■	▒	10
Durham	■	■	■		■	▒	■	■	■	■	9
Orange	■	■	■	▒	■	■	■		■		8
Mecklenburg	■	▒	▒	▒				■			5
Union	▒	▒	▒	▒							4
Chatham		▒	▒	▒		■					4
Iredell	■						■				2
Polk	■					■					2
New Hanover	■	▒									2
Buncombe	■	▒									2
Currituck	■			▒							2
Moore	■	▒									2
Transylvania	■	▒									2
Forsyth		▒			■						2
Pitt	▒				▒						2
Watauga	▒	▒									2
Dare	▒	▒									2
Cabarrus		▒		▒							2
Count	**15**	**13**	**6**	**6**	**5**	**5**	**4**	**3**	**3**	**2**	**18**

■ At least 50% above the U.S. Average ▒ Greater than 25% but less than 50% above the U.S. Average ▒ Less than 25% greater than the U.S. Average

General Population Indicators General Economy Indicators Innovation Economy Indicators

[12] All measures in this table are normalized (as ratios or percentages) by a factor, thus enabling an "apples to apples" comparison. Educational measures are normalized by county population; KTI companies and jobs are relative to total companies and jobs within a county, respectively, income is median household income; and the remainder of the measures are relative to county-level Gross Domestic Product. Dates of source data for these measures: College-Ed. In-migrants / County Population (2017-2021, five-year estimates), College-Ed. Pop. / County Population (2018-2022, five-year estimates), KTI Co.s / Total Co.s (2022), Median Household Income (2018-2022 five-year estimates), Univ. R&D / GDP (2022), Patents / GDP (2018-2020 average), SBIR & STTR $ / GDP (2020-2022 average), Per Capita GDP (2022), KTI Jobs / All County Jobs (2022), Venture Capital / GDP (2020-2022 average).

COUNTY-LEVEL SUMMARY OF KEY MEASURES

Specifically, 18 counties perform above the U.S. average on two or more key measures. As such, this listing expands beyond the top 9 counties to include those that may not hold the highest share of the state's resources but that perform above expectations (or have the potential to) given their size. This is a measure of how concentrated or strong certain factors are within each county.

In general, these additional counties are characterized by their proximity to metropolitan cores like Charlotte (Union, Moore, and Cabarrus) and Durham-Chapel Hill (Chatham). While Moore and Cabarrus Counties are notable for their educated populations or higher-than-average income, Union county contains a relatively high concentrations of technology-based businesses conducting research and development to drive their local innovation economies.

Smaller counties with a relatively large academic presence also show strengths, such as Pitt County, home to East Carolina University, and Watauga County, home to Appalachian State University. A greater portion of Pitt County's local economic productivity is generated by academic research and development, because of ECU's size and presence of a medical school, whereas Watauga County has a relatively well-educated population but research and development activity below the U.S. average. Other counties with key measures above the U.S. average are primarily those with tourism-based economies and high levels of retirees, which contribute to higher educational attainment and income levels per household (e.g., Currituck, Dare, and Transylvania Counties).

Other counties perform above expectations (e.g., Iredell County in SBIR/STTR funding, and Chatham County in patent activity), but factors like KTI jobs and venture capital remain highly concentrated in the Research Triangle region. These findings indicate that other regions with emerging innovation economies would benefit from a larger supply of KTI workers and additional sources of capital to drive and sustain economic growth and resiliency.

Together, these county level differences reveal that North Carolina is a tale of two innovation economies: One economy is based primarily in more research-intensive areas, which have large populations that are growing rapidly and that have economic and innovation assets, activities, and outcomes well above the U.S. average. The other is based largely in less developed areas, which have much smaller populations that are stable or shrinking and that have economic outcomes well below the U.S. average.

Understanding the nature and performance of these two economies is critical for informed decision making and policies that improve the economic well-being and quality of life for all North Carolinians. The more detailed 42 measures that follow in the body of this report provide a strong, multilevel basis for that understanding.

IMPLICATIONS AND PRIORITIES

These findings and trends paint a picture of North Carolina that is both rich with opportunities but also facing challenges. The degree to which North Carolina prospers in response to these challenges depends on how quickly and effectively it addresses them in tailored ways. Drawing on the findings of this report, the following priorities are crucial for growing and developing North Carolina's innovation-fueled economy statewide:

- **Research & Development - Increase Volume and Intensity:** To grow its economy significantly in both the short term and long term, North Carolina must continue to increase the volume and intensity of its research & development efforts—particularly those performed by business—relative to other U.S. states and to leading countries. Business-performed R&D in NC has accelerated faster than the U.S. average but has recently slowed down to a value just below average. One way North Carolina businesses could improve further is by closer and more frequent research & development partnerships with the state's universities, which have well-above-average research & development performance, and facilities, equipment, and expertise often beyond the scope of many of the state's businesses.
- **Commercialization - Better Leverage Strong Asset Base:** To foster the start and growth of businesses developing and commercializing innovative technologies, North Carolina's universities should be incentivized and equipped to focus more on company and industry engagement, as well as technology commercialization. Additionally, the state must continue to support its programs focused on capturing and leveraging the benefits of federal grant programs, such as Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, which provide working capital to small and emerging companies.[13] These steps will make North Carolina more attractive for later-stage commercialization resources such as venture capital, but they must also be leveraged further by strategic, proactive efforts to attract and develop investors and innovative businesses and market the state's innovative activities.
- **Innovative Organizations - Boost Entrepreneurship and Business Linkages**: To advance the technology and innovation levels of its existing businesses and to start, grow, and attract new high-technology businesses, North Carolina must ensure that a greater share and range of its population has the training, resources, and support to be entrepreneurial. Similarly, it must enhance and extend programs focused on technology adoption and diffusion, particularly in rural regions with historically lower levels of innovation and that are struggling to fully participate in the benefits of the innovation economy. In addition, to remain competitive in the global economy, the state must continue to explore new markets for the goods and services it produces, particularly by understanding how North Carolina industries fit within global commodity value chains, and deepening and expanding relationships with overseas trading partners.
- **Education & Workforce - Emphasize STEM and Strengthen Fundamentals:** To intensify the innovation-relevant education and training levels of its workforce, North Carolina must grow the share of its community college and university-level students earning degrees in science, technology, engineering, and math (STEM) disciplines. One way to achieve this could entail industries, educators, and government regularly collaborating to develop a North Carolina innovation-focused technology workforce agenda and strategy. The strategy could organize education and workforce programs around broad clusters and skills, particularly ones the state has determined to be in its strategic interests, such as data science and data analytics. Additionally, North Carolina must continue to raise the educational attainment of its citizens at all levels of the educational spectrum, to a level at least equal to, and preferably greater than, the national average. Doing so would enhance efforts in the three priorities discussed above and multiply their impacts.
- **Environment & Infrastructure - Reinforce, Enhance, and Broaden:** To ensure that the greatest number and range of its citizens enjoy the economic and social benefits of science, technology, and innovation, North Carolina must continue to invest, throughout its regions, in basic infrastructure elements of its innovation economy. Examples include elementary, secondary, and higher education organizations; broadband deployment and adoption; and industries that use science and technology and a highly skilled workforce to develop, manufacture, distribute, and export products. Combined with North Carolina's low cost of living and high quality of life, these elements provide the richest and most fundamental foundation for starting, growing, and attracting businesses that improve our economic well-being and quality of life.

Efforts such as those above must be sufficiently long-term and well-funded to make a difference, and they must have the flexibility to respond to continually changing circumstances and to support different needs across regions and sectors. Moreover, decisions about their continuation and modification must be guided by clear benchmarks and performance criteria, such as those provided and explained in more detail throughout this report. With this information, key stakeholders—including policymakers, industries, academic institutions, nonprofits, and citizens—will have appropriate and timely baseline information on science, technology, and innovation throughout the state.

[13] For example, the One North Carolina Small Business Program, administered by the North Carolina Board of Science, Technology & Innovation, awards state-funded Incentive ans Matching grants to North Carolina Small Businesses that have applied for or won, respectively, highly competitive Phase I SBIR or STTR grants.

Introduction

WHAT ARE SCIENCE, TECHNOLOGY & INNOVATION?

Innovation is the creation and adoption of new products, services, and business models to yield value. While innovation has many sources, science (systematic knowledge) and technology (the practical application of knowledge) are its fundamental elements. Throughout history, science, technology, and innovation have brought about the development of tools, products, processes, and services such as the wheel, sailing ships, the plow, agricultural irrigation systems, municipal water and sewer systems, the internal combustion engine, the telegraph, audio and video, accounting processes, medicines and medical technologies, and information and communications technologies. Each generation of civilization has built on the technological achievements of prior generations and used them to create new possibilities and wealth and security. In short, science and technology, and their practical advancement via innovation, are what have enabled humans to get—on an ongoing basis—more value out of the earth's natural resources.

WHY ARE SCIENCE, TECHNOLOGY & INNOVATION IMPORTANT FOR THE ECONOMY?

Through decades of empirical research, economists have documented the central role of science, technology, and innovation in long-term productivity, job growth, output growth, and higher incomes.[1] In terms of productivity and growth, economic studies have valued the return on research, development, and innovation to be four times the return on investment in physical capital.[2] Put another way, between one-third to one-half of economic growth in the United States can be attributed to innovation.[3] And in terms of income, U.S. Bureau of Labor Statistics (BLS) data show that in all but one of 71 technology oriented occupations, the median income exceeds the median for all occupations; moreover, in 57 of these occupations, the median income is 50 percent or more above the overall industry median.[4]

Two fundamental effects of science- and technology-based innovation drive these impacts:

- Innovation empowers product and productivity improvements in *existing* companies;
- Innovation spurs the dynamic creation of *new* companies that create new value.

Together, these effects lead to a virtuous cycle of expanding employment, as well as increased wages and lower prices, all of which expand domestic economic activity and create jobs.[5,6] A high-productivity, high-employment, high-income, growing economy must be a high-technology, innovation-driven economy. Other economies around the world, recognizing this and aspiring to the U.S. standard of living, have examined the technology-based economic growth process and are progressively evolving public-private asset growth models. The current global trends in investment and innovation are exceeding those in the U.S., and many economies across the globe are now establishing public-private research partnerships to pool risk, improve the efficiency of research and development (R&D), and diffuse innovation and new technology platforms more rapidly across and within domestic supply chains.

WHY *TRACKING INNOVATION* 2024?

A major impediment to the proper design and implementation of policies and programs that help advance innovation is a lack of accurate, comprehensive, and up-to-date information on the various factors related to innovation—R&D performance, innovation rates, technology commercialization rates, trends in high-technology industries, education and training levels of the workforce, and how all these relate to overall economic performance.[7] Nearly all states and regions are grappling with this problem, including North Carolina. Critical questions concern the level of North Carolina's innovative activity, as well as whether it has the proper infrastructure and resources in place to support innovation, as well as overall economic development, to its fullest extent.

For nearly a century, North Carolina has been transitioning from primarily agricultural and traditional manufacturing economy to a more knowledge- and innovation-based economy fueled by science and technology. In the process, the state's policymakers, businesses, educational institutions, and citizens have made strategic investments in infrastructure, institutions, and human capital. Because of these investments (and as illustrated later in this report), North Carolina has achieved a leading role in the "basic" and early-stage "applied" research that forms the foundation for breakthrough innovations.

[1] For a review of these studies, see Tassey 2007, Chapter 3.

[2] Jones and Williams 1998, 2000.

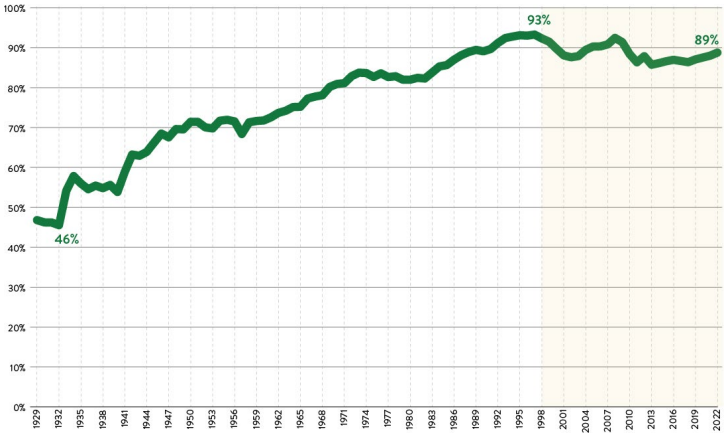
[3] U.S. Department of Commerce 2012.

[4] Hecker 2005.

[5] Atkinson and Ezell 2012.

[6] Atkinson and Foote 2020.

Figure 1 *N.C. Per Capita Income as share of U.S. Per Capita Income, 1929-2022*



Source: U.S. Bureau of Economic Analysis

These innovations have helped North Carolina's per capita income as a share of U.S. per capita income more than double during the last century, increasing steadily from a low of 46 percent in 1932 to a high of 93 percent in 1997 **[Figure 1]**. But while significant and impactful, these investments have not been sufficient to propel North Carolina's per capita income to a level above the average per capita income for the nation as a whole. And since 1997, North Carolina's per capita income as a share of U.S. per capita income has decreased, currently at 89% in 2022, the latest year for which data are available. Ensuring proper infrastructure and resources for innovation is important not just for sparking economic well-being and prosperity, but also for sustaining them over time. At a minimum, finding answers regarding how to do so and to what extent requires appropriate and timely baseline information on science, technology, and innovation in the state. This, in turn, will help identify strengths and weaknesses, inform decisions and policy making, and establish benchmarks for measuring effectiveness.

WHAT IS *TRACKING INNOVATION* 2024?

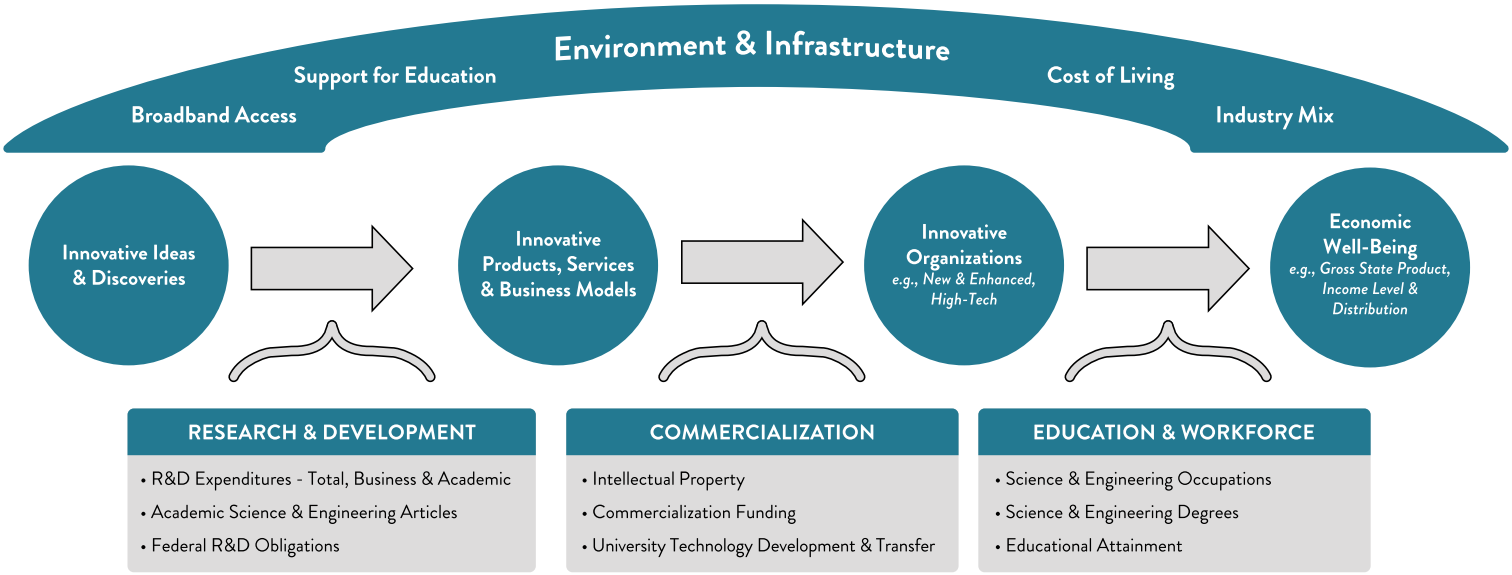
The goal of *Tracking Innovation* 2024 is to provide that information in a systematic and accessible format, in order to help inform science, technology, and innovation planning and policy at all levels throughout the state. As a follow-up to previous reports tracking North Carolina's innovation performance,[7] this report enables North Carolina to join a growing number of states regularly monitoring innovation trends within and outside their borders. It assembles information from a wide variety of sources to document innovation-related activity in North Carolina, six comparison states, and the U.S. Its 42 measures are summarized under 26 broad indicators of innovation, technology, and economic well-being. Each of the 42 measures, in turn, falls into one of six general categories:

1. **Economic Well-Being** (e.g., gross domestic product, income level and distribution)
2. **Research & Development** (e.g., R&D expenditures, academic articles)
3. **Commercialization** (e.g., intellectual property, commercialization funding)
4. **Innovation Organizations** (e.g., high-technology establishments, entrepreneurs)
5. **Education & Workforce** (e.g., science & engineering occupations, educational attainment)
6. **Environment & Infrastructure** (e.g., support for education, broadband access)

The report does not make normative judgments regarding which of its measures are most important for plotting the course of science, technology, and innovation policy in North Carolina. Instead, the facts—as best they can be gathered from existing secondary sources—are presented as concisely and clearly as possible, leaving it primarily to the reader to gauge the significance of specific trends. Though every measure is insufficient in isolation, together they lend useful insight into the status of science, technology, and innovation activity in North Carolina.

[7] The NC Board of Science, Technology & Innovation has produced eight innovation indexes during past 24 years, in 2000, 2003, 2008, 2013, 2015, 2017, 2019, and 2021. See: https://www.nccommerce.com/documents/innovation-reports. While the 2008 report was titled "Advancing Innovation" rather than "Tracking Innovation," it includes a detailed innovation index in "Chapter 2: North Carolina's Innovation Performance.

Figure 2 *Innovation Ecosystem*



WHAT IS THE METHODOLOGY OF *TRACKING INNOVATION* 2024?

INNOVATION ECOSYSTEM

Innovation occurs in an "innovation ecosystem"—the complex and dynamic collection of people, organizations, cultures, policies, and programs that creates innovative ideas and discoveries, translates those ideas into innovative products, services and business models, and enhances existing organizations and builds new organizations to improve our economic well-being and quality of life **[Figure 2].** Accordingly, any effort to measure innovation comprehensively, accurately, and effectively in North Carolina should:

1. Focus on multiple components of the state's innovation ecosystem;
2. Include multiple indicators for each component.

The indicators included in this report meet these two goals while capturing, to the extent possible, the intersection of both what we want to measure and what we can measure using available data sources.[8] It also compares these indicators on multiple dimensions—spatially and temporally[9]—to generate a rich and comprehensive understanding of the health of North Carolina's innovation ecosystem.[10]

DATA SOURCES

The report relies primarily on existing secondary data sources (see detailed listing in the Sources section at the end of this report). In rare cases, and unless otherwise noted, no surveys or other forms of primary data collection were undertaken to assemble measures. Additionally, all measures are:

- As current and accurate as possible;[11]
- Derived from objective and reliable data sources;
- Easy to understand and compare across states; and
- Relevant and of interest to the public.

The measures included in this report are meant to serve as a baseline for decision making and further inquiry. To the extent possible, and when appropriate, future updates of the report will include additional data and measures.

[8] This acknowledges the oft-cited aphorism that "Not everything that can be measured matters, and not everything that matters can be measured."

[9] The typical over-time period assessed in this report ranges from 2000 to the most recent year(s) for which current data are available, most often 2020, 2021, and 2022. For virtually all the indicators, there is a one- to three-year lag time between the current year (2024) and the most recent year for which data are available. This is because obtaining comprehensive (across all 50 states) data that are both reliable and accurate is labor intensive and time consuming and must be done with care and rigor.

[10] The index is analogous to the results of regular, comprehensive medical examination designed to evaluate and understand the health of a person. In this case, the health of North Carolina's innovation ecosystem is being evaluated.

[11] For a small number of indicators, the most current data are from as far back as 2017, but data from these years are averaged with data from more recent years.

STATE-BY-STATE COMPARISONS

For the point-in-time comparisons focused on the most recent periods possible, the report presents information for the U.S. average and each of the 50 states in bar-chart form. This enables a comprehensive and informative assessment of where North Carolina currently fares relative to the nation overall and to each of the 49 other states. In addition, to enable a more targeted assessment of North Carolina's performance relative to a handful of important states, the report highlights North Carolina's performance on each measure to that of the following six comparison states:

- Two leading technology states (California and Massachusetts)
- Two strong southeastern states (Georgia and Virginia)
- Two strong and "up and coming" technology states (Colorado and Washington)[12]

For the over-time comparisons, the report presents information only for North Carolina, the U.S. average, and the six comparison states in line-chart form.[13] This enables an informative assessment of how North Carolina has fared relative to the nation overall and to each of the six comparison states over time, in particular the extent to which North Carolina is gaining ground, losing ground, or holding its own.[14]

WITHIN-NORTH CAROLINA COMPARISONS

When available, within-North Carolina data (most often in the form of county level data, but occasionally at other levels, such as ZIP code, city, Metropolitan Statistical Area (MSA), or university) are presented.[15] These additional levels of comparison provide deeper context for evaluating North Carolina's performance, which provide a more nuanced understanding of the location and concentration of innovation-related factors throughout the state.[16]

NEW IN THIS REPORT

While this 2024 report is very similar to the most recent (2021) *Tracking Innovation* report, it differs in a small number of notable ways. Specifically, the report:

- Uses knowledge- and technology-intensive (KTI) employment industries rather than high science, engineering, and technology (SET) employment industries.[17]
- Includes:
  - One new measure as a component of indicator 4.1:
    - 4.1B: Net KTI Employment Business Formations as a Percentage of all Business Establishments[18]
  - Two new measures as components of indicator 4.5:[19]
    - 4.5A and 4.5B: Gender Diversity in Knowledge- and Technology- Intensive Industry (KTI) Industries
    - 4.5C and 4.5D: Ethnic Diversity in Knowledge- and Technology- Intensive Industry (KTI) Industries
  - One new measure as a component of indicator 6.2:
    - 6.2F: Digital Divide Index (Percent Households in a High Digital Divide Tract)[20]

These changes refine and supplement the data but do not notably change North Carolina's overall innovation rank.[21]

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[12] California and Massachusetts typically rank high on several indicators of science and technology. Georgia and Virginia are typically regarded as leading southeastern technology states with which North Carolina competes. Colorado and Washington often rank close to North Carolina on various innovation indicators and have improved their rankings significantly in recent years.

[13] Line charts including all 50 states are too detailed to interpret meaningfully.

[14] To facilitate a comparison of North Carolina's performance relative to that of the U.S. average and the six comparison states, the following color scheme is used on all charts: North Carolina (bold green), U.S. average (bold blue), California (lightish red), Massachusetts (yellow), Georgia (purple), Virginia (burgundy), Colorado (pale blue), and Washington (teal).

[15] For each indicator, the decision regarding the level at which to display the data was determined by a combination of (a) the most precise level at which accurate and comprehensive data were available and (b) the level at which displaying the data proved most informative for the purposes of this report.

[16] Accurate and reliable within-North Carolina data are available much less often than are state-level data. Hence, not every indicator includes within-North Carolina data.

[17] This change occurred because the National Science Foundation (NSF), which is the source much of the data in this *Tracking Innovation* report, began classifying industries using the KTI method in 2022. Under this method, industries are classified according to the United Nations' International Standard Industrial Classification of All Economic Activities, Revision 4 (ISIC, Rev.4), thus creating internationally comparable data.

[18] Data for this measure were unavailable for the 2021 report.

[19] These measures were added to fill a gap in previous *Tracking Innovation* reports and because diversity may spark new ideas and spur innovation.

[20] Previous editions of the *Tracking Innovation* report did not have access to data from the Digital Divide Index.

[21] In both the 2021 report and the 2024 report, North Carolina's average rank across all measures is 20th.

INTERPRETING THE DATA

The data in this report are voluminous and can be overwhelming, and therefore must be interpreted appropriately and carefully. To that end, several points should be kept in mind:

- **Values for most indicators are expressed as ratios or percentages.** This "normalizes" the data by controlling for factors such as state population and gross domestic product, thus enabling an "apples to apples" comparison.

- **Small differences in rankings and changes in value over time are not significant.** In the text description accompanying each indicator, the words "significant" or "significantly" are used only when differences across rankings or values over time surpassed a minimum and commonly accepted level of significance—i.e., at least one standard deviation away from the mean value of the data. In some cases, what appears to be a large difference in percentages is not, in fact, a statistically significant difference. Care was taken not to overinterpret the data.

- **Broad patterns and trends matter most.** While it is tempting to draw conclusions based on a comparison of a small number of states or years (e.g., two or three), those conclusions are far less valid and compelling than ones based on a comparison of a larger number of states and years.

- **Interpretation of an indicator should not be made in isolation.** While each indicator, by itself, provides valuable information, that value increases dramatically when judged in light of the information provided by other indicators, as each is just one component of the larger interconnected innovation ecosystem. Moreover, whereas some indicators primarily reflect outcomes (e.g., gross state product, educational attainment, income levels, poverty levels), others primarily reflect causes or the broader environment and context (e.g., R&D expenditures, support for education, broadband access, industry mix). As such, each should be evaluated in light of its place in the ecosystem **[Figure 2]**.

- **Data for states with smaller populations are less precise and may be misleading.** While the data for states with small populations are correct in that they reflect what is available, they should potentially be discounted because the smaller number of observations means their error level may be higher and their smaller magnitude may be less meaningful and impactful overall.

- **Rankings tend to divert attention from the actual value of a given measure, which often is more important.** On many indicators, there is very little statistically significant variation between state ranks, which simply are an ordinal-level measure.[22] This is most true for rankings with a low level of variation across the distribution, in which case the difference between the top-ranked state and the lowest-ranked state may be small and not particularly meaningful. Thus, in this report North Carolina's actual value (a ratio or percentage) on each indicator is reported, in addition to its rank (which is revealed by default in each graphic), permitting more meaningful interpretation of the findings. When measuring North Carolina's performance, it is better to know both its national rank and its percent of U.S. value. Each tells us something unique and helps us make sense of the other. Together, they provide more information than they would by themselves. The two numbers typically track together (e.g., when one is high, so is the other). When they don't, it typically is when a small number of states dominate U.S. activity (e.g., see Venture Capital in indicator 3.4) or when there is little statistically significant difference between states.

- **Rankings are for the state as a whole.** Because the rankings are in summary form and reflect an average score for the entire state, they do not convey information about the performance of specific regions or areas (e.g., counties, cities, metropolitan statistical areas) within the state. Where such sub-state data are available (as they are for 25 of the 42 measures, they are presented, typically in map form, to provide a more nuanced and explicit understanding of the location of innovation-related assets and the performance of those locations, which can vary considerably across the state.

We hope you find the data informative and useful.

[22] Ordinal-level measures allow only for the rank order [1st, 2nd, 3rd, etc.] by which data can be sorted, but do not allow for relative degree of difference between the data

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Section 1: Economic Well-Being

INDICATOR 1.1: GROSS DOMESTIC PRODUCT

KEY FINDINGS

- North Carolina's per capita GDP ranks below the U.S. average, has since at least 2017, and is increasing at a rate slightly slower than the U.S. average.
- Within North Carolina, three Metropolitan Statistical Areas (MSAs) had per capita GDPs higher than or equal to the national average for MSAs in 2022; since 2017, the per capita GDP of all but three of North Carolina's MSAs has increased at a rate slower than the U.S. average.

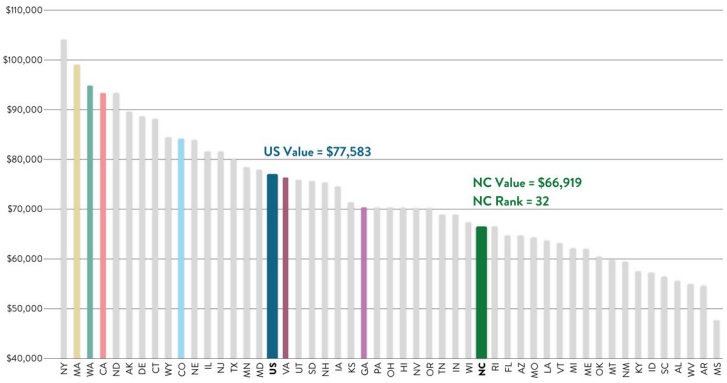
OVERVIEW

Gross domestic product (GDP) per capita captures the overall economic performance of a locale (e.g., state, country, or region). GDP is a measure of the total value of goods and services produced by an economy; on a per capita basis, GDP provides a measure of the productive capacity of a locale's workforce.[1] Although GDP is influenced by a wide range of factors—many of which are unrelated to the state's innovation economy—one of the ultimate aims of fostering innovation is to increase per capita GDP and other related indicators of economic performance.

HOW DOES NORTH CAROLINA PERFORM?

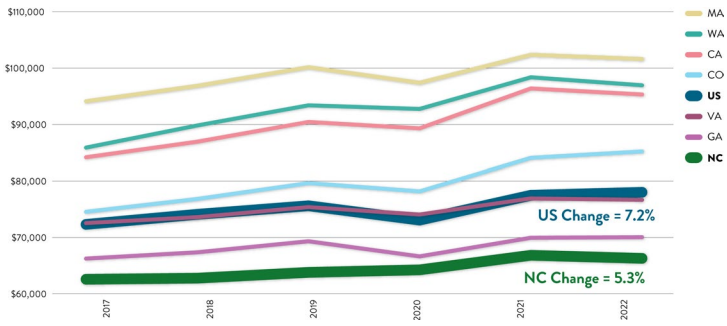
In 2022, North Carolina's per capita GDP of $66,919 was below the national average ($77,583) and below the midpoint of the individual state distribution, ranking 32nd overall **[1.1A]**. All the comparison states except Georgia and Virginia had an average per capita GDP above the national average. Since 2017, inflation-adjusted per capita GDP has increased in North Carolina by 5.3 percent.[2] This percentage increase is slightly slower than the 7.2 percent growth rate for the nation **[1.1B]**. North Carolina has fallen from the 21st-ranked state in per capita GDP in 2000 to 32nd in 2022. Among the comparison states, Virginia (5.2 percent) and Georgia (5.1 percent) also experienced lower-than-the-U.S.-average growth in per capita GDP since 2017.

1.1A *Per Capita Gross Domestic Product, All U.S. States, 2022*



Source: U.S. Bureau of Economic Analysis.

1.1B *Per Capita Gross Domestic Product, Comparison States, 2017-2022*



Source: U.S. Bureau of Economic Analysis.
Note: Adjusted for Inflation (2022 dollars).

[1]For the purposes of this report, the term "gross domestic product (GDP)" is used as a general counterpart to the more specific terms "gross state product (GSP)" at the state level, "gross regional product (GRP)" at the regional level, and "gross metro product (GMP)" at the metropolitan statistical area level.

[2]At the time data was collected for this report, the U.S. Bureau of Economic Analysis (BEA) had annual estimates of GDP by state available only for 2017-2022. These estimates were published in 2023 as part of a comprehensive update of BEA statistics. Real GDP statistics in these new estimates from last September 2023 are in 2017 dollars, which is a change from the previous data that was in 2012 dollars. GDP estimates for states for 1997-2016 will be released by BEA at a later date. These estimates will be released as part of a comprehensive update of BEA's GDP statistics. The previously released statistics for 1997-2016 were removed from BEA's official data tables because those back years were not consistent with the new 2017-2022 statistics.

INDICATOR 1.1: GROSS DOMESTIC PRODUCT

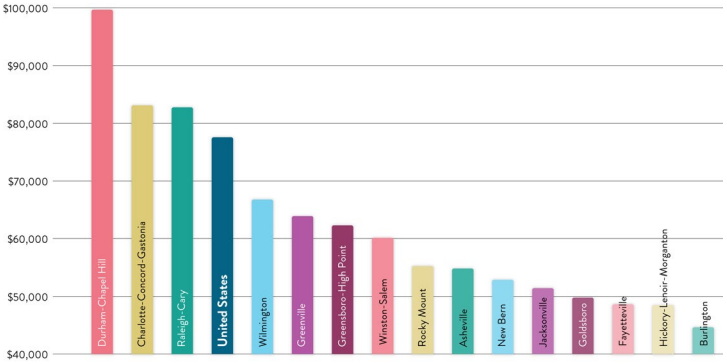
Within North Carolina, three Metropolitan Statistical Areas (MSAs)—Durham-Chapel Hill, Charlotte-Concord, and Raleigh-Cary—have higher per capita GDPs than the U.S. average in 2022 **[1.1C]**. GDP is even more concentrated than indicated by MSA-level data, as only five counties have a per capita GDP above the U.S. average: Durham, Mecklenburg, Wake, Dare, and Forsyth **[1.1D]**. While three MSAs rank above the U.S. average value of per capita GDP, only the Durham-Chapel Hill, Raleigh-Cary, and Wilmington MSAs increased at a rate (13.9 percent, 10.2 percent, and 16.5 percent, respectfully) higher than the U.S. average (7.2 percent) between 2017 and 2022 **[1.1E]**. Other large North Carolina MSAs such as Charlotte-Concord-Gastonia increased by 6.9 percent. Additionally 4 out of 15 North Carolina MSAs decreased in per capita GDP over the same period.

In terms of total GDP, two NC MSAs combined—Charlotte-Concord-Gastonia (35 percent) and Raleigh-Cary (19 percent)—account for more than half (54 percent) of the state's GDP accounted for by MSAs **[1.1F]**. The next three MSAs combined—Durham-Chapel Hill (10 percent), Greensboro-High Point (8 percent), and Winston-Salem (6 percent)—account for another 25 percent of the state's GDP accounted for by MSAs. This means that five of the state's 15 MSA's account for 78 percent of the state's GDP accounted for by MSAs. The next six MSAs combined: Fayetteville (4 percent), Asheville (4 percent), Hickory-Lenoir-Morganton (3 percent), Wilmington (3 percent), Jacksonville (2 percent), and Greenville (2 percent)—account for another 18 percent of the state's GDP accounted for by MSAs, bringing the total accounted for by the preceding MSAs to 95 percent. The remaining four MSAs (Rocky Mount, Burlington, New Bern, and Goldsboro) each account for 1 percent of the state's GDP accounted for by MSAs.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

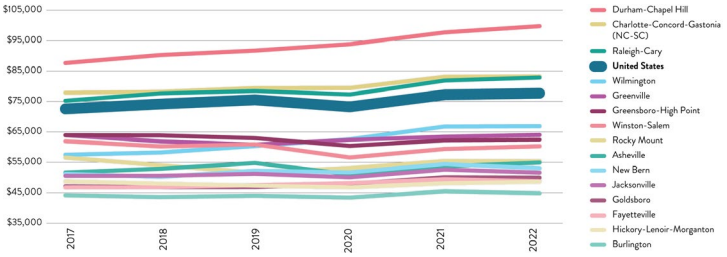
Trends in per capita GDP in North Carolina are a cause for concern. As of 2022, the state performed well below average in comparison with the U.S. average and other states. Additionally, North Carolina's per capita GDP value has grown more slowly since 2017 than has the national value and those of several comparison states. Because per capita GDP measures the ability of the state economy to support residents and weather economic turbulence, it is important that North Carolina improve this statistic by taking smart, strategic steps to grow the economy. Fostering innovation is one such step; the value added by innovation can improve productivity and is often compensated with increasing jobs, income, and profit.

1.1C *Per Capita Gross Domestic Product, N.C. MSAs, 2022*



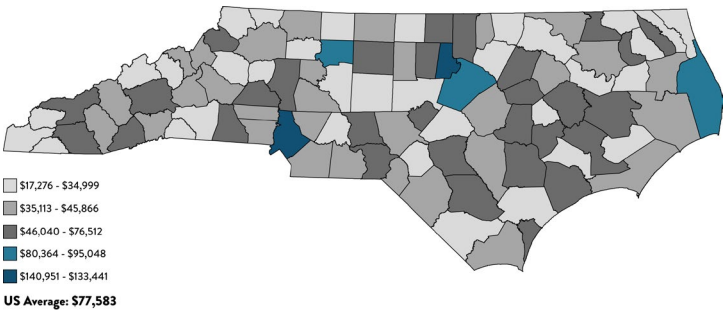
Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.

1.1D *Per Capita Gross Domestic Product, N.C. MSAs, 2017-2022*



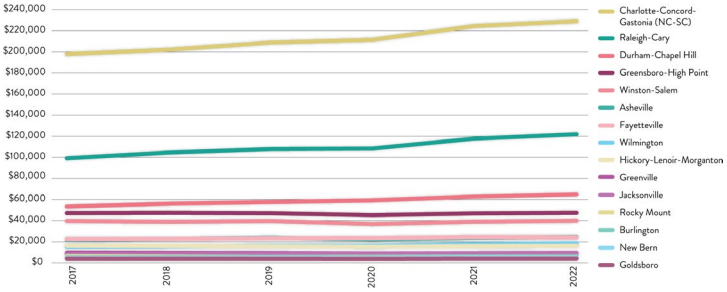
Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.

1.1E *Per Capita Gross Domestic Product, N.C. Counties, 2022*



Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.
Note: Blue counties rank above U.S. average.

1.1F *Total Gross Domestic Product, N.C. MSAs, 2017-2022*



Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.
Notes: Dollars are in Millions; Adjusted for inflation (2022 dollars).

INDICATOR 1.2: INCOME

KEY FINDINGS

- North Carolina's per capita income ranks below the U.S. average, has since at least 2000, and, adjusted for inflation, is increasing more slowly than the U.S. per capita income is increasing.
- North Carolina's median household income ranks below the U.S. average, has since at least 2005, and, adjusted for inflation, is increasing more slowly than the U.S. median household income is increasing.
- Within North Carolina, county per capita income and median household income vary considerably. On both income measures, most North Carolina counties have incomes well below the state average and the U.S. average.

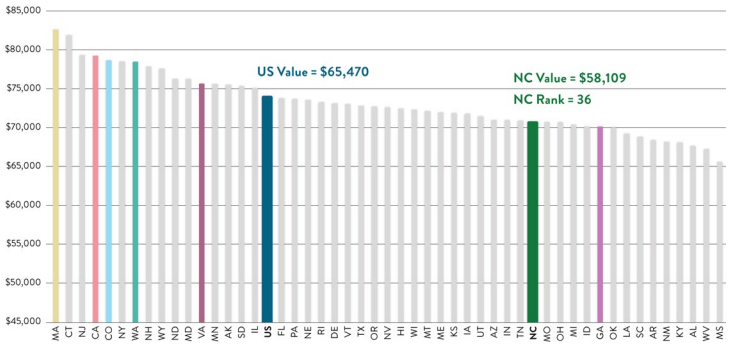
OVERVIEW

The two measures of income examined within this Section—per capita income and median household income—can be used to approximate economic prosperity and the ability of the economy to generate improved standards of living for its citizens.[1] Per capita personal income is the total income received from all sources divided by the total population; it measures the amount of wealth generated by an economy from wages and salaries, transfer payments, dividends, interest, rents and proprietor's income for each person in that economy. Per capita income may, however, obscure differences in income distribution, as it depends somewhat on demographics, such as the share of a state's population that is of working age. Thus, to add more clarity to North Carolina's income picture, median household income—the income amount at which half of all households fall above and half of all households fall below—is included here as a second measure of income. Median household income provides insight into changes in economic conditions for middle-income households.

HOW DOES NORTH CAROLINA PERFORM?

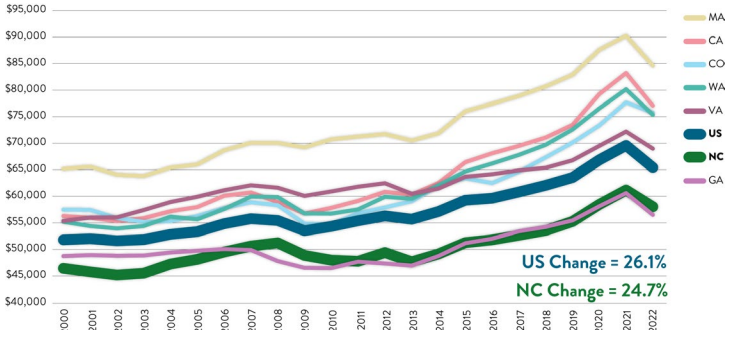
Per capita personal income in North Carolina was $58,109 in 2022 **[1.2A]**. This income is 89 percent of the national per capita personal income ($65,470) and places North Carolina as the 36th-highest performing state in the country. North Carolina's per capita personal income ranks below that of all the comparison states, except for Georgia, having increased over the past 20 years but at a slower rate. Since 2000, the inflation-adjusted per capita personal income in North Carolina increased by 24.7 percent, while U.S. average per capita income increased by 26.1 percent **[1.2B]**. Over the same period, per capita income in some comparison states has increased faster than the national average; for example, per capita income increased in California by 36.6 percent, Washington by 36.3 percent, and Massachusetts by 29.6 percent. Georgia and Virginia were the only comparison states for which the per capita income increased at a slower rate than North Carolina.

1.2A *Per Capita Income, All U.S. States, 2022*



Source: U.S. Bureau of Economic Analysis.

1.2B *Per Capita Income, Comparison States, 2000-2022*



Source: U.S. Bureau of Economic Analysis.

Note: Adjusted for inflation (2022 dollars).

[1] Income measures in this indicator do not account for differences in cost of living. Thus, the income earned in one state may provide a citizen in that state with more or less purchasing power than the same income provides a citizen in a different state. See Indicator 6.3 for cost-of-living comparisons.

INDICATOR 1.2: INCOME

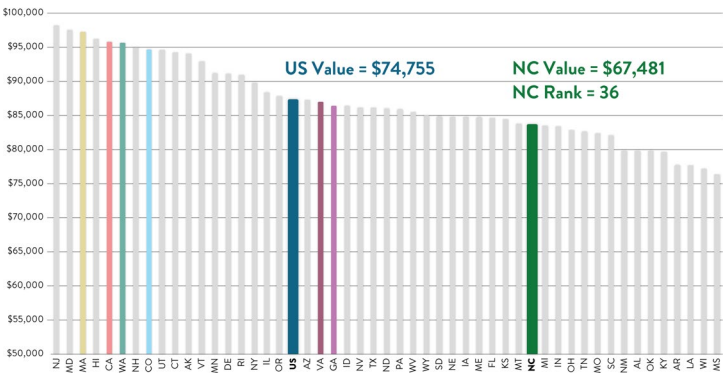
North Carolina's performance in median household income mirrors its performance in per capita income **[1.2C]**. With a median household income of $67,481 in 2022, North Carolina ranks 36th in the nation and has a median income that is 90 percent of the national average ($74,755). Furthermore, North Carolina had the lowest median household income among all comparison states. Only Georgia, Virginia, and Massachusetts have experienced slower growth than North Carolina among the comparison states. Median household income for North Carolina increased at a higher rate from 2005 to 2022 (10.6 percent) than did the national median household income (7.9 percent) **[1.2D]**.

Within North Carolina, 17 counties have a per capita personal income higher than the state average, and six of those have a per capita personal income higher than the national average.[2] The low number of counties above the state average indicates that high-income counties like Orange and Chatham, with per capita personal incomes of $77,568 and $79,769, respectively, skew the distribution. Twenty-two counties had a median household income higher than the state average and twelve counties had a median income higher than the U.S. median income in 2022 **[1.2E]**. Median household income ranged from $96,734 in Wake County to $38,927 in Washington County.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

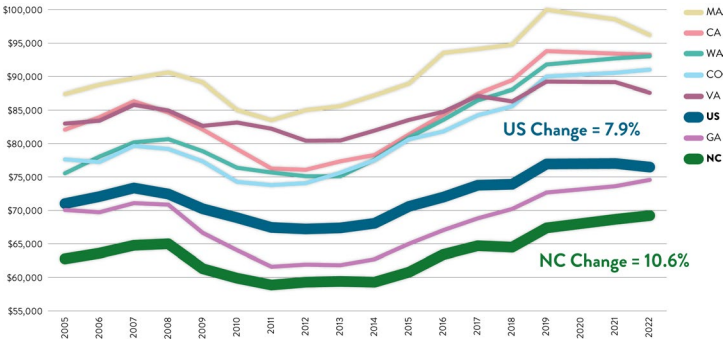
Per capita personal income and median household income in North Carolina compared unfavorably with the U.S. and comparison states in 2022, the most recent years for which data were available for each indicator. Furthermore, historical data show that North Carolina's performance has been comparatively poor over time. Slow income growth indicates that the state economy may not be generating new opportunities for households to increase wealth and standards of living. Occupations in the innovation economy are often compensated with high incomes; to the extent that more individuals can enter the innovation economy, North Carolina income performance will improve. This may be accomplished through measures like improving education levels in the workforce and increasing the share of Knowledge- and Technology-Intensive (KTI) or Science, Technology, Engineering, and Mathematics (STEM) companies in the state's economy.

1.2C *Median Household Income, All U.S. States, 2022*



Source: U.S. Census Bureau.

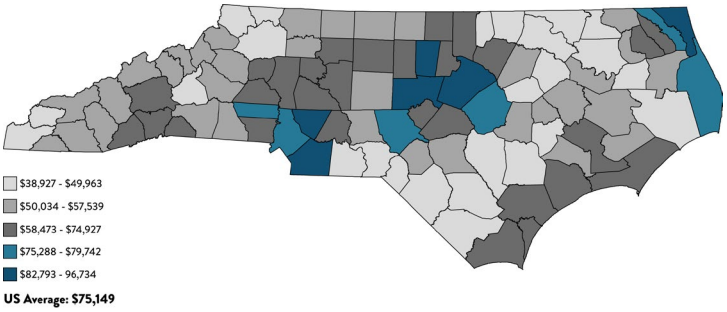
1.2D *Median Household Income, Comparison States, 2005 - 2022*



Source: U.S. Census Bureau.

Note: Adjusted for inflation (2022 dollars).

1.2E *Median Household Income, N.C. Counties, 2018-2022 Average*



Source: U.S. Census Bureau.

Note: Blue counties rank above U.S. average.

[2] U.S. Bureau of Economic Analysis, "Personal Income Summary, County," 2023.

INDICATOR 1.3: AVERAGE ANNUAL WAGE

KEY FINDINGS

- North Carolina's average annual wage in 2022 ranked considerably below the U.S. average and the average wages of all comparison states.
- Between 2001 and 2022, North Carolina's inflation-adjusted average wage increased at a rate slightly faster than the rate of increase in the U.S. average wage. Average annual wages for workers in Knowledge-and Technology Intensive (KTI) employment industries, in both North Carolina and the U.S. overall, are consistently much higher than the average annual wages for workers in all industries.
- Within North Carolina, only four counties had average annual wages higher than the N.C. average in 2022. The same four counties also had higher average annual wages than the U.S. average, even though the state ranked below the U.S. as a whole.

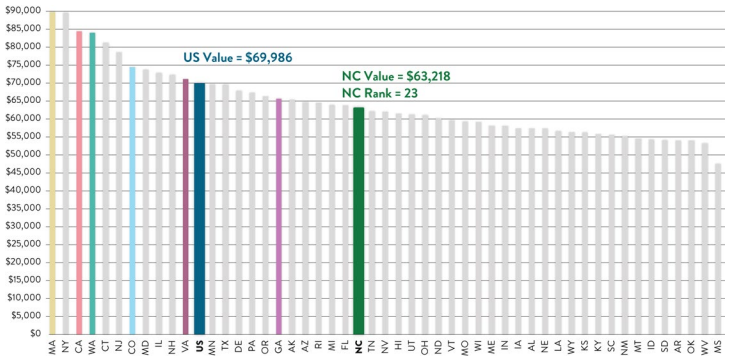
OVERVIEW

An economy's average annual wage reflects and provides insight into its mix of jobs. Low average annual wages typically indicate that an economy has a high percentage of low-wage jobs that may be in low-technology and labor-intensive economic sectors. High average annual wages typically indicate that a state's industry mix provides a larger share of middle- and high-wage jobs and generates relatively high standards of living. Enhancing North Carolina's innovation-based economy, fueled by industries with Knowledge-and Technology Intensive (KTI) employment, can lead to higher average annual wages, ultimately leading to greater economic well-being and quality of life.

HOW DOES NORTH CAROLINA PERFORM?

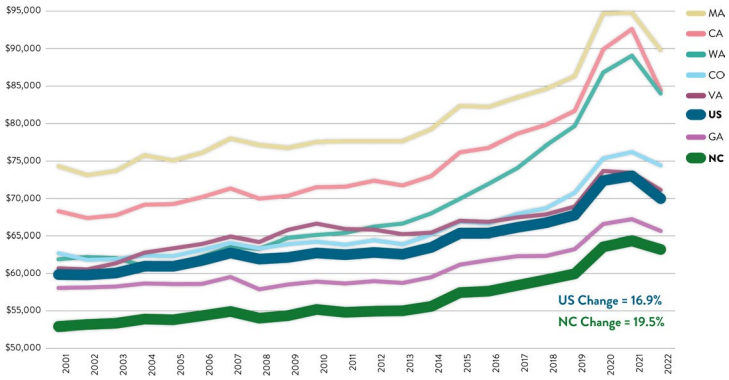
In 2022, the average annual wage in North Carolina was $63,218, ranking the state 23rd highest in the country and well below the national average of $69,986 **[1.3A]**. All six comparison states had higher average wages than North Carolina, and Georgia was the only other comparison state with an average wage lower than the national average. North Carolina's modest performance relates to the industry mix of its economy overall, which continues to depend—more than many other states do—on low-technology industries that are sensitive to labor costs, particularly in rural regions, the majority of the state. From 2001 to 2022, the inflation-adjusted average annual wage in North Carolina grew by 19.5 percent, which is slightly above the national growth rate (16.9 percent) and in the middle of the pack among the comparison states—behind Washington, California, and Massachusetts, and ahead of Virginia, Colorado, and Georgia **[1.3B]**.

1.3A *Average Annual Wage, All U.S. States, 2022*



Source: Bureau of Labor Statistics, U.S. Department of Labor.

1.3B *Average Annual Wage, Comparison States, 2001-2022*



Source: Bureau of Labor Statistics, U.S. Department of Labor.
Notre: Adjusted for inflation (2022 dollars).

INDICATOR 1.3: AVERAGE ANNUAL WAGE

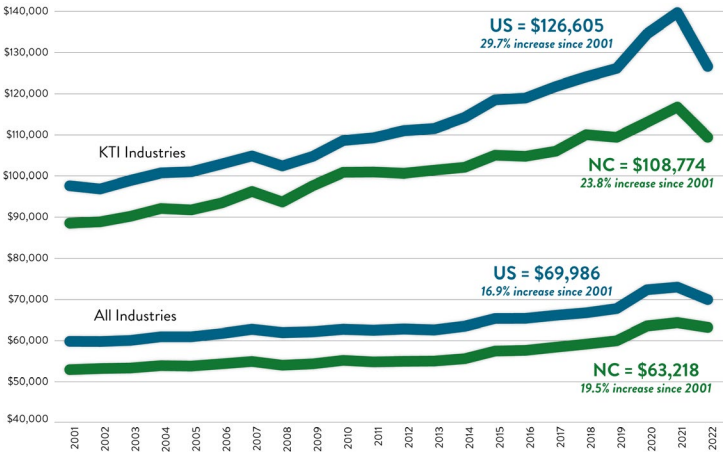
In 2022, the average annual wage for workers in KTI employment industries in North Carolina was $108,774, 72 percent greater than the average wage for workers in all industries in the state, $63,218 **[1.3C]**. This pattern reflects national patterns, in which the KTI employment average wage of $126,605 is 80 percent above the average wage for all industries, $69,986. Additionally, the average annual wage for KTI employment industries in both the U.S. and North Carolina increased at rates faster than the rates for all industries.

Within North Carolina, the vast majority of counties have an average annual wage lower than the state average. Only four counties—Durham, Mecklenburg, Wake, and Orange—had a 2022 average wage higher than the state average; the same four counties had average wage higher than the U.S. average **[1.3D]**. This pattern reflects the fact that high-wage, innovation-based jobs typically are concentrated in a few, typically urban, counties (see indicators 4.1 and 4.2).

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's average annual wage in 2022 was below the average annual wage for the nation as a whole and for all comparison states. However, average wages in North Carolina have increased over time, and this increase has slightly exceeded the country as a whole. Overall, the wage picture in North Carolina is improving somewhat but is still lower than it should be. A key way to increase wages is to increase the number of workers employed in KTI industries and other knowledge-based industries. Growth in these occupations will lead to higher standards of living for North Carolinians, increased consumer spending, and economic growth across the state.

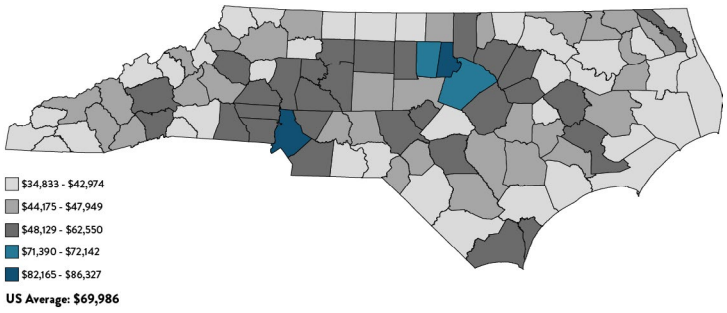
1.3C *Average Annual Wage, KTI Employment Industries and All Industries, U.S. and N.C., 2001-2022*



Source: Bureau of Labor Statistics, U.S. Department of Labor.

Notre: Adjusted for inflation (2022 dollars).

1.3D *Average Annual Wage, N.C. Counties, 2022*



Source: Bureau of Labor Statistics, U.S. Department of Labor.

Note: Blue counties rank above the U.S. average.

INDICATOR 1.4: UNEMPLOYMENT

KEY FINDINGS

- North Carolina's unemployment rate has generally trended higher than the U.S. average since 2000, particularly during the 2007-2009 recession, but since 2014 has decreased to closely follow the national average.
- Over a third of North Carolina counties had unemployment rates lower than the national average (38 out of 100) and over half lower than the state average (53 out of 100) in 2022.

OVERVIEW

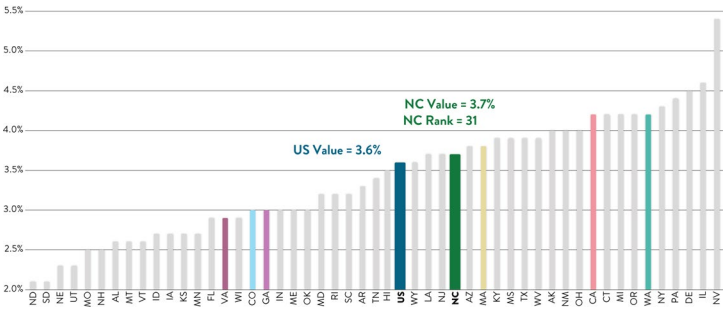
The unemployment rate is the percentage of labor force participants who are unemployed but actively seeking and available for work. Unemployment is generally viewed as a lagging indicator that reflects the performance of an economy. Unemployment rates indicate the degree to which an economy provides sufficient jobs to its labor force; higher rates show a relative inability to generate job opportunities.

HOW DOES NORTH CAROLINA PERFORM?

The average unemployment rate for North Carolina in 2022 was 3.7 percent **[1.4A]**. This unemployment rate is slightly higher than the national unemployment rate of 3.6 percent and is the 31st lowest rate of all states in the country. Among comparison states, North Carolina ranks in the middle of the pack, behind Virginia, Georgia, and Colorado, and ahead of Washington, Massachusetts, and California.

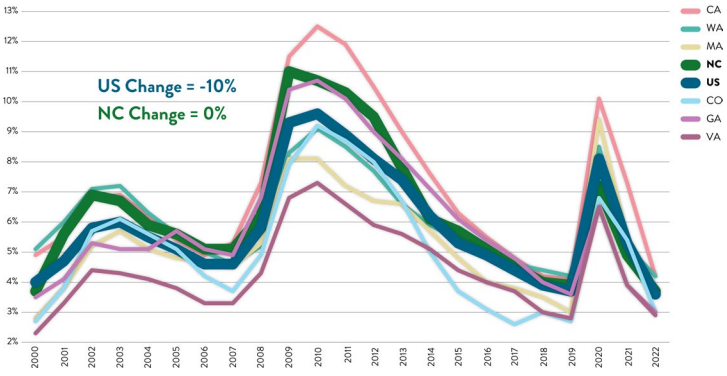
Between 2000 and 2022, the long-term trend for North Carolina's unemployment has been to stay the same, whereas the long-term trend for the national rate was to decrease slightly **[1.4B]**. The recession beginning in late 2007 and early 2008 caused unemployment rates to spike in 2010 (particularly in North Carolina and California) but then to reverse and decrease steadily to pre-recession levels by 2018. Unemployment spiked again between 2019 and 2020 due to the COVID-19 pandemic, but North Carolina fared better than the U.S. average (92 percent increase versus 119 percent). By 2022, the comparison states have returned to pre-pandemic unemployment rates or lower, except for Massachusetts (3.8 percent).

1.4A *Unemployment Percentage Rate, All U.S. States, 2022*



Source: Bureau of Labor Statistics, U.S. Department of Labor

1.4B *Unemployment Rate, Comparison States, 2000-2022*



Source: Bureau of Labor Statistics, U.S. Department of Labor

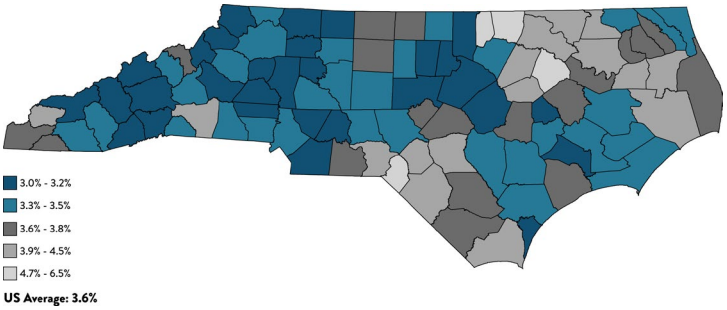
INDICATOR 1.4: UNEMPLOYMENT

There is significant variability in unemployment rates across North Carolina **[1.4C]**. In 2022, unemployment rates were lower than or equal to the state average and U.S. average in 53 counties, with 38 counties having rates below the U.S. average. At 3.0 percent, Orange and Buncombe Counties had the lowest unemployment rate of all counties, whereas Edgecombe County, with unemployment at 6.5 percent, had the highest unemployment in the state.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

In terms of unemployment, North Carolina is in the middle of the pack compared to other states. North Carolina's higher than average unemployment increase during the 2007-2009 recession resulted primarily from the disproportionate unemployment impact on sectors such as financial services and low-skill, low-tech manufacturing, in which North Carolina has had a higher-than-average presence. Though North Carolina's employment rate has since converged with the U.S. average, growing the state's innovation economy would serve to increase employment in STEM (science, technology, engineering, and math) fields and would have strong multiplier effects in industries seemingly unrelated to technology and innovation. These developments would help insulate the state's unemployment rate further from recessionary impacts. As the North Carolina economy continues to shift to higher-skill jobs, the job creation potential of the innovation economy could help the state to replace jobs in declining industries.

1.4C ***Unemployment Rate, N.C. Counties, 2022***



Source: Bureau of Labor Statistics, U.S. Department of Labor.
Note: Blue counties rank below the U.S. average.

INDICATOR 1.5: POVERTY

KEY FINDINGS

- The percentage of North Carolinians in poverty is above the U.S. average, has been since at least 2005, and is decreasing at a rate faster than the U.S. average.
- Within North Carolina, the percentage of the population living in poverty varies greatly from 5.9 percent to 29.9 percent; one-third of counties had poverty levels lower than the state average, and only 29 out of 100 had poverty levels lower than the U.S. average.

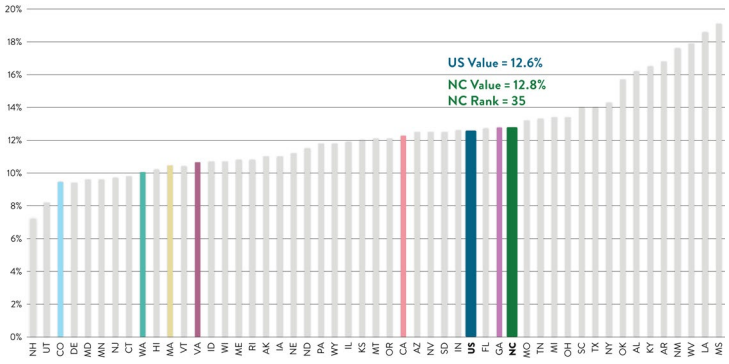
OVERVIEW

This indicator explores the extent to which the North Carolina innovation economy provides opportunities for the entire state workforce. Monitoring poverty is important for examining the effects of the state economic shift from a low-skill manufacturing-based economy to one based on knowledge production and use. High or widespread poverty levels indicate that advances in the innovation economy are failing to translate into greater opportunity for all North Carolinians. On the other hand, low or decreasing poverty levels may suggest that the high-wage jobs associated with the knowledge-based economy are leading to the improved economic standing of all North Carolinians.

HOW DOES NORTH CAROLINA PERFORM?

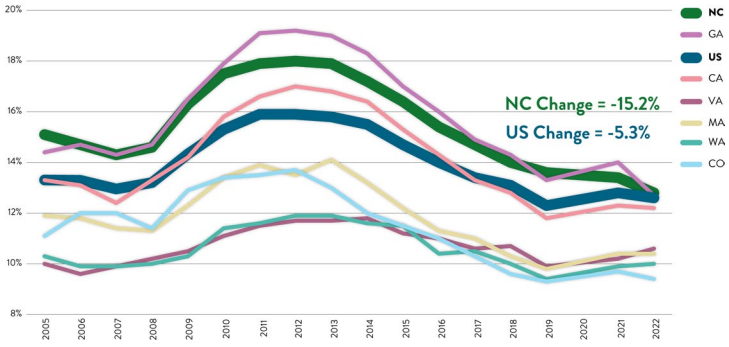
In 2022, 12.8 percent of North Carolinians lived in poverty **[1.5A]**. This is above the national poverty rate of 12.6 percent and ranks North Carolina 35th lowest in the country in terms of the share of its population in poverty. North Carolina's rank places it below all comparison states. All comparison states except Georgia had a poverty rate lower than the national average. Over time, North Carolina's poverty rate has decreased by 15.2 percent from 2005 to 2022 **[1.5B]**. This percentage decrease is more than the national decrease (5.3 percent) and more than the decrease in all but one of the comparison states, Colorado (15.3 percent).

1.5A *Percentage of Citizens in Poverty, All U.S. States, 2022*



Source: U.S. Census Bureau.

1.5B *Percentage of Citizens in Poverty, Comparison States, 2005-2022*



Source: U.S. Census Bureau.

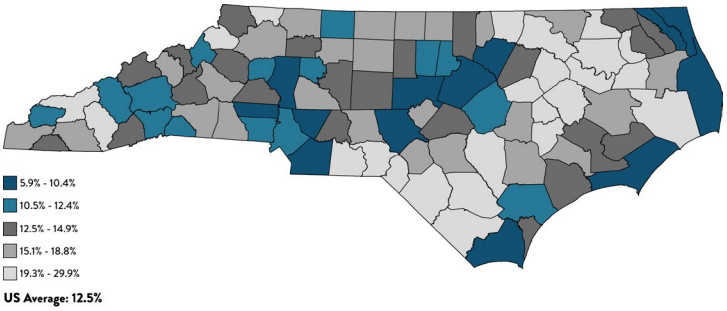
INDICATOR 1.5: POVERTY

Five-year average poverty within North Carolina (2018–2022) ranged from a low of 5.9 percent in Camden County to 29.9 percent in Hyde County, with a state average of 13.3 percent **[1.5C]**. Sixty-five counties had an average poverty level higher than the state five-year average, and seventy had a poverty level higher than the U.S. average.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Current levels of poverty in North Carolina are not favorable when compared to national levels, though over-time trends are improving slightly. As the North Carolina economy becomes increasingly reliant on knowledge-based jobs, it will be vitally important that no segment of the population be isolated without means of generating income. The high and widespread poverty levels across the state indicate that advances in the innovation economy are failing to translate into greater opportunity for all North Carolinians. To the extent the state has low or improving poverty levels, they are concentrated in a small minority of counties. North Carolina policy should seek to reduce poverty, and income inequality more generally, to ensure that the economy of the future—highly reliant on innovation and knowledge production—generates economic opportunities for all citizens.

1.5C ***Percentage of Population Below Poverty Level, N.C. Counties, 2018-2022 Average***



Source: U.S. Census Bureau.

Note: Blue counties rank below the U.S. average.

INDICATOR 1.6: POPULATION GROWTH

KEY FINDINGS

- Between 2000 and 2022, North Carolina moved from the 11th to the 9th most populous state, growing at a rate 79 percent faster than the U.S. average.
- Within North Carolina, the location and growth of the population are highly concentrated in a very small number of counties; 10 counties (out of 100) accounted for 70 percent of the change in population between 2000 and 2020.

OVERVIEW

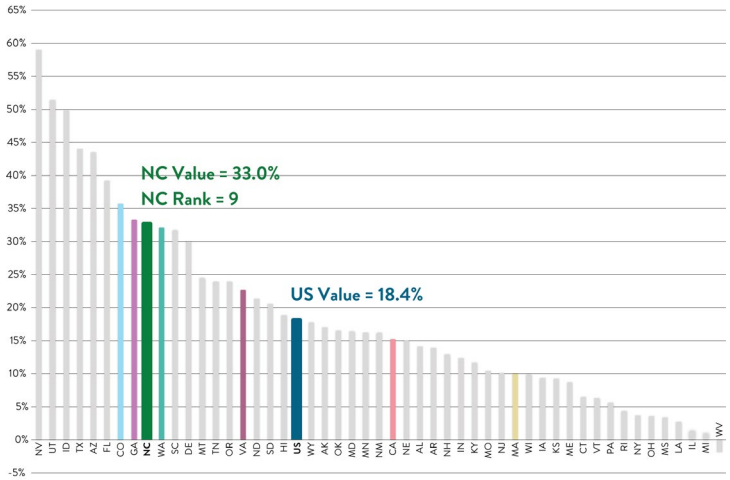
This indicator measures the extent to which North Carolina's total population is growing over time. For a given state, three components make up population growth: (1) natural growth—the excess of births over deaths; (2) in-migration—the movement of people from another state; and (3) immigration—the movement of people from outside the country to the state. Changes in population have social and economic implications that influence business location decisions, infrastructure demands, and service requirements. Population growth is also considered an indicator of economic and social opportunities, as people often move to regions where there are job opportunities or a high quality of life.

HOW DOES NORTH CAROLINA PERFORM?

In 2022, North Carolina ranked as the 9th most populous state in the country, with a total resident population of 10,698,973, according to the2022 Annual Estimates of Resident Population from the U.S. Census Bureau. In terms of percentage change in population between 2000 and 2022, North Carolina ranked 9th in the nation, with a growth rate that was 79 percent faster than the U.S. average and 44 percent slower than the fastest growing state, Nevada **[1.6A]**. Among the comparison states, North Carolina ranked in the middle, ahead of Virginia, California, and Massachusetts. Colorado, Georgia, Washington, and North Carolina all had similar growth rates and were the 7th, 8th, 10th, and 9th fastest growing states, respectively, over the 22-year period. The populations of California and Massachusetts increased slower than the national average during the same period.

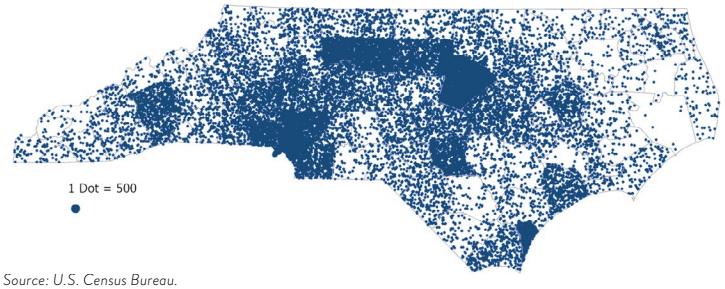
Within North Carolina, the location and growth of the population are highly concentrated in a small number of counties **[1.6B]**. In terms of location, the state's three most populous counties account for 26.8 percent of the state's population—Wake (11 percent), Mecklenburg (10.7 percent), and Guilford (5.1 percent). Together, the 10 next most populous counties—Forsyth (3.6 percent), Cumberland (3.1 percent), Durham (3.1 percent), Buncombe (2.6 percent), Union (2.3 percent), Gaston (2.2 percent), Cabarrus (2.2 percent), New Hanover (2.2 percent), Johnston (2.2 percent), and Onslow (1.9 percent)—account for 25.5 percent of the state's population. In total, this means that 13 of the state's 100 counties account for slightly more than half the state's population.

1.6A *Percentage Change in Population, All U.S. States, 2000-2022*



Source: U.S. Census Bureau.

1.6B *Estimated Location of Population in N.C., 2022*



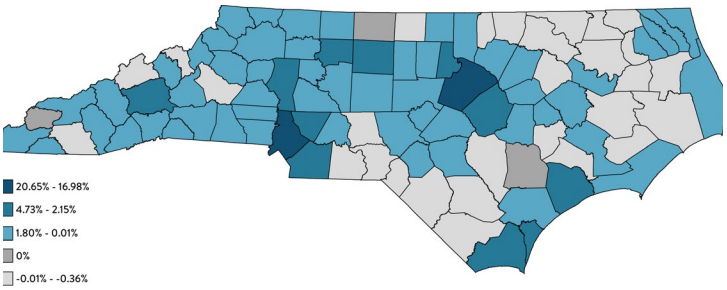
Source: U.S. Census Bureau.

INDICATOR 1.6: POPULATION GROWTH

Each of the 13 next most populous counties—Iredell, Alamance, Pitt, Davidson, Catawba, Orange, Rowan, Randolph, Brunswick, Harnett, Wayne, Robeson, and Henderson—has between 1.8 and 1.1 percent of the state's population, a percentage slightly greater than each county's respective share (1 percent) of the total number of counties (100). These 13 counties, plus the 13 more populous ones, account for 70.7 percent, or nearly three-fourths of the state's total population. Each of the remaining 74 counties has 1 percent or less of the state's total population, and together they account for 29.3 percent of the state's total population.

In terms of growth, the level of concentration is even greater than the distribution of population **[1.6C, 1.6D]**. Two counties account for 39 percent of the population growth between 2000 and 2022—Wake (21.4 percent) and Mecklenburg (17.6 percent). Together, the next three counties—Guilford (4.9 percent), Union (4.9 percent), and Johnston (4.4 percent)—account for another 14.2 percent of the state's population growth. In total, this means that five of the state's 100 counties account for more than half the state's population growth since 2000. To reach over 75 percent of the state's population growth, only 8 more counties (for a total of 13) are needed—Cabarrus (4.1 percent), Durham (4. percent), Forsyth (3.3 percent), New Hanover (2.9 percent), Iredell (2.9 percent), Brunswick (3.1 percent), Buncombe (2.6 percent), Onslow (2.2 percent). Another eight counties—Harnett, Alamance, Gaston, Pitt, Franklin, Orange, Henderson, and Moore—each account for between 1.8 and 1.1 percent of the state's population growth between 2000 and 2022. Each of the remaining 79 counties comprise approximately one percent or less of the state's total population growth, and together they account for 9.8 percent of the state's total population growth.

1.6C ***Population Change, Percent of Total Change, N.C. Counties, 2000-2022***



Source: U.S. Census Bureau.

Note: Blue counties have positive population growth; gray counties have zero population growth or are decreasing in population.

1.6D ***Population Change, N.C. Counties, 2000-2022***

County	Population 2000	Population 2022	Absolute Change 2000-2022	Percent of Total Change	Cumulative Percent of Total Change
Wake	627,846	1,175,021	547,175	21.4%	21.4%
Mecklenburg	695,454	1,145,392	449,938	17.6%	39.0%
Union	123,677	249,070	125,393	4.9%	43.9%
Guilford	421,048	546,101	125,053	4.9%	48.8%
Johnston	121,965	234,778	112,813	4.4%	53.2%
Durham	223,314	332,680	109,366	4.3%	57.5%
Cabarrus	131,063	235,797	104,734	4.1%	61.6%
Forsyth	306,067	389,157	83,090	3.3%	64.8%
Brunswick	73,143	153,064	79,921	3.1%	68.0%
New Hanover	160,307	234,921	74,614	2.9%	70.9%
Iredell	122,660	195,897	73,237	2.9%	73.8%
Buncombe	206,330	273,589	67,259	2.6%	76.4%
Onslow	150,355	207,298	56,943	2.2%	78.6%
Harnett	91,025	138,832	47,807	1.9%	80.5%
Alamance	130,800	176,353	45,553	1.8%	82.3%
Gaston	190,365	234,215	43,850	1.7%	84.0%
Pitt	133,798	173,542	39,744	1.6%	85.5%
Orange	118,227	150,477	32,250	1.3%	86.8%
Moore	74,769	105,531	30,762	1.2%	88.0%
Henderson	89173	118,106	28,933	1.1%	89.1%
Franklin	47260	74,539	27,279	1.1%	90.2%
79 Other	3,394,595	3,644,955	250,360	9.8%	100.0%
Total	**7,633,241**	**10,189,315**	**2,556,074**	**100.0%**	

Note: Listed counties each accounted for >1% of the population change between 2000 and 2022

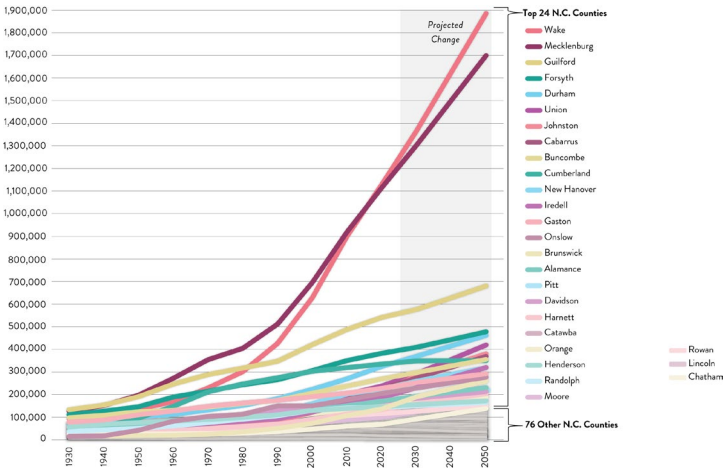
INDICATOR 1.6: POPULATION GROWTH

These recent population growth trends reflect longer-term population growth trends. Whereas in 1930 the respective populations of each of North Carolina's 100 counties were relatively similar, by 2050 the respective county populations are projected to differ considerably **[1.6E]**. Specifically, in 1930 the most populous county (Guilford: 133,010) had 26 times more people than the least populous county (Tyrrell: 5,164), but in 2050 the most populous county (Wake: 1,885,406) is projected to have more than 780 times as many people as the least populous county (Tyrrell: 2,409). Between 1930 and 2050, two highly populated counties, Wake and Mecklenburg, are projected to grow by 1,890 percent and 1,228 percent, respectively, while the projected average growth rate across all other counties for that period is 235 percent. Moreover, the top 26 counties in terms of growth rate between 1930 and 2050 account for 84 percent of the change in the state's population during that period, whereas the other 74 counties account for 16 percent of the change in the state's population during that period. And each of top 26 counties accounts for at least 1 percent of the change in the state's population between 1930 and 2050, whereas each of the other 74 counties accounts for less than 1 percent of the change in the state's population between during that period; of those 74 counties, 13 are decreasing in population. Overall, the pattern is for more populated counties to grow faster than less populated counties.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

The relationship between population growth and economic well-being is strong and positive, as evidenced by high rates of population growth in counties and regions ranking high on the indicators of economic well-being (see indicators 1.1–1.5). North Carolina will continue to experience population growth from in-migrants and immigrants into those locales having high economic output, employment opportunities, and high wages. To the extent state leaders want that growth to continue, and to the extent that it actually does continue, the need to enhance and grow infrastructure (schools, utilities, roads/transit, broadband, water/sewer, etc.) will increase as well. Failure to meet the needs of a growing population will result in higher levels of unemployment and poverty.

1.6E ***Change in Population, N.C. Counties, 1930-2050***



Source: U.S. Census Bureau, via North Carolina Office of State Budget and Management State Demographer.

Section 2: Research & Development

Research & Development

INDICATOR 2.1: TOTAL R&D

KEY FINDINGS

- North Carolina's total Research & Development (R&D) expenditures as a percentage of gross domestic product (GDP) ranks below the U.S. average and has since at least the early 2000s, but is increasing at a rate faster than the U.S. average.
- Businesses perform three-fourths of the R&D in North Carolina, and business-performed R&D is most concentrated in metropolitan regions; 72 percent of business-performed R&D occurs in the Research Triangle region, along with 87 percent of the state's university R&D.

OVERVIEW

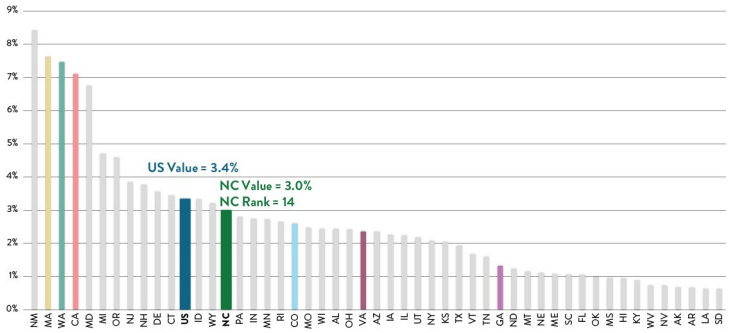
This indicator represents the extent to which R&D plays a role in a state's economy. R&D expenditures refer to R&D activities performed by businesses, universities, nonprofit organizations, and federal and state agencies.[1] R&D is the driving force behind innovation and sustained economic growth. Organizations performing R&D create new product or process innovations, thus expanding markets and sales, stimulating investment, and ultimately creating jobs. Companies located near R&D centers benefit from shared knowledge and expertise and are often the first to adopt new product and production technologies.

HOW DOES NORTH CAROLINA PERFORM?

In terms of total R&D (industry + academic + all other) as a percentage of GDP, North Carolina's value ranks 14th in the nation, with a level that is 90 percent of the U.S. value **[2.1A]**. In other words, the ratio of R&D to GDP in North Carolina is 90 percent of what we would expect based on the national ratio of R&D to GDP. Moreover, the ratio of North Carolina's total R&D to GDP is just over one-third the value of the top-ranking state, New Mexico.[2]

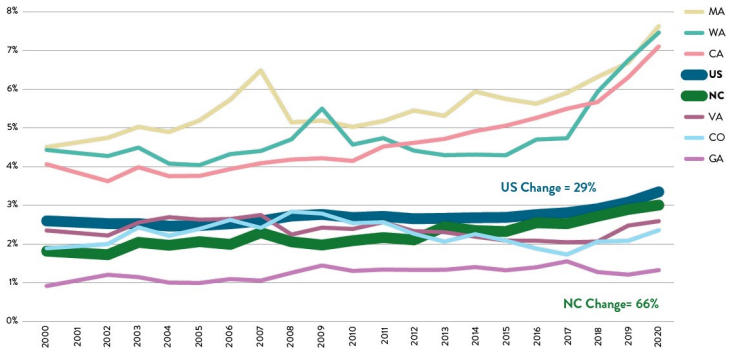
This ranking reflects the relative distribution of academic R&D to industry R&D within North Carolina and nationally. Specifically, North Carolina's academic R&D level per state GDP (see indicator 2.3) is 140 percent of the U.S. level, while its industry R&D level per industry output (see indicator 2.2) is 98 percent of the U.S. level and 33 percent of the leading state's (Washington). Nationwide and in North Carolina, industry R&D accounts for approximately 74 percent of total R&D,[3] meaning that North Carolina's lower-than-average rate of industry R&D puts it at a competitive disadvantage in total R&D. Since 2000, however, North Carolina's total R&D rate has been growing more than two times faster than the U.S. rate, narrowing the gap between the two **[2.1B]**.

2.1A *Total R&D Expenditures as a Percentage of GDP, All U.S. States, 2020*



Source: National Science Board.

2.1B *Total R&D Expenditures as a Percentage of GDP, Comparison States, 2000-2020*



Source: National Science Board.

Note: 2001 data was not available. Plotted data for 2001 was interpolated from 2000 and 2002 data.

[1] R&D-performing organizations either fund their own R&D activities or receive funding from other organizations. For example, a considerable portion of academic R&D performance is funded by the federal government.

[2] New Mexico commonly has the greatest value for this indicator by a significant margin due to the high concentration of R&D activities at two national laboratories in the state, combined with the state's relatively small gross domestic product.

[3] National Science Board, Science and Engineering Indicators 2022, Chapter 4, "U.S. R&D Performance and Funding," pp. 10-11.

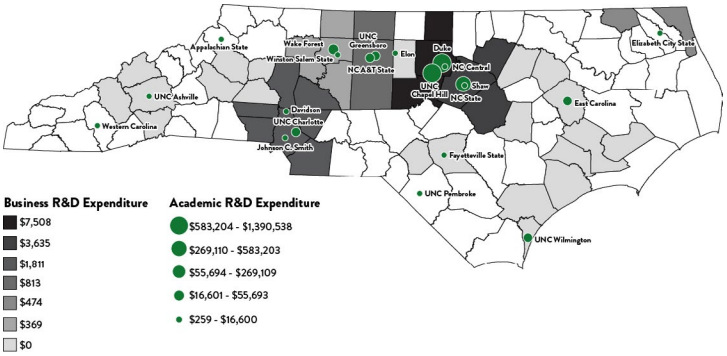
INDICATOR 2.1: TOTAL R&D

Within North Carolina, R&D is highly concentrated in a pattern that reflects the location of the state's population and research universities **[2.1C]**. While it is reasonable to assume more balanced rates of R&D across the state's industries,[4] the rate of R&D across North Carolina universities is considerably less equal, with nearly 86 percent occurring in the Research Triangle Region (Wake, Durham, and Orange counties). In general, this pattern suggests that R&D is most concentrated in metropolitan regions (areas surrounding the cities of Raleigh, Charlotte, Durham, and Chapel Hill), particularly those with major research universities, where companies have access to the talent needed to conduct R&D activities.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

For North Carolina to grow its economy significantly in both the short term and long term, it needs to increase the volume and intensity of its R&D efforts relative to other U.S. states. In the near term it should, at a minimum, strive to be at parity with the U.S. value. Given the R&D strengths of its universities, an efficient and effective way NC industry could achieve this goal is by tighter and more frequent R&D partnerships with the state's universities, which have above-average research expenditures.

2.1C *Location of R&D Expenditures in N.C., 2021-2022*



Source: Quarterly Census of Employment and Wages, Labor & Economic Analysis Division, NC Department of Commerce; National Science Foundation.

Notes: Business R&D from 2021 survey and Academic R&D from 2022. Business establishments perform 74% of R&D in NC; of that, manufacturing establishments perform 54%; universities perform 19% of R&D.

[4] The extent to which this approximation is accurate depends on the size of the businesses and the industry mix across the state. In general, large companies conduct more research than small companies do. Moreover, National Science Foundation data indicate that trends in U.S. business R&D performance are driven by five industries that together accounted for 443 billion, or 74%, of domestic business R&D performance in 2021: chemicals manufacturing; computer and electronic products manufacturing; transportation equipment manufacturing; information; and professional, scientific, and technical (PST) services (National Science Foundation, National Center for Science and Engineering Statistics, Business Research and Development Survey, 2021).

INDICATOR 2.2: INDUSTRY R&D

KEY FINDINGS

- North Carolina's business-performed R&D as a percentage of private-industry output ranks slightly below the U.S. average and has since at least the early 2000s, but is increasing at a rate faster than the U.S. average.
- Within North Carolina, business-performed R&D is highly concentrated in the three largest metropolitan regions of the state.
- Relative to the U.S. average business R&D pattern, business R&D within North Carolina is more concentrated in the pharmaceutical, computer and electronic products, and software publishing sectors.

OVERVIEW

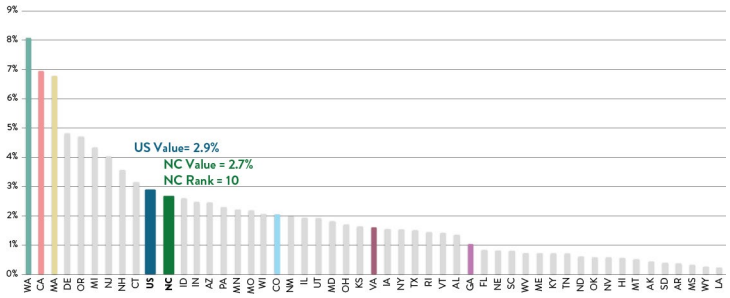
The business sector is the largest performer of U.S. R&D. Nationwide, business-performed R&D accounts for 58 percent of all U.S. applied research and 90 percent of all development.[1] For a given state, a high value for this indicator shows that businesses within the state are making a large investment in their R&D activities. Across states, this indicator reflects state differences in industrial structure as well as the behavior or priorities of individual businesses. Private-industry output, against which the level of business-performed R&D is normalized for this indicator, is the portion of state gross domestic product contributed by state businesses.

HOW DOES NORTH CAROLINA PERFORM?

In terms of business-performed R&D as a percentage of private-industry output, North Carolina's value ranks 10th in the nation, with a level that is 98 percent of the U.S. value **[2.2A]**. However, this value is only 33 percent of the value of the top-ranking state, Washington.

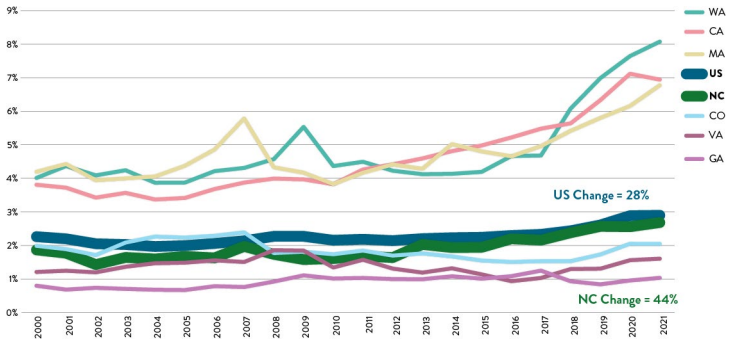
This ranking reflects North Carolina's economic history, which is heavily based in agricultural, industrial, and branch-plant operations. Because of this, historically, comparatively few companies within the state have had significant research operations, which typically locate at or near company headquarters, often located outside of North Carolina. This is changing over time, however, as North Carolina's business-performed R&D rate has increased nearly 44 percent since 2000, almost twice the rate for the U.S. overall at 28 percent **[2.2B]**. The top three comparison states (Washington, California, and Massachusetts) are also the top three states nationally. Furthermore, they each have a much higher percentage of private-industry output devoted to business-performed R&D than North Carolina and have increased this value as fast or faster since 2000.

2.2A *Business-Performed R&D as a Percentage of Private-Industry Output, All U.S. States, 2021*



Source: National Science Board.

2.2B *Business-Performed R&D as a Percentage of Private-Industry Output, Comparison States, 2000-2021*



Source: National Science Board.

[1] National Science Board, Science and Engineering Indicators 2022, Chapter 4, "U.S. R&D Performance and Funding," pp. 10-11.

2.2C *Business-Performed R&D Expenditures in U.S. and N.C. by Industry, 2021*

SUBSECTOR	NAICS CODE	UNITED STATES		NORTH CAROLINA	
		Expenditures *In Millions*	% of All Industries	Expenditures *In Millions*	% of All Industries
All Industries	**21–23, 31–33, 42–81**	**$527,804**	**-**	**$9,812**	**-**
Chemicals	325	$97,097	18%	$2,077	21%
Computer and electronic products	334	$94,211	18%	$2,052	21%
Publishing	511	$38,521	7.3%	$1,133	12%
Data processing, hosting, and related services	518	$44,585	8.4%	$938	9.6%
Professional, scientific, and technical services	541	$32,083	6.1%	$923	9.4%
Machinery	333	$16,726	3.2%	$432	4.4%
Transportation equipment	336	$34,405	6.5%	$248	2.5%
Miscellaneous	339	$20,822	3.9%	$243	2.5%
Electrical equipment, appliances, and components	335	$5,007	0.9%	$158	1.6%
Beverage and tobacco products	312	$1,228	0.2%	$84	0.9%
Subtotal		**$384,685**	**73%**	**$8,288**	**84%**

Source: National Center for Science and Engineering Statistics and U.S. Census Bureau.

Note: Dollars in Millions. Expenditures by company, not including expenditures by others for R&D performed by the company.

Following national trends, 59 percent of R&D is performed in manufacturing sectors.[2] Almost all North Carolina business-performed and paid R&D occurs in 10 subsectors **[2.2C]**. R&D expenditures were more highly concentrated than the U.S. average in six of those subsectors (chemicals, computer and electronic products, publishing, professional services, data processing and hosting, and machinery). 79% of chemical subsector R&D is performed by the pharmaceuticals and medicines industry (NAICS code 3254), 100% of publishing subsector expenditures are by the software publishing industry (5112), and 89% of miscellaneous is attributed to the medical equipment and supplies industry (3391). While not a large portion of total expenditures, North Carolina businesses are much more heavily involved in beverage and tobacco product R&D than would be expected based on the U.S. average. This is likely a result of North Carolina's historical involvement in the tobacco and agricultural industries whose businesses are innovating beyond traditional products.

[2] National Center for Science and Engineering Statistics and U.S. Census Bureau, Business Research and Development Survey, 2021.

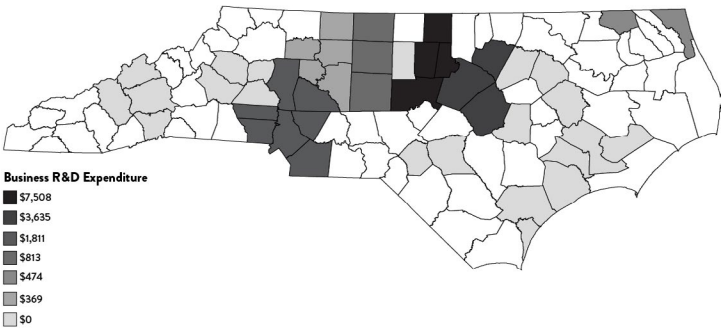
INDICATOR 2.2: INDUSTRY R&D

Within North Carolina, business-performed R&D is highly concentrated in three regions **[2.2D, 2.2E]**. 72 percent of business R&D was performed in the Durham-Chapel Hill and Raleigh-Cary metropolitan statistical areas (MSAs). Another 12 percent was conducted by companies in the Charlotte metro area, and 8 percent within the Piedmont Triad region (Greensboro-High Point, Winston-Salem, and Burlington MSAs). Research and development operations require a highly skilled workforce and proximity to leading research universities in these three regions likely explains this trend.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

For North Carolina to grow its economy significantly in both the short term and long term, it needs to increase the level and intensity of business-performed R&D relative to that in other U.S. states. In the short term, an efficient and effective way the state's businesses could achieve this goal is by tighter and more frequent R&D partnerships with the state's universities, which have above-average R&D expenditures and can serve as strong R&D partners with the businesses. This approach may also prove useful in the longer term, as trends over the past several decades reveal that businesses increasingly partner with universities to conduct R&D, which often requires facilities, equipment, and expertise beyond the scope and budgets of most businesses. The largest determinant of North Carolina's level of business-performed R&D is its industrial structure, which currently exhibits a lower share of high-tech establishments nationally and relative to comparison states (see, e.g., indicators 4.1–4.3 and 6.4). For North Carolina to increase its business-performed R&D, it will need to increase the share of Knowledge- and Technology Intensive (KTI), innovation-focused businesses in its economy.

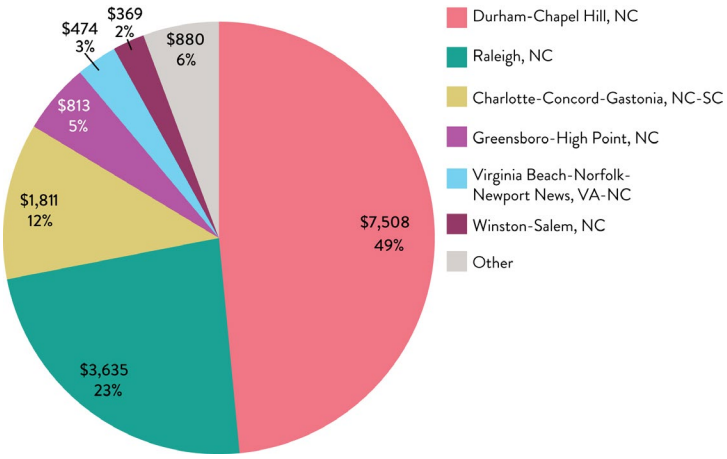
2.2D *Location of Business-Performed R&D Expenditures in N.C., 2021*



Source: National Center for Science and Engineering Statistics and U.S. Census Bureau.

Notes: Dollars in Millions. Companies that performed or funded less than $50,000 of R&D were excluded from tabulation. 5.7% of North Carolina business-performed R&D expenditures were not attributed to a particular area by the U.S. Census Bureau's Business Research and Development Survey.

2.2E *Location of Business-Performed R&D Expenditures in N.C., 2021*



Source: National Center for Science and Engineering Statistics and U.S. Census Bureau.

Notes: Dollars in Millions.

INDICATOR 2.3: ACADEMIC R&D

KEY FINDINGS

- North Carolina's academic R&D spending as a share of state GDP ranks well above the U.S. average, has since at least the early 2000s, and is increasing at a rate faster than the U.S. average.
- North Carolina's academic R&D is highly concentrated in a small number of universities located primarily in the Research Triangle Region.
- The federal government funds the majority of North Carolina's academic R&D, but some universities also receive significant funding from state and local government and business.

OVERVIEW

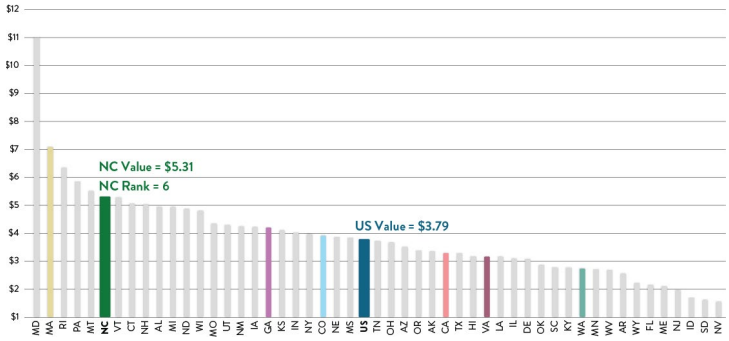
R&D is the driving force behind innovation and sustained economic growth. The ratio of R&D expenditures at a state's colleges and universities relative to the size of the state's economy measures the intensity of the state's academic R&D. Across the U.S., academic institutions perform nearly half of basic research (46 percent) and 13 percent of all R&D conducted in the United States.[1] While industry performs 76 percent of all U.S. R&D, academic R&D serves as a valuable foundation for industry R&D and future economic development.

HOW DOES NORTH CAROLINA PERFORM?

In terms of the level of North Carolina's academic R&D expenditures relative to the size of its economy, North Carolina ranks sixth in the nation and is 40 percent higher than the U.S. average **[2.3A]**.[2] North Carolina's academic R&D intensity is 140 percent of the U.S. value, meaning that the amount of academic R&D in North Carolina is 40 percent higher than what we would expect based on the levels of academic R&D in all other states. As with business R&D (indicator 2.2), the top states far exceed the rest of the country, and North Carolina's academic R&D intensity is half of the top-performing state, Maryland.

This strong ranking reflects a long-standing pattern in North Carolina: The core strength of North Carolina's R&D activities is in its colleges and universities. North Carolina has a comparatively large number of colleges and universities for its population, and several are national leaders in STEM fields. Thus, a large proportion of research conducted in North Carolina is basic in nature and, therefore, not heavily focused on industry requirements or direct economic outcomes. This fact underlies North Carolina's lower-than-expected performance on some of the commercially focused indicators discussed elsewhere in this report.

2.3A *Academic R&D per $1,000 of State GDP, All U.S. States, 2021*



Source: National Science Board.

[1] National Science Board, Science and Engineering Indicators 2022, Chapter 4, "U.S. R&D Performance and Funding," pp. 10-11.

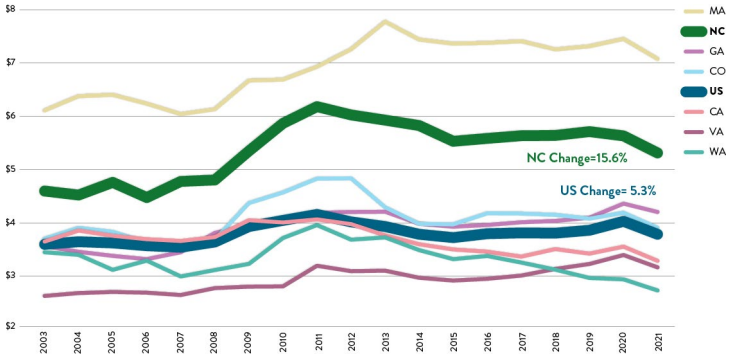
[2] Academic R&D is reported for institutions with R&D more than $150,000.

INDICATOR 2.3: ACADEMIC R&D

Between 2003 and 2011, North Carolina's academic R&D intensity grew at a rate three times faster than the U.S. rate, further increasing the gap between the two **[2.3B]**. Since 2011 the U.S. rate as well as all comparison states has been largely stagnant or in a slight decline.This total rate of increase since 2003 has historically been faster than the rate of increase in any of the comparison states. Within the last few years Massachusetts, Georgia, and Virginia have increased their rate of growth past North Carolina's 15.6 percent. Only Massachusetts has a higher academic R&D intensity among comparison states, and North Carolina has a 26% higher value than the next highest comparison state, Georgia.

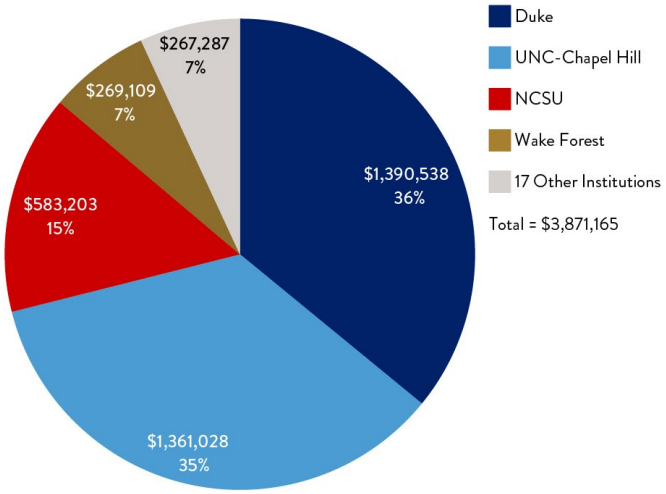
Within North Carolina, academic R&D is highly concentrated in the Research Triangle region. The three largest universities located in that region—Duke University, UNC-Chapel Hill, and North Carolina State University—account for 86 percent of all academic R&D expenditures within the state **[2.3C, 2.3D]**. Wake Forest University in Winston-Salem also has significant academic R&D (seven percent of the state total), while 17 other public and private universities conduct the state's remaining 7 percent academic R&D across the state.

2.3B *Academic R&D per $1,000 of State GDP, Comparison States, 2003-2021*



Source: National Science Board.

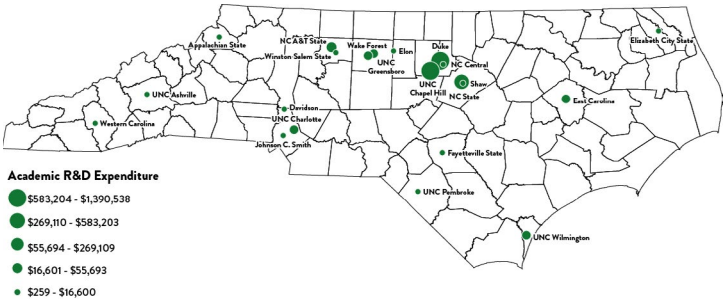
2.3C *N.C. Universities R&D Expenditures, 2022*



Source: National Science Board.

Note: Dollars in thousands.

2.3D *N.C. Universities R&D Expenditures, 2022*



Source: National Science Foundation.

Note: Dollars in thousands.

INDICATOR 2.3: ACADEMIC R&D

The source of funds for academic R&D reflects, to some extent, the nature of the R&D, and varies considerably across the U.S. and North Carolina's academic institutions **[2.3E]**. Nationwide and across North Carolina, the federal government is the largest supporter of academic R&D, in most cases funding a significant majority of that R&D. Within North Carolina, North Carolina State University is the only academic institution that receives less than 50 percent of its academic R&D funding from the federal government, although the federal government remains the university's largest source of funding. This lower share of federal funding reflects the fact that, as a land-grant university with a historical focus on agricultural and mechanical arts, as well as material science, North Carolina State University receives a significant and much higher than average share (more than 20 percent) of its funding from state and local government.

While business also funds a substantial share of academic R&D, for most North Carolina institutions that share is less than 10 percent, with the exception in North Carolina being Duke University, which receives 15 percent of its funding from business. This larger-than-average share results from the activities of the Duke Clinical Research Institute (DCRI), which conducts medically focused clinical trials for business.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's academic research, the majority of which focuses on basic fundamental science, is important for producing new knowledge and scientific stature. Industry R&D is more often the engine that translates the basic research discoveries into commercial products. This suggests that attention should be given to continuing to strengthen both academic R&D and academic-industry collaborative R&D. Strengths in both, particularly across a wider range of North Carolina's geography, will help improve the economic well-being and quality of life across the state. A supporting factor of academic R&D are having universities that hold R1 designations from the Carnegie Classification of Institutions of Higher Education. These "very high research activity" universities can help drive regional R&D. North Carolina currently has three R1 universities (Duke, UNC Chapel Hill, and North Carolina State Universities) with NC A&T, East Carolina University, and UNC Charlotte closing in on an R1 status.

2.3E ***Higher Education R&D Expenditures at Institutions in Both Survey Populations, by State, Institutional Control, System, and Institution, FY 2022***

HIGHER EDUCATION INSTITUTION	SOURCE OF FUNDS					
	Federal Gov.	State & Local Gov.	Business / Industry	Institution Funds	Nonprofits	Other
US Average	**55%**	**5%**	**6%**	**25%**	**6%**	**3%**
Duke	65%	0%	15%	12%	7%	1%
UNC-Chapel Hill	61%	3%	4%	25%	6%	1%
NC State University	43%	22%	9%	25%	1%	0%
Wake Forest	67%	3%	8%	10%	8%	3%
17 Other NC Institutions	60%	7%	4%	24%	4%	1%

Source: Higher Education Research and Development (HERD) Survey 2022, National Science Foundation.

INDICATOR 2.4: FEDERAL R&D

KEY FINDINGS

- North Carolina's ratio of federal R&D obligations per employed worker ranks well below the U.S. average.
- North Carolina's ratio of federal R&D obligations to employed worker has increased significantly since 2000, at a rate faster than the rate of the U.S. ratio overall and is in the middle among comparison states.

OVERVIEW

This indicator represents how federal R&D obligations are disbursed geographically relative to the size of a state's employed civilian workforce. Federal R&D obligations are a binding financial commitment in a congressional budget appropriation and include contracts, staff employment, and purchases of goods and services. For the purposes of this indicator, federal R&D obligations are attributed to the states in which the prime recipients of federal obligations are located and are provided in current dollars (not adjusted for inflation).[1] While this funding comes from 11 federal agencies, the Department of Defense (DoD) disburses the most funding, approximately 40 percent of the total.[2] A high value on this indicator may indicate the existence of many large prime contractors or major federally funded R&D facilities in a state. Higher values for this indicator occur in the states surrounding the District of Columbia and in less populated states with national laboratories or federal facilities.

HOW DOES NORTH CAROLINA PERFORM?

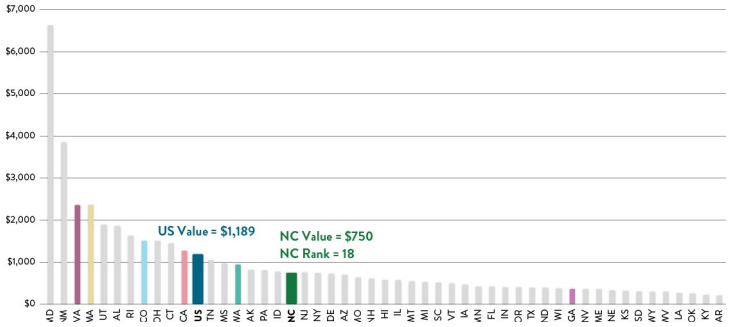
The value of North Carolina's federal R&D obligations per employed worker ranks 19th in the nation, with a level that is 66 percent of the U.S. value and 10 percent of the value of the top-ranking state, Maryland **[2.4A]**. North Carolina's ranking reflects the fact that it has a relatively small number of federal prime contractors and federally funded R&D centers.

Between 2000 and 2020, North Carolina's federal R&D obligations per employed worker increased by 172 percent in current dollars **[2.4B]**, faster than the rate of increase for the U.S. overall (105 percent). Among the comparison states, North Carolina's level of increase in federal R&D obligations per employed worker ranks second only to Colorado, though considerably so; Colorado had an increase of 187 percent in federal R&D obligations per employed worker over the same period.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

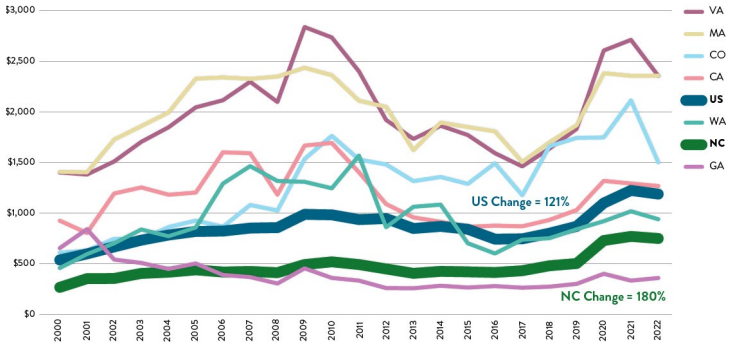
Federal R&D obligations to all U.S. states amounted to an estimated $139 billion in 2019. Although this amount represents less than one-third the amount of industry R&D in 2019 ($464 billion), it is substantial and drives a considerable amount of innovation.[2] In 2020, only 9 states exceeded the national average of $1,100 in federal R&D obligations per worker, meaning that these states received more federal R&D obligations than expected based on the size of their workforce. North Carolina should strive to remain competitive on this front by working to increase its number of prime federal contractors. It should also work to increase its number of subcontractors to prime federal contractors.

2.4A *Federal R&D Obligations per Employed Worker, All U.S. States, 2020*



Source: National Science Board.

2.4B *Federal R&D Obligations per Employed Worker, Comparison States, 2000-2020*



Source: National Science Board.

[1] Tracking federal R&D obligations below the prime contractor level is beyond the scope of the data sources used in this report.

[2] National Science Board, National Science Foundation. 2024. Research and Development: U.S. Trends and International Comparisons. Science and Engineering Indicators 2024. NSB-2024-6. Alexandria, VA. Available at https://ncses.nsf.gov/pubs/nsb20246/.

INDICATOR 2.5: ACADEMIC ARTICLES

KEY FINDINGS

- North Carolina's academic science & engineering (S&E) article output per 1,000 science, engineering, and health (SEH) doctorate holders in academia is similar to the U.S. average, and since 2000 has increased at a rate slightly faster than the U.S average rate.
- North Carolina's academic S&E articles are highly concentrated in a small number of cities located primarily in the Research Triangle Region, though cities outside that region also produce a significant number of articles.

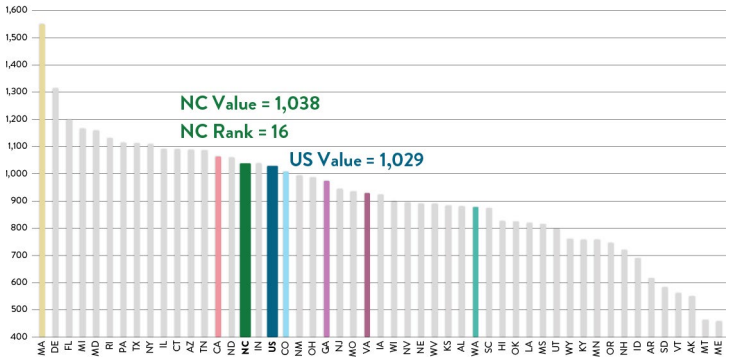
OVERVIEW

The volume of peer-reviewed articles published per 1,000 academic SEH doctorate holders is an approximate measure of their contribution to scientific knowledge, which includes, among other outputs, research & development (R&D) activities and funding (see indicator 2.3); patents (see indicator 3.2); and trademarks, copyrights, and licenses (see indicator 3.5). The volume of peer-reviewed S&E articles per 1,000 academic SEH doctorate holders is an approximate measure of their contribution to scientific knowledge. A high value on this indicator shows that the SEH faculties in a state's academic institutions are generating a high volume of publications relative to the number of SEH doctorate holders employed at academic institutions in the state. Academic institutions include 2-year colleges, 4-year colleges and universities, medical schools, and university-affiliated research centers.[1] SEH doctorates include those in computer sciences; mathematics; the biological, agricultural, or environmental life sciences; physical sciences; social sciences; psychology; engineering; and health fields.[2]

HOW DOES NORTH CAROLINA PERFORM?

The value of North Carolina's academic S&E article output per 1,000 SEH doctorate holders in academia ranks 16th in the nation, a level that is very similar to the U.S. value and 69 percent of the value of the top-ranking state, Massachusetts **[2.5A]**. Massachusetts and California were the only two comparison states that outranked North Carolina (among the comparison states, Massachusetts was the only state that outranked North Carolina on this indicator in 2019). North Carolina and the remaining comparison states all compared similarly to the U.S. average. As with S&E R&D (see indicator 2.3), this strong ranking reflects a longstanding pattern in North Carolina: The core strength of North Carolina's innovation ecosystem is its colleges and universities.

2.5A *Academic S&E Article Output per 1,000 SEH Doctorate Holders in Academia, All U.S. States, 2001-2021*



Source: National Science Board.

[1] Research is more central to the mission of some of these institutions than others. As used in this indicator, publication counts are based on the number of articles that appear in a set of journals tracked by Elsevier's Scopus database. The journal set consists of S&E publications (including publications on the natural sciences, applied sciences, medical sciences, and social sciences but excluding the arts and humanities). Only documents published in refereed scientific journals were counted (mostly articles, reviews, and conference proceedings), as these documents were reviewed by peers prior to being accepted for publication. The peer-review process is designed to ensure that the research is of good quality and constitutes an original contribution to scientific knowledge. Fractional counting at the level of researchers is used to ensure that a single paper is not counted several times. For example, if two of three authors are in state A and the third author is in state B, then two-thirds of the publication is attributed to state A, and one-third is attributed to state B.

[2] SEH doctorate data are estimates and exclude those with doctorates from foreign institutions and those older than the age of 75. Data for SEH doctorate holders in academia are presented by employment location, regardless of residence. Estimates for states with smaller populations of SEH doctorate holders are generally less precise than estimates for states with larger populations.

INDICATOR 2.5: ACADEMIC ARTICLES

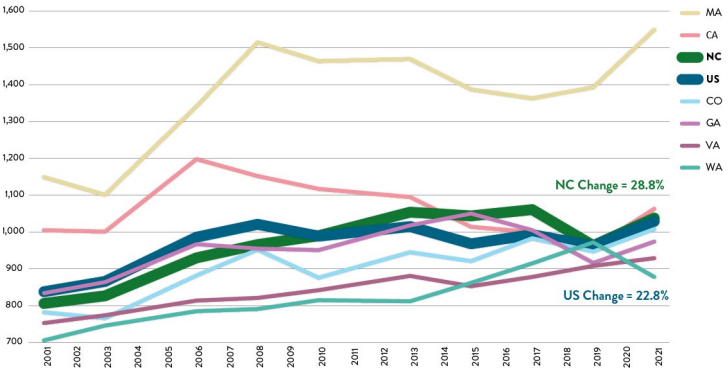
Since 2003, North Carolina's S&E article output per 1,000 SEH doctorate holders in academia has increased by 14.7 percent, a rate that is 50% higher than the U.S. rate, 9.6 percent **[2.5B]**. North Carolina ranks third just behind California among comparison states in terms of article output, however North Carolina's rate of increase is lower than that of Virginia, Colorado, Massachusetts, and Washington.

Within North Carolina, the production of S&E articles is highly concentrated in the Research Triangle region. Together, three cities in that region—Durham (31.6 percent), Chapel Hill (20.3 percent), and Raleigh (9.2 percent)—account for 61 percent of all S&E articles produced within North Carolina **[2.5C]**. Research Triangle Park, located between those three cities, also accounts for a significant share of articles (4.6 percent), bringing the Triangle's regional total to nearly ⅔ of the state total. Outside the Triangle region, Winston-Salem accounts for a significant share of the state's S&E articles (12.6 percent), as does, Charlotte (5.9 percent), Greenville (4.5 percent), Wilmington (2.1 percent), Greensboro (2.0 percent), Boone (1.5 percent), and Fayetteville (1.1 percent). The remaining four percent of the state's S&E articles is spread across 14 other cities, none of which produces more than one percent of the state's S&E articles.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

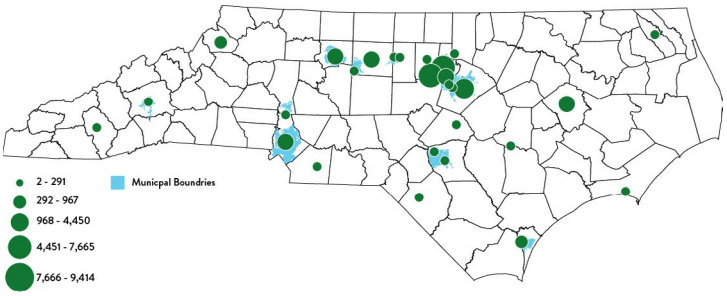
North Carolina has considerable strengths in academic S&E, as evidenced by its higher-than-average performance on academic S&E articles per 1,000 SEH doctorate holders in academia. These strengths, however, are highly concentrated in a small number of universities and other R&D-focused organizations located primarily in the Research Triangle region and other metropolitan areas, such as the Piedmont Triad. As evidenced in the Economic Well-Being indicators in Section 1 and the Innovative Organizations indicators in Section 4, these academic S&E strengths are benefiting a less-than-optimal share and geographic distribution of North Carolina's citizens and companies. North Carolina's academic, corporate, and policy leaders should increase their efforts designed to spread the benefits of the state's academic S&E strengths throughout all regions of the state.

2.5B *Academic S&E Article Output per 1,000 SEH Doctorate Holders in Academia, Comparison States, 2001-2021*



Source: National Science Board.

2.5C *Location of S&E Articles Published, 2018 - 2019 Annual Average*



Source: Scopus, Elsevier.

Section 3: Commercialization

INDICATOR 3.1: SBIR & STTR AWARDS

KEY FINDINGS

- After the years 2016 to 2018, North Carolina's Small Business Innovation Research and Small Business Technology Transfer (SBIR, STTR) funding as a share of state GDP has stayed ahead of the U.S. average, having increased considerably faster than the U.S. average since 2000.
- North Carolina's SBIR/STTR funding is highly concentrated in a small number of cities and regions in the state.

OVERVIEW

Funds awarded through the highly competitive federal Small Business Innovation Research (SBIR) grant program support technological innovation in companies with 500 or fewer employees. The awards enable the small businesses to evaluate the feasibility and scientific merit of new technology (Phase I up to $306,872) and to develop the technology to a point where it can be commercialized (Phase II up to $2,045,816).[1] Small Business Technology Transfer (STTR) is a similar but smaller program; its unique feature is the requirement for the small business to collaborate with a nonprofit research institution.[2]

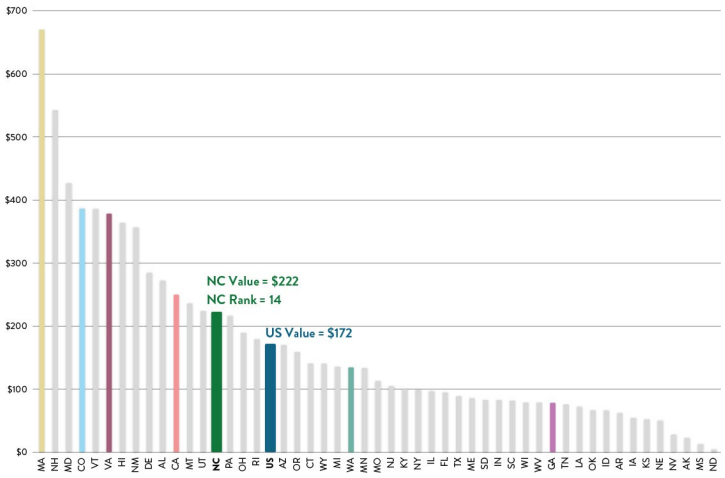
SBIR and STTR grants are the single largest governmental source of early-stage technology development and commercialization funding for small businesses (more than $4.4 billion in 2022). Success in the SBIR/STTR programs attracts additional outside capital investment, and companies that receive SBIR Phase II funding typically outperform similar companies that do not receive such support.[3] The amount of SBIR/STTR funding in a state strongly correlates with successful technology-based economic development.

HOW DOES NORTH CAROLINA PERFORM?[4]

In terms of the level of SBIR/STTR funding relative to the size of its economy, North Carolina ranks 14th in the nation and above the U.S. average **[3.1A]**.[5] Specifically, the ratio of North Carolina's SBIR/STTR funding relative to the size of its total GDP is 29 percent higher than the U.S. value, meaning that the amount of SBIR/ STTR funding in North Carolina is about 29 percent higher than what we would expect based on the levels of such funding in all other states. However, its per-GDP level of SBIR/STTR funding is only 33 percent of the leading state's (Massachusetts) level. These levels of early-stage funding suggest that North Carolina is capitalizing on opportunities to fund and commercialize its innovative discoveries but still has room to improve given the disproportionate amount that goes to the top-performing states.

It is important to note that a large percentage of the small tech-based businesses in North Carolina focus on the life sciences and medical technology sectors, which are among the state's strengths. Those businesses, in fact, have a high success rate in receiving SBIR grants from the Department of Health and Human Services. However, the interests of other large SBIR-granting agencies—such as the Department of Defense, the National Aeronautics and Space Administration, and the Department of Energy—either do not align as well with the majority of North Carolina businesses' commercialization interests, or companies lack knowledge about these other agencies and the goals they are trying to achieve.[6]

3.1A *Average Annual SBIR & STTR Dollars per $1 Million of GDP, All U.S. States, 2020-2022*



Source: National Science Board.

[1] Amounts federal agencies may award without approval as of October 2023 retrieved from www.sbir.gov/about. [2] Eleven federal agencies participate in the SBIR program and five in the STTR program.

[3] See, e.g., National Research Council. 2008. An Assessment of the SBIR Program. Washington, DC: The National Academies Press.

[4] The total award dollars reported here include both Phase I and Phase II SBIR/STTR awards.

[5] The high average U.S. value results primarily from the high concentration of SBIR/STTR awards in MA, which has well-recognized academic research institutions from which innovative small businesses have emerged. In addition, many of the states with the highest rankings on this indicator are locations of federal laboratories.

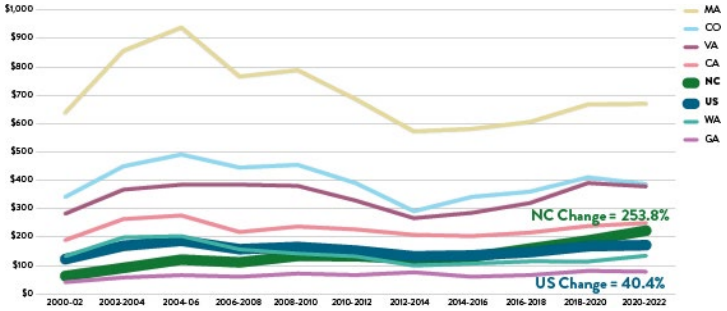
[6] In 2022, the BSTI released the Advancing Defense Innovation report which explained the deficiencies around obtaining Department of Defense funding in North Carolina.

INDICATOR 3.1: SBIR & STTR AWARDS

Since 2000, the ratio of North Carolina's SBIR & STTR funding relative to its GDP has increased by 254 percent, compared to the 40.4 percent increase for the U.S. overall **[3.1B]**. In contrast, the ratio of SBIR/STTR funding to GDP has increased 28.9 percent in all the comparison states on average. During this time period North Carolina experienced the largest increase compared to the U.S. and any of the comparison states. This is due, in part, to two steps taken to improve North Carolina's SBIR/STTR award rate: (1) the creation in 2001 of an SBIR program specialist position at the North Carolina Small Business and Technology Development Center (STBDC), (2) the creation in 2006 of the state's SBIR/STTR matching fund program, the One North Carolina Small Business Program, administered by the North Carolina Board of Science, Technology & Innovation (BSTI), (3) an increased focus on SBIR & STTR grants in universities, and (4) activities of entrepreneur and innovation-support organizations in the state. The former provides assistance to small businesses to help them identify and apply for SBIR/STTR proposal opportunities; the latter, awards matching grants to small businesses in North Carolina that have received SBIR/ STTR grants. These state matching grants supplement and leverage the federal grants and make North Carolina small businesses better investment opportunities in the eyes of federal funding agencies.

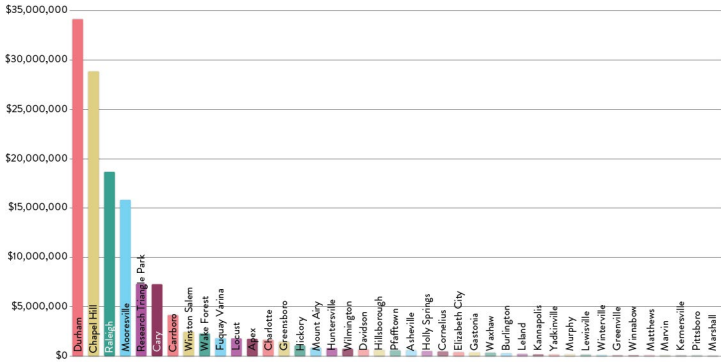
Within North Carolina, SBIR/STTR funding is highly concentrated in the Research Triangle Region of the state, which contains the cities of Durham, Chapel Hill, the Research Triangle Park region, and Raleigh **[3.1C, 3.1D]**. Combined, these four locales receive 64 percent of the state's SBIR/STTR funding. The next 21 percent goes primarily to cities in the Piedmont Triad (e.g., Greensboro and Winston-Salem), Charlotte region (e.g., Charlotte and Mooresville), and the cities of Cary and Morrisville (within the Triangle region). The remaining 15 percent is dispersed across 38 other cities across the state. Overall, this highly concentrated SBIR/STTR award activity reflects the level of concentration in North Carolina's R&D activity, particularly its academic R&D, as well as its population.

3.1B *Average Annual SBIR & STTR Dollars per $1 Million of GDP, Comparison States, 2000-2022*



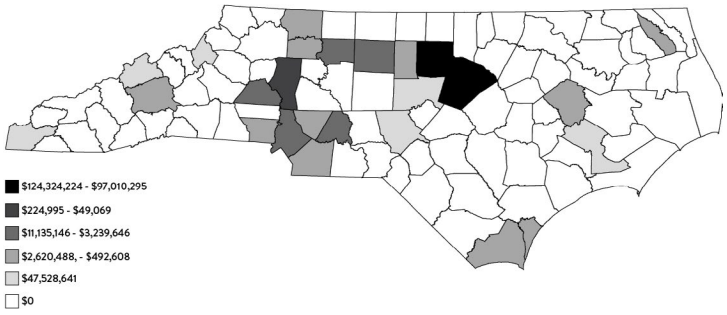
Source: National Science Board.

3.1C *Average Annual SBIR & STTR Awards, N.C. Cities, 2020-2022*



Source: SBIR.gov.

3.1D *Average Annual Amount of SBIR & STTR Awards, N.C. Counties, 2020–2022*



Source: SBIR.gov..

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's strong funding under the SBIR/STTR programs indicates both how aggressive the state's small businesses are in pursuing federal support for innovation activity, as well as their competitiveness in developing and commercializing innovative ideas, technologies, and products.

Given the importance of such funding, emphasis should be placed on further improving the state's position in this category. Continued funding for the One North Carolina Small Business Program, which provides state grants to match the SBIR/STTR grants, is critical on this front.[6] Additionally, proposal opportunity identification and counseling services, such as those provided by North Carolina's Small Business and Technology Development Center (SBTDC) and other organizations, should be continued and enhanced to ensure that North Carolina businesses are maximizing their ability to receive SBIR/STTR grants

[6] This program was started after the BSTI's 2003 *Tracking Innovation in NC* report (available at: https://www.commerce.nc.gov/about-us/divisions-programs/science-technology-innovation#ResearchReports-435) indicated that NC ranked 34th in terms of SBIR funding per capita and had a value 41 percent of the U.S. value. While all of the top-performing states were increasing in the 2000-2004 timeframe, only NC continued to increase in the latter part of the decade. This coincides with the One NC Small Business Program beginning in 2006. For additional evidence of the program's impacts, see https://www.commerce.nc.gov/grants-incentives/technology-funds/one-north-carolina-small-business-program#program-impacts-&-success-stories and John W. Hardin, David J. Kaiser and Albert N. Link (2020), "Public Support of Private Innovation: An Initial Assessment of the North Carolina SBIR/STTR Phase I Matching Funds Program", Annals of Science and Technology Policy: Vol. 4: No. 1, pp 1-79 (https://www.nowpublishers.com/article/Details/ASTP-015).

INDICATOR 3.2: ACADEMIC PATENTS

KEY FINDINGS

- The ratio of North Carolina's academic patents per 1,000 science & engineering doctorate holders in academia ranks below the U.S. average and is increasing at a rate slower than the U.S. average.
- North Carolina's academic patenting activity is highly concentrated in a small number of universities located primarily in the Research Triangle Region.

OVERVIEW

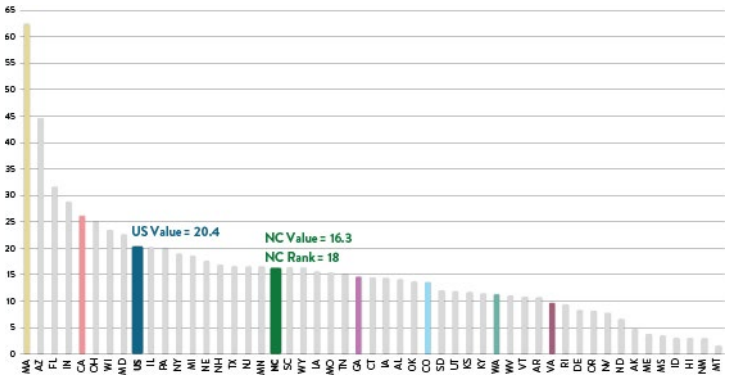
This indicator relates the number of academic-owned utility patents to the size of the doctoral science & engineering (S&E) workforce in academia. Academia includes two-year colleges, four-year colleges and universities, medical schools, and university-affiliated research centers. S&E doctorates include those in computer sciences; mathematics; biological, agricultural, or environmental life sciences; physical sciences; social sciences; psychology; engineering; and health fields.[1] Utility patents, commonly known as patents for inventions, include any new, useful, or improved method, process, machine, device, manufactured item, or chemical compound, and represent a key measure of intellectual property.[2] As such, academic patents are one approximate measure of the degree to which the doctoral academic workforce generates results with perceived economic value.[3]

HOW DOES NORTH CAROLINA PERFORM?

The value of North Carolina's academic patents per 1,000 S&E doctorate holders in academia ranks 18th in the nation, with a level that is 80 percent of the U.S. value and 26 percent of the value of the top-ranking state, Massachusetts **[3.2A]**. North Carolina's below-average ranking may indicate that North Carolina has potential to increase patent productivity, given the relatively high academic R&D activity within the state (see Indicator 2.3) and that many universities have offices dedicated to commercialization.[4] Another explanation for the recent decrease in patents per 1,000 S&E doctorate holders may be the above-normal recent increase in North Carolinians who hold a doctorate. Between 1997 and 2017 the number of doctorate holders in North Carolina increased at an average annual rate of 2.3 percent, but between 2017 and 2019 the annual rate was 7.5 percent. This jump may have diluted the value for 2019 and may suggest increased patent productivity during the coming years.

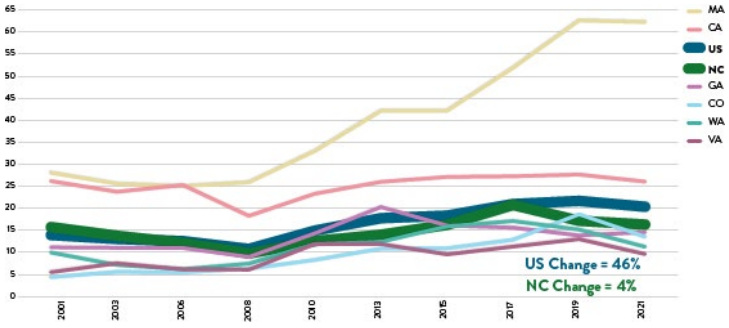
Between 2001 and 2017, the ratio of North Carolina's academic patents relative to S&E doctorate holders in academia increased at a rate of 32 percent and largely tracked the U.S. average **[3.2B]**. Including the recent decline since 2019, however, North Carolina's ratio is only 4 percent higher than in 2001, whereas the ratio for the U.S. overall increased by 46 percent as of 2021. All comparison states except California have increased more than North Carolina in terms of academic patents per 1,000 S&E doctorate holders.

3.2A *Academic Patents Awarded per 1,000 S&E Doctorate Holders in Academia, All U.S. States, 2021*



Source: National Science Board.

3.2B *Academic Patents Awarded per 1,000 S&E Doctorate Holders in Academia, Comparison States, 2001-2021*



Source: National Science Board.

[1] S&E doctorate data exclude those with doctorates from foreign institutions and those above the age of 75.

[2] Patent assignments are made on the basis of the address of their original assignee(s). For patents with multiple U.S. university assignees from different U.S. states, the data credit each participating U.S. state as owning one patent.

[3] Another measure of academic economic value is the actual or expected revenue derived from academic patents. However, because actual revenue accrues over time and expected revenue is difficult to estimate with a reasonable level of accuracy, revenue data are not presented for this indicator. License income, which depends heavily on patent activity, is presented in indicator 3.5.

[4] The offices go by different names (e.g. Office of Technology Transfer; Office of Technology Commercialization) at different institutions, but all have patenting academic discoveries as one of their primary activities.

INDICATOR 3.2: ACADEMIC PATENTS

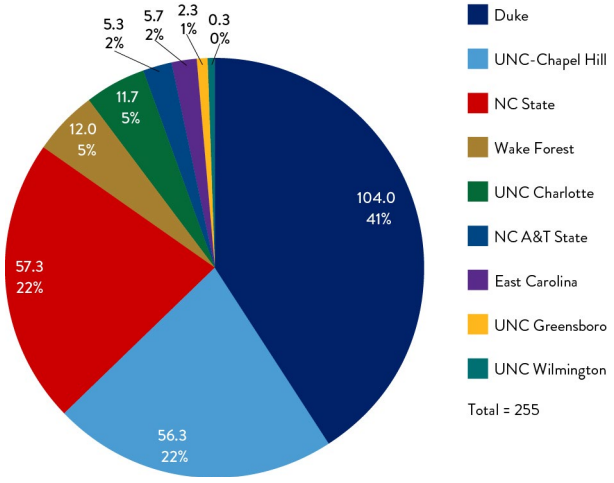
Within North Carolina, academic patenting activity is highly concentrated in the Research Triangle region and reflects both the nature and size of that region's universities' R&D activities, as well as the resources devoted to their patenting offices **[3.2C, 3.2D]**. The three largest universities in that region—Duke University, the University of North Carolina at Chapel Hill, and North Carolina State University—account for 85 percent of all academic patenting activity within the state, a pattern very similar to the pattern for academic R&D expenditures (see Indicator 2.3). UNC-Charlotte and Wake Forest University in Winston-Salem also have significant academic patenting activity, receiving 5 percent each. North Carolina A&T State University, East Carolina University, UNC Greensboro, and UNC Wilmington account for 2 percent, 2 percent, 1 percent, and less than 1 percent of the state total, respectively.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

While one of North Carolina's innovation-related strengths is its academic R&D (see indicator 2.3, on which NC ranks in the top 10 percent of states and has a value significantly greater than the U.S. value), it fares less well on academic patenting, one of the key measures of the economic value of its academic discoveries. Its 18th place ranking on academic patenting puts it in the upper middle of the U.S. states, but the ratio of its academic patenting activity relative to S&E doctorate holders in academia ranks slightly lower than the U.S. average ratio.

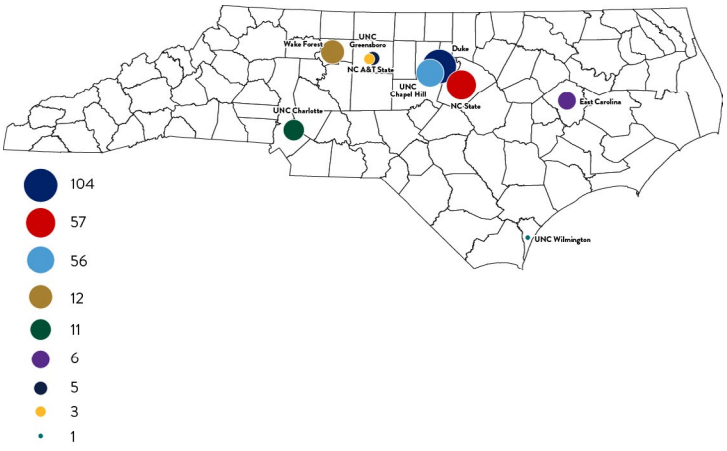
To continue making improvements, North Carolina's universities should focus their attention on their offices and activities that generate patents. For example, the University of North Carolina's 2013–2018 strategic directions include establishing and supporting a "scout team" and core support staff that any campus could utilize for market assessment, legal assistance, new venture services, and other operational support, such as patenting for commercialization. Additionally, in 2014 the Governor's Innovation-to-Jobs Working group recommended that the state's public and private universities create a University Innovation Commercialization Council, which would define best practices for innovation commercialization at the state's universities, promote inter-university cooperation and standardization where possible, and catalyze transformation in culture to encourage technology commercialization.[6] Initiatives such as these and others focused on increasing the commercial impact of academic discoveries should be a high priority for state and university policy makers.

3.2C *Average Annual Academic Patents Awarded to N.C. Universities, 2020-2022*



Source: Association of University Technology Managers.

3.2D *Average Annual Academic Patents Awarded to N.C. Universities, 2020-2022*



Source: Association of University Technology Managers.

[5] Our Time, Our Future: The UNC Compact with North Carolina, Strategic Directions 2013-2018, available at https://facultygov.unc.edu/2013/02/documents-related-to-unc-strategic-plan/

[6] Recommendations of the Governor's Innovation-to-Jobs Working Group. March 2015. Available at: https://www.commerce.nc.gov/governors-innovation-jobs-working-group-recommendations/open.

INDICATOR 3.3: PATENTS

KEY FINDINGS

- The ratio of North Carolina's patents awarded per 1,000 individuals in science & engineering occupations ranks below the U.S. average, and since the early 2000's has been increasing at a rate lower than the U.S. average.[1]
- North Carolina's patenting activity is highly concentrated in a small number of counties located primarily in the Research Triangle region.

OVERVIEW

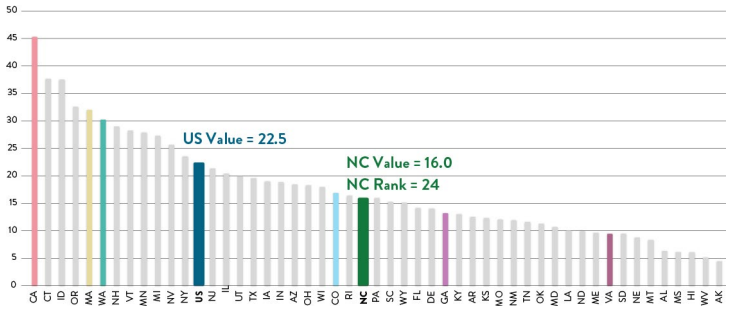
This indicator represents state patent activity normalized to the size of a locale's science & engineering workforce and its economy. For the state-by-state charts (3.3A and 3.3B), utility patents—commonly known as patents for inventions—are presented.[2] The science & engineering workforce includes engineers and computer, mathematical, life, physical, and social scientists.[3] Gross Domestic Product (GDP) is a measure of the total value of goods and services produced by an economy.

Patents are the leading form of legal codification and ownership of innovative thinking and its application. As such, they are a key indicator of the rate of new product and process innovation. There are considerable differences in the propensity of different industries to patent new ideas, and thus the industry mix partially explains differences in patenting rates across locales. Patents are particularly important for companies whose success depends on their ability to protect their innovative products.

HOW DOES NORTH CAROLINA PERFORM?

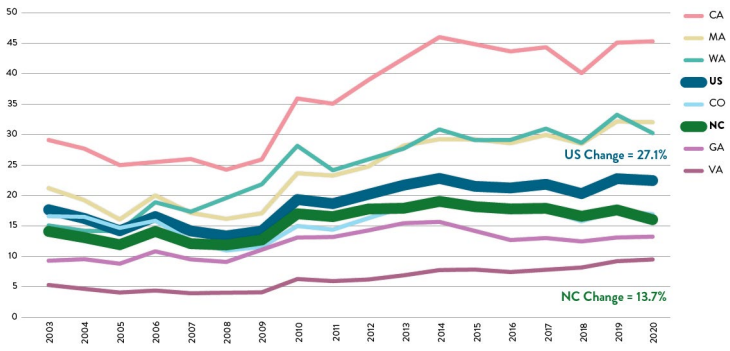
The value of North Carolina's patents per 1,000 individuals in science & engineering occupations ranks 24th in the nation, with a level that is 71 percent of the U.S. value and 35 percent of the value of the highest-ranking state, California **[3.3A]**. Among the comparison states, North Carolina's rate of patenting ranks ahead of its neighbors, Virginia, and Georgia but behind California, Washington, and Massachusetts, and Colorado. Overall, North Carolina's rate of patents compares less favorably than its rate of academic patents, reflecting, in part, its lower industry R&D ranking (see indicator 2.2) relative to academic R&D (see indicator 2.3). As a broad indicator of nonacademic innovative activity within a state, this indicator suggests that North Carolina's nonacademic private sector is not as strong as its academic sector at initial discovery and protection of innovative ideas. From 2003 to 2015, the ratio of North Carolina's patents to individuals in science & engineering occupations increased at a rate similar to the U.S. but has lagged behind from 2015 up to 2020, growing at an overall rate of 13.7% compared to the national average of 27.1% **[3.3B]**. Among the comparison states, North Carolina's rate of increase is ahead of Colorado's rate, but behind Washington, California, Virginia, Massachusetts, and Georgia. Combined, the comparison states' patenting activity increased 55 percent, which is significantly higher than North Carolina's increase.

3.3A *Patents Awarded per 1,000 Individuals in S&E Occupations, All U.S. States, 2020*



Source: National Science Board.

3.3B *Patents Awarded per 1,000 Individuals in S&E Occupations, Comparison States, 2003-2020*



Source: National Science Board.

[1] State level data, provided by the National Science Foundation, have not been updated since the previous *Tracking Innovation* report. The data are expected to be updated in fall 2024.

[2] See indictor 3.2 for a more detailed description of utility patents. The U.S. Patent and Trademark Office (USPTO) classifies patents geographically according to the residence of the first-named inventor. Only U.S.-origin patents are included.

[3] Managers, technicians, elementary and secondary schoolteachers, and medical personnel are not included.

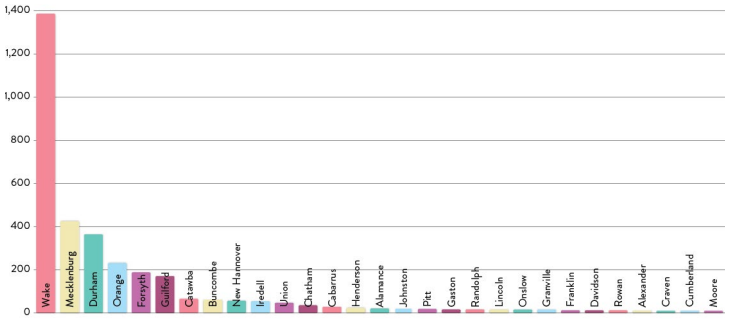
INDICATOR 3.3: PATENTS

Within North Carolina, patenting activity is highly concentrated in a small number of counties, with nearly 80 percent of all patents being awarded in six counties **[3.3C, 3.3D]**. Wake County, with 39 percent of all the state's patents, has the largest share, followed by Mecklenburg (12 percent), Durham (10 percent), Orange (7 percent), Forsyth (5 percent) and Guilford (5 percent). The next 16 counties, ranging between .5 and 2 percent of all the state's patents, account for 15 percent of the state's patents overall, while the remaining 77 counties account for the final 7 percent of the state's patents. This high concentration of patents reflects a combination of the state's population (see indicator 1.6), the location and mix of its companies (see indicators 4.1, 4.2, and 6.4), the location and mix of its academic and business R&D (see indicator 2.2 and 3.1), the location of its academic patents (see indicator 3.2), and the educational attainment levels of its citizens (see indicator 5.6).

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Academic institutions hold less than 10 percent of North Carolina's patents,[4] meaning businesses and individuals hold the vast majority of legally protected intellectual property in the state. Although North Carolina's patenting rate ranks slightly below the U.S. average, its rate is above that of most states and is growing slightly faster than the U.S. average. Together, these facts suggest that North Carolina has a considerable and growing amount of intellectual property with the potential to yield new, as well as enhanced, products and services to improve the economic well-being and quality of life of its citizens. The extent to which that potential is realized ultimately depends on the ability of the state's businesses and individuals to capitalize on their intellectual property in ways that allow them to appropriate economic and social value from it. The state should work to enhance the conditions that facilitate the commercialization of intellectual property.

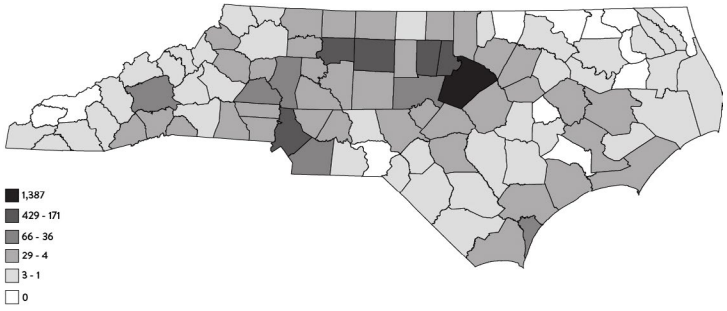
3.3C *Average Annual Number of Patents, N.C. Counties, 2020-2022*



Source: U.S. Patent and Trademark Office, via Neo IP Intellectual Property Law Firm and Magic Number, Inc. d/b/a Patent Forecast.

Note: Counties with 10 or more patents.

3.3D *Average Annual Number of Patents, N.C. Counties, 2020–2022*



Source: U.S. Patent and Trademark Office, via Neo IP Intellectual Property Law Firm and Magic Number, Inc. d/b/a Patent Forecast.

[4] This percentage is derived from National Science Foundation data, specifically by dividing the total number of patents by the number of academic patents for recent years for which both total patent and academic patent data were available.

INDICATOR 3.4: VENTURE CAPITAL

KEY FINDINGS

- The ratio of North Carolina's venture capital dollars to state GDP ranks well below the U.S. average and is increasing slower than the U.S. average.
- The average size of North Carolina's venture capital deals ranks below the U.S. average and is increasing slower than the U.S. average.
- North Carolina's venture capital investments are highly concentrated in a small number of urban counties and counties containing major universities.

OVERVIEW

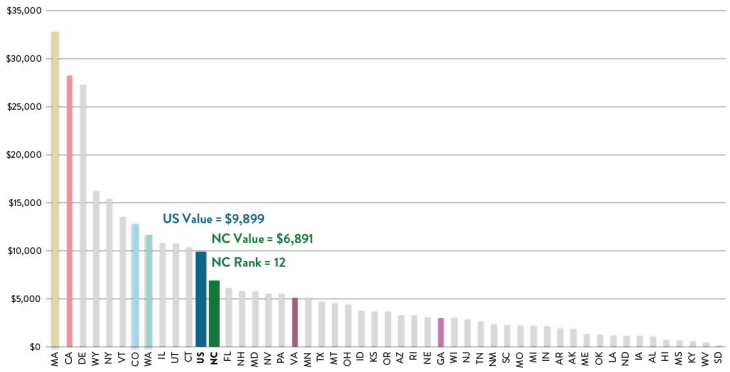
Venture capital dollars disbursed per $1,000 in state Gross Domestic Product (GDP) is a measure of the magnitude of venture capital investment, adjusting for the size of a state economy. Venture capital is financial capital provided to early-stage, high-potential, high-risk, growth startup companies. The typical venture capital investment occurs as growth funding after the seed funding round in the interest of generating a return through an event, such as an initial public offering or sale of the company. Venture capital is especially important to startup companies in the early stages of development; these companies often need financing to get a project off the ground but are unable to access traditional financing because of an insufficient cash flow history. States that rank well in this measure possess companies that have been successful in attracting venture capital investment. Positive trends in this measure may be predictors of new products and services, job creation, and revenue growth.

HOW DOES NORTH CAROLINA PERFORM?

In terms of venture capital investment adjusted for state economy size, North Carolina ranks 12th in the nation, with a value that is 70 percent of the U.S. value **[3.4A]**. This below-the-national average value reflects the very high concentrations of venture capital investment relative to state domestic product in Massachusetts and California, which skew the national average upward. 40 percent of all U.S. venture capital disbursements were made in California in 2022. New York and Massachusetts companies received 12.4 percent and 8.9 percent, respectively, of all venture capital investments, and no other state received more than 5 percent.

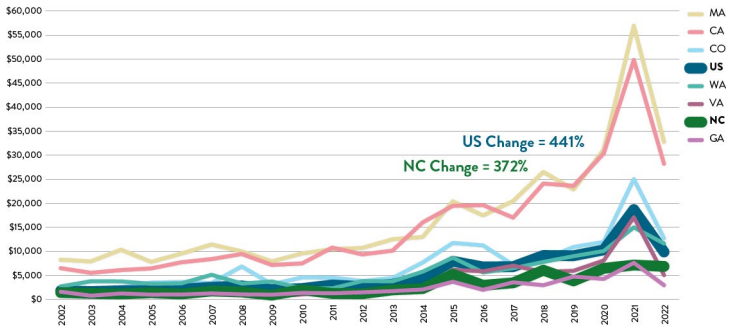
Venture capital investment within the U.S. increased relative to GDP by 441 percent from 2002 to 2022 **[3.4B]**. Investments by North Carolina firms also rose over the same period but at a lower rate of 372 percent. North Carolina ranked second to last among comparison states in 2022, behind its regional neighbor Virginia but ahead of Georgia, which all ranked below the U.S. average. Recent trends suggest there is potential for North Carolina to improve its standing, as San Francisco and New York-based venture capital firms increasingly divert their funding away from the Bay Area, New York, and Boston.[1] Further, venture capital firms have increased their physical presence in the Southeastern U.S., with venture capital establishments up 30 percent between 2019 and 2021.[2] It is important that the start-up communities across North Carolina are poised to take advantage of this shift.

3.4A *Venture Capital Dispersed per $1 Million of GDP, All U.S. States, 2022*



Source: National Science Board, Pitchbook.

3.4B *Venture Capital Dispersed per $1 Million of GDP, Comparison States, 2002-2022*



Source: National Science Board, Pitchbook.

[1] Revolution and PitchBook, "Beyond Silicon Valley: Coastal Dollars and Local Investors Accelerate Early-Stage Startup Funding Across the US", 2021.

[2] Embarc Collective, "Southeast Capital Landscape Report", 2021.

INDICATOR 3.4: VENTURE CAPITAL

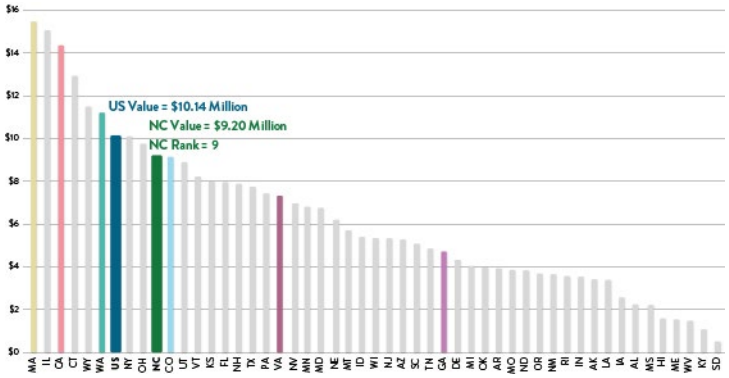
The average funding amount per deal is another indicator of venture capital activity, though it can vary widely year-to-year, especially in states with low number of deals. For example, in 2019 South Dakota ranked second in venture capital disbursed per deal among all states but was ranked last in 2017. North Carolina ranked 9th in 2022, with a value that was 91 percent of the U.S. average **[3.4C]**. Between 2002 and 2022, North Carolina's performance on this measure increased by 50.3 percent, compared to the U.S. rate of 22.1 percent **[3.4D]**. It should be noted that these dollar amounts are not adjusted for inflation, which increased by 63 percent over the same period meaning the purchasing power of the average deal has decreased.[3] Among comparison states, the average deal size within North Carolina was higher than in Colorado, Georgia, and Virginia in 2022. Only Massachusetts and California average deal sizes have matched the rate of inflation.

From 2020 to 2022, a total of $12 billion worth of venture capital investments were made in North Carolina. However, 85 percent of this investment was made in three urban counties (Wake, Durham, and Mecklenburg) **[3.4E]**. Overall, 53 percent of all venture capital investments took place in Wake County, followed by Durham (20.5 percent) and Mecklenburg (11.5 percent) over this timeframe. Venture capital investments took place in twenty-eight other counties, which had a combined total of 15 percent of North Carolina's remaining investment activity.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Innovative companies often need venture capital to realize their growth potential. If they are unable to access venture capital in North Carolina, entrepreneurs may need to relocate to venture capital-rich parts of the country—for example, Silicon Valley in California or the New York and Boston metro areas—in order to develop and expand. To the extent that venture capital investments in North Carolina are able to retain innovative companies spun off from North Carolina businesses, universities, and innovation infrastructure, the state will receive benefits such as job growth and income increases. Increasing access to venture capital is vitally important, but the direct impact of increased venture capital in North Carolina may not be uniformly felt across the state.

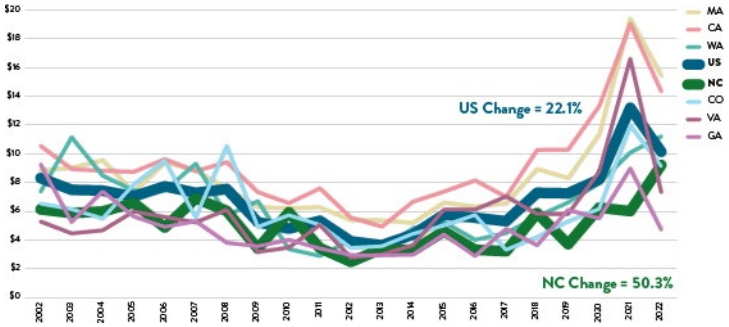
3.4C *Venture Capital Disbursed per Deal, All U.S. States, 2022*



Source: National Science Board, Pitchbook.

Note: Dollars in Millions.

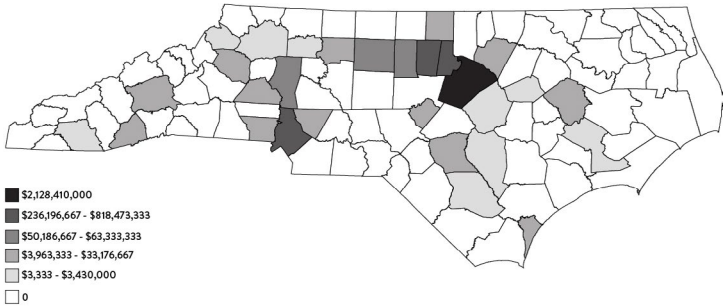
3.4D *Venture Capital Disbursed per Deal, Comparison States, 2002-2022*



Source: National Science Board, Pitchbook.

Note: Current dollars, in Millions.

3.4E *Location of Venture Capital Investments in N.C., Average Annual Investments, 2020-2022*



Source: Pitchbook Data, Inc.

[1] U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers (CPI-U).

INDICATOR 3.5: TECHNOLOGY LICENSE INCOME

KEY FINDINGS

- North Carolina's gross income received from technology licenses as a percentage of academic R&D expenditures ranks slightly below the U.S average.
- North Carolina's running royalties received from technology licenses as a percentage of academic R&D expenditures ranks above the U.S average for the first time since 2011.
- Within North Carolina, at least seven universities have significant technology license income.

OVERVIEW

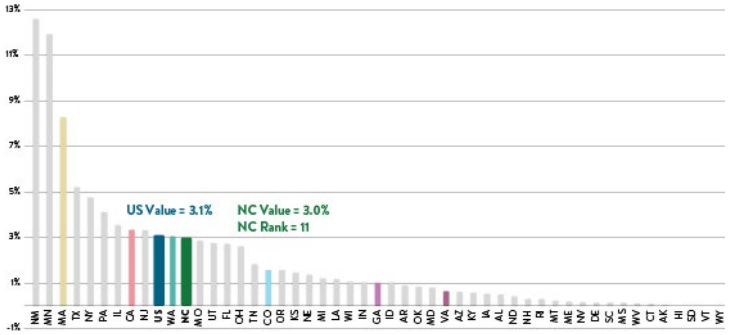
Universities and nonprofit research organizations use technology license agreements to transfer codified knowledge in the form of intellectual property (IP) to companies and entrepreneurs seeking to commercialize the technology. The income generated from license agreements is a key measure of the value of that IP. In addition, net licensing income can be used to support subsequent research and development (R&D) and education activities, as well as patenting and other commercialization-related costs.

This indicator measures technology license income two ways: 1) gross income received and 2) running royalties received, with each measured as a percentage of academic science & engineering R&D expenditures. Gross income is the more inclusive measure, and it includes license issue fees, payments under options, annual minimums, running royalties, termination payments, the amount of equity received when cashed-in, and software and biological material end-user license fees equal to $1,000 or more. Running royalties, a subset of the more inclusive gross income measure, are usage-based payments made by the licensee to the licensor for ongoing use of an asset or IP right. As such, running royalties are evidence of the perceived value of IP in the marketplace or the achievement of milestones on the path toward commercialization.

HOW DOES NORTH CAROLINA PERFORM?

In terms of gross income received as a percentage of academic science & engineering R&D expenditures, North Carolina ranks 11th in the nation, with a value that is 96 percent of the U.S. value and 24 percent of the value of the top-ranking state, New Mexico **[3.5A]**. Among the comparison states, North Carolina ranks behind Massachusetts, California, and Washington, but ahead of Georgia, Virginia, and Colorado.

3.5A *Academic License Income (Gross Received) as a Percentage of Academic R&D Expenditures, All U.S. States, 2020-2021 Average*

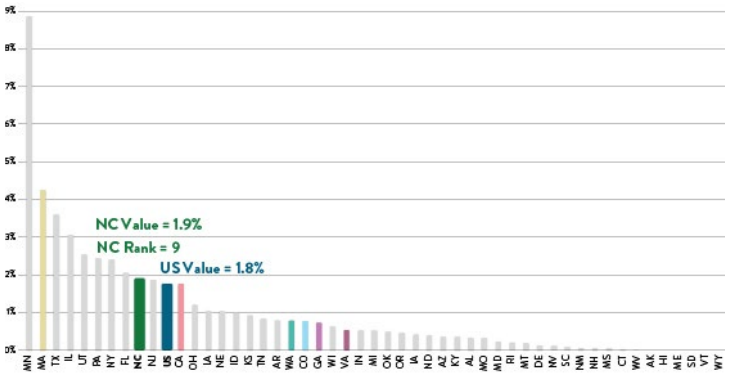


Sources: Association of University Technology Managers, National Science Foundation

INDICATOR 3.5: TECHNOLOGY LICENSE INCOME

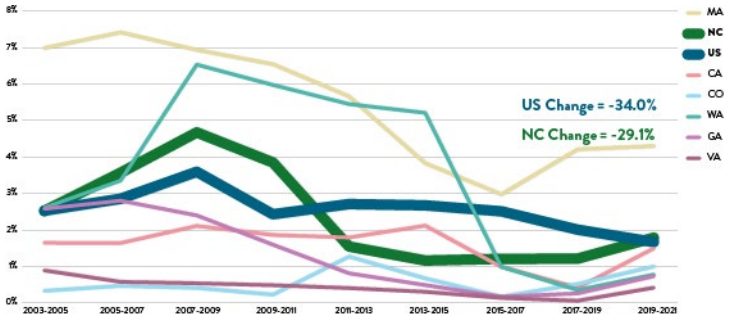
North Carolina fares similarly for running royalties as a percentage of academic science & engineering R&D expenditures, ranking 9th in the nation, with a value that is 108 percent of the U.S. value and 21 percent of the value of the top-ranking state, Minnesota **[3.5B]**. Among the comparison states, North Carolina ranks behind Massachusetts, but ahead of California, Colorado, Georgia, Washington, and Virginia. Since 2003, North Carolina's running royalties as a percentage of academic science & engineering R&D expenditures have decreased by 29.1 percent. The U.S. average has also decreased over the same period but to a greater extent, with a decrease of 34.0 percent. Colorado is the only comparison state whose universities and nonprofit research institutions have increased their running royalties as a percentage of academic R&D over time. **[3.5C]**.[1]

3.5B *Academic License Income (Running Royalties) as a Percentage of Academic R&D Expenditures, All U.S. States, 2020-2021 Average*



Sources: Association of University Technology Managers, National Science Foundation

3.5C *Academic License Income (Running Royalties) as a Percentage of Academic R&D Expenditures, Comparison States, Three-Year Averages, 2003-2021*



Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.

[1] A small number of technologies at a small number of universities often account for a large majority of a state's running royalties. In North Carolina, a handful of medical devices and diagnostics generated large royalties between 2002 and 2012. When those royalties ended, North Carolina's total royalties decreased.

INDICATOR 3.5: TECHNOLOGY LICENSE INCOME

Within North Carolina, nine universities report significant technology license income—Duke University, East Carolina University, North Carolina Agricultural & Technical University, North Carolina State University, the University of North Carolina at Charlotte, the University of North Carolina at Greensboro, the University of North Carolina at Chapel Hill, University of North Carolina at Wilmington, and Wake Forest University **[3.5D and 3.5E]**.[2] During 2021 and 2022, together the universities received, on average, more than $68 million in licensing income, compared to a high of more than $107 between 2009 and 2010.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

One of North Carolina's core innovation-related strengths is its academic R&D (see indicator 2.3), which suggests the state could rank better on income from university technology license agreements as a percentage of academic science & engineering R&D expenditures. The level of license income varies considerably across the state's universities and is concentrated in a relatively small number of universities overall. To maximize the value of the state's strong academic R&D, a larger number of North Carolina's universities should focus increased attention on their offices and activities that generate patents and other forms of IP that can be licensed.

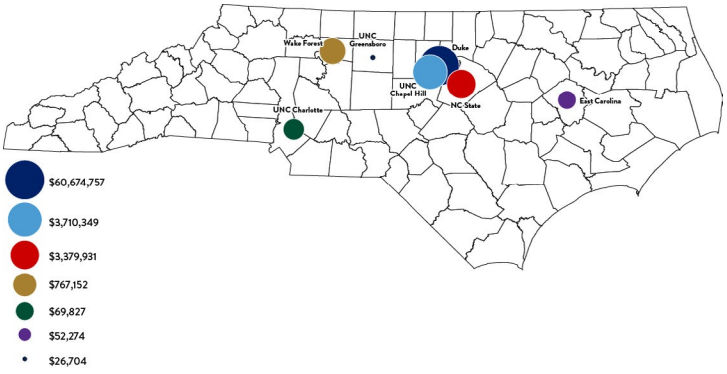
For example, the University of North Carolina's 2013–2018 strategic directions included establishing and supporting a "scout team" and core support staff that any campus could utilize for market assessment, legal assistance, new venture services, and other operational support, such as patenting for commercialization.[4] Additionally, in 2014 the Governor's Innovation-to-Jobs Working group recommended that the state's public and private universities create a University Innovation Commercialization Council, which would define best practices for innovation commercialization at the state's universities, promote inter-university cooperation and standardization where possible, and catalyze transformation in culture to encourage technology commercialization.[5] The recent establishment and funding of the nonprofit organization NCInnovation manifests these recommendations and is a significant step toward improving North Carolina's university innovation commercialization rate for the state's public universities.[6] Future additions of this *Tracking Innovation* report will help determine the impact of investment.

3.5D ***Average Annual Academic License Income, U.S. Average and N.C. Institutions, 2021-2022***

Higher Education Institution	Gross Received	Running Royalties
US Average	**$19,291,605**	**$8,385,159**
Duke	$93,504,264	$60,674,757
East Carolina	$192,328	$52,274
NC A&T	$87,500	$0
NC State	$6,310,509	$3,379,931
UNC-Chapel Hill	$21,658,489	$3,710,349
UNC-Charlotte	$101,110	$69,827
UNC-Greensboro	$12,639	$26,704
UNC-Wilmington	$67,157	$0
Wake Forest	$1,096,802	$767,152

Source: Association of University Technology Managers.

3.5E ***Location of Academic License Income (Running Royalties) in N.C., Average Annual Income, 2021-2022***



Source: Association of University Technology Managers.

[2] These nine universities have offices focusing on technology patenting and commercialization All data are self-reported by the universities to the Association of University Technology Managers (AUTM) via its Annual Licensing Survey. While it is possible that some NC universities have technology license income not reported to AUTM, the likelihood and amount are very low and not likely to change the findings presented here significantly.

[3] Duke is the only North Carolina university with running royalties considerably higher than the U.S. average. The remaining six universities have running royalties significantly lower than the U.S. average.

[4] Our Time, Our Future: The UNC Compact with North Carolina, Strategic Directions 2013-2018.

[5] Recommendations of the Governor's Innovation-to-Jobs Working Group. March 2015, available at: https://files.nc.gov/nccommerce/documents/files/I2J_Recommendations.pdf.

[6] NCInnovation's mission is to unlock the innovative potential of North Carolina's world-class public universities. It provides grant funding and support services to public university applied researchers working on discoveries that have commercial promise. NCInnovation helps inventions advance towards commercialization – accelerating the transition from academia to industry – by supporting university applied research through the critical research & development (R&D) phase between proof concept and readiness for the private market. More information is available at https://ncinnovation.org/.

INDICATOR 3.6: UNIVERSITY STARTUPS

KEY FINDINGS

- North Carolina's average number of university startups formed per $1 million of academic R&D expenditures ranks above the U.S average.
- North Carolina's average number of startups formed & remaining in home state per $1 million of academic R&D expenditures ranks above the U.S. average.
- North Carolina has experienced an upward trend in the number of university startups formed per $1 million of academic R&D expenditures since 2003, particularly since 2011.
- Within North Carolina, eight universities produced startups during 2021 and 2022, four of them at a rate higher than the national average.

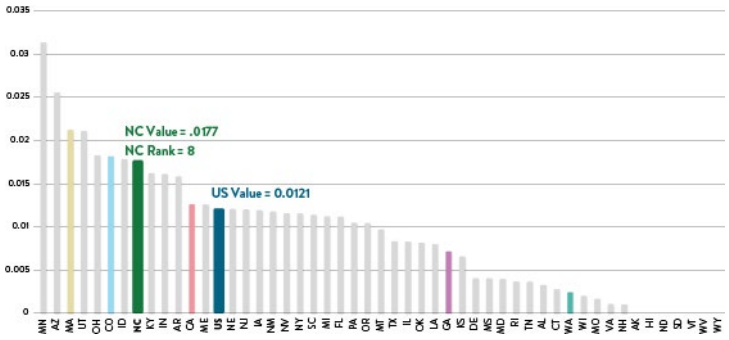
OVERVIEW

Startup companies that originate within universities, also commonly known as spinoffs, are companies founded to commercialize technologies that were developed through university research and development (R&D). Often, universities claim the intellectual property (IP) rights to these technologies, which results in the creation of licenses to this IP for the university and patents for new companies. Most, but not all, university startups remain within the state in which they were founded, providing significant development and income gains to those local economies. This indicator measures university startups in two ways: 1) the average number of university startups formed per $1 million of academic R&D expenditures, and 2) the average number of university startups formed and stayed in their home state per $1 million of academic R&D expenditures.

HOW DOES NORTH CAROLINA PERFORM?

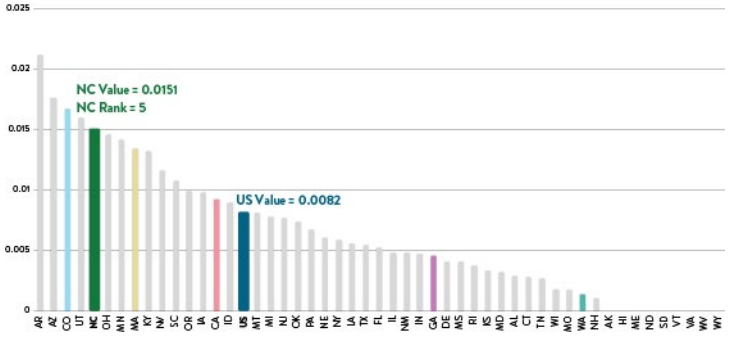
In terms of the number of university startups formed per $1 million of academic science and engineering R&D expenditures, North Carolina ranks 8th in the nation, with a rate 46 percent above the national average **[3.6A]**. North Carolina also ranks above all comparison states, except for Massachusetts and Colorado, and has a value that is 57 percent of the rate of the highest-ranking state, Minnesota. Similarly, when measured against university startups that remained within their home state, North Carolina ranks 5th in the nation and is 84 percent above the national average **[3.6B]**. North Carolina ranks ahead of all comparison states for the number of start-ups remaining in-state, except for Colorado. Although in the top ten, North Carolina's value on this measure is 72 percent the value of Arkansas, the highest-raking state.

3.6A *Average Number of University Startups Formed per $1 Million of Academic R&D Expenditures, All U.S. States, 2020-2021*



Sources: Association of University Technology Managers, National Science Foundation

3.6B *Average Number of University Startups Formed & Remaining in Home State per $1 Million of Academic R&D Expenditures, All U.S. States, 2020-2021*



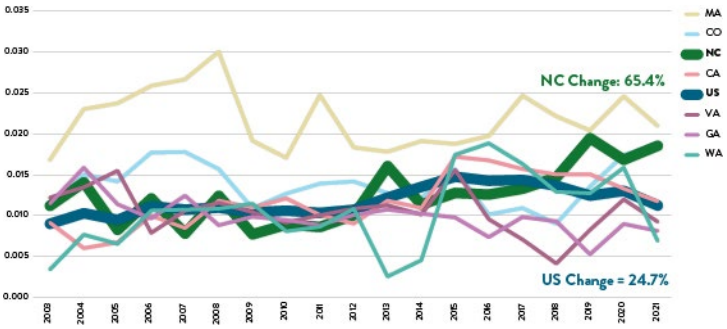
Sources: Association of University Technology Managers, National Science Foundation

INDICATOR 3.6: UNIVERSITY STARTUPS

Since 2003, North Carolina has experienced an upward trend in the number of university startups formed per $1 million of academic science and engineering R&D expenditures.[1] While quite variable over this time fame, North Carolina experienced an increase of 65.4 percent from 2003 to 2021 **[3.6C]**. Meanwhile, the U.S. experienced a positive trend of 24.7 percent. North Carolina has improved more than all other comparison states, except for Washington, which has increased by 103 percent since 2003 but started at a low value, and Colorado which has increased by 71.5 percent. The rate of start-up formation has accelerated in North Carolina over the past few years across multiple universities. The trend is important, because no single institution is driving the change, however this indicator is sensitive to yearly variations.

From 2021-2022, eight North Carolina universities reported having formed university startups—Duke University, East Carolina University, North Carolina State University, the University of North Carolina at Chapel Hill, the University of North Carolina at Charlotte, the University of North Carolina at Greensboro, the University of North Carolina at Wilmington, and Wake Forest University. Among all universities within the state, North Carolina State University had the highest average number of startups formed during this time period, and also had the highest average number of startups formed that remained in the state **[3.6D]**. North Carolina State University, Duke University, the University of North Carolina at Greensboro, and the University of North Carolina at Chapel Hill were the only universities whose averages were higher than the U.S. average for both the average number of university startups formed and those that stayed in the home state.

3.6C ***Number of University Startups Formed per $1 Million of Academic R&D Expenditures, Comparison States, 2003-2021***



Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.

3.6D ***Average Annual Number of University Startups Formed and Stayed in Home State, U.S. Average and N.C. Institutions, 2021-2022***

Higher Education Institution	Average Annual Number of University Startups Formed	Average Annual Number of University Startups Formed & Stayed in Home State
US (per Institution)	**6**	**4**
Duke	14	9
ECU	2	2
NC State	19	14
UNC-Chapel Hill	9	7
UNC-Charlotte	4	4
UNC-Greensboro	10	10
UNC-Wilmington	1	1
Wake Forest	1	1

Source: Association of University Technology Managers.

[1] Though not presented in chart form here, the data indicate a slight upward trend in the average number of university startups formed and stayed in their home state per $1 million of academic science and engineering R&D expenditures for both North Carolina and the United States.

INDICATOR 3.6: UNIVERSITY STARTUPS

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina improved from 20th to 8th in university start-ups formed as a percentage of academic R&D spending compared to the 2015-2017 average. Because North Carolina's innovation- and research-related strengths are derived heavily from academic institutions (see indicators 2.3 and 2.5), it is not surprising that several of the state's universities produce startup companies. All else equal, a high ranking in start-up formation could be expected given the level of R&D expenditures at North Carolina's universities. However, the translation of research and science to commercialize technology does not happen passively, as evident from the previous ranking of 20th when academic R&D spending was 3rd nationally. This upward trend is likely attributable to several factors, and may result from a series of recommendations on this topic for several years.

For example, the University of North Carolina's 2013–2018 strategic directions included establishing and supporting a "scout team" and core support staff that any campus could utilize for market assessment, legal assistance, new venture services, and other operational support, such as patenting for commercialization.[2] Additionally, in 2014 the Governor's Innovation-to-Jobs Working group recommended that the state's public and private universities create a University Innovation Commercialization Council, which would define best practices for innovation commercialization at the state's universities, promote inter-university cooperation and standardization where possible, and catalyze transformation in culture to encourage technology commercialization.[3] The recent establishment and funding of the nonprofit organization NCInnovation manifests these recommendations and is a significant step toward improving North Carolina's university innovation commercialization rate for the state's public universities.[4] Future additions of this *Tracking Innovation* report will help determine the impact of investment.

[2] Our Time, Our Future: The UNC Compact with North Carolina, Strategic Directions 2013-2018, available at https://www.northcarolina.edu/sites/default/files/strategic_directions_2013-2018_0.pdf.

[3] Recommendations of the Governor's Innovation-to-Jobs Working Group. March 2015. Available at: https://www.commerce.nc.gov/governors-innovation-jobs-working-group-recommendations/open.

[4] NCInnovation's mission is to unlock the innovative potential of North Carolina's world-class public universities. It provides grant funding and support services to public university applied researchers working on discoveries that have commercial promise. NCInnovation helps inventions advance towards commercialization – accelerating the transition from academia to industry – by supporting university applied research through the critical research & development (R&D) phase between proof concept and readiness for the private market. More information is available at https://ncinnovation.org/.

Section 4: Innovative Organizations

INDICATOR 4.1: KTI EMPLOYMENT ESTABLISHMENTS

KEY FINDINGS

- The percentage of North Carolina's business establishments classified as knowledge- and technology-intensive (KTI) employment establishments ranks above the U.S. average and increased at a rate nearly twice that of the U.S. average between 2000 and 2022.
- North Carolina's KTI employment establishments are highly concentrated in a small number of urban counties.
- The number of net business formations in KTI employment industries as a percentage of the total number of business establishments is higher than the U.S. average and since 2001 has been increasing at a rate faster than the U.S. average rate.

OVERVIEW

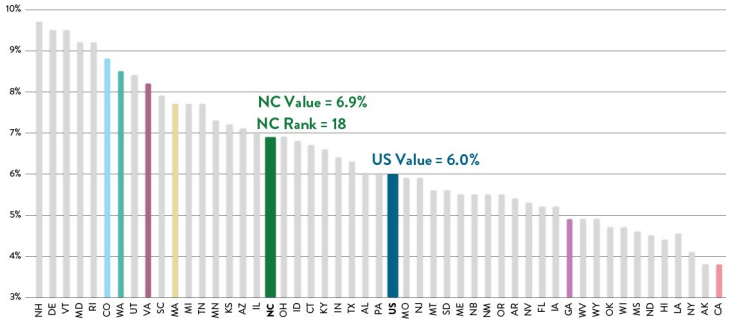
This indicator represents the portion of a state's total employment attributable to the knowledge- and technology-intensive (KTI) industries compared to the state's total employment.[1] KTI industries are those industries with high and medium-high R&D intensity, where R&D intensity is defined as the ratio of R&D expenditures to production. They consist of nine manufacturing industries—chemicals and chemical products; pharmaceuticals; computer, electronic, and optical products; electrical equipment; other machinery and equipment; motor vehicles, trailers, and semi-trailers; air and spacecraft and related machinery; railroad, military vehicles and other transport equipment; medical and dental instruments—and three services industries—information technology and other information services; software publishing; and scientific research and development.[2]

States often consider KTI employment industries desirable, in part because they typically compensate workers better than other industries do (see indicator 1.3C). Moreover, because the business base of a state is constantly changing as new businesses form and others cease to function, a high percentage of KTI employment business formations indicates an increasingly prominent role for these industries.

HOW DOES NORTH CAROLINA PERFORM?

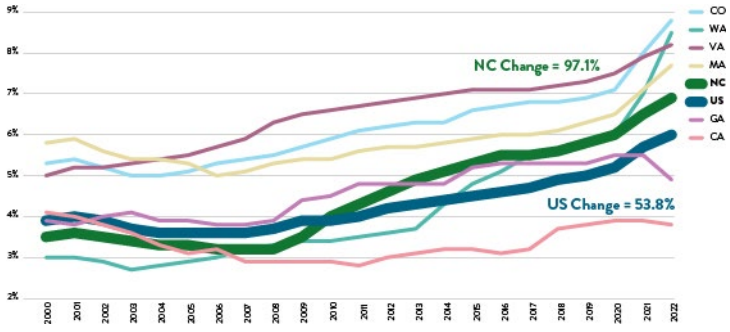
North Carolina's KTI employment establishments represent 6.9 percent of all business establishments in the state, with a value that ranks 18th in the nation and is 115 percent of the U.S. value and 78 percent of the value of the top-ranking state, Colorado **[4.1A]**. Among the comparison states, North Carolina's percentage of KTI employment establishments ranks ahead of only Georgia and California, but is growing faster than every comparison state except Washington (183 percent). The percentage of KTI employment business establishments in North Carolina has increased by 97.1 percent since 2000, however, a rate almost twice the rate for the U.S., 53.8 percent, and faster than the rates of all comparison states except Washington, which average 60.7 percent **[4.1B]**. Notably, after 2008, the percentage of KTI employment establishments started to increase at a faster rate in North Carolina. This was more likely due to closures of non KTI establishments than an increase in KTI business formations, which would indicate their benefit to the economic resiliency of a region.

4.1A *KTI Employment Establishments as a Percentage of All Business Establishments, All U.S. States, 2022*



Source: U.S. Bureau of Labor Statistics.

4.1B *KTI Employment Establishments as a Percentage of All Business Establishments, Comparison States, 2000-2022*



Source: U.S. Bureau of Labor Statistics.

[1] Data for the current report was taken from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages. Previous reports used the high SET definition rather than KTI for "high tech" businesses , which has been discontinued. The two datasets provide similar insights but cannot be directly compared.

[2] See Appendix A for a list of the 41 industries (by 3 to 6-digit NAICS code) that are defined as having KTI employment.

INDICATOR 4.1: KTI EMPLOYMENT ESTABLISHMENTS

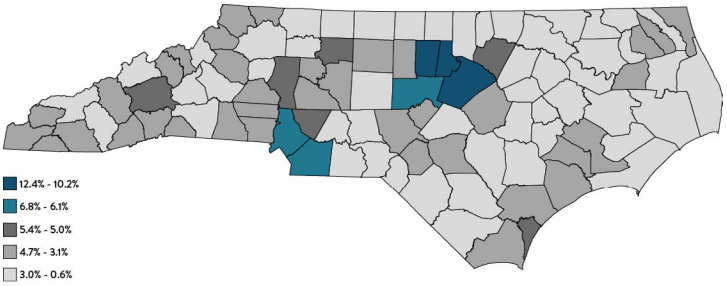
Although KTI employment establishments are located in each of North Carolina's 100 counties, over half (54.4 percent) of those establishments are located in just three counties—Wake (28.5 percent), Mecklenburg (18.5 percent), and Durham (7.4 percent) **[4.1C]**. The next seven counties combined—Guilford (4.2 percent), Buncombe (3.4 percent), Forsyth (3.0 percent), New Hanover (2.9 percent), Orange (2.9 percent), Union (2.4 percent), and Iredell (2.0 percent)—account for another 20.8 percent of the state's KTI employment establishments. This means that 10 of the state's 100 counties contain three-fourths of the state's KTI employment establishments. Five of these top 10 counties also have a higher concentration of KTI employment establishments compared to the U.S. average (Guilford, Buncombe, Forsyth, and New Hanover counties have values lower than the U.S. average). One additional county, Chatham, also has higher than national average concentrations. Of the remaining 90 counties, each has less than 2 percent or less of the state's KTI employment establishments.

In terms of KTI employment business formations as a percentage of all business establishments, North Carolina's value of 1.02 percent is larger than the U.S. value of .64 percent but just over half of the value of the highest state, Delaware, 1.94 percent **[4.1D]**. Among comparison states, North Carolina is ahead of all states except Colorado and Washington. The percentage of high KTI employment business formations in North Carolina has increased by 522 percent since 2001. This rate of increase is 15 percent higher the rate of increase for the U.S., 453 percent **[4.1E]**.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's economy has historically been driven by lower-technology manufacturing industries, but since 2010 has achieved an above-average level of KTI employment establishments. In the innovation-driven economy, the presence and formation of KTI employment establishments indicates the degree to which a state's economy is dynamic, innovative, and a positive environment for economic growth and job creation. To compete favorably in this economy, North Carolina must continue to increase the technology levels of its existing establishments and to start and grow new KTI employment establishments at a faster-than-average rate, particularly in more rural regions.

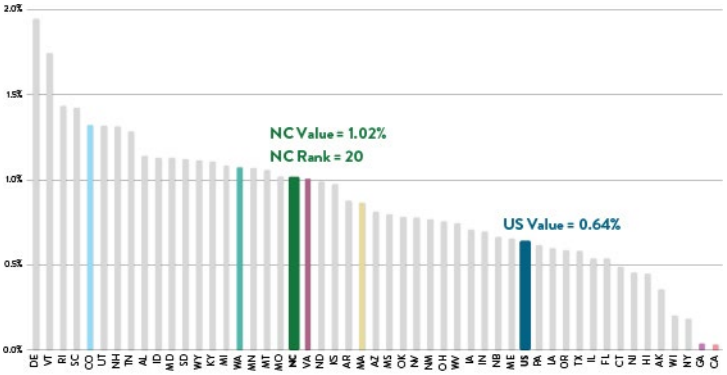
4.1C *KTI Establishments as a Percentage of Total Establishments, N.C. Counties, 2022*



Source: Quarterly Census of Employment and Wages, Labor and Economic Development Division, NC Department of Commerce.

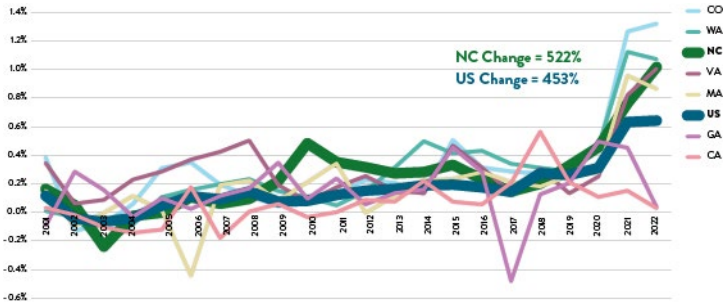
Note: Blue counties rank above the U.S. average.

4.1D *Net KTI Employment Business Formations as a Percentage of all Business Establishments, All U.S. States, 2022*



Source: BSA data from Labor & Economic Development Division, NC Department of Commerce.

4.1E *Net KTI Employment Business Formations as a Percentage of all Business Establishments, Comparison States, 2001-2022*



Source: BSA data from Labor & Economic Development Division, NC Department of Commerce.

INDICATOR 4.2: KTI EMPLOYMENT

KEY FINDINGS

- The percentage of North Carolina's workforce employed in knowledge- and technology- intensive (KTI) employment establishments ranks slightly above the U.S. average but since 2000 has decreased slightly, at a rate similar to the U.S. average.
- North Carolina's employment in KTI employment establishments is highly concentrated in a very small number of urban counties.

OVERVIEW

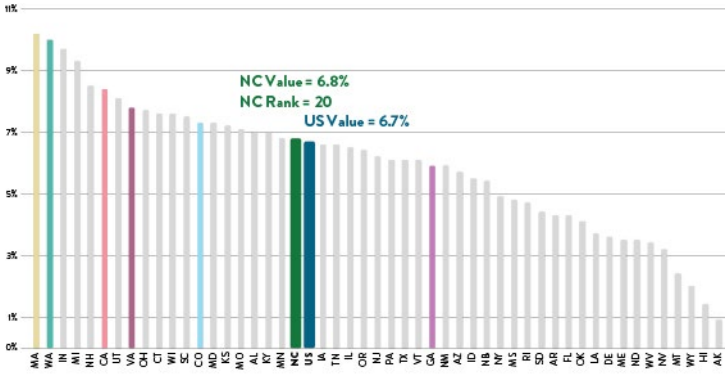
This indicator represents the extent to which a state's workforce is employed in industries with high employment in knowledge- and technology- intensive (KTI) occupations.[1] KTI employment industries are defined as those with high and medium-high R&D intensity. R&D intensity is defined by the ratio of R&D expenditures to production. KTI occupations include scientific, engineering, and technician occupations that employ workers primarily in manufacturing and service industries.

States often consider such industries desirable, in part because they tend to compensate workers better than other industries do (see indicator 1.3C). Skilled and educated workers are the core drivers of states' most important industries, from research and development, to high value-added manufacturing, to high-wage traded services.

HOW DOES NORTH CAROLINA PERFORM?

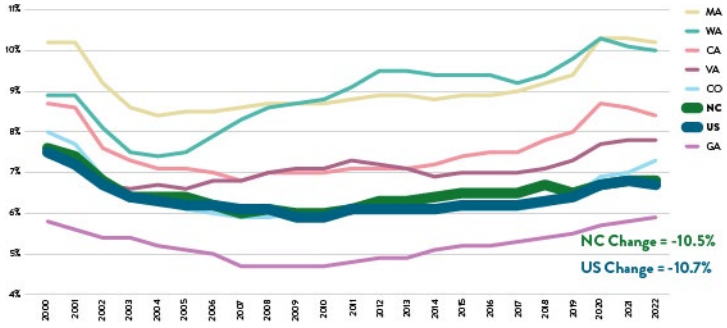
6.8 percent of North Carolina employees work in KTI employment establishments, a value that ranks 20th in the nation and is just above the U.S. average value and 67 percent of the value of the top-ranking state, Massachusetts **[4.2A]**. Among the comparison states, North Carolina's employment in KTI employment establishments as a percentage of total employment ranks second to last, but is just above, Georgia, which has a value of 5.9 percent. The percentage of North Carolina's employment in KTI employment establishments has decreased by 10.5 percent since 2000. This rate of decrease is marginally lower than the 10.7 percent rate of decrease for the U.S. and higher than the rates of all other comparison states **[4.2B]**. Out of the comparison states Washington has the highest rate of increase at 12.4 percent.

4.2A *Employment in KTI Employment Establishments as a Percentage of Total Employment, All U.S. States, 2022*



Source: U.S. Bureau of Labor Statistics.

4.2B *Employment in KTI Employment Establishments as a Percentage of Total Employment, Comparison States, 2000-2022*



Source: U.S. Bureau of Labor Statistics.

[1] See Appendix A for a list of the 41 industries (by 3 to 6-digit NAICS code) that are defined as having KTI employment.

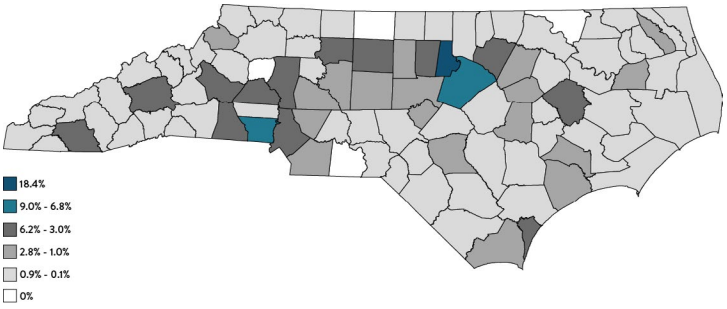
INDICATOR 4.2: KTI EMPLOYMENT

Although KTI employment establishments employ workers in nearly all of North Carolina's 100 counties, two-thirds (66.7 percent) of those employees work in just three urban counties—Wake (27.2 percent), Durham (20.5 percent), and Mecklenburg (19.0 percent) **[4.2C]**. Moreover, those three counties, along with Gaston (6.9 percent), are the only ones in the state whose employment in KTI employment establishments as a percentage of total county employment is greater than or equal to than the U.S. average (6.7 percent). Establishments located in each of the next nine counties—Guilford (6.4 percent), New Hanover(2.9 percent), Forsyth (2.8 percent), Gaston (2.5 percent), Catawba (2.5percent), Buncombe (2.5 percent), Pitt (1.7 percent), Iredell (1.4 percent), and Orange (1.3 percent)—account for 24 percent of the state's KTI workers. This means that establishments located in only 12 percent of the state's counties employ 91 percent of the state's KTI workers. Each of the remaining 88 counties has less than one percent of the state's KTI employment.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

As with KTI employment establishments (see indicator 4.1), North Carolina's above-average level of employment in KTI employment establishments reflects the recent growth in KTI industries forming within and locating to the state despite the facts that a large proportion of North Carolina remains rural in nature and has historically had a higher-than-average share of companies in lower-technology manufacturing industries and agriculture. Moreover, looking across the state, the distribution of KTI workers is more concentrated than the distribution of KTI employment establishments. This pattern of geographically concentrated KTI employment establishments and KTI workers is considerably more concentrated than the state's population (see indicator 1.6). Together, these patterns suggest that more factors than just the location of the state's population influence where people work and the types of establishments in which they work. These other factors include, among others, the location of research and development assets and activities (see indicators in Section 2) and the education attainment levels of the population across the state (see indicator 5.6). For North Carolina to increase the percentage of its workforce in KTI employment establishments, it must not only increase the technology levels of its existing companies and start and grow new KTI employment companies. It must also ensure that a greater share and range of its population has the educational requirements and training to work in KTI employment establishments.

4.2C ***Employment in KTI Employment Establishments as a Percentage of Total Employment, N.C. Counties, 2022***



Source: Quarterly Census of Employment and Wages, Labor and Economic Development Division, NC Department of Commerce.

Note: Blue counties rank above the U.S. average.

INDICATOR 4.3: ENTREPRENEURIAL ACTIVITY

KEY FINDINGS

- North Carolina's monthly rate of new business creation ranks well below the U.S. average and, since 1998, has increased moderately but at a rate slower than the U.S. average.
- North Carolina's average opportunity share of new entrepreneurs ranks below the U.S. average entrepreneurs and, since 1998, has decreased moderately but at a rate faster than the U.S. average.

OVERVIEW

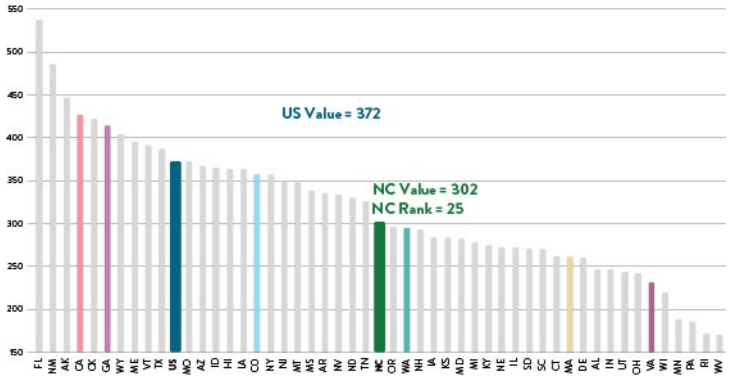
This indicator measures the state of entrepreneurial activity in North Carolina. Entrepreneurs provide expertise in transforming innovative ideas into valuable innovations. Strong entrepreneurial activity will help advance North Carolina's transition to a knowledge-based, technology-driven economy and also create new jobs for the state workforce. Data for entrepreneurial activity are drawn from the Kauffman Foundation, which measures entrepreneurial activity in two ways presented here. First, it uses the Current Population Survey to measure the monthly rate of business creation to approximate entrepreneurial activity.[1] Second, it measures the average opportunity share of new entrepreneurs using a proxy indicator of the percent of new entrepreneurs starting businesses because they saw market opportunities. Specifically, it measures the percentage of new entrepreneurs who were not unemployed before starting their businesses.

HOW DOES NORTH CAROLINA PERFORM?

North Carolina's monthly rate of business creation ranks 25th in the nation, with a level that is 73 percent of the U.S. value and 56 percent of the value of the top-ranking state, Florida[2] **[4.3A]**. Specifically, North Carolina's monthly rate of business creation is 0.302 percent; in other words, entrepreneurs in North Carolina started 302 businesses each month for every 100,000 adults living in the state. Among comparison states, North Carolina's monthly rate is in the middle—lower than California, Georgia, and Colorado, but higher than Washington, Massachusetts, and Virginia.

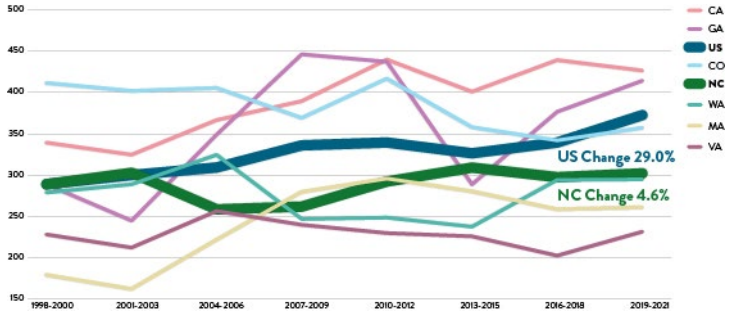
Since 1998, North Carolina's three-year entrepreneurship index average has increased only moderately, while the U.S. average has steadily increased **[4.3B]**. Specifically, North Carolina's current 3-year average (2019-2021) is 4.6 percent higher than its 1998-2000 value, and the U.S. index is 29.0 percent higher. Two of the comparison states—Massachusetts and Georgia—experienced significant increases over time and grew faster than the North Carolina and U.S. averages. Colorado experienced declines in entrepreneurship from 1998-2021.

4.3A *Average Monthly Number of New Entrepreneurs Per 100,000 People, All U.S. States, 2019-2021*



Source: Kauffman Foundation.

4.3B *Average Monthly Number of New Entrepreneurs Per 100,000 People, Comparison States, 1998 - 2021*



Source: Kauffman Foundation.

[1] The Kauffman Index of Entrepreneurial Activity (Kauffman Index) measures the rate of business creation at the individual owner level. Presenting the percentage of the adult, non-business owner population that starts a business each month, the Kauffman Index captures all new business owners, including those who own incorporated or unincorporated businesses, and those who are employers or non-employers. The Kauffman Index is calculated from matched data from the Current Population Survey, a monthly survey conducted by the U.S. Bureau of the Census and the Bureau of Labor Statistics. For more information, see https://indicators.kauffman.org/data-tables.

[2] To increase sample sizes and precision, monthly entrepreneurial activity rates for each state are averaged over a three-year period to calculate an average monthly estimate for the period. Year-to-year estimates are not presented here because of the lack of precision in entrepreneurship rates, especially for smaller states.

INDICATOR 4.3: ENTREPRENEURIAL ACTIVITY

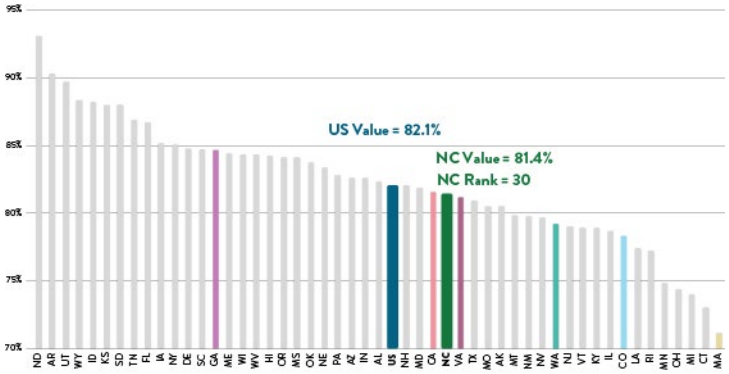
In terms of the average opportunity share of new entrepreneurs, North Carolina's ranks 30th in the nation, with a level that is 1 percent below the U.S. value and 88 percent of the value of the top-ranking state, North Dakota **[4.3C]**. Specifically, North Carolina's average opportunity share of new entrepreneurs averaged 82.1 percent between 2019 and 2021, meaning 82.1 percent of North Carolina's new entrepreneurs were not unemployed before starting their businesses. North Carolina's opportunity share of new entrepreneurs is higher than all comparison states except Georgia and California.

Since 1998, North Carolina's average opportunity share of new entrepreneurs has decreased by 4.6 percent **[4.3D]**. During that same period of time, the opportunity share of new entrepreneurs in the U.S. overall increased by 0.1 percent. In two of the comparison states, the opportunity share of new entrepreneurs also increased—Georgia and California—and at rates that were faster than the U.S. rate of change. Massachusetts, Virginia, Colorado, and Washington had negative rates of change.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

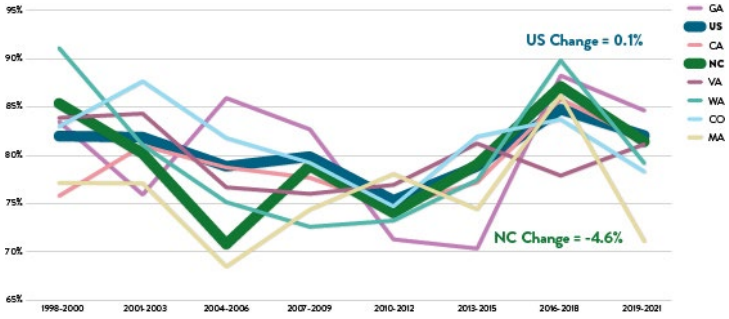
Several factors—such as economic and labor market conditions, industry mix, education, and culture—affect rates of entrepreneurship across states. Thus, while it is difficult to pinpoint causes of the different business creation rate scores across states, this indicator provides important insight into how quickly North Carolina's economy is changing to provide new opportunities and employment in economic sectors of the future. In general, North Carolina's performance is at or slightly below the national average; more can be done to improve state conditions for, and levels of, entrepreneurial activities.

4.3C *Average Opportunity Share of New Entrepreneurs, All U.S. States, 2019-2021*



Source: Kauffman Foundation.

4.3D *Average Opportunity Share of New Entrepreneurs, Comparison States, 1998-2021*



Source: Kauffman Foundation.

INDICATOR 4.4: EXPORTS

KEY FINDINGS

- The value of North Carolina's exports as a percentage of state Gross Domestic Product (GDP)[1] ranks below the U.S. average and has since at least the early 2000s.
- North Carolina and U.S. exports as a percentage of GDP have decreased from 20-year highs in the early 2010s, but have started to trend upward since 2020.

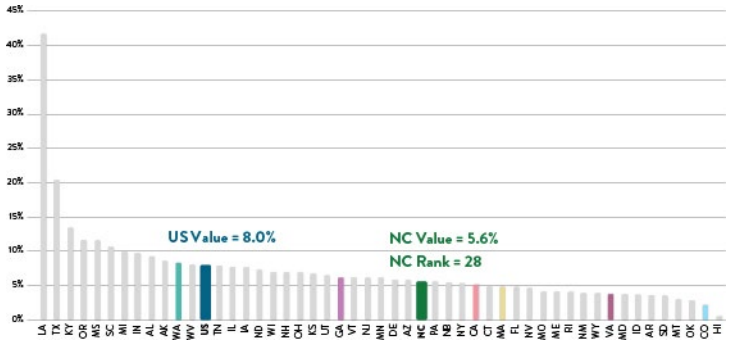
OVERVIEW

This indicator measures the dollar value of each state's international exports as a percentage of its GDP. Export statistics are based on the state from which goods start their journey to the port of export; that is, the data reflect the transportation origin of exports.[2] Exports are an important indicator of a state's potential for generating income and increasing the competitiveness of businesses in the state. More than 95 percent of the world's population lives outside the U.S., 80 percent of the world's buying power lies outside the U.S., and money brought into the state from export businesses allows for the purchase of local goods and services and thus improves the state's local economy.[3] Export-based companies also are frequently required to adapt products in unique ways for foreign consumers. They may be called upon to negotiate trade restrictions and certification requirements, work with foreign suppliers, and/or manage expansive distribution channels, all of which create the flexibility and determination that result in greater competitiveness for home markets.

HOW DOES NORTH CAROLINA PERFORM?

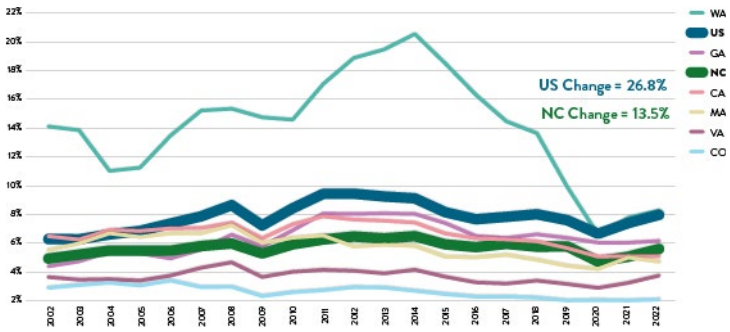
In terms of exports as a percentage of state GDP, North Carolina ranks 28th in the nation, with a value that is 70 percent of the U.S. value and 14 percent of the value of the top-ranking state, Louisiana **[4.4A]**. Among the comparison states, North Carolina's exports as a percentage of state GDP ranks behind Washington and Georgia, but ahead of California, Massachusetts, Virginia, and Colorado. Between 2002 and 2022, North Carolina's exports as a percentage of state GDP increased by 13.5 percent, a rate below the 26.8 percent increase for the U.S. average **[4.4B]**. While North Carolina's increase falls behind Georgia (39.9 percent), whose exports as a percentage of state GDP increased, its rate of increase is greater than the rates for all other comparison states.[4]

4.4A *Exports as a Percentage of GDP, All U.S. States, 2022*



Sources: U.S. Census Bureau, National Science Foundation.

4.4B *Exports as a Percentage of GDP, Comparison States, 2002-2022*



Sources: U.S. Census Bureau, National Science Foundation.

[1] When used in the context of states, "domestic" refers to the state level. When used as the context of nations, "domestic" refers to the national level.

[2] The data come from the Origin of Movement (OM) series, available since 1987 from the U.S. Census Bureau, Foreign Trade Division. OM data cover exports of goods only; there are no comparable statistics for exports of services at the state level.

[3] Export income is considered "new" money introduced into a state's economy. This "new" money can be spent on local goods and services, resulting in an income multiplier effect.

[4] After the 2008 global recession that negatively impacted economic and trade activity in 2009 and 2010, a quick recovery over the next 5 years resulted in 20-year highs in export levels, which have since declined and have dropped further following the global pandemic that started in early 2020.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Exports continue to be one of the key drivers for North Carolina's economic development. In 2020, for example, North Carolina exported more than $28.4 billion in products and services to international markets.[5] Exporting helps companies in North Carolina diversify their business portfolios and become more profitable and resilient in the global market. Furthermore, much of the 9 percent reduction in the trade deficit from 2011 to 2016 can be attributed to the 20 percent growth in services exports over the same period, and specifically, strong growth in information and communication technologies (ICT)-enabled service exports.[6] For North Carolina to remain competitive in the global economy, it must continue to explore new markets for the goods and services it produces. Such efforts require focus in strengthening and expanding relationships with overseas trading partners and understanding how North Carolina industries fit within global commodity value chains. Infrastructure investment in highways, inland terminals, and port facilities is needed to improve the ability to efficiently move goods. Enhanced export assistance and increased availability of financial credits to small and medium-sized companies seeking to export are crucial in connecting businesses to the global economy.[7]

[5] WISERTrade: State Exports by SIC & HS Database.

[6] See Atkinson, R. D. & Wu, J. J. (November 2017.) The 2017 State New Economy Index: Benchmarking Economic Transformation in the States. Information Technology & Innovation Foundation. Available at: https://itif.org/publications/2017/11/06/2017-state-new-economy-index; U.S. Census Bureau, Foreign Trade Historical Series (Annual goods (BOP basis), services, and total balance, exports and imports, 1960 – present; accessed May 18, 2017), https://www.census.gov/foreign-trade/statistics/historical/index.html.

[7] In addition to the U.S. Department of Commerce's presence across the globe, the International Trade Division of the Economic Development Partnership of North Carolina (EDPNC) has staff in the state and in locations around the globe to facilitate export growth.

INDICATOR 4.5: DIVERSITY IN KTI INDUSTRIES

KEY FINDINGS

- North Carolina's gender diversity in KTI industries ranks ahead of the U.S. average.
- North Carolina's gender diversity in KTI industries has decreased since 2001 but started increasing in 2019.
- North Carolina ranks above the U.S. average in terms of racial and ethnic diversity in KTI industries.
- North Carolina's ratio of racial and ethnic diversity in KTI industries has decreased since 2001.

OVERVIEW

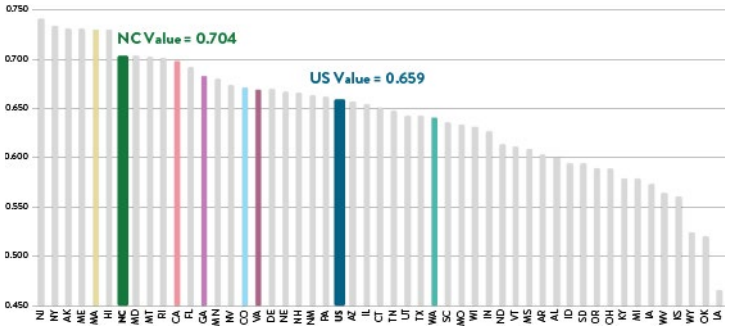
This indicator measures diversity in knowledge- and technology- intensive (KTI) industries. Diversity provides not only an equitable environment but also spurs innovation. Collaboration between those with diverse backgrounds creates new ideas. Data for this indicator are drawn from the Lightcast database, a collection of labor market information gathered from public and private sources, in two ways. First the percentage of women in KTI industries is compared to population percentage of women in that area.[1] This creates a ratio where a value of one, or 100 percent, means that women in that geographic area are proportionally represented in the KTI industry.[2] Second, it measures the ethnic diversity in KTI industries by comparing the percentage of workers that identify as Black or African American and Hispanic or Latino to their share of the population.[3] This also creates a ratio in which a value of one, or 100 percent, indicates that those ethnicities are proportionally represented in that geographic area.

HOW DOES NORTH CAROLINA PERFORM?

North Carolina's gender diversity in KTI industries ranks 7th in the nation, with a level that is 107 percent of the U.S. value and 95 percent of the top-ranking state, New Jersey **[4.5A]**. Specifically, North Carolina's proportion of women workers is 0.704, meaning that the number of women in KTI industries is 70% as representative of the population. Among comparison states, North Carolina ranks only behind Massachusetts (0.730) and is marginally above California (0.698).

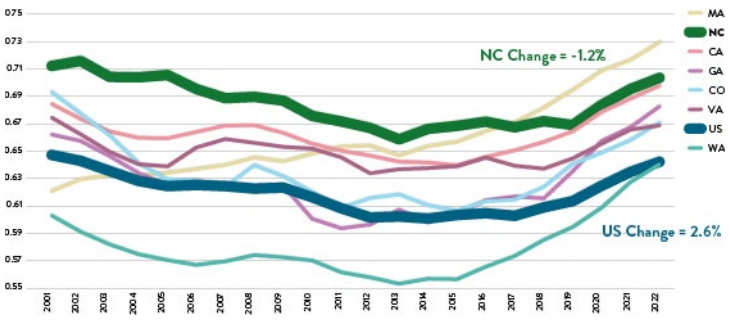
Since 2001, North Carolina's gender diversity has decreased by 1.2 percent while the U.S. average has increased by 2.6 percent **[4.5B]**. North Carolina's rate of change is only better than Colorado with a decrease of 3.2 percent and far behind Massachusetts which had an increase of 17.5 percent. Since the 2010's all comparison states have begun trending upwards, with North Carolina having an increased rate of change in 2019.

4.5A *Gender Diversity of KTI Industries, All U.S. States, 2022*



Source: Lightcast.

4.5B *Gender Diversity of KTI Industries, Comparison States, 2001-2022*



Source: Lightcast.

[1] In July 2021 census, along with other federal agencies, first started asking questions about sexual orientation and gender identity. They are still refining methodology to accurately capture population characteristics. Due to data availability the only recorded options for gender are male (man) or female (woman).

[2] Industry NAICS codes were chosen over occupation SOC codes for this indicator because of data availability and conformity with other sections of the report.

[3] Ethnicity results are reported with the following categories that are standard to the Office of Management and Budget (OMB): Hispanic or Latino as an ethnicity, White, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, and two or more races as a race. We acknowledge that these categories may not fully capture a diverse ethnic background. The categories are set to change with the 2030 Census.

INDICATOR 4.5: DIVERSITY IN KTI INDUSTRIES

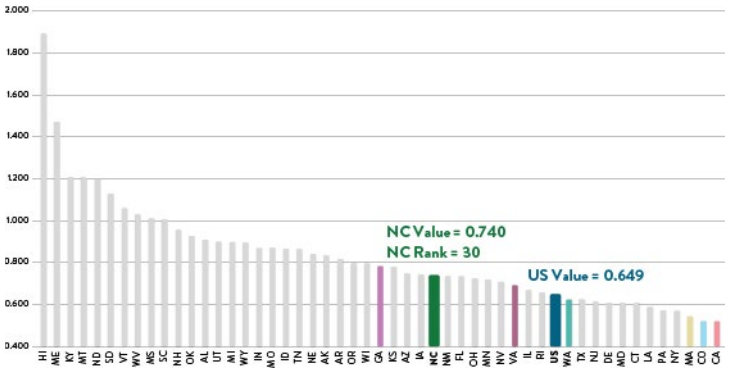
In terms of racial and ethnic diversity in KTI industries, North Carolina ranks 30th in the nation, with a level that is 114 percent of the U.S. value and 39 percent of the value of the top-ranking state, Hawaii **[4.5C]**[4]. in 2022 North Carolina's score for racial and ethnic diversity in KTI industries had a value of 0.740, indicating that the number of Black or African American and Hispanic or Latino workers in KTI industries is 74 percent as representative of the population. North Carolina's racial and ethnic diversity of KTI industries is higher than all comparison states except Georgia.

Since 2001, North Carolina's racial and ethnic diversity in KTI industries has decreased 3.3 percent while the U.S. average has increased by 1.3 percent **[4.5D]**. North Carolina has a growth rate behind Washington (12.1 percent), Georgia (0.5 percent), and Virginia (0.4 percent). Since the 2010's many states have seen a slow increase in racial and ethnic diversity in KTI industries, with a small dip in 2020 as the pandemic caused potentially disproportionate layoffs.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

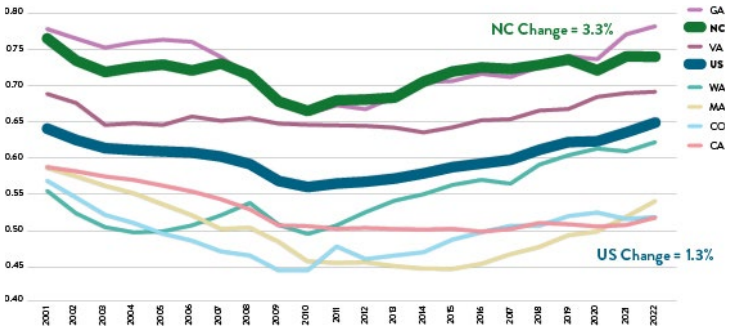
Several factors- including culture, geography, education, economic, and labor markets- affect levels of diversity. North Carolina performs well in gender diversity of KTI industries but is lacking in racial and ethnic diversity. While North Carolina ranks above the U.S. average and most comparison states for this indicator, it is important to work toward having a representative workforce.

4.5C *Racial and Ethnic Diversity of KTI Industries, All U.S. States, 2022*



Source: Lightcast.

4.5D *Racial and Ethnic Diversity of KTI Industries, Comparison States, 2001-2022*



Source: Lightcast.

[4] The U.S. average is lower than expected because racial and ethnic groups are not equally dispersed across the country. This causes national data to be skewed by states with abnormally high or low demographic concentrations.

Section 5: Education & Workforce

INDICATOR 5.1: S&E WORKFORCE

KEY FINDINGS

- The percentage of North Carolina's workforce in Science & Engineering (S&E) occupations ranks slightly above the U.S average and is increasing at a rate faster than the U.S. average.[1]

OVERVIEW

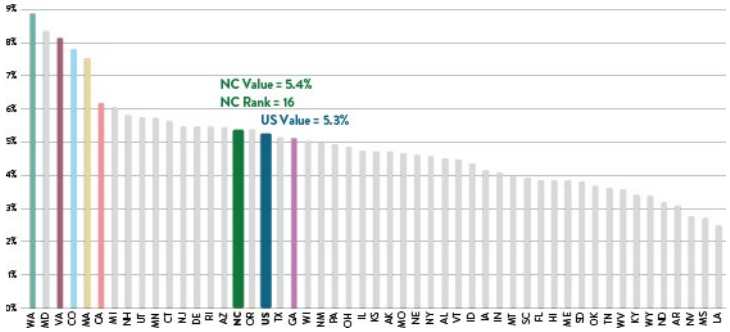
This indicator represents the extent to which a state's workforce is employed in S&E occupations. A high value indicates that a state's economy has a high percentage of technical jobs relative to other states. As such, it reflects the labor pool's interests, its level of skill development, and the nature of the employment opportunities in the state. Policymakers and scholars consistently emphasize innovation based on S&E research and development as a vehicle for economic growth and competitiveness. In the increasingly interconnected 21st-century world, workers with S&E expertise are integral to a nation's and state's innovative capacity because of their high skill level, their creative ideas, and their ability not only to advance basic scientific knowledge but also to transform advances in fundamental knowledge into tangible and useful products and services.

Occupations for S&E are defined by Standard Occupational Classification (SOC) codes[2] and include engineers and computer, mathematical, life, physical, and social scientists. Managers, technicians, elementary and secondary schoolteachers, faculty teaching in S&E fields, and medical personnel are not included.[3]

HOW DOES NORTH CAROLINA PERFORM?

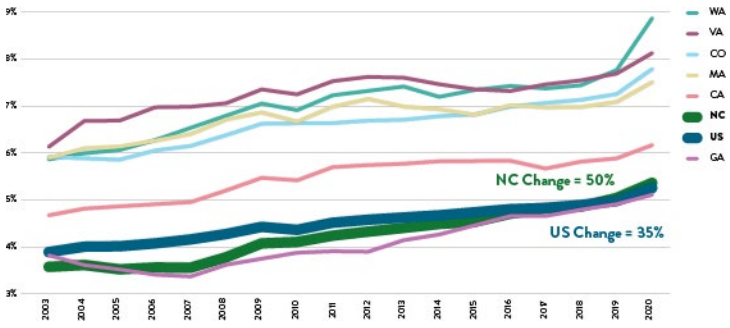
In terms of individuals in S&E occupations as a percentage of the workforce, North Carolina ranks 16th in the nation, with a level that is one tenth of a percent higher than the U.S. average value and 60 percent of the value of the top-ranking state, Washington **[5.1A]**. Apart from Georgia, all comparison states rank well ahead of North Carolina and are within the top 6 among all states. From 2003 to 2020, the percentage of North Carolina's workforce in S&E occupations increased significantly, by 50 percent. This rate is faster than the rate of increase for the U.S. overall (35 percent) and ahead of the rate for all comparison states expect Washington **[5.1B]**.

5.1A *Individuals in S&E Occupations as a Percentage of the Worksforce, All U.S. States, 2020*



Source: National Science Board.

5.1B *Individuals in S&E Occupations as a Percentage of the Workforce, Comparison States, 2003-2020*



Source: National Science Board.

[1] State level data, provided by the National Science Foundation, have not been updated since the 2021 *Tracking Innovation* report. The data are expected to be updated in fall 2024.

[2] The SOC system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 867 detailed occupations according to their occupational definition.

[3] Data on individuals in S&E occupations come from a survey of workplaces that assigns workers to a state based on where they work. Estimates do not include self-employed persons and are developed by the U.S. Bureau of Labor Statistics (BLS) from data provided by state workforce agencies. Data on the size of the workforce are BLS estimates and represent the employed component of the civilian labor force. In these estimates, workers are assigned to a state based on where they live.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's high rate of growth in S&E occupations indicates that it is gaining relative to the U.S. overall. The share of the state's workers in S&E occupations reflects the share of its establishments composed of knowledge- and technology- intensive (KTI) employment establishments (see indicator 4.1) and the share of its employment that works in KTI employment establishments (see indicator 4.2). On both these measures, North Carolina ranks at or above average among all states and is increasing faster than the U.S. average. For North Carolina to exceed the comparison states and rise above the U.S. average on S&E employment, it would likely also need to continue to increase the technology levels of its existing companies and to start and grow new KTI companies. The concentrated geographic distribution and employment of the state's KTI establishments suggest that broadening the distribution of such establishments across North Carolina, as well as deepening the existing concentrations of such establishments, would help increase the share of the state's employment in S&E occupations.

INDICATOR 5.2: EMPLOYED SEH DOCTORATE HOLDERS

KEY FINDINGS

- The percentage of North Carolina's workforce holding science, engineering, and health (SEH) doctorates ranks just above the U.S. average and has been roughly equal to the U.S. average since the early 2000s.
- Since 2001, the percentage of North Carolina's workforce holding SEH doctorates has increased slightly faster than the U.S. average.

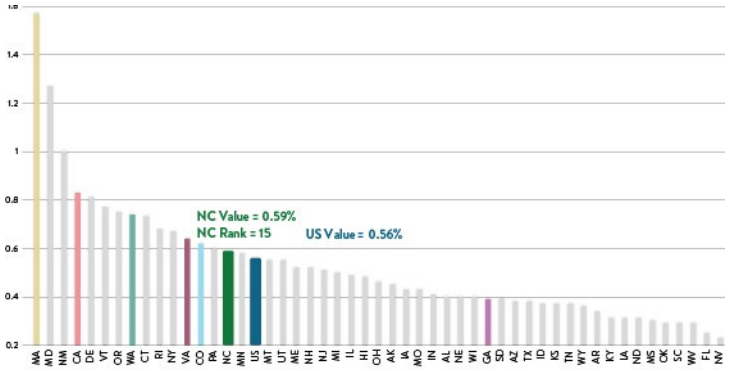
OVERVIEW

This indicator represents a state's ability to attract, retain and grow highly trained scientists, engineers, and healthcare (SEH) professionals. These individuals often conduct R&D, manage R&D activities, or are otherwise engaged in knowledge-intensive activities. As such, this indicator reflects the labor pool's interests, its level of skill development, and the nature of the employment opportunities in the state. A high value for this indicator in a state suggests employment opportunities for individuals with highly advanced training in SEH fields. Data on employed SEH doctorate holders include those with doctoral degrees in computer and mathematical sciences; the biological, agricultural, or environmental life sciences; physical sciences; social sciences; psychology; engineering; and health fields. SEH doctorate data exclude individuals with doctorates from foreign institutions and those above the age of 75.[1]

HOW DOES NORTH CAROLINA PERFORM?

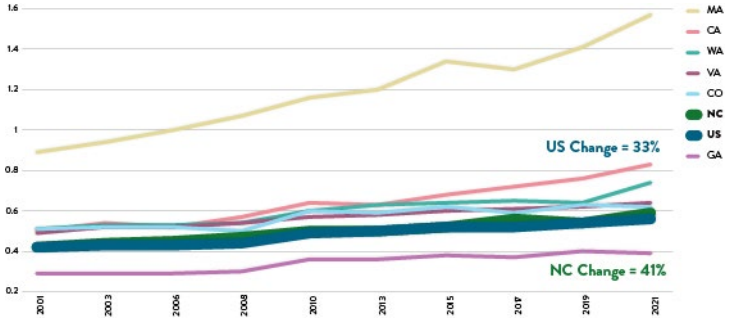
In terms of employed SEH doctorate holders as a percentage of the workforce, North Carolina ranks 15th in the nation, with a level that is 105 percent of the U.S. average value and 38 percent of the value of the top-ranking state, Massachusetts **[5.2A]**.[2] With the exception of Georgia, all the comparison states rank ahead of North Carolina, and three (Massachusetts, California, and Washington) rank in the top 10 among all states. From 2001 to 2021, employed S&E doctorate holders as a percentage of the workforce in North Carolina increased significantly, by 41 percent. This rate is faster than the U.S. average (33 percent) and slower than half of the comparison states except for Colorado, Virginia, and Georgia **[5.2B]**.

5.2A *Employed SEH Doctorate Holders as a Percentage of the Workforce, All U.S. States, 2021*



Source: National Science Board.

5.2B *Employed SEH Doctorate Holders as a Percentage of the Workforce, Comparison States, 2001-2021*



Source: National Science Board.

Note: Data interpolated between years listed on x-axis.

[1] Employed workforce data are developed by the U.S. Bureau of Labor Statistics (BLS), which assigns workers to a state based on where they live. Workforce data represent annual estimates of the employed civilian labor force; estimates are not seasonally adjusted.

[2] States in the top quartile for this indicator tend to have high concentrations of major research laboratories, research universities, or research-intensive industries.

INDICATOR 5.2: EMPLOYED SEH DOCTORATE HOLDERS

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's relatively high rate of growth in SEH doctorate holders indicates that it is keeping pace relative the U.S. overall but is slightly behind leading comparison states. As with science & engineering occupations as a percentage of the workforce (see indicator 5.1), the share of the state's workers holding SEH doctorates reflects the share of its establishments composed of knowledge- and technology- intensive (KTI) employment establishments (see indicator 4.1) and the share of its employment that works in KTI employment establishments (see indicator 4.2). On both these measures, North Carolina ranks at or above average among all states and is increasing faster than the U.S. average. For North Carolina to outpace the comparison states and rise above the U.S. average on employed SEH doctorate holders, it would likely also need to continue to increase the technology levels of its existing companies, start and grow new KTI companies, or increase its number of other research-intensive organizations. The concentrated geographic distribution and employment of the state's KTI establishments suggest that broadening the distribution of such establishments across North Carolina, as well as deepening the existing concentrations of such establishments, would help increase the share of the state's employees holding SEH doctorates.

INDICATOR 5.3: ENGINEERS AS A PERCENTAGE OF THE WORKFORCE

KEY FINDINGS

- The percentage of trained engineers in North Carolina's workforce ranks below the U.S average and has since at least the early 2000s, but is increasing at a rate nearly three times faster than the U.S. average.

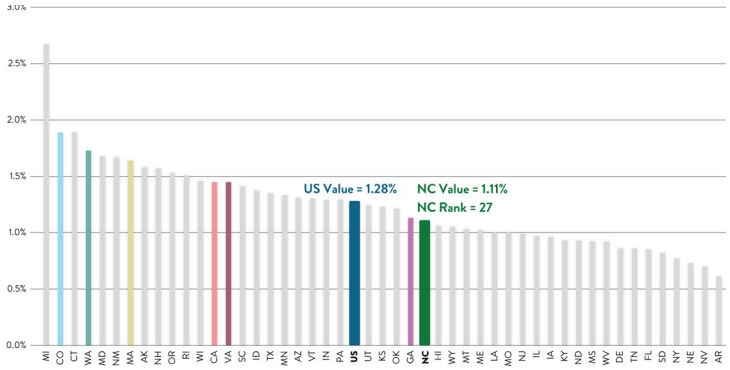
OVERVIEW

This indicator represents the percentage of trained engineers in a state's workforce. Engineers design and operate production processes and create new products and services. This indicator includes the Standard Occupational Classification (SOC) codes for engineering fields:[1] aerospace, agricultural, biomedical, chemical, civil, computer hardware, electrical and electronics, environmental, industrial, marine and naval architectural, materials, mechanical, mining and geological, nuclear, and petroleum.[2] Occupations also include postsecondary teachers in these fields.

HOW DOES NORTH CAROLINA PERFORM?

In terms of the percentage of trained engineers in a state's workforce, North Carolina ranks 27th in the nation, with a level that is 87 percent of the U.S. average value and 42 percent of the value of the top-ranking state, Michigan **[5.3A]**. All comparison states rank ahead of North Carolina **[5.3B]**. Three comparison states (Colorado, Washington, and Massachusetts) are within the top 10 among all states. From 2003 to 2020, the percentage of trained engineers in North Carolina's workforce increased by 32.1 percent, higher than the rate of increase for the U.S. overall (11.3 percent). This rate is slightly slower than the rate of increase for Georgia, but much faster than the rate of increase for the other comparison states.

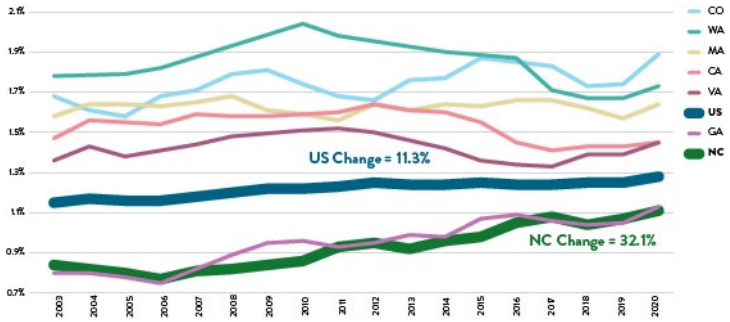
5.3A *Engineers as a Percentage of All Occupations, All U.S. States, 2020*



Source: National Science Board.

Note: 2020 data not available for Alabama & Ohio.

5.3B *Engineers as a Percentage of All Occupations, Comparison States, 2003-2020*



Source: National Science Board.

Note: Data not available for Washington for 2004, 2007, 2009, 2012, 2013, and 2015; Virginia for 2009. Lines for missing years were interpolated using other years' data.

[1] The SOC system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 867 detailed occupations according to their occupational definition.

[2] Data on individuals in S&E occupations come from a survey of workplaces that assigns workers to a state based on where they work. Estimates do not include self-employed persons and are developed by the U.S. Bureau of Labor Statistics (BLS) from data provided by state workforce agencies. Data on the size of the workforce are BLS estimates and represent the employed component of the civilian labor force. In these estimates, workers are assigned to a state based on where they live.

INDICATOR 5.3: ENGINEERS AS A PERCENTAGE OF THE WORKFORCE

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

In general, the states with the highest percentage of engineers in their workforce are centers of automobile and aircraft manufacturing, such as Michigan and Washington, or states that rank high on employment in high knowledge- and technology-intensive establishments as share of total employment, such as Washington, Virginia, and California (see indicator 4.2). The relatively low percentage of trained engineers in North Carolina's workforce is a cause for concern, because regions with a high concentration of engineers have a greater capacity for innovation and often lead in key industries.[3] For North Carolina to outpace the comparison states and rise above the U.S. average on the percentage of trained engineers in its workforce, it would also need to continue to increase the technology levels of its existing companies and to start and grow new high science, engineering and technology companies. The concentrated geographic distribution and employment of the state's high science, engineering and technology employment establishments suggest that broadening the distribution of such establishments across North Carolina, as well as deepening the existing concentrations of such establishments, would help increase the share of the state's employees trained as engineers.

[3] Notably, San Jose/Silicon Valley's ratio of 47 engineers and architects per 1,000 employees is a key reason it is one of the nation's most affluent metro areas. The Detroit MSA has a concentration of 43 engineers and architects per 1,000, while Raleigh has 25 per 1,000. (Bureau of Labor Statistics, "May 2020 Occupational Employment and Wage Statistics Survey," accessed February 21, 2022 at https://www.bls.gov/oes/#data).

INDICATOR 5.4: BACHELOR'S DEGREES IN S&E

KEY FINDINGS

- The ratio of S&E bachelor's degrees to the population aged 18–24 years in North Carolina ranks below the U.S average, has been similar to the U.S. average for nearly twenty years, and in recent years has been increasing at a rate slightly below the U.S. average.

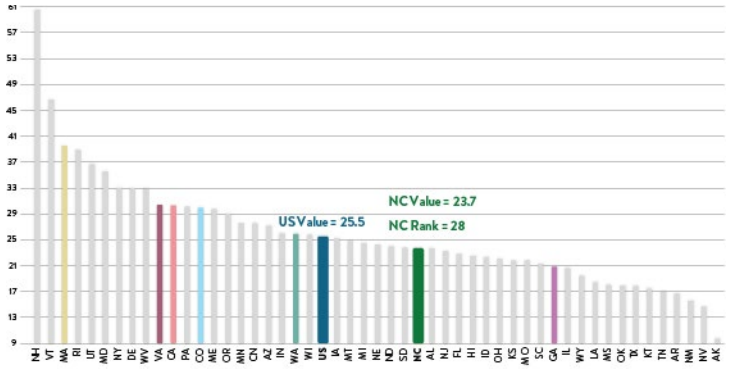
OVERVIEW

This indicator is the ratio of new S&E bachelor's degrees to the population ages 18–24 years and represents the extent to which a state prepares young people to enter technology-intensive occupations that are fundamental to a knowledge-based, technology-driven economy. S&E fields include the physical, life, earth, ocean, atmospheric, computer and social sciences; mathematics; engineering; psychology; science technologies; and engineering technologies. They do not include medical fields or technologies.[1]

HOW DOES NORTH CAROLINA PERFORM?

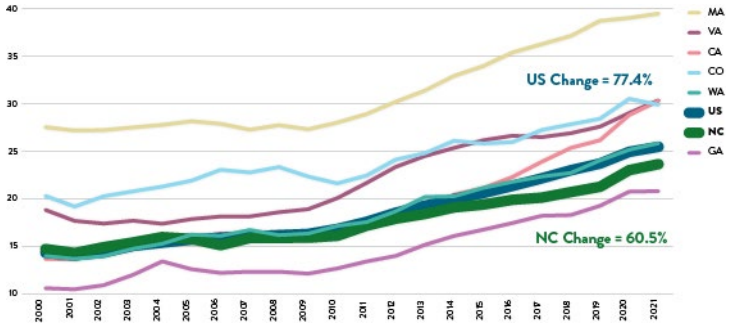
In terms of the ratio of new S&E bachelor's degrees to the population ages 18–24 years, North Carolina ranks 28th in the nation, with a level that is 93 percent of the U.S. average value and 39 percent of the value of the top-ranking state, New Hampshire **[5.4A]**. Relative to the comparison states, North Carolina ranks above only Georgia. From 2000 to 2021, North Carolina's ratio of new S&E bachelor's degrees to the population ages 18–24 years increased by 61 percent, a rate lower than the rate of increase for the U.S. overall (77 percent). North Carolina's rate of increase is also slower than that of half of other comparison states except for Colorado, Virginia, and Massachusetts **[5.4B]**.

5.4A *Bachelor's Degrees in S&E Conferred per 1,000 Individuals 18–24 Years Old, All U.S. States, 2021*



Source: National Science Board.

5.4B *Bachelor's Degrees in S&E Conferred per 1,000 Individuals 18–24 Years Old, Comparison States, 2000-2021*



Source: National Science Board.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Educational attainment in an S&E field gives people greater opportunities to work in higher-paying technical jobs than are generally available to those in other fields of study. Earning a bachelor's degree in an S&E field also prepares an individual for advanced technical education. A high value for this indicator indicates the successful provision of undergraduate training in S&E fields. North Carolina's slightly below average performance on this indicator suggests room for improvement. While the ratio of new S&E bachelor's degrees to the population ages 18–24 years in North Carolina is increasing over time, this rate of slower than the rate for the U.S. overall. For North Carolina to have the skilled workforce necessary to drive the innovation economy, it should work to increase the share of its college-age population earning degrees in S&E fields. Relocating companies are likely to gravitate to North Carolina if it has the required workforce pool available, and companies already located in North Carolina are more likely to remain here if it has a strong pool of S&E workers.

[1] The number of bachelor's degrees awarded in S&E fields is an actual count provided by the National Center for Education Statistics. Estimates of the population aged 18–24 years old are provided by the U.S. Census Bureau. A high value for this indicator may suggest the successful provision of undergraduate training in S&E fields. Because students often relocate after graduation, this measure does not directly indicate the qualifications of a state's future workforce. A state's value for this indicator may also be high when its higher education system draws a large percentage of out-of-state students, a situation that sometimes occurs in states with small resident populations and the District of Columbia.

INDICATOR 5.5: SET DEGREES

KEY FINDINGS

- The percentage of higher education degrees conferred in S&E fields in North Carolina ranks above the U.S average and has since at least the early 2000s, but is increasing slower than the U.S. average.

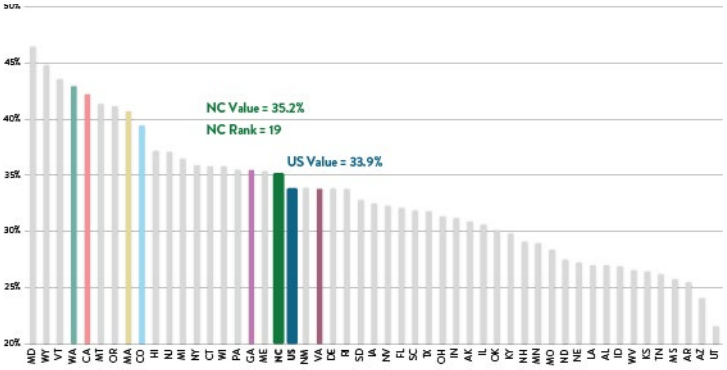
OVERVIEW

This indicator represents the extent to which a state's higher education programs are concentrated in S&E fields. S&E fields include the physical, life, earth, ocean, atmospheric, computer, and social sciences; mathematics; engineering; and psychology. They do not include medical fields or technologies. Counts of both S&E degrees and higher education degrees conferred include bachelor's, master's, and doctoral degrees; associate's degrees and professional degrees are not included.

HOW DOES NORTH CAROLINA PERFORM?

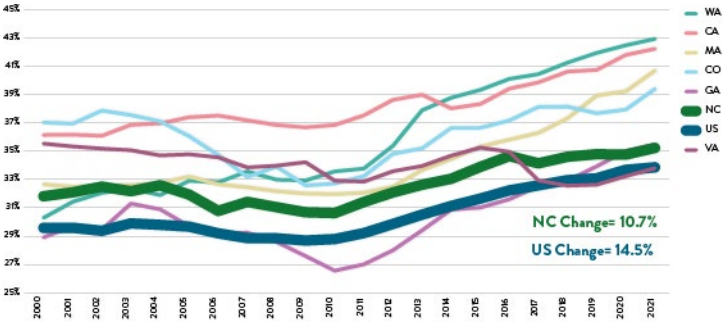
In terms of S&E degrees as a percentage of higher education degrees conferred, North Carolina ranks 19th in the nation, with a level that is 104 percent of the U.S. average value and 76 percent of the value of the top-ranking state, Maryland **[5.5A]**. Relative to the comparison states, North Carolina ranks below all the comparison states except Virginia. From 2000 to 2021, S&E degrees as a percentage of higher education degrees conferred in North Carolina increased by 10.7 percent, a rate slightly lower than the rate of increase for the U.S. overall (14.5 percent) **[5.5B]**. North Carolina's rate of increase is less than the rates of increase for Washington, Georgia, Massachusetts, and California, but higher than the rates of increase for Colorado and Virginia, the latter of whose rate decreased.[1]

5.5A *S&E Degrees as Percentage of Higher Education Degrees Conferred, All U.S. States, 2021*



Source: National Science Board.

5.5B *S&E Degrees as Percentage of Higher Education Degrees Conferred, Comparison States, 2000-2021*



Source: National Science Board.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Irrespective of degree level, educational attainment in S&E fields gives people greater opportunities to work in higher-paying technical jobs than are generally available to those in other fields of study. A high value for this indicator suggests the successful provision of higher education training in S&E fields at both the undergraduate and graduate levels. North Carolina's above-average performance on this indicator but below-average performance on bachelor's degrees in S&E fields (see indicator 5.4) suggests that North Carolina's provision of S&E degrees is stronger at the master's and doctoral level than at the bachelor's level. The percentage of higher education degrees overall that were conferred in S&E fields in North Carolina is increasing over time, and this rate of increase is just behind the rate of increase for the U.S. overall. However, for North Carolina to have the skilled workforce necessary to drive the innovation economy, it should work to increase the share of its undergraduate-level students earning degrees in S&E fields.

[1] Degree data reflect the location of the degree-granting institution, not the state where degree-earning students permanently reside. The year indicates the end date of the academic year. For example, data for 2019 represent degrees conferred during the 2018–19 academic year. All degree data are actual counts.

INDICATOR 5.6: EDUCATIONAL ATTAINMENT

KEY FINDINGS

- North Carolina's educational attainment composite score is slightly above the U.S. average and is increasing at a rate slightly faster than the U.S. average.
- Within North Carolina, educational attainment levels vary considerably; 17 counties, the majority of which are urban, have an educational composite score higher than the U.S. average composite score.

OVERVIEW

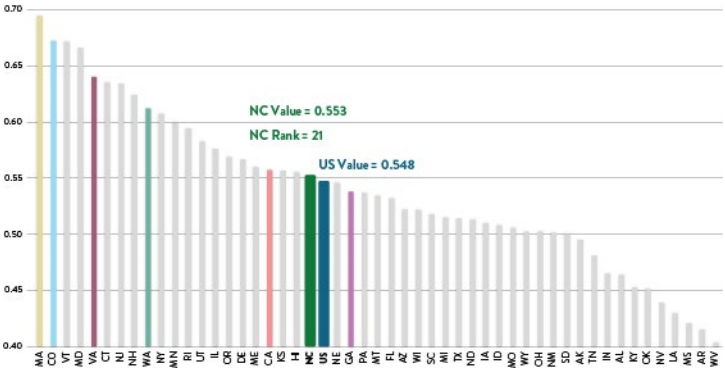
Regardless of industry or occupation, a well-educated, skilled workforce is a prerequisite for success in the innovation economy. The educational attainment of the workforce—measured here as an aggregate using a composite score (see Methodological Note on the last page of this indicator)—is a fundamental determinant of how well a state can generate and support economic growth centered on innovation. Moreover, the greater the share of well-educated workers within a state, the less the state has to rely on in-migration (see indicator 5.7) to sustain its pool of workers. North Carolina's ability to compete in the innovation economy is heavily dependent on its ability to produce and maintain a well-educated workforce.

HOW DOES NORTH CAROLINA PERFORM?

In terms of its educational attainment composite score, North Carolina's value ranks 21st in the nation, with a level that is 101 percent of the U.S. value and 80 percent of the value of the top-ranking state, Massachusetts **[5.6A]**. This composite score derives from the following statistics:[1] 9.8 percent of North Carolina citizens over 25 years of age have not completed high school, 24.9 percent completed their education with a high school degree, 19.3 percent completed with a high school degree and have some college experience, 10.1 percent completed with an associate degree, 22.8 percent completed with a bachelor's degree, and 13.2 percent completed with a graduate or professional degree.

All comparison states have a higher educational attainment composite score than North Carolina, apart from Georgia. From 2005 to 2022, North Carolina's composite score increased by 47 percent, which was greater than the increase for the U.S. average composite score (35 percent) and the average of the composite scores for the comparison states (32 percent) **[5.6B]**. It was also greater than the increase for any of the comparison states individually.

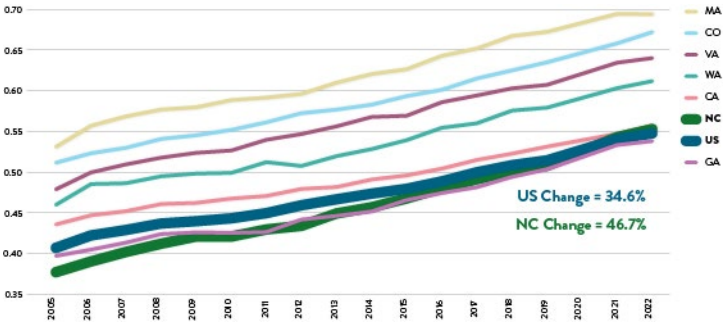
5.6A *Educational Attainment, All U.S. States, 2022*



Source: U.S. Census Bureau.

Note: Weighted measure (composite score) of the educational attainment of residents aged 25 years and over.

5.6B *Educational Attainment, Comparison States,2005–2022*



Source: U.S. Census Bureau.

Notes: Weighted measure (composite score) of the educational attainment of residents aged 25 years and over. Data for 2020 was not comparable to other years and is removed. The missing data is ignored for the line construction.

[1] Using these statistics and the weighted measure methodology described on the last page of this indicator, North Carolina's composite score for 2022 is calculated as follows .098(-0.05) + 0.249(0) + 0.193(0.25) + 0.10.1(0.5) + 0.228(1) + 0.132(1.75) = 0.553 (as shown in charts 5.6a and 5.6b).

INDICATOR 5.6: EDUCATIONAL ATTAINMENT

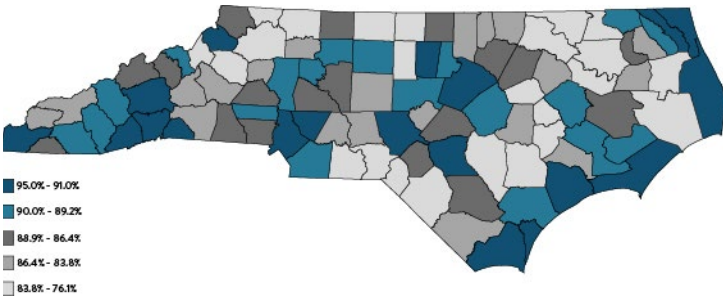
Within North Carolina, educational attainment is considerably higher in urban counties (e.g., Mecklenburg, Wake, Guilford, Forsyth, Durham, etc.) and counties with high numbers of retirees (e.g., Moore, Buncombe, Dare, New Hanover), or universities (e.g., Orange, Pitt, Watauga) **[5.6C, 5.6D]**. Of the state's 100 counties, only 38 have, for residents 25 years and older, a high-school completion rate higher than the U.S. average, 89 percent. In terms of the percentage of residents 25 years and over who have completed a bachelor's degree or more education, only 15 counties have a rate higher than the U.S. average, 34 percent. The educational attainment composite score follows a similar pattern but adds or exchanges several counties, Chatham, Union, Guilford, Transylvania, Cabarrus, and Henderson, for a total of 17 counties above the national average **[5.6E]**.

Thus, the overall pattern across North Carolina is that a majority of counties have relatively low educational attainment levels (83 have an educational composite score below the U.S. average composite score) and typically are in rural regions. Of the 17 counties that have an educational composite score higher than the U.S. average composite score, 8 counties are among the top 10 most populous counties in the state; the remainder are less populous counties that are the home to universities, are adjacent to these counties, or have a large number of retirees or military personnel.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

More than a decade ago, the 2011 State of the North Carolina Workforce report highlighted four key facts focused on educational attainment: (1) individuals with a baccalaureate degree were half as likely to be unemployed as the average worker, while individuals without a high school degree were twice as likely as the average worker to be unemployed; (2) workers with a baccalaureate degree can expect to earn $1.5 million more over a 30-year career than a high school dropout; (3) nearly half of the new jobs being created in North Carolina will require, at a minimum, some postsecondary education, many in science, technology, engineering and math (STEM) disciplines; (4) STEM jobs will constitute an increasing share of higher- and medium-wage jobs, creating significant barriers to employment for unprepared young adults and existing workers. These facts, combined with the educational attainment findings presented above, make it clear that North Carolina must improve the educational attainment levels of its citizens in order to generate innovative ideas, to support the expansion of a knowledge-based economy, and to increase the economic well-being and quality of life of its citizens.

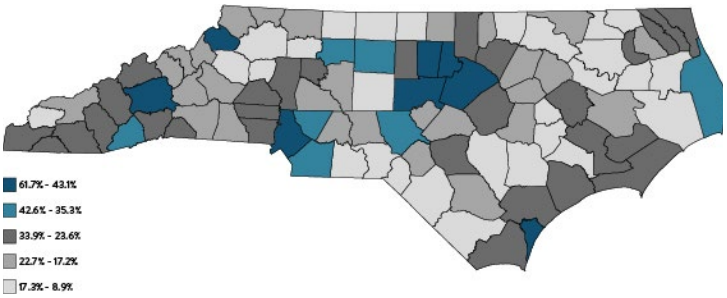
5.6C ***Percentage of Residents 25 Years and Over Who Have Completed High School or More Education, N.C. Counties, 2018-2022 Estimate***



Source: U.S. Census Bureau.

Note: Blue counties rank above the U.S. average.

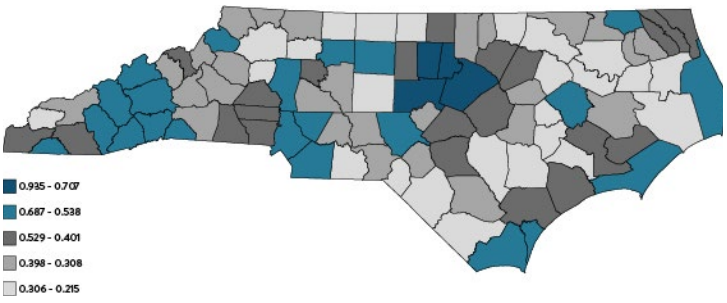
5.6D ***Percentage of Residents 25 Years and Over Who Have Completed a Bachelor's Degree or More Education, N.C. Counties, 2018-2022 Estimate***



Source: U.S. Census Bureau.

Note: Blue counties rank above the U.S. average.

5.6E ***Weighted Measure (composite score) of the Educational Attainment of Residents Aged 25 Years and Over, N.C. Counties, 2018-2022 Estimate***



Source: U.S. Census Bureau.

Note: Blue counties rank above the U.S. average.

INDICATOR 5.6: EDUCATIONAL ATTAINMENT

METHODOLOGICAL NOTE

The weighted measure (composite score) used in charts 5.6A and 5.6B and map 5.6E is virtually identical to the one developed and used by the Information Technology & Innovation Foundation (ITIF) in its 2017 State New Economy Index. Specifically, it uses U.S. Census Bureau data to determine, for each state, the share of the state's population aged 25 years and over with the following six educational attainments: no high school diploma, high school diploma, some college (1 or more years, no degree), associate's degree, bachelor's degree, graduate or professional school degree, and doctorate degree. It then assigns each degree class a weight, as follows:

- -0.05 for no high school diploma
- 0.0 for a high school diploma
- 0.25 for some college
- 0.50 for associate's degree
- 1.00 for bachelor's degree
- 1.75 for graduate or professional degree

Each share is multiplied by its respective weight and the products are summed to arrive at the final score. This composite score is valuable for at least two reasons:

1. It includes, in a single measure, the full spectrum of relevant degree classes, and
2. It assigns greater weight to higher-level degrees.

Accordingly, it provides an efficient and effective measure of the general educational attainment level of each state.

INDICATOR 5.7: EDUCATIONAL ATTAINMENT OF IN-MIGRANTS

KEY FINDINGS

- North Carolina's average years of education among in-migrants ranks slightly above the U.S. average, has more often than not since at least the mid-2000s, and is increasing at a rate slightly above the U.S. average.
- North Carolina's in-migration of college-educated adults as a percentage of total state population ranks above the U.S. average, has more often than not since at least the mid-2000s, and is increasing at a rate slightly above the U.S. average.
- Within North Carolina, the in-migration of individuals with a bachelor's degree or higher is very concentrated in a small number of counties.

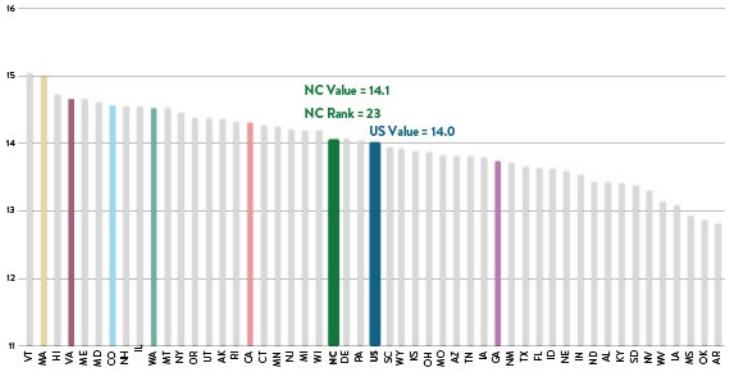
OVERVIEW

The ability of a state to successfully attract well-educated, skilled individuals to relocate from other states and countries enhances that state's ability to foster an innovation economy. This indicator measures the education attainment of in-migrants in two ways: average years of education among in-migrants, and in-migration of college-educated adults as a percentage of total state population. The first measure is a more comprehensive indicator of the educational attainment of in-migrants, whereas the second measure is a more targeted indicator of the higher-level educational attainment of in-migrants. States better able to attract educated and skilled workers provide organizations in the innovation economy with the skill sets necessary to compete in knowledge-intensive production. Furthermore, attracting outside talent enhances a state's ability to generate new innovative ideas that may have economic impacts in the future.

HOW DOES NORTH CAROLINA PERFORM?

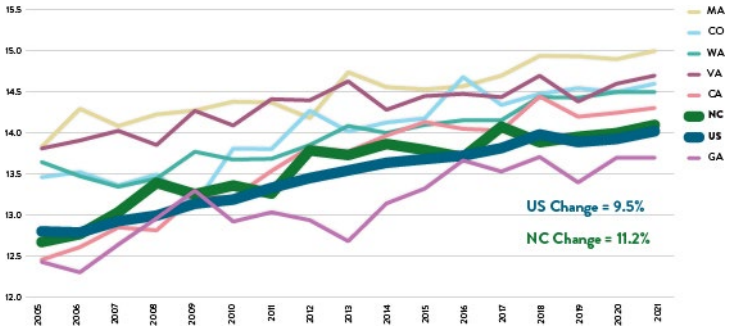
In terms of average years of education among in-migrants, North Carolina ranks 23rd in the nation, with a value just above the U.S. average (14.1 years versus 14.0 years), and 94 percent of the value of the top-ranking state, Vermont (15.0 years) **[5.7A]**. Among the comparison states, North Carolina ranks above Georgia and below all other comparison states on this measure. Massachusetts ranks in the top 5 among all states historically, and California has improved by the greatest amount since 2005 among comparison states. From 2005–2021, the average years of education among in-migrants in North Carolina increased by 11.2 percent, which is faster than the 9.5 percent increase for the U.S. overall and the average of all comparison states (9.1 percent) **[5.7B]**.

5.7A *Average Years of Education Among In-Migrants, All U.S. States, 2021*



Source: U.S. Census Bureau.

5.7B *Average Years of Education Among In-Migrants, Comparison States, 2005-2021*



Source: U.S. Census Bureau.

INDICATOR 5.7: EDUCATIONAL ATTAINMENT OF IN-MIGRANTS

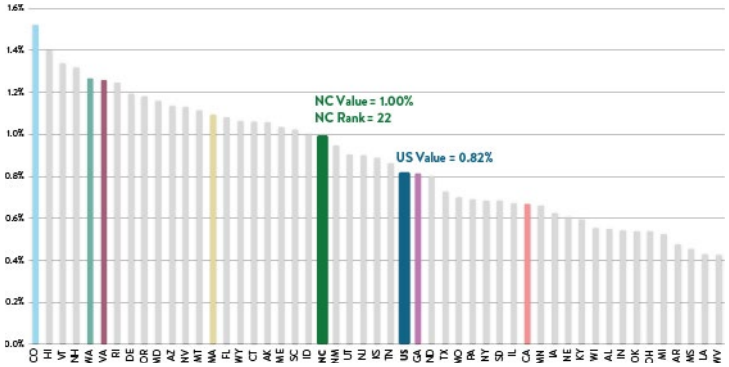
College-educated adult in-migrants account for 1.0 percent of North Carolina's population. North Carolina's value ranks 22nd in the nation, 22 percent above the U.S. average value, and 66 percent of the value of the top-ranking state, Colorado **[5.7C]**. Among the comparison states, California and Georgia rank lower than North Carolina on this measure. From 2005–2021, North Carolina in-migration of college-educated adults as a percentage of total state population increased by 21.7 percent, whereas the percentage for the U.S. overall increased by 20.1 percent **[5.7D]**. Relative to the comparison states, North Carolina's rate of increase is higher than those of Washington, Virginia, and Georgia.

Within North Carolina, the in-migration of individuals with a bachelor's degree or higher is very concentrated in a small number of counties **[5.7E]**.[1] Two counties combined accounted for 37.3 percent of the state's in-migrants with a bachelor's degree or higher between 2017 and 2021—Mecklenburg (18.8 percent) and Wake (18.6 percent). Another third of college-educated in-migrants moved to nine counties—Durham (6.9 percent), Cumberland (4.2 percent), Guilford (4.4 percent), Orange (3.2 percent), Buncombe (4.5 percent), Forsyth (2.9 percent), New Hanover (3.1 percent), Onslow (2.3 percent), and Iredell (2.3 percent). In total, this means that 11 of the state's 100 counties account for 71 percent of the state's in-migrants with a bachelor's degree or higher between 2017 and 2021. The next 7 counties combined— Union (2.0 percent), Brunswick (1.7 percent), Pitt (1.5 percent), Moore (1.7 percent), Cabarrus (1.0 percent), Harnett (1.0 percent), NS Henderson (1.1 percent)—account for another 10.0 percent of the state's in-migrants with a bachelor's degree or higher over the same period. Each of the remaining 82 counties accounts for less than one percent of the state's in-migrants with a bachelor's degree or higher between 2017 and 2021, and together they account for 18.8 percent of that in-migration.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

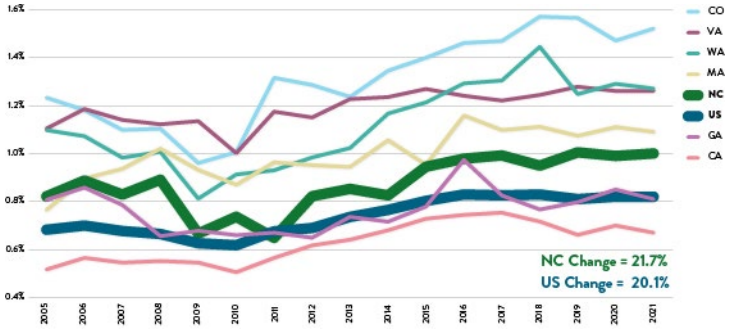
The ability of the state to attract highly educated individuals is a key factor that influences the generation of innovative ideas and strengthens a knowledge-based economy. Strong influxes of highly educated workers strengthen the innovation economy labor pool by providing diverse and highly demanded skill sets. North Carolina's performance on this factor—slightly above the middle of the U.S. state distribution—suggests that the state can continue to do more to attract highly educated individuals to relocate here. Additionally, a small number of counties accounts for the majority of the state's in-migration of individuals with a bachelor's degree or higher. These findings suggest that the state should work to increase the opportunities for highly educated individuals to relocate from other states and countries. This holds especially true for counties with a low percentage of college-educated in-migrants.

5.7C *In-Migration of College Educated Adults as a Percentage of Total State Population, All U.S. States, 2021*



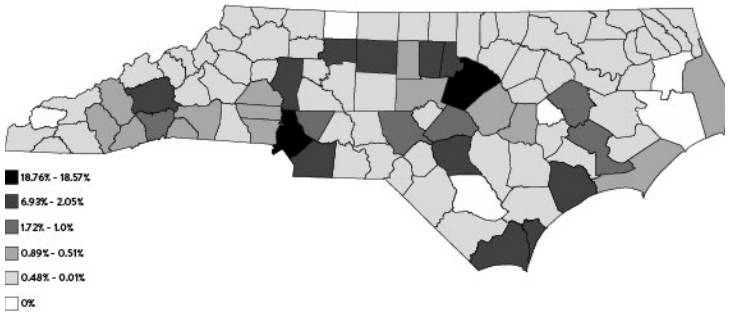
Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.

5.7D *In-Migration of College Educated Adults as Percentage of Total State Population, Comparison States, 2005-2021*



Source: U.S. Census Bureau.

5.7E *In-Migration of College Educated Adults, Percent of State Total, N.C. Counties, 2017-2021*



Source: U.S. Census Bureau.

[1] The percentages presented here are based, for a given county, on the number of in-migrants that have a bachelor's degree or higher and that relocated from another county within the state, a different state, or from a different country between 2017 and 2021. The trends illustrated in map 5.7E are highly correlated with trends illustrated in map 1.6B and chart 1.6C.

Section 6: Environment & Infrastructure

INDICATOR 6.1: PUBLIC INVESTMENT IN EDUCATION

KEY FINDINGS

- North Carolina's elementary and secondary public school current expenditures as a percentage of state gross domestic product (GDP) rank well below the U.S. average, have since at least the early 2000s, and are decreasing over time.
- North Carolina's appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP rank well above the U.S. average, have since at least the early 2000s, but are decreasing over time.

OVERVIEW

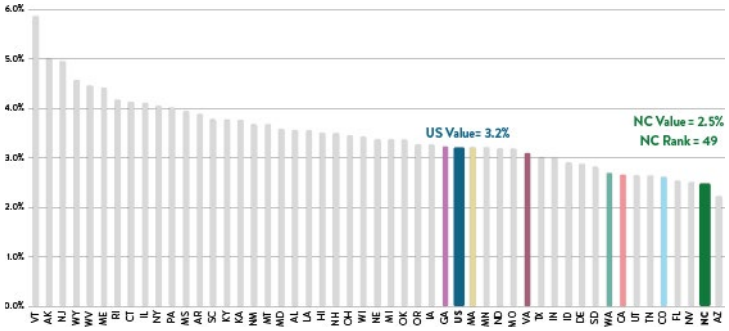
This indicator measures public investment in education two ways: 1) elementary and secondary public school current expenditures, and 2) appropriations of state tax funds for operating expenses of higher education, each as a percentage of state GDP. The first measure represents the relative amount of resources that state governments expend to support public education in pre-kindergarten through grade 12. Current expenditures include instruction and instruction-related costs, student support services, administration, and operations; they exclude funds for school construction and other capital outlays, debt service, and programs outside of public elementary and secondary education. State and local support are the largest sources of funding for elementary and secondary education.[1] The second measure represents the relative amount of resources that state governments expends to support higher education operating expenses.[2]

For each measure, a higher value indicates that a state has made financial support of the respective education level more of a priority.[3] Investments in public pre-kindergarten through grade 12 are important for preparing a broadly educated and innovation-capable workforce. Investments in public postsecondary education are critical to increase the ability of public academic institutions to prepare students for skilled and well-paying employment. Well-regarded public higher education programs enhance a state's ability to attract students from around the globe, many whom choose to remain and work in the state after graduation.

HOW DOES NORTH CAROLINA PERFORM?

In terms of the elementary and secondary public school current expenditures as a percentage of state GDP, North Carolina ranks 49th in the nation, with a level that is 77 percent of the U.S. average value and 42 percent of the value of the state with the highest value, Vermont **[6.1A]**. Among comparison states, North Carolina expends the least on primary and secondary public schools relative to their state domestic products. Between 2002 and 2021, U.S. average elementary and secondary public school current expenditures as a percentage of state GDP decreased by 5.3 percent, whereas North Carolina's percentage decreased by 12.9 percent. **[6.1B, following page]**. Over this same period, all comparison states except for Virginia also had decreasing rates in the percentage of their state GDP on elementary and secondary public school current expenses, though their rates of decrease were smaller than the rate for North Carolina, except for California.

6.1A ***Elementary and Secondary Public School Current Expenditures as a Percentage of State GDP, All U.S. States, 2021***



Source: U.S. Census Bureau.

[1] Current expenditures are expressed in actual dollars and their data year is the end date of the academic year. GDP data refer to the calendar year in current dollars.

[2] Because of decreases in state tax collections in FY 2009–11 during the Great Recession, state monies allocated to higher education decreased in many states. This decrease was offset to a degree by federal stimulus funds that were used to restore the level of state support for public higher education. Nationally, state financial support of higher education operating expenses relative to GDP has experienced a downward trend since the early 2000s. The state monies used to calculate this indicator do not include federal stimulus funds for education stabilization or federal, state, or local government funds for the modernization, renovation, or repair of higher education facilities.

[3] This does not assume that more spending necessarily leads to improved educational outcomes.

INDICATOR 6.1: PUBLIC INVESTMENT IN EDUCATION

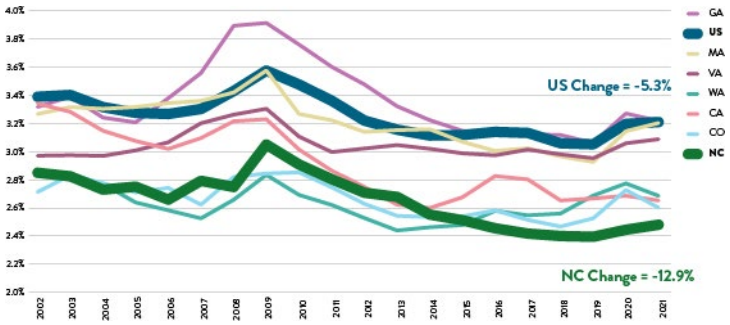
In terms of appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP, North Carolina ranks 5th in the nation, with a level that is 75 percent greater than the U.S. average and 90 percent of the value of the state with the highest value, Hawaii **[6.1C]**. North Carolina ranks well above all of the comparison states, of which three—California, Virginia, and Georgia—have percentages above the U.S. average. Each of the three other comparison states—Washington, Massachusetts, and Colorado—has a percentage below the U.S. average. From 2001 to 2022, North Carolina's appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP decreased by 19.0 percent, which is smaller than the 32.0 percent decrease for the U.S. overall **[6.1D]**. Over this same period, each of the comparison states had a decrease in the percentage of its GDP appropriated for operating expenses of higher education (an average of 31 percent), and all were larger decreases than the decrease in North Carolina.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

In general, North Carolina's public investment in education correlates highly with its performance in the other education-related indicators tracked in this report. Specifically, given the state's low ranking on elementary and secondary public school current expenditures as a percentage of state GDP, it isn't surprising that the state ranks below the national average on eight grade math and science proficiency.[4] Conversely, given the state's near-top ranking on appropriations of state tax funds for operating expenses of higher education as a percentage of state GDP, it isn't surprising that the state ranks similarly high in terms of academic science & engineering (S&E) research and development as a percentage of State GDP (see indicator 2.3) and science, engineering & technology degrees as percentage of total higher education degrees conferred (see indicator 5.5).

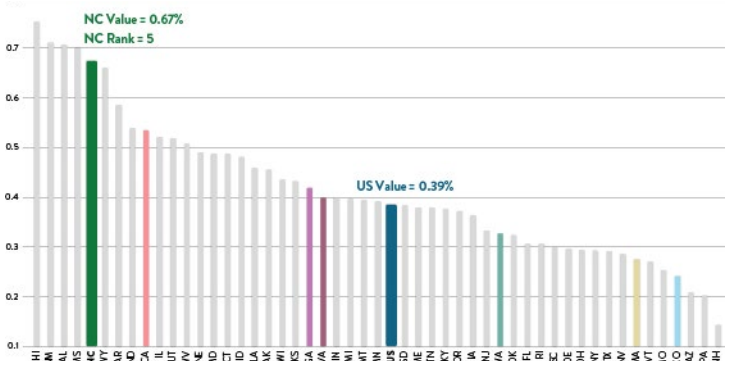
North Carolina's ability to compete in a knowledge- and innovation-driven economy depends critically on the education and training of its workforce at all levels. Given the link between investment in education and related measures of success in education, it is clear that North Carolina should continue its strong levels of investment in higher education and significantly increase its levels of investment in elementary and secondary education.

6.1B *Elementary and Secondary Public School Current Expenditures as a Percentage of State GDP, Comparison States, 2002-2021*



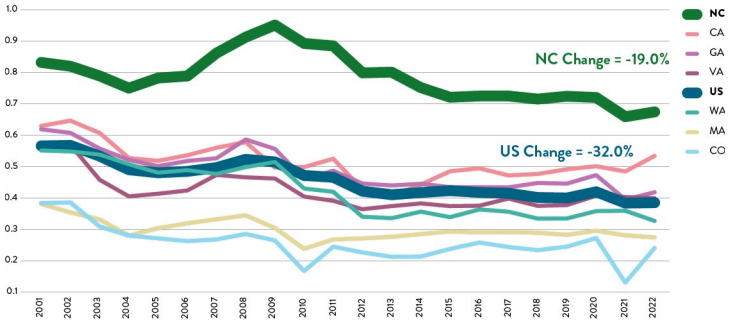
Sources: U.S Census Annual Survey of School System Finances and U.S. Bureau of Economic Analysis.

6.1C *Appropriations of State Tax Funds for Operating Expenses of Higher Education as a Percentage of State GDP, All U.S. States, 2022*



Source: U.S. Bureau of Economic Analysis, U.S. Census Bureau.

6.1D *Appropriations of State Tax Funds for Operating Expenses of Higher Education as a Percentage of State GDP, Comparison States, 2001-2022*



Source: U.S. Census Bureau.

[4] For more information, see: National Science Board. 2024. Science & Engineering State Indicators, https://ncses.nsf.gov/indicators/states/indicators. North Carolina has similar low rankings on other measures of educational achievement not tracked in this report, such as individuals with high school or higher level degree among 25–44-year-old population.

INDICATOR 6.2: BROADBAND

KEY FINDINGS

- North Carolina's percentage of homes with an internet-accessible device ranks similar to but slightly lower than the U.S. average, has since at least 2015, and is increasing at a rate slightly faster than the rate for the U.S. overall.
- North Carolina's percentage of homes with a broadband subscription ranks similar to but slightly lower than the U.S. average, has since at least 2015, and is increasing at a rate slightly faster than the rate for the U.S. overall.
- Across North Carolina, internet access rates vary considerably by county, with more prosperous counties generally having the highest rates.
- The level of digital divide (the difference in access to technology, the internet, and digital literacy training) varies considerably across North Carolina counties, with more prosperous and urban counties having a lower divide.

OVERVIEW

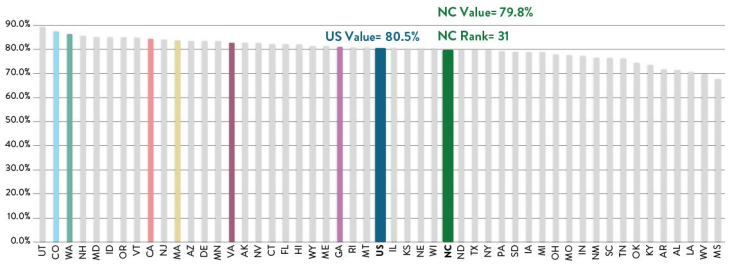
The term "broadband" refers to a range of technologies (e.g., fiber, coax cable, copper, and wireless technologies) that allow for higher capacity and faster data transmission with the Internet. Broadband is a platform for innovation, in that using broadband technologies can foster and enable innovation in all sectors by increasing business productivity, improving health care and education, and enabling the creation and use of new technologies.

Broadband is examined here at the state level in two ways: (1) internet-accessible device rate and (2) household subscription rates. Internet-accessible device rate is the percentage of homes with a device that can connect to the internet and perform necessary functions for work or educational needs.[1] The broadband subscription rate measures the demand for broadband by calculating the number of households with broadband subscriptions divided by the number of homes.[2] Fixed broadband is defined by the Federal Communication Commission (FCC) as 25 Mbps (download)/3 Mbps (upload) over the time period for which data are reported here.[3]

HOW DOES NORTH CAROLINA PERFORM?[4]

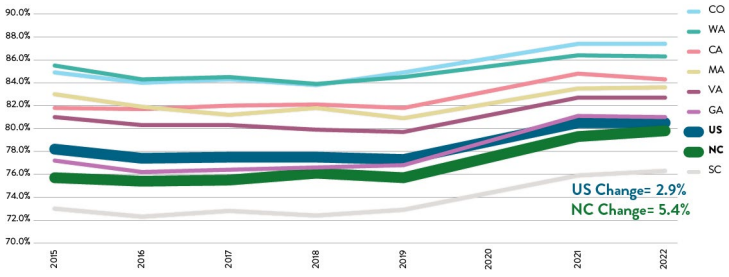
North Carolina's internet-accessible device rate (79.8 percent) ranks 31st in the nation, which is similar to the U.S. average of 80.5 percent and 90 percent of the rate of the top–ranking state, Utah **[6.2A]**. Among the comparison states, North Carolina's rank is ahead of only South Carolina, but it has a higher rate of improvement than any of the comparison states since 2015 **[6.2B]**.

6.2A *Percentage of Homes with an Internet-Accessible Device, All U.S. States, 2022*



Source: U.S. Census Bureau.

6.2B *Percentage of Homes with an Internet-Accessible Device, Comparison States, 2015-2022*



Source: U.S. Census Bureau.

[1] This excludes smart phones and tablets, which are not considered sufficient to perform necessary functions for work or educational needs.

[2] This measure is slightly different than the measure used to gauge demand for broadband in *Tracking Innovation 2021* (broadband adoption rate), which was calculated as the number of households with internet subscriptions divided by the total number of households/populations with broadband availability.

[3] Beginning in 2024, the new definition is 100 Mbps (download)/20 Mbps (upload).

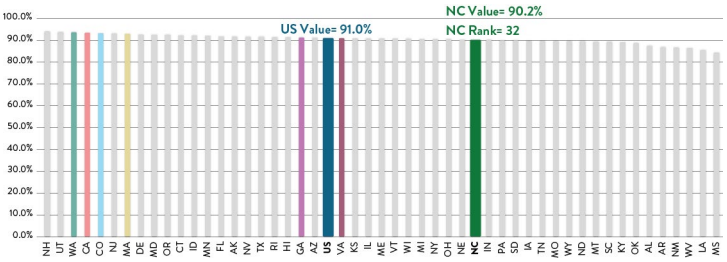
[4] Over-time data are not available prior to 2015 due to definition and methodological changes for data collection.

INDICATOR 6.2: BROADBAND

Broadband subscription rates give a clear picture of the number of households with service to their homes. North Carolina's subscription rate (90.2 percent) is just below the U.S. average of 91.0 percent **[6.2C]**. North Carolina ranks 32nd nationally and is notably behind the top-ranking state of New Hampshire, which has an adoption rate of 93.9 percent. North Carolina also ranks lower than all comparison states except for South Carolina but is growing faster than all comparison states except South Carolina **[6.2D]**.

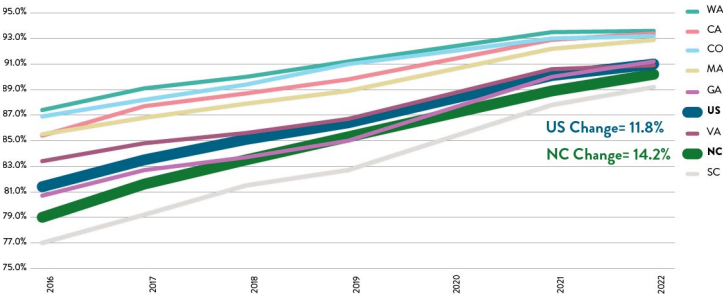
Within North Carolina, during the 2017-2021 time period the percent of homes with any internet access varied considerably, with 17 counties having higher than the U.S. average (89.7 percent), 54 counties having between 89.3 and 80 percent, 24 counties between 79.7 and 72.5 percent, and 5 counties under 70.0 percent. **[6.2E]**. In general, more prosperous counties have higher broadband subscription rates.

6.2C *Percentage of Homes with a Broadband Subscription, All U.S. States, 2022*



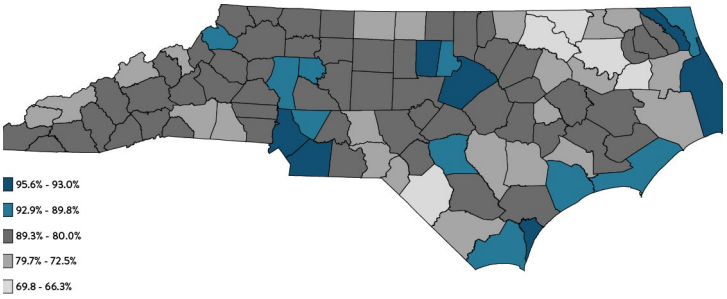
Source: U.S. Census Bureau.

6.2D *Percentage of Homes with a Broadband Subscription, Comparison States, 2015-2022*



Source: U.S. Census Bureau.

6.2E *Percent of Homes with Internet Access, 2017-2021, 5 Year Average*



Source: U.S. Census Bureau.

Note: Blue counties rank above the U.S. average.

[5] Many states share the same subscription rate and thus are "tied."

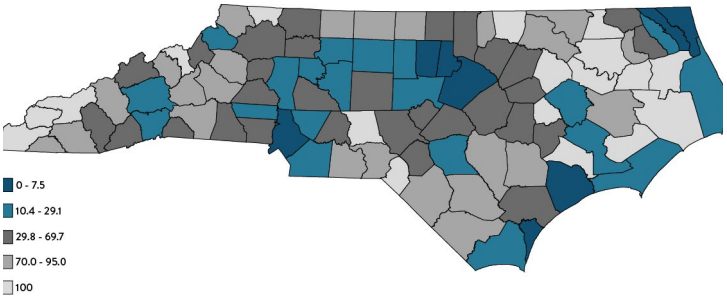
These previously mentioned metrics and others all go into determining what the North Carolina Department of Information Technology (NCDIT) calls the "digital divide," described as "the gap between those who have access to technology, the internet, and digital literacy training and those who do not."[6] Limited access to digital skills, tools, and technologies causes inequitable opportunities for those not in areas with substantial infrastructure or a focus on innovation. The digital divide in North Carolina resembles the broadband subscription rates but can be heightened by availability, cost, lack of digital skills, and devices. According to the Digital Divide Index, which includes 10 variables related to the digital divide, including infrastructure, devices, and demographic characteristics, in 2017-2021, 28 North Carolina counties had a percentage of homes in a high digital divide tract lower than (i.e., better than) the U.S. average percentage (29.6),[7] 30 counties had between 29.9 and 69.7 percent of homes in a high digital divide tract, 34 counties had between 70 and 95 percent of homes in a high digital divide tract, and 18 counties had 100 percent of homes in high digital divide tract **[6.2F]**.[8]

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

Subscription rates show that much of North Carolina has access to basic broadband. However, roughly 419,000 North Carolinian households continue to lack service, and 328,000 households lack a home desktop or laptop computer —a large majority of which live in the state's rural areas. These sparsely populated areas generally lack a traditional business case for private sector providers to serve them, and as the last unserved areas in the state, are the hardest and most expensive to serve. Moreover, as speeds increase, availability of broadband drops, which can hinder innovation as data trends suggest the need and demand for faster broadband speeds is growing and will continue to increase.

For these reasons, the Division of Broadband and Digital Equity in the Department of Information and Technology seeks to accomplish its vision that every North Carolinian should be able to access affordable high-speed internet anywhere, at any time. The division works to achieve this vision through the design of programs, policies and tools all aimed to close the digital divide in North Carolina.

6.2F ***Digital Divide Index (Percent Households in a High Digital Divide Tract), 2017-2021, 5 Year Average***



Source: Source: Division of Broadband Digital Equity, North Carolina Department of Information Technology
Note: Blue counties rank better than the U.S. average.

The chief obstacles to effectively harnessing broadband's power as an innovation enabler are the remaining unserved households throughout the state, the state's low adoption rate, and the ever-increasing need for higher speeds. Broadband adoption is a complex challenge, with many factors impacting the subscription of wired broadband at home, such as the cost of the service and the device, literacy and digital literacy, availability of other public internet access (such as libraries), and relevancy. But through North Carolina's strong sector broadband providers and the State's dedication to broadband expansion, North Carolina is well positioned to remain innovative in expanding broadband availability and use. [10]

[6] For more information, see https://www.ncbroadband.gov/digital-divide/what-digital-divide.

[7] Percentages lower than the U.S. average percentage are better. This digital divide scale is relative, so that counties can be compared, but does not mean that a score of 0 indicates no digital divide. Data provided by the North Carolina Division of Broadband and Digital Equity and can be found at https://www.ncbroadband.gov/digitalequity. Information about the Digital Divide Index from Purdue can be found at: https://storymaps.arcgis.com/stories/8ad45c48ba5c43d8ad36240ff0ea0dc7.

[8] For other data related to internet adoption and the digital divide, see https://www.ncbroadband.gov/data-reports.

[9] 2021 American Community Survey (ACS) Microdata.

[10] North Carolina's Broadband Equity, Access, and Deployment (BEAD) Five-Year Plan seeks to achieve reliable, affordable universal access to broadband and to significantly increase adoption rates by dedicating nearly $1 billion in federal American Rescue Plan Act (ARPA) funds and more than $1.5 billion in Infrastructure Investment and Jobs Act BEAD program funds to achieve the following goals: (1) Investing $971 million to build critical infrastructure to deliver internet speeds of 100/20 Mbps to 98% of unserved households with the ability to handle future speeds of 100/100 Mbps; (2) investing BEAD funding to build infrastructure to deliver internet speeds of 100/20 Mbps to the remaining unserved households and 100% of all underserved households, locations in high-cost areas, and community anchor institutions; (3) investing $50 million to create awareness and support digital literacy and skills training to enable the state's workforce to participate in the digital economy; (4) deploying Digital Equity Act funding to increase high-speed internet adoption.

INDICATOR 6.3: COST OF LIVING INDEX

KEY FINDINGS

- North Carolina's Cost of Living Index is below the U.S. average.
- Within North Carolina, the cost of living varies, but only moderately compared to variations nationwide. Forty-eight North Carolina counties have a Cost of Living Index plus or minus five percent different from the U.S. average, two are more than five percent higher, and the remaining 50 are more than five percent below the U.S. average.

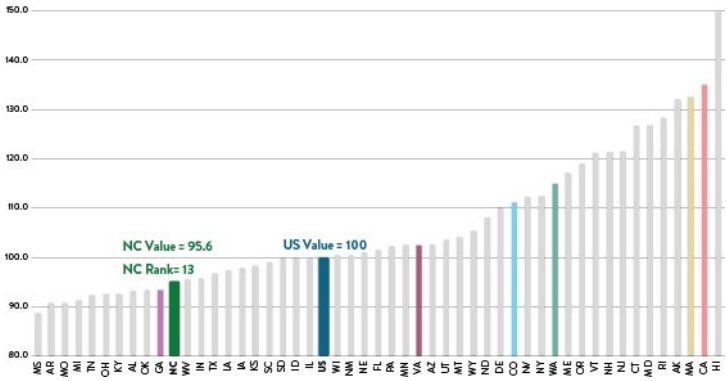
OVERVIEW

This indicator is a price index that compares cost of living differences among urban areas based on the price of consumer goods and services. Specifically, it uses the Cost of Living Index produced quarterly by the Council for Community and Economic Research (C2ER).[1] The Cost of Living Index assumes that prices collected at a specified time, in strict conformance with standard specifications, provide a sound basis for constructing a reasonably accurate gauge of relative differences in the cost of consumer goods and services. The average for all participating areas, both metropolitan and nonmetropolitan, equals 100, and each participant's index is read as a percentage of the average for all areas combined, i.e., the U.S average.[2] Assessments of quality of life, of which cost of living is a major component, influence states' and regions' ability to attract and retain talented people. A reasonable and affordable cost of living can attract people to an area, thus facilitating businesses' ability to fill open positions and fuel expansion in the area.[3]

HOW DOES NORTH CAROLINA PERFORM?

In terms of the Cost of Living Index, North Carolina ranks 13th in the nation, with a level that is 95.2 percent of the U.S. average value and 108 percent of the value of the state with the lowest Cost of Living Index value, Mississippi **[6.3A]**. Among the comparison states, only Georgia has a Cost of Living Index lower than North Carolina, and they are the only two comparison states to have values lower than the U.S. average. The Cost of Living Index value for Virginia is slightly above the U.S. average, while the values for California, Massachusetts, Washington, and Colorado are considerably above the U.S. average and among the top-16 most expensive states, with Colorado ranking 16th.

6.3A *Cost of Living Index, All U.S. States, 2023*



Source: Council for Community and Economic Research (C2ER)

[1] For more detail on the Cost of Living Index and C2ER, see https://www.coli.org/. In general, the Cost of Living Index is intended to measure differences among urban areas; however, C2ER has developed a county-level Cost of Living Index based on an econometric model that identifies key determinants of an area's cost of living. Data using that model appear in map 6.3B.

[2] For example, if City A has an index of 98.3, the cost of living in that city is approximately 1.7 percent less than the U.S. average cost of living. If City B has a composite index of 128.5, the cost of living in that city is approximately 28.5 percent higher than the U.S. average. Thus, if a worker lives in City A and is contemplating a job offer in City B, that worker would need a 30.72 percent increase in after-tax income to remain at his/her City A lifestyle once moving to City B (30.72% = 100*[(128.5 - 98.3)/98.3]). Conversely, if the same worker were considering a move from City B to City A, that worker could sustain a 23.5 percent decrease in after-tax income without reducing his/her lifestyle (23.5% = 100*[(98.3 – 128.5)/128.5]).

[3] For the purposes of this report, a Cost of Living Index slightly above or slightly below the U.S. average is advantageous, as it indicates that an area's cost of living is reasonably affordable, but not so extreme as to suggest that the area is excessively expensive (in the case of a high index value) or has low-quality infrastructure, amenities, goods, and services (in the case of a low index value).

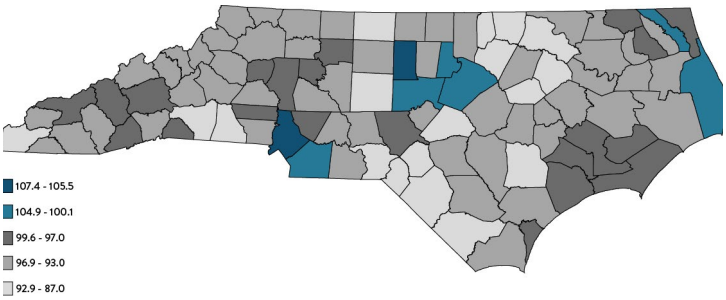
INDICATOR 6.3: COST OF LIVING INDEX

Within North Carolina, the Cost of Living index varies by county, but only moderately when compared to the variance across all counties nationwide **[6.3B]**. The NC county indexes range from a high of 107.4 (Orange County) to a low of 87.0 (Robeson County). In 2023, county values nationwide ranged widely from as high as 283.9 in New York County, New York to as low as 79.0 in Oglala Lakota County, South Dakota.[4] In total, eight (Orange, Mecklenburg, Wake, Chatham, Dare, Union, Durham, and Carteret) of North Carolina's 100 counties have a cost of living higher than the U.S. average, whereas another 42 have a cost of living slightly lower than the U.S. average. The 50 remaining North Carolina counties have a cost of living that is more than five percent lower than the U.S. average.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

In general, independent of other factors, an affordable, close-to-average cost of living is an advantage for a state or region. A cost of living that is notably higher than the U.S. average could be unattractive to both employers and employees, as costs for employers could be excessive, and workers may prefer to live in lower-cost areas. Alternatively, a cost of living that is notably lower than the U.S. average could also be unattractive to both employers and employees, potentially indicating the area has fewer amenities and infrastructure. On average, North Carolina's cost of living is neither excessively high nor overly low. In general, counties with a cost of living slightly above or slightly below the U.S. average are more likely to be the targets for, and sources of, innovative activity, as they are relatively affordable and more likely to possess a good mix of infrastructure, amenities, goods, and services. Those counties with a cost of living that is notably lower than the U.S. average, while more affordable, may have a less suitable mix of infrastructure, amenities, goods, and services. To the extent that is the case, efforts may be needed to increase those factors in order to increase the innovative activity and economic growth of those areas.

6.3B ***Cost of Living Index, N.C. Counties, 2023***



Source: Council for Community and Economic Research.
Blue counties rank above the U.S. average.

[4] The standard deviation of the 2023 Cost of Living Index across all U.S counties is 11.74, and approximately 84% of all U.S. counties fall within one standard deviation from the mean (mean = 100.0). Only one NC county (Robeson County) falls outside of the standard deviation, suggesting its cost living is notably different from the U.S. average.

INDICATOR 6.4: INDUSTRY MIX

KEY FINDINGS

- North Carolina's sector and industry mix positions the state, overall, to be an innovation leader in only a small number of sectors and industries.
- A large portion of the state's sectors and employment is not knowledge- and technology- intensive (KTI) in nature and, therefore, is less likely to produce the types of innovations that drive growth, employment, and higher wages in the economy.
- Among the small number of sectors that are KTI, virtually all have wages well above the U.S. average for all sectors. Slightly less than half are increasing in employment, but overall KTI employment as a percentage of total employment is increasing.
- North Carolina's manufacturing GDP as a percentage of state GDP ranks above the U.S. average, has since at least the early 2000s, and is decreasing at a rate slightly faster than the U.S. average.

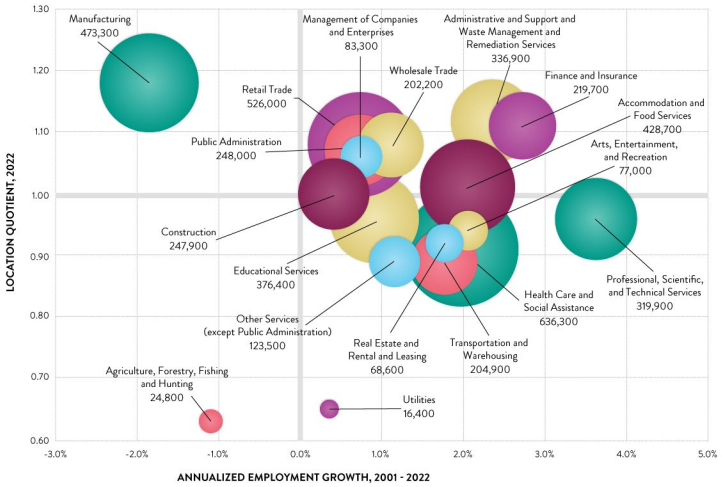
OVERVIEW

This indicator measures North Carolina's industry mix (i.e., the basic industry composition and patterns of North Carolina's economy) in three ways. Industry mix is measured first by detailing—for each major economic sector—four factors:[1] the level of employment, employment change (2001-2022), relative concentration (see Methodological Note on the last page of this indicator), and average wage. The second measure details—for knowledge- and technology- intensive (KTI) employment industries only, which are 75 percent manufacturing based[2]—the same four factors. The third measures manufacturing GDP as a percentage of state GDP. Together, these measures provide useful context for interpreting and explaining many of the other indicators in this report, particularly the ones focused on industry activity (e.g., 2.2 - Industry R&D and Innovative Organizations in Section 4) and Employment (e.g., Workforce in Section 5).[3]

HOW DOES NORTH CAROLINA PERFORM?[4]

In terms of major economic sectors, half of North Carolina's employment is in five major economic sectors—Health Care and Social Assistance (13.5 percent), Retail Trade (11.2 percent), Manufacturing (10.1 percent), Accommodation and Food Services (9.1 percent), and Educational Services (8.0 percent) **[6.4A , 6.4B]**.[5]

6.4A ***Industry Employment, Annualized Employment Growth, and Concentration, All Sectors, N.C., 2022***



Source: Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics (BLS).

Note: Employment numbers rounded to the nearest hundreds; excludes NAICS codes 99 (Unclassified Industry) and 21 (Mining, Quarrying, & Oil & Gas Extraction).

[1] Economic sectors are defined by 2-digit North American Industry Classification System (NAICS) codes. NAICS is the standard used by federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS is a 2- through 6-digit hierarchical classification system, offering five levels of detail. Each digit in the code is part of a series of progressively narrower categories, and more digits in the code signify greater classification detail. The first two digits designate the economic sector, the third digit designates the subsector, the fourth digit designates the industry group, the fifth digit designates the NAICS industry, and the sixth digit designates the national industry. For more information about NAICS codes, see www.census.gov/naics/.

[2] The data pertaining to establishments are based on their classification according to the 2012 edition of the North American Industry Classification System (NAICS). See Appendix A for a list of the 41 industries (by NAICS code) that are defined having knowledge- and technology- intensive (KTI) employment. These 41 codes are divided into nine manufacturing industries and three service industries. Also see the Source information for indicator 6.4 at the end of this report for more description of the data used for this particular indicator.

[3] This indicator does not present a "cluster" analysis. A cluster is a group of businesses and industries that are related through presence in a common product chain, dependence on similar labor skills, or utilization of similar or complementary.

[4] The measures reported here are for the state overall, not just the small number of much-acclaimed, very well-performing regions such as the Research Triangle and Charlotte.

[5] The data in table 6.4B are the source for the graphics in chart 6.4A, which simply provides a summary-level pictorial representation of the data, from which it is easier to discern patterns.

6.4B *Sector Employment, Annualized Employment Growth, Concentration (Location Quotient), and Average Wage, All Sectors, N.C.*

2-DIGIT NAICS CODE	SECTOR	EMPLOYMENT					
		Total 2022 *(rounded)*	Share of Total 2022	Cumulative Share of Total 2022	Annualized Growth Rate *(Compound Annual Growth Rate)* 2001-2022	Location Quotient 2022	2022 Average Earnings *(rounded)*
62	Health Care and Social Assistance	636,300	13.5%	13.5%	2.0%	0.91	$62,700
44-45	Retail Trade	526,000	11.2%	24.7%	0.7%	1.08	$37,700
31-33	Manufacturing	473,300	10.1%	34.8%	-1.9%	1.18	$68,000
72	Accommodation and Food Services	428,700	9.1%	43.9%	2.0%	1.01	$23,500
61	Educational Services	376,400	8.0%	51.9%	0.9%	0.96	$56,800
56	Administrative and Support and Waste Management and Remediation Services	336,900	7.2%	59.1%	2.3%	1.12	$51,100
54	Professional, Scientific, and Technical Services	319,900	6.8%	65.9%	3.6%	0.96	$101,200
92	Public Administration	248,000	5.3%	71.2%	0.7%	1.07	$59,200
23	Construction	247,900	5.3%	76.5%	0.4%	1.00	$66,200
52	Finance and Insurance	219,700	4.7%	81.1%	2.7%	1.11	$120,700
48-49	Transportation and Warehousing	204,900	4.4%	85.5%	1.7%	0.89	$55,600
42	Wholesale Trade	202,200	4.3%	89.8%	1.1%	1.08	$91,600
81	Other Services (except Public Administration)	123,500	2.6%	92.4%	1.1%	0.89	$44,700
55	Management of Companies and Enterprises	83,300	1.8%	94.2%	0.7%	1.06	$136,700
51	Information	82,600	1.8%	96.0%	22.1%	0.83	$109,600
71	Arts, Entertainment, and Recreation	77,000	1.6%	97.6%	2.0%	0.94	$39,600
53	Real Estate and Rental and Leasing	68,600	1.5%	99.1%	1.8%	0.92	$65,500
11	Agriculture, Forestry, Fishing and Hunting	24,800	0.5%	99.6%	-1.1%	0.63	$45,100
22	Utilities	16,400	0.3%	99.9%	0.3%	0.65	$104,600
21	Mining, Quarrying, and Oil and Gas Extraction	3,100	0.1%	100.0%	-1.4%	0.18	$86,700
	Total	**4,699,600**	**100.0%**		**2.1%**		**$71,300**

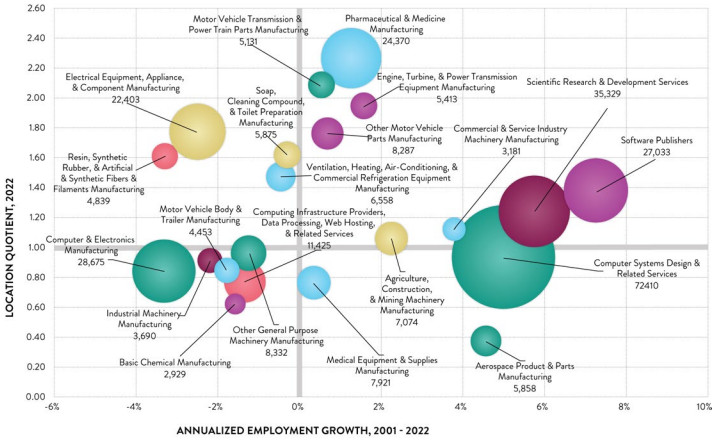
Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics (BLS).

Note: Excludes NAICS code 99 (Unclassified Sector); Average Wage, and Employment numbers rounded to the nearest hundreds. Sectors sorted in descending order by employment.

Of these, three—Health Care and Social Assistance, Manufacturing, and Educational Services—have wages above the North Carolina average, $63,218 (see indicator 1.3),[6] and only Manufacturing has a substantial share of KTI employment industries and employment **[6.4C , 6.4D]**.[7] The next four sectors—Administrative and Support and Waste Management and Remediation (7.2 percent), Professional, Scientific, and Technical Services (6.8 percent), Public Administration (5.3 percent), and Construction (5.3 percent)—together account for another almost one quarter of all of North Carolina's employment. Of these, Professional, Scientific, and Technical Services, Public Administration, and Construction have above-NC average wages, and Professional, Scientific, and Technical Services has a substantial share of KTI employment industries and employment. The remaining 25 percent of North Carolina's employment is spread across 11 additional sectors, of which only a small minority consists of KTI employment industries. **A key point worth noting is that the average wages ($56,784) of the nine sectors comprising approximately three-fourths of North Carolina's employment are lower than the average wages ($84,115) of the 11 sectors comprising approximately one-fourth of North Carolina's employment. In order to increase North Carolina's average wage, it is necessary to start, grow, and attract companies in these higher-wage sectors and train the workforce for them.**

In terms of the sectors' relative concentration, as measured by location quotients, there are three sectors in which North Carolina has a larger share of activity sector than we would expect based on national trends[8]—Manufacturing, Administrative and Support and Waste Management Remediation Services, and Finance and Insurance. While Manufacturing and Finance and Insurance have wages above the state average, only Manufacturing has a substantial share of KTI employment industries. The Manufacturing sector has decreased, whereas Waste Management Remediation Services, and Finance and Insurance have grown in employment over time. Of the sectors in which North Carolina has a smaller share of activity than we would expect based on national trends, there is one that has above-average wages and a substantial share of KTI employment—Information. This sector contains industries that account for 8.5 percent of KTI industry employment in North Carolina and has grown over time (1.1 percent AGR).

6.4C ***Industry Employment, Annualized Employment Growth, and Concentration, KTI Employment Industries, N.C., 2022***



Source: Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics (BLS).

Note: Employment numbers rounded.

In terms of KTI employment industries, the top two subsectors comprise one third (33.9 percent) of North Carolina's KTI employment—Computer Systems Design and Related Services (22.8 percent) and Scientific Research and Development Services (11.1%) **[6.4C, 6.4D]**.[9] In the first subsector—Computer System Designs and Related Services—North Carolina has a slightly smaller share of activity than we would expect based on national trends (location quotient = .93). In the second subsector—Scientific Research and Development Services—North Carolina has a larger share of activity than we would expect based on national trends (location quotient = 1.24). Each subsector is growing in employment and has average wages well above the U.S. average wage for all industries, $69,986 (see indicator 1.3).

[6] "Wage" includes wages, salaries, commissions, tips, overtime pay, hazard pay, bonuses, stock options, and severance pay. It does not include supplements, such as employer contributions to 401(k) plans, pensions, insurance funds, and government social insurance (FIA/FUTA). The 2022 average wage in North Carolina is $63,218 (see indicator 1.3).

[7] Each sector consists of a large number of subsectors and an even larger number of industries, of which only a minority (41) is classified as having knowledge- and technology- intensive employment (KTI). See Appendix A for a list of the 41 industries.

[8] For the purposes of this report, location quotients of at least 1.1 designate industries in which North Carolina has a larger share of activity sector than we would expect based on national trends. See Methodological Note below for more detail.

[9] Employment numbers, location quotients, and average wages are reported only for those industry that are identified as a KTI employment industry.

6.4D *Employment and Wages in KTI Employment Industries, N.C.*

NAICS CODE	KTI INDUSTRY	EMPLOYMENT					
		Total 2022	Share of Total 2022	Cumulative Share of Total 2022	Annualized Growth Rate *(Compound Annual Growth Rate)* 2001-2022	Location Quotient 2022	Average Earnings 2022
5415	Computer Systems Design and Related Services	72,410	22.8%	22.8%	5.0%	0.93	$124,870
5417	Scientific Research and Development Services	35,329	11.1%	33.9%	5.8%	1.24	$136,082
334	Computer and Electronics Manufacturing	28,675	9.0%	42.9%	-3.3%	0.84	$129,833
5132	Software Publishers	27,033	8.5%	51.4%	7.3%	1.37	$146,026
3254	Pharmaceutical and Medicine Manufacturing	24,370	7.7%	59.0%	1.2%	2.26	$108,330
335	Electrical Equipment, Appliance, and Component Manufacturing	22,403	7.0%	66.1%	-2.5%	1.77	$72,468
518	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services	11,425	3.6%	69.7%	-1.3%	0.77	$124,299
3339	Other General Purpose Machinery Manufacturing	8,332	2.6%	72.3%	-1.2%	0.96	$76,625
33639	Other Motor Vehicle Parts Manufacturing	8,287	2.6%	74.9%	0.7%	1.76	$60,417
3391	Medical Equipment and Supplies Manufacturing	7,921	2.5%	77.4%	0.3%	0.76	$68,877
3331	Agriculture, Construction, and Mining Machinery Manufacturing	7,074	2.2%	79.6%	2.3%	1.07	$69,837
3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	6,558	2.1%	81.7%	-0.4%	1.47	$69,967
3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	5,875	1.8%	83.5%	-0.3%	1.61	$69,635
3364	Aerospace Product and Parts Manufacturing	5,858	1.8%	85.3%	4.6%	0.37	$100,186
3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	5,413	1.7%	87.1%	1.6%	1.94	$87,923
33635	Motor Vehicle Transmission and Power Train Parts Manufacturing	5,131	1.6%	88.7%	0.5%	2.08	$63,310
3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing	4,839	1.5%	90.2%	-3.3%	1.61	$114,359
3362	Motor Vehicle Body and Trailer Manufacturing	4,453	1.4%	91.6%	-1.8%	0.84	$60,128
3332	Industrial Machinery Manufacturing	3,690	1.2%	92.7%	-2.2%	0.91	$68,378

Source: QCEW Employees, Non-QCEW Employees, Self-Employed & Extended Proprietors - EMSI 2021.3 Class of Worker

Note: Average Wage and Employment numbers rounded to the nearest hundreds. Sorted in descending order by number of employees.

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6.4D *Employment and Wages in KTI Industries, N.C. CONTINUED*

NAICS CODE	KTI INDUSTRY	EMPLOYMENT					
		Total 2022	Share of Total 2022	Cumulative Share of Total 2022	Annualized Growth Rate *(Compound Annual Growth Rate)* 2001-2022	Location Quotient 2022	Average Earnings 2022
333310	Commercial and Service Industry Machinery Manufacturing	3,181	1.0%	93.7%	3.8%	1.12	$69,953
3251	Basic Chemical Manufacturing	2,929	0.9%	94.7%	-1.6%	0.62	$93,483
3255	Paint, Coating, and Adhesive Manufacturing	2,503	0.8%	95.5%	0.7%	1.2	$69,075
3259	Other Chemical Product and Preparation Manufacturing	2,465	0.8%	96.2%	-2.2%	0.96	$73,971
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	2,253	0.7%	96.9%	-1.8%	1.92	$124,086
519	Web Search Portals, Libraries, Archives, and Other Information Services	2,217	0.7%	97.6%	1.0%	0.23	$140,184
332913	Plumbing Fixture Fitting and Trim Manufacturing	1,226	0.4%	98.0%	N/A	3.31	$54,164
33631	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing	1,096	0.3%	98.4%	-2.0%	0.62	$58,159
33634	Motor Vehicle Brake System Manufacturing	1,073	0.3%	98.7%	2.3%	1.64	$60,799
333515	Cutting Tool and Machine Tool Accessory Manufacturing	990	0.3%	99.0%	0.8%	1.52	$59,997
333517	Machine Tool Manufacturing	892	0.3%	99.3%	-0.9%	0.68	$79,204
3369	Other Transportation Equipment Manufacturing	769	0.2%	99.5%	N/A	0.61	$66,547
333514	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	675	0.2%	99.7%	7.1%	0.4	$54,353
33632	Motor Vehicle Electrical and Electronic Equipment Manufacturing	276	0.1%	99.8%	-5.6%	0.15	$57,028
33633	Motor Vehicle Steering and Suspension Components (except spring) Manufacturing	246	0.1%	99.9%	-5.5%	0.24	$49,024
33636	Motor Vehicle Seating and Interior Trim Manufacturing	223	0.1%	100.0%	-7.3%	0.1	$49,741
333519	Rolling Mill and Other Metalworking Machinery Manufacturing	75	0.0%	100.0%	N/A	0.2	$59,451
3361	Motor Vehicle Manufacturing	-	0.0%	100.0%	-100.0%	0	$0
3365	Railroad Rolling Stock Manufacturing	-	0.0%	100.0%	N/A	0	$0
332991	Ball and Roller Bearing Manufacturing	-	0.0%	100.0%	-100.0%	0	$0
	Total	**318,165**	**100.00%**				**$82,521**

Source: QCEW Employees, Non-QCEW Employees, Self-Employed & Extended Proprietors - EMSI 2021.3 Class of Worker

Note: Average Wage and Employment numbers rounded to the nearest hundreds. Sorted in descending order by number of employees.

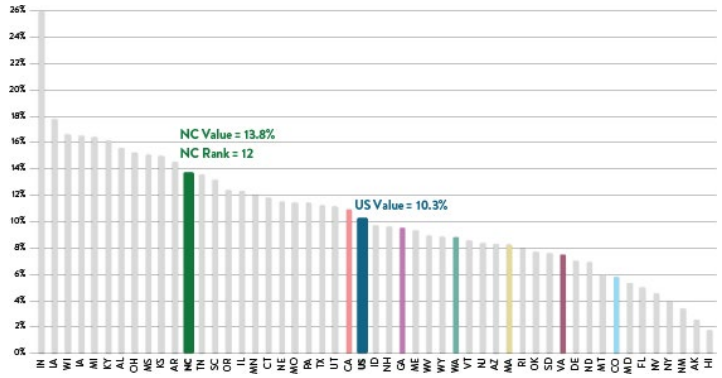
INDICATOR 6.4: INDUSTRY MIX

The next two subsectors together account for 17.5 percent of North Carolina's KTI employment—Computer and Electronics Manufacturing (9.0 percent) and Software Publishers (8.5 percent). North Carolina has a larger share of activity than we would expect based on national trends in the Software Publisher subsector (location quotient = 1.37), and slightly lower than expected in Computer and Electronic Products (location quotient = .84). Both have average wages well above the U.S. average wage for all industries, but employment levels are decreasing for Computer and Electronics Manufacturing. Together, these first four subsectors account for more than half (51.4 percent) of North Carolina's KTI industry employment, and three out of the four are growing in employment.[10]

Adding the next three subsectors brings the total to 69.7 percent of North Carolina's KTI industry employment—Pharmaceutical and Medicine Manufacturing (7.7 percent), Electrical Equipment Appliance and Component Manufacturing (7.0 percent), and Computing Infrastructure Providers Data Processing Web Hosting and Related Services (3.6 percent). North Carolina's share of activity for two subsectors—Pharmaceuticals and Electrical Equipment, is more concentrated than what we would expect based on national patterns (location quotients = 2.26 and 1.77, respectively). Additionally, their average wages are well above the U.S. average wage for all industries, $69,986 (see indicator 1.3). Employment in Electrical Equipment and Computing Infrastructures has decreased over time, while Pharmaceuticals has increased. The 31 remaining subsectors together account for 30.3 percent of North Carolina's KTI industry employment, with three subsectors not having data reported for the 2022 time period.[11]

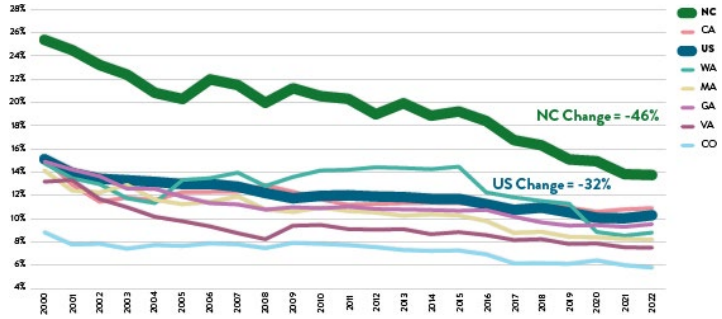
In terms of manufacturing GDP as a percentage of state GDP, North Carolina ranks 12th in the nation, with a level that is 134 percent of the U.S. average value and 53 percent of the value of the state with the highest value, Indiana **[6.4E]**. North Carolina ranks well ahead of all the comparison states, and California is the only other comparison state that has a value above the U.S. average. From 2000 to 2022, the percentage of North Carolina's GDP accounted for by manufacturing decreased significantly, by 46 percent, which is greater than the decrease for the U.S. overall, 32 percent and the most out of the comparison states. California is the only comparison state to have a decrease in the manufacturing percentage of GDP be lower than the U.S. average. **[6.4F]**.

6.4E *Manufacturing GDP as Percentage of State GDP, All U.S. States, 2022*



Source: U.S. Bureau of Economic Analysis

6.4F *Manufacturing Percentage of State GDP, Comparison States, 2000-2022*



Source: U.S. Bureau of Economic Analysis

[10] Although North Carolina is well known for having a strong financial services and banking sector, major portions of those sectors do not appear here because this analysis includes only the portions defined as having KTI employment. Additionally, a considerable portion of those jobs are classified in other sectors, such as Management of Companies and Enterprises, which does appear here and in which North Carolina performs well.

[11] The Bureau of Labor Statistics suppressed data for these three subsectors (motor vehicle manufacturing, railroad rolling stock manufacturing, and ball and roller bearing manufacturing) for North Carolina for the 2022 time period. Historical data exist for these three subsectors for North Carolina. Data may be suppressed to protect the identity, or identifiable information, of cooperating employers. Most of the suppressed data are often provided by or are substantially attributable to a single large employer. Suppressions may also be necessary for otherwise disclosable data that may be used to derive sensitive information from another industry or area.

WHAT DOES THIS MEAN FOR NORTH CAROLINA?

North Carolina's industry mix positions the state, overall, to be an innovation leader in only a small number of sectors and industries. Specifically, as summarized in indicators 4.1 (KTI Employment Establishments) and 4.2 (Employment in KTI Establishments) and illustrated in more detail here, a large portion of the state's industries and employment is not KTI in nature and, therefore, less likely to produce the types of innovations that drive growth, employment, and higher wages in the economy. Among the small number of sectors in the state that are defined as having KTI employment, however, nearly 2/3 have wages well above the state average for all sectors, and slightly less than half are increasing in employment.

While North Carolina has lost several manufacturing jobs since 2001, it is notable that most of those job losses have been in low-technology, low-skill industries, while productivity and job gains have been the case in KTI employment, high-skill industries. Overall in North Carolina, manufacturing wages are higher than the U.S. average, and for KTI employment manufacturing industries, the average wages are even higher. In general, manufacturing (particularly technology-based advanced manufacturing) remains the key source of U.S. traded-sector strength.[12] This is important because traded-sector establishments provide the economic foundation upon which the rest of the economy grows. Manufacturing jobs also have large employment multiplier effects (nationally, each manufacturing job supports as many as 2.9 other jobs in the rest of the economy).[13]

Within North Carolina, only 35 percent of the manufacturing jobs are currently in KTI employment industries.[14] Given the importance and impact of KTI manufacturing, and given that manufacturing establishments perform 59 percent of industry R&D (see indicator 2.2, Industry R&D), North Carolina should work to ensure that new KTI employment manufacturing industries are forming in or relocating to the state. North Carolina should also work to ensure that existing manufacturing industries are innovating and incorporating new technologies to increase their productivity. Similar efforts should also be devoted to KTI employment industries not in the manufacturing sector, such as Professional, Scientific, and Technical Services. Such efforts would expand innovation in North Carolina, thereby improving the economic well-being and quality of life of all its citizens.

METHODOLOGICAL NOTE

Relative concentration is measured using a simple descriptive measure called a location quotient. For a given industry, the location quotient is the ratio of the industry's share of employment in North Carolina to its share of employment in the U.S. as a whole. A location quotient equal to 1.0 indicates that the industry's share in North Carolina matches the comparable share for the U.S. as a whole. A location quotient significantly above 1.0 (i.e., more than 10 percent higher) signifies state specialization, i.e., the state has a larger share of activity (more concentration) in the industry than we would expect based on national trends. Conversely, a location quotient significantly below 1.0 (i.e., more than 10 percent lower) signifies state lack of specialization, i.e., the state has a smaller share of activity (less concentration) in the industry than we would expect based on national trends. The formula for computing a location quotient is as follows:

$$\frac{\text{EMPLOYMENT INDUSTRY i, NC}}{\text{(TOTAL EMPLOYMENT, NC)}} \div \frac{\text{EMPLOYMENT INDUSTRY i, US}}{\text{(TOTAL EMPLOYMENT, US)}}$$

[12] The traded sector comprises those industries and establishments that produce goods and services (e.g., electronics, management consulting, advertising) that have a high potential to be consumed outside the region of production. The non-traded sector comprises local-serving industries (e.g., construction, personal services, real estate).

[13] For more information, see Ezell, Stephen, and Robert D. Atkinson. 2011. The Case for a National Manufacturing Strategy. Information Technology and Innovation Foundation (www.itif.org/publications/case-nationalmanufacturing-strategy).

[14] This percentage results from dividing the number of KTI manufacturing jobs (i.e., those with 3 to 6-digit NAICS codes within the 2-digit range 31–33) in table 6.4D (169,751) by the total number of manufacturing jobs (473,254) in table 6.4B.

Section 7: Appendices, etc.

Appendix A

KTI EMPLOYMENT INDUSTRIES

To define knowledge-and technology-intensive (KTI) employment industries, this report uses the approach employed by the National Science Foundation (NSF) in its Science & Engineering Indicators report.[1] NSF's approach is based on the R&D intensity of an industry, which is determined by the ratio of the industry's R&D expenditures to its value-added output. This approach uses an Organization for Economic Co-operation and Development (OECD) taxonomy of economic activities based on research and development (R&D) intensity developed by Galindo-Rueda and Verger (2016).[2]

KTI employment occupations center around high and medium-high R&D intensity industries based on manufacturing and services occupations. These occupations employ workers who possess an in-depth knowledge of the theories and principles of science, engineering, and mathematics, which is generally acquired through postsecondary education in some field of technology. An industry is considered a KTI employment industry if R&D expenditures as a percent of Gross Value Added is five percent or higher based on OECD classification of three-digit International Standard Industrial Classification (ISIC) Rev.4 codes.

In this report, the category "KTI employment industries" refers only to private sector businesses. Each industry is defined by a three to six-digit code that is based on the North American Industry Classification System (NAICS). The NAICS classifications are periodically revised, thereby affecting the trend data presented in the tables. Relevant NAICS codes were used for the appropriate years of data presented (so in time-series analyses, multiple versions of the NAICS codes were used.) The list of KTI employment industries used in this report includes the 41 codes from the 2012 NAICS listing, as well as a crosswalk to codes from 2002, 2007, 2017, and 2022, as outlined below, for time-series charts.[3]

Figure 4 *NAICS Codes that Constitute KTI Employment Industries*

2002 NAICS	2007 NAICS	2012 NAICS (NSF Standard)	2017 NAICS	2022 NAICS	Industry
334	334	334	334	334	Computer and Electronic Product Manufacturing
335	335	335	335	335	Electrical Equipment, Appliance, and Component Manufacturing
518	518	518	518	518	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services
519	519	519	519	519	Web Search Portals, Libraries, Archives, and Other Information Services
3251	3251	3251	3251	3251	Basic Chemical Manufacturing
3252	3252	3252	3252	3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing
3253	3253	3253	3253	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
3254	3254	3254	3254	3254	Pharmaceutical and Medicine Manufacturing
3255	3255	3255	3255	3255	Paint, Coating, and Adhesive Manufacturing
3256	3256	3256	3256	3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing
3259	3259	3259	3259	3259	Other Chemical Product and Preparation Manufacturing
3331	3331	3331	3331	3331	Agriculture, Construction, and Mining Machinery Manufacturing
3332	3332	3332	3332	3332	Industrial Machinery Manufacturing
3334	3334	3334	3334	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
3336	3336	3336	3336	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing
3339	3339	3339	3339	3339	Other General Purpose Machinery Manufacturing
3361	3361	3361	3361	3361	Motor Vehicle Manufacturing
3362	3362	3362	3362	3362	Motor Vehicle Body and Trailer Manufacturing

** Indicates when a code was merged with, or converted to, another code.*

CONTINUED ON NEXT PAGE ▸

[1] See "Knowledge- and Technology-Intensive Industry Employment" in the Technical Notes section: https://ncses.nsf.gov/indicators/states/technical-notes.

[2] Galindo-Rueda F, Verger F, OECD Taxonomy of Economic Activities Based on R&D Intensity, OECD Science, Technology and Industry Working Papers, 2016/04, OECD Publishing, Paris (2016).

[3] The two additional codes (beyond the first 41 codes) at the bottom of the table—333515 and 333518—are crosswalks from the 2002 and 2007b NAICS versions, as those industries were separate in those NAICS versions.

Figure 4 *NAICS Codes that Constitute KTI Employment Industries, CONTINUED*

2002 NAICS	2007 NAICS	2012 NAICS (NSF Standard)	2017 NAICS	2022 NAICS	Industry
3364	3364	3364	3364	3364	Aerospace Product and Parts Manufacturing
3365	3365	3365	3365	3365	Railroad Rolling Stock Manufacturing
3369	3369	3369	3369	3369	Other Transportation Equipment Manufacturing
3391	3391	3391	3391	3391	Medical Equipment and Supplies Manufacturing
5112	5112	5112	5112*	5132	Software Publishers
5415	5415	5415	5415	5415	Computer Systems Design and Related Services
5417	5417	5417	5417	5417	Scientific Research and Development Services
33631	33631	33631	33631	33631	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing
33632	33632	33632	33632	33632	Motor Vehicle Electrical and Electronic Equipment Manufacturing
33633	33633	33633	33633	33633	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing
33634	33634	33634	33634	33634	Motor Vehicle Brake System Manufacturing
33635	33635	33635	33635	33635	Motor Vehicle Transmission and Power Train Parts Manufacturing
33636	33636	33636	33636	33636	Motor Vehicle Seating and Interior Trim Manufacturing
33639	33639	33639	33639	33639	Other Motor Vehicle Parts Manufacturing
332913	332913	332913	332913	332913	Plumbing Fixture Fitting and Trim Manufacturing
332991	332991	332991	332991	332991	Ball and Roller Bearing Manufacturing
333314	333314	333314	333314*	333310	Commercial and Service Industry Machinery Manufacturing
333315	333315*	333316	333316*	333514	Commercial and Service Industry Machinery Manufacturing
333319	333319*	333318	333318*	333515	Commercial and Service Industry Machinery Manufacturing
333318	333318	333514	333514	333517	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing
333512	333512*	333515	333515	333519	Cutting Tool and Machine Tool Accessory Manufacturing
333513	333513*	333517	333517		Machine Tool Manufacturing
333514	333514	333519	333519		Rolling Mill and Other Metalworking Machinery Manufacturing
333515	333515*				Cutting Tool and Machine Tool Accessory Manufacturing
333518	333518				Other Metalworking Machinery Manufacturing

** Indicates when a code was merged with, or converted to, another code.*

Appendix B

SCORE-BASED RANKINGS

Previous editions of the *Tracking Innovation* report have used a ranking method in which North Carolina's overall rank is the average of its rank across all the individual measures. This average-ranking method provides an estimate of the average performance of the state across those measures but does not allow for an interval-level comparison to other states.[1] With 42 measures across 50 states, many states' averages fall within each other's standard deviation of their average rank,[2] meaning that the significance of a summary average rank across all measures may be limited. On many measures, there is very little statistically significant variation between state ranks. This is most applicable to rankings with a low level of variation across the distribution, in which case the difference between the top-ranked state and the lowest-ranked state may be small and not particularly meaningful.[3]

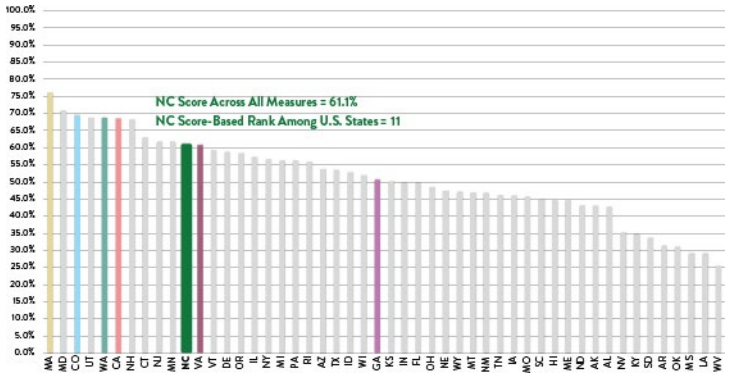
An alternative approach is to use the rankings on each measure to determine a total "score" for each state and then rank and array the states in order of their score. Specifically, for a given state, the overall state rank is determined first by having each measure's rank serve as a score out of 100 (e.g., for each measure, at the top of the distribution a state rank of 1 scores 100, a rank of 2 scores 98, a rank of 3 scores 96, etc.; at the other end of the distribution, a rank of 50 scores a 2, a rank of 49 scores a 4, a rank of 48 scores a 6, etc.). These scores are then summed across all 42 measures for each state, and the sum for each state is divided by the total possible points (4,200) to create an interval-level percentage score relative to 100 percent for each state.

Using this score-based method and the most recent data available, North Carolina scores 61.1 percent, ranking it 11th among all U.S. states; the average score for all states is 51 percent **[Score-Based State Rankings]**. This indicates that North Carolina's rank is above the U.S. average and in the top quartile of all U.S. states. Among the six comparison states referenced in this report,[4] Massachusetts is the highest scoring state (76.0 percent) in the nation. Three other comparison states (Colorado, 69.4 percent; Washington, 68.7 percent; California, 68.5 percent) also score above North Carolina, and two (Virginia, 60.7 percent; Georgia, 50.6 percent) score below North Carolina. Overall, the score-based ranks show which states are most competitive relative to North Carolina and provide more detail regarding their degree of separation.[5]

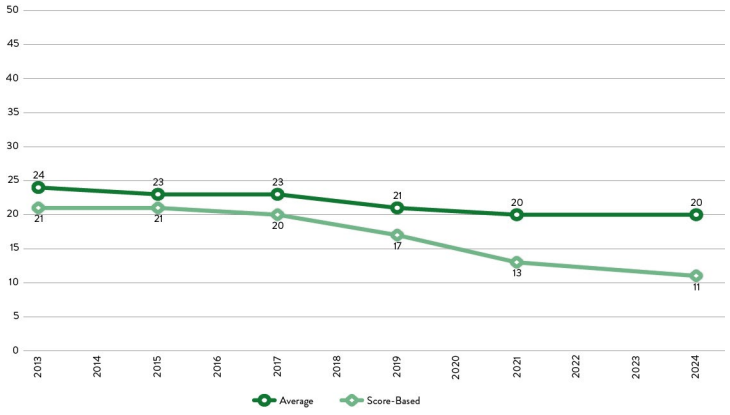
The 2013 *Tracking Innovation* report was the first to calculate and report average ranks, and the five reports since then have continued that practice. This 2024 report is the first to calculate and report score-based ranks using current data as well as data from the previous reports.

Both the average-rank and score-based rank methods show North Carolina consistently in the second quartile of all U.S. states and improving over time **[North Carolina Rank Over Time]**.[6] While the two methods show similar results for the years 2013-2017, the score-based method suggests greater improvement for North Carolina in recent years. This is because scores are more discerning of the relative degree of difference between North Carolina and several states that have the same or a proximate summary average rank. To the extent North Carolina has made improvements relative to states in its peer group in recent years, the score-based rank is better able to measure the cumulative impact of those improvements.

Score-Based State Rankings



North Carolina Rank Over Time: Average Rank vs. Score-Based Rank, 2013-2024



[1] The average-ranking method produces ordinal-level measures, which allow only for the rank order (1st, 2nd, 3rd, etc.) by which data can be sorted, but does not allow for relative degree of difference between the data. In contrast, the scoring method explained here allows for rank order and yields more meaningful differences between data values.

[2] The average standard deviation across all the states' average rank is 13.14. The minimum standard deviation is 9.38; the maximum is 16.25.

[3] This causes a situation in which many states have the same summary average rank and are essentially "tied" with other states. For example, three other states (Connecticut, New Jersey, and Minnesota) are tied with North Carolina, each with a summary average rank of 20th. For more detail, see the "Interpreting the Data" section in the Introduction. As explained there, rankings tend to divert attention from the actual value of a given measure, which often is more important. Care must be taken not to overinterpret rankings.

[4] For more discussion of the comparison states, see the Introduction.

[5] Two innovation indexes produced by other organizations use score-based ranking methods and show similar levels of performance for North Carolina. Using 25 measures, the Information Technology & Innovation Foundation's (ITIF) 2020. *State New Economy Index yields a score of 62.2 for North Carolina and a state rank of 19th (https://itif.org/publications/2020/10/19/2020-state-new-economy-index/). Using 106 measures, the Milken Institute's 2022 State Technology and Science Index yields a score of 62.5 and a rank of 11th for North Carolina (https://statetechandscience.org/).*

[6] In rank order across the 50 states, the first quartile ranges from 1 to 12.5, the second quartile ranges from 12.5 to 25, the third quartile ranges from 25 to 37.5, and the fourth quartile ranges from 37.5 to 50.

Sources

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INDICATORS

The indicators in this report were compiled using existing secondary data sources. The specific measures within the various indicators typically required reconfiguration of existing datasets. Because the measures were derived from a wide range of sources, there are variations in the time frames used and in the specific data that define the indicators being measured. The information below provides detailed notes on data sources used for each indicator. When available, website addresses are provided. Where relevant for an indicator, the citations of publications referenced in the indicator explanation are also presented.

1.1: Gross Domestic Product (GDP)

State-level GDP data are from the Real GDP in Chained Dollars dataset, U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, accessed December 18, 2023, https://www.bea.gov/iTable/index_regional.cfm. State-level GDP data are normalized using population data from the U.S. Census Bureau (see 1.6: Population Growth). National-level GDP data are from the World Bank, GDP Per Capita dataset, accessed January 16, 2024, https://databank.worldbank.org/source/world-development-indicators. MSA-level GDP data are from the Real GDP by Metro Area dataset, U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, accessed December 18, 2023, https://www.bea.gov/iTable/index_regional.cfm. MSA population data for 2000 to 2010 are midyear population estimates obtained via the MSA-level Personal Income dataset, U.S. BEA, U.S. Department of Commerce, accessed December 18, 2023. MSA population data for 2010 to 2019 are from Vintage 2020 Population Estimates, Metropolitan and Micropolitan Statistical Areas Totals, U.S. Census Bureau, accessed December 18, 2023, https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates.html. MSA population data for 2020 to 2022 are from the Annual Resident Population Estimates for Metropolitan and Micropolitan Statistical Areas and Their Geographic Components for the United States: April 1, 2020 to July 1, 2022, U.S. Census Bureau, Metropolitan and Micropolitan Statistical Areas Totals: 2020-2023 (census.gov), accessed December 18, 2023. County-level GDP data are from Real GDP by county dataset, U.S. BEA, U.S. Department of Commerce, https://www.bea.gov/iTable/index_regional.cfm, accessed January 23, 2024. County-level GDP was normalized using population data from the U.S. Census Bureau (see Indicator 1.6: Population Growth). Subnational over-time data are adjusted for inflation using the BEA's GDP deflator.

1.2: Income

State-level per-capita income data are from the U.S. Bureau of Economic Analysis (BEA), U.S. Department of Commerce, Per Capita Personal Income dataset, accessed December 12, 2023, http://www.bea.gov/iTable/index_regional.cfm. State-level median household income data are from the U.S. Census Bureau, American Community Survey, S1093-Median Income in the Last 12 Months dataset, 1-Year Estimates, accessed October 10, 2023, https://data.census.gov/cedsci/all?q=s1903. County-level median household income data are from the U.S. Census Bureau, American Community Survey, S1903-Median Income in the Last 12 Months dataset, 5-Year Estimates, accessed December 12, 2023, https://data.census.gov/cedsci/all?q=s1903. Over-time data are adjusted for inflation using the Bureau of Labor Statistics (BLS), U.S. Department of Labor, All Urban Consumers Consumer Price Index (CPI), accessed October 23, 2023, https://www.bls.gov/cpi/data.htm.

Sources

1.3: Average Annual Wage

State and county-level average annual wage data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages program, accessed January 10, 2024, https://data.bls.gov/PDQWeb/en. Over-time data are adjusted for inflation using the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Consumer Price Index (CPI), accessed October 23, 2023, https://www.bls.gov/cpi/data.htm.

1.4: Unemployment

State and county-level unemployment data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Local Area Unemployment (LAU) Statistics, LAU Tables, accessed January 10, 2024, https://www.bls.gov/lau/#tables. Total U.S. unemployment is from the Current Population Survey, U.S. BLS, U.S. Department of Labor, Employment status of the civilian noninstitutional population, 1950 to date, https://www.bls.gov/cps/tables.htm#empstat, accessed January 10, 2024.

1.5: Poverty

State-level poverty data are from the U.S. Census Bureau, American Community Survey, S1701: Poverty Status in the Last 12 Months dataset, 1-Year Estimates. 2005 to 2022 data were accessed October 16, 2023, http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml and 2010 to 2019 data were accessed November 8, 2021, https://data.census.gov/cedsci/table?q=s1701. County-level poverty data are from the U.S. Census Bureau, American Community Survey, S1701: Poverty Status in the Last 12 Months dataset, 5-Year Estimates, accessed February 22, 2024, https://data.census.gov/cedsci/table?q=s1701.

1.6: Population Growth

State-level 2020 to 2022 population data are from the Annual Estimates of the Residential Population for the United States, Regions, States, District of Columbia, and Puerto Rico: April 1, 2020 to July 1, 2022, National Population Totals: 2020-2023 (census.gov), accessed November 28, 2023. State-level 2010 to 2019 population data are from the U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population for the United States, Regions, States, the District of Columbia, and Puerto Rico: April 1, 2010 to July 1, 2019; April 1, 2020; and July 1, 2020, accessed November 28, 2023, https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-totals-national.html. State-level 2000 to 2010 population data are from the U.S. Census Bureau, Intercensal Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2010, accessed November 28, 2023, https://www.census.gov/data/tables/time-series/demo/popest/intercensal-2000-2010-state.html. County-level 2022 population data are from the Annual Estimates of the Resident Population for Counties: April 1, 2020 to July 1, 2022, accessed November 29, 2023, County Population Totals: 2020-2023 (census.gov). County-level 2000 population data are from the U.S. Census Bureau, accessed November 29, 2023, https://www2.census.gov/programs-surveys/popest/datasets/2000-2009/counties/totals/. Historical total population data are from the U.S. Census Bureau, via the North Carolina State Demographer, Historic Census dataset, accessed November 28, 2023, https://demography.osbm.nc.gov/explore/?sort=modified. Total population projections are from the North Carolina Office of State Budget and Management, Demographic and Economic Analysis Section, Population Overview, 2010-2050, accessed November 28, 2023, https://files.nc.gov/ncosbm/demog/countytotals_populationoverview.html.

2.1: Total Research & Development (R&D)

State-level total R&D data are from the National Science Board, *Science and Engineering State Indicators*, State Indicator S-41: R&D as a Percentage of Gross Domestic Product (Percent) dataset, accessed December 20, 2023, https://www.nsf.gov/statistics/state-indicators/indicator/rd-performance-to-state-gdp. MSA-level business R&D data are from the National Center for Science and Engineering Statistics and U.S. Census Bureau, Business Research and Development Survey, Table 14, 2021, accessed October 10, 2023, https://ncses.nsf.gov/pubs/nsf21312. University-level R&D data are from the National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2022, Table 5, accessed December 21, 2023, https://ncses.nsf.gov/pubs/nsf21314.

2.2: Business-Performed R&D

State-level business-performed R&D data are from the National Science Board, *Science and Engineering Indicators*, State Indicator S-45: Business-Performed R&D as a Percentage of Private-Industry Output (Percent) dataset, accessed December 20, 2023,https://www.nsf.gov/statistics/state-indicators/indicator/business-performed-rd-to-private-industry-output. MSA-level business R&D data are from the National Center for Science and Engineering Statistics and U.S. Census Bureau, Business Research and Development Survey, Table 14, 2021, accessed October 10, 2023, https://ncses.nsf.gov/pubs/nsf21312. Industry-specific business R&D data is also from the 2021 Business Research & Development Survey, Table 29-B. National Science Board, Science and Engineering Indicators 2022, Chapter 4, "U.S. R&D Performance and Funding," available at https://ncses.nsf.gov/pubs/nsb20201/.

Sources

2.3: Academic Science & Engineering R&D

State-level academic science & engineering R&D data are from the National Science Board, *Science and Engineering Indicators*, State Indicator S-46: Academic Science and Engineering R&D per $1,000 of Gross Domestic Product (Dollars) dataset, accessed January 2, 2024, https://www.nsf.gov/statistics/state-indicators/indicator/academic-rd-per-1000-state-gdp. University-level R&D data are from the National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2022, Table 5, accessed December 21, 2023, https://ncses.nsf.gov/pubs/nsf21314. National Science Board, Science and Engineering Indicators 2022, Chapter 4, "U.S. R&D Performance and Funding," available at https://ncses.nsf.gov/pubs/nsb20201/.

2.4: Federal R&D

State-level federal R&D obligations data are from the National Science Board, *Science and Engineering Indicators*, State Indicator S-42: Federal R&D Obligations per Employed Worker (Dollars) dataset, accessed May 24, 2024, https://www.nsf.gov/statistics/state-indicators/indicator/federal-rd-obligations-per-employed-worker. This indicator draws from the National Center for Science and Engineering Statistics, Federal Funds for Research and Development: Fiscal Year 2022-23 report, available at Survey of Federal Funds for Research and Development 2022-2023 | NSF - National Science Foundation.

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2.5: Academic Articles

State-level academic articles data are from the National Science Board, *Science and Engineering Indicators*, State Indicator S-48: Academic Science and Engineering Article Output per 1,000 Science, Engineering, and Health Doctorate Holders in Academia (Articles) dataset, accessed January 3, 2024, https://www.nsf.gov/statistics/state-indicators/indicator/academic-se-articles-per-1000-seh-doctorate-holders-in-academia.

3.1: SBIR & STTR Funding

State-level SBIR data are from the National Science Board, *Science and Engineering Indicators*, State Indicator S-55: Average Annual Federal Small Business Innovation Research and Small Business Technology Transfer Funding per $1 Million of Gross Domestic Product (Dollars) dataset, accessed January 9, 2024, https://www.nsf.gov/statistics/state-indicators/indicator/ave-sbir-and-sttr-funding-per-1-million-state-gdp. City, county, and ZIP Code-level SBIR and STTR data are from SBIR.gov, Awards Search, accessed January 9, 2024, https://www.sbir.gov/sbirsearch/award/all.

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3.2: Academic Patents

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4.1: Knowledge- and Technology- Intensive (KTI)) Employment Establishments and Formations

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4.2: KTI Employment

KTI business employment by state and county data are from the Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages program, accessed January 3, 2024, https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables. The data pertaining to establishments are based on their classification according to the 2012 edition of the North American Industry Classification System (NAICS). See Appendix A for a list of the 41 industries that are defined as having KTI employment.

4.3: Entrepreneurial Activity

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6.3: Cost of Living Index

State-level and county-level Cost of Living Index data are from the Council for Community and Economic Research (C2ER), Bureau of Labor Statistics (BLS), U.S. Department of Labor, Quarterly Census of Employment and Wages program on December 15, 2023, http://www.coli.org/.

6.4: Industry Mix

Industry mix data are from the Quarterly Census of Employment and Wages (QCEW) produced by the Bureau of Labor Statistics (BLS), accessed on January 3, 2024 and provided by the Labor & Economic Analysis Division (LEAD) in the North Carolina Department of Commerce. Data from the third quarter of 2022 were used to produce the estimates provided in indicator 6.4. Projections for QCEW and Non-QCEW Employees are informed by the National Industry-Occupation Employment Matrix and long-term industry projections provided by individual states. The average earnings, also called "Current Total Earnings," is the total industry earnings for a region divided by number of jobs. It includes wages, salaries, supplements (additional employee benefits), and proprietor income.

The National Science Foundation (NSF) created a table that showed a list of 2012 NAICS codes that constitute Knowledge- and Technology- Intensive (KTI) or high-technology industries. Like the 2021 *Tracking Innovation* data, we utilized Census NAICS crosswalks from 2012 NAICS codes to compare the vintage codes for the high-technology industries

State-industry combinations whose employment data are reported as "<10" were adjusted to 0. A complete list of NAICS codes with the year appropriate crosswalk can be seen in Appendix A.

Gross Domestic Product by manufacturing and all industries data are from the GDP by state dataset, Bureau of Economic Analysis, U.S. Dept. of Commerce, accessed January 18,2024, https://apps.bea.gov/itable/index.cfm. Manufacturing industries are defined as those industries whose 2-digit NAICS code ranges from 31-33.

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Thanks also go to the North Carolina Board of Science, Technology & Innovation members who provided valuable oversight and feedback on this report.

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