The *Annual Index of the Massachusetts Innovation Economy* - 2023 Edition

Welcome

Welcome to the 2023 Edition of the "*Index of the Massachusetts Innovation Economy*." The *Index* provides an important benchmark for the performance of the Commonwealth's Innovation Economy, which accounts for nearly 40% of jobs in Massachusetts. The *Index* has provided analysis of the growth and performance of the state's Innovation Economy since its first publication in 1997. Access to these data and insights inform our approach to economic development, as we work to build an inclusive and prosperous economy in all regions of the Commonwealth.

The Commonwealth's economy is in a strong position coming out of the COVID-19 pandemic, but continued effort is needed to ensure the Commonwealth remains at the forefront of innovation for decades to come. Our workforce is the most educated in the country, but it is also aging at a faster rate than most other states due to a combination of factors, especially the high cost of housing and childcare in Massachusetts which make it challenging for people to move to or remain in the Commonwealth. The Healey-Driscoll administration is committed to addressing these issues, which impact all sectors of the economy, as well as keeping our workforce training system responsive to industry needs and accessible to all.

The Commonwealth's innovation edge extends well beyond our workforce. As you will see in this year's *Index,* critical inputs such as research activity and capital investment continue to be strong in Massachusetts relative to other states, which bodes well for the future. The Healey-Driscoll administration will continue to support emerging technologies and industries through targeted investments that will help ensure that the future continues to be made in Massachusetts.

Thank you for your interest in the *Index* and the performance of the Massachusetts Innovation Economy. We encourage you to explore the data to see why Massachusetts remains the leading state for innovation and join the conversation around ways we can continue to build an inclusive and innovation-driven economy that fuels prosperity for all residents of our state.

Carolyn Kirk
CEO, MassTech Collaborative

Introduction

The Massachusetts Innovation Economy continues to recover from the impact of the COVID-19 pandemic. Job growth occurred in nine of 11 Innovation Economy sectors and by 2.5% overall. However, over the past two years, inflation and rising interest rates intending to combat it have created headwinds for several innovation economy industries, especially in digital technology. Layoffs have occurred at some of the largest and most valuable technology companies, sometimes for the first time in their histories. The Commonwealth has not been immune to these trends, yet it is poised to take advantage of what comes next. The importance of innovation to economic growth has not disappeared even if certain technologies and business models have seen sudden changes of fortune. The world still faces challenges from climate change to disease that need technological solutions while emerging technologies such as artificial intelligence, robotics and quantum computing open entirely new pathways to economic growth and improved lives. While individual industries rise and fall, the foundations of an innovation economy (talent, research activity and investment capital) remain as important as ever. Fortunately, as the *Index* demonstrates, Massachusetts remains a leader on all three fronts and is still among the best places in the world to develop new innovations.

On the pages that follow, the *Index* of the Massachusetts Innovation Economy examines the factors that make Massachusetts a global hub of innovation, how the Commonwealth's performance compares to the Leading Technology States (LTS) and the challenges Massachusetts faces to maintain its leading position.

Talent Highlights

- The Commonwealth's K-12 education system consistently ranks among the top in the leading technology states when comparing fourth and eighth grade math test scores and leading the LTS in fourth and eighth grade math performance in 2021. However, scores across the LTS have trended downwards since 2013.
- Massachusetts is also a leading producer of technical and scientific talent, graduating nearly 64% more STEM degrees per capita than New York, the next closest LTS on this measure.
- The Commonwealth's workforce is the best educated in the nation, with 54% of the working age population holding a college degree, higher than any other state.

Research Highlights

- The Commonwealth attracts more research investment than any among the LTS other than California ($44.9 billion in 2021) and has the highest level of research investment relative to the size of its economy among the LTS.
- Research investment into Massachusetts has grown by more than 56% since 2015 and places Massachusetts behind only California and New York in rate of research investment growth.

Capital Highlights

- The Commonwealth is second nationally in Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) investment and first among the LTS in SBIR/STTR investment as a percent of Gross Domestic Product (GDP).

- The Commonwealth received $15.3B in venture capital (VC) investment in 2023, placing it third nationally. However, VC investment is down 58% from its peak in 2021.

Economic Impact Highlights

The Commonwealth's median household income ($94,488) is higher than any other state in the LTS but has declined by 2.4% since 2020.

- Innovation Economy employment grew by 2.5% in 2022, sixth among the LTS.
- The Commonwealth's exports reached a new total peak of $35.2 billion in 2023.

While maintaining a position of leadership, the Commonwealth is not without its challenges. Investment capital is increasingly available to start-ups and scaling companies in states other than the traditional hubs of investment in California, Massachusetts, and New York. In 2013 only California, Massachusetts, New York, and Texas received more than $1 billion in venture funding, and while venture investment levels have declined from their record peaks in all the LTS in 2023, all but two received more than $1B in venture investment. This level of growth across the country in VC investment demonstrates that it is possible to build a venture backed business in many other parts of the country than assumed just a decade ago. The spread of such investments around the country benefits the broader national economy and Massachusetts still receives more than its fair share of venture investment, but it does suggest that the Commonwealth must ensure that it maintains and enhances its world class research enterprise and talent pool in the face of increased competition.

Massachusetts must remain focused on strengthening its research enterprise in emerging technologies that will continue to drive broad-based prosperity in the future. The Commonwealth's network of research institutions and researchers is a formidable advantage, one that other states seek to emulate and, in some cases, utilize as a direct source of talent. Massachusetts also faces threats to its dominance in R&D. National Institutes of Health funding has stagnated but remains at a level well above most states. In addition, Washington has seen a surge in R&D investment from industry and has claimed the number two spot in total R&D investment as of 2021.

The relative high cost of living in Massachusetts and the increased prevalence of remote work provides both an incentive and an opportunity for valuable tech talent to relocate to other states, sometimes without even changing jobs. The Commonwealth's high overall quality of life is still a strength relative to many places, but many people encounter financial obstacles to move to or stay in Massachusetts considering the cost of housing and childcare. The Greater Boston Chamber of Commerce released a survey in March finding that 25% of 20-30 year olds in Greater Boston are considering leaving the region within the next five years and for reasons that extend beyond financial considerations to include cultural and racial diversity as well as entertainment options[1]. Fortunately, Massachusetts is not standing still on these issues, whose employment impacts reach beyond the Innovation Economy.

The challenges listed above are neither new nor insurmountable and the long history of Massachusetts as a leading hub of innovation is an indicator that the Commonwealth has consistently adapted to emerging competition, the rise and fall of industries, and global economic trends.

[1] https://bostonchamber.com/wp-content/uploads/2024/03/City-Awake-Young-Residents-Survey-2023.pdf

Leading Technology States

Every year, the *Index* compares Massachusetts' performance on several metrics to a group of "Leading Technology States" (LTS). The LTS have economies with a significant level of economic concentration and size in the 11 key sectors that compose the Innovation Economy (IE) in Massachusetts. The *Index* accounts for three metrics deemed representative of not only the intensity of the Innovation Economy, but also the size and breadth of a state's Innovation Economy and evaluates them simultaneously.

Eleven Key Innovation Economy Sectors

- Advanced Materials
- Biopharmaceuticals and Medical Devices
- Business Services
- Computer & Communications Hardware
- Defense Manufacturing and Instrumentation
- Diversified Industrial Manufacturing
- Financial Services
- Healthcare Delivery
- Postsecondary Education
- Scientific, Technical and Management Services
- Software and Communications Services

Leading Technology States (LTS), 2023

State	LTS Score	Number of IE Jobs	Percent of Jobs in IE	Number of Key Sectors with LQ Above 1.1
Massachusetts	2.26	1,413,943	39.32%	8
California	2.15	5,346,270	29.86%	5
Pennsylvania	1.96	1,985,273	33.86%	7
New York	1.85	3,194,162	34.48%	4
Texas	1.59	4,097,760	30.93%	5
North Carolina	1.56	1,525,013	32.45%	4
Minnesota	1.49	950,825	33.32%	4
Illinois	1.45	1,863,352	31.48%	5
New Hampshire	1.41	231,372	34.50%	5
Connecticut	1.38	576,366	35.09%	5

The Metrics Used to Select the 2023 LTS

The number of key sectors with significantly above average employment concentration are defined as the number of innovation economy sectors in each state where employment concentration is more than 10% above the national average and is a measure of the breadth of a state's Innovation Economy.

Overall Innovation Economy employment concentration relative to the nation is defined as the percent of a state's workers who are employed in the Innovation Economy relative to the national percentage and is a measure of the overall intensity of a state's Innovation Economy.

Total Innovation Economy employment measures the number of employees who work within one of the Innovation Economy sectors in each state and is a measure of the absolute size of a state's Innovation Economy. A score is then applied to all states to determine the top 10.

Talent

Talent provides the most basic and essential foundation for the Massachusetts Innovation Economy. The Commonwealth is known worldwide for its high-quality public-school systems, excellent system of public and private colleges and universities, and innovative workforce development programs that sustain and improve the state's well-educated workforce. These strengths are frequently cited among the main reasons that businesses choose to locate and grow in Massachusetts. Access to top notch intellectual, technical and managerial talent allows innovative companies of all sizes to develop groundbreaking products and services in Massachusetts.

PUBLIC COMMITMENT TO EDUCATION

Development of talent in Massachusetts begins with a strong commitment to high-quality K-12 education. Investments in elementary, middle, and high schools are critical for preparing an innovation ready workforce. The Commonwealth's strong education systems attract and retain workers desiring excellent educational opportunities and skills for themselves and their children, an attribute that is frequently cited in other publications such as the 2021 and 2022 CNBC Top States for Business reports where Massachusetts was ranked as having the number one education system in the country[2].

Fourth and Eighth Grade Mathematics[3]
Massachusetts and LTS, 2013, 2019, 2022 and 2003-2022

Fourth Grade Mathematics Performance				
State	2013	2019	2022	2003-2022
MA	253	247	242	
MN	253	248	239	
NH	253	245	239	
TX	242	244	239	
PA	244	244	238	
IL	239	237	237	
CT	243	243	236	
NC	245	241	236	
US	241	240	235	
CA	234	235	230	
NY	240	237	227	

Eighth Grade Mathematics Perfomance				
State	2013	2019	2022	2003-2022
MA	301	294	284	
MN	295	291	280	
NH	296	287	279	
CT	285	286	276	
IL	285	283	275	
NY	282	280	274	
NC	286	284	274	
PA	290	285	274	
TX	288	280	273	
US	284	281	273	
CA	276	276	270	

[2] https://www.cnbc.com/2022/07/13/top-states-for-business-massachusetts.html

KEY TAKEAWAYS:

- Massachusetts led the LTS in both fourth and eighth grade mathematics performance in 2022.
- Mathematics scores in all states declined from 2013-2022. The COVID-19 pandemic may have accelerated this trend, but 2019 scores were below 2013 as well.

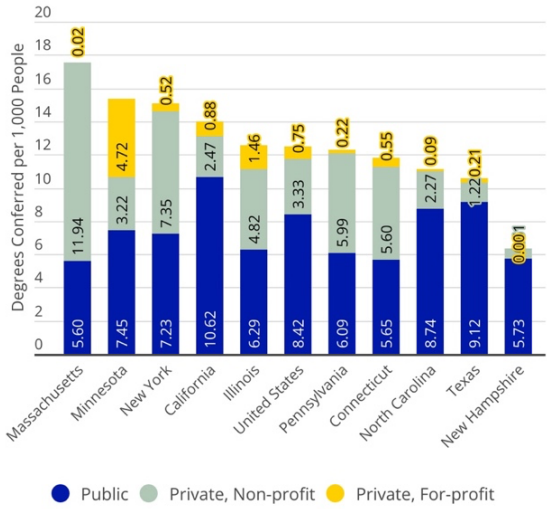
POST-SECONDARY EDUCATION

The Commonwealth's strong performance in education extends into the post-secondary level where colleges and universities train many of the skilled workers who are so vital to sustaining the growth of emerging tech sectors in Massachusetts. The Commonwealth continues to stand out as a leader in both the training of college educated workers and the proportion of its workforce with college degrees. While college degrees are not the only signifier of valuable innovation economy skills, they are a reliable historical metric that provides a useful gauge for prevalence of these skills in a state, since colleges and universities remain a core component of the talent pipeline.

State Higher Education Appropriations per Full-Time Equivalent Student (FTSE) [2]
Massachusetts, LTS and U.S., 2017-2022

State	State Educational Appropriations per FTSE 2017	State Educational Appropriations per FTSE 2022	2016-2021 Percent Change
Illinois	$19,600	$22,970	17.19%
Connecticut	$10,406	$14,827	42.49%
New York	$12,590	$13,897	10.38%
North Carolina	$11,925	$12,513	4.93%
California	$9,480	$11,694	23.35%
Massachusetts	$8,420	$10,513	24.86%
U.S.	$8,907	$10,237	14.93%
Minnesota	$8,417	$9,802	16.45%
Texas	$8,480	$9,084	7.12%
Pennsylvania	$5,168	$6,090	17.84%
New Hampshire	$2,901	$3,699	27.51%

Post-Secondary Degrees Conferred per 1,000 People[5]
Massachusetts and LTS, 2021-2022

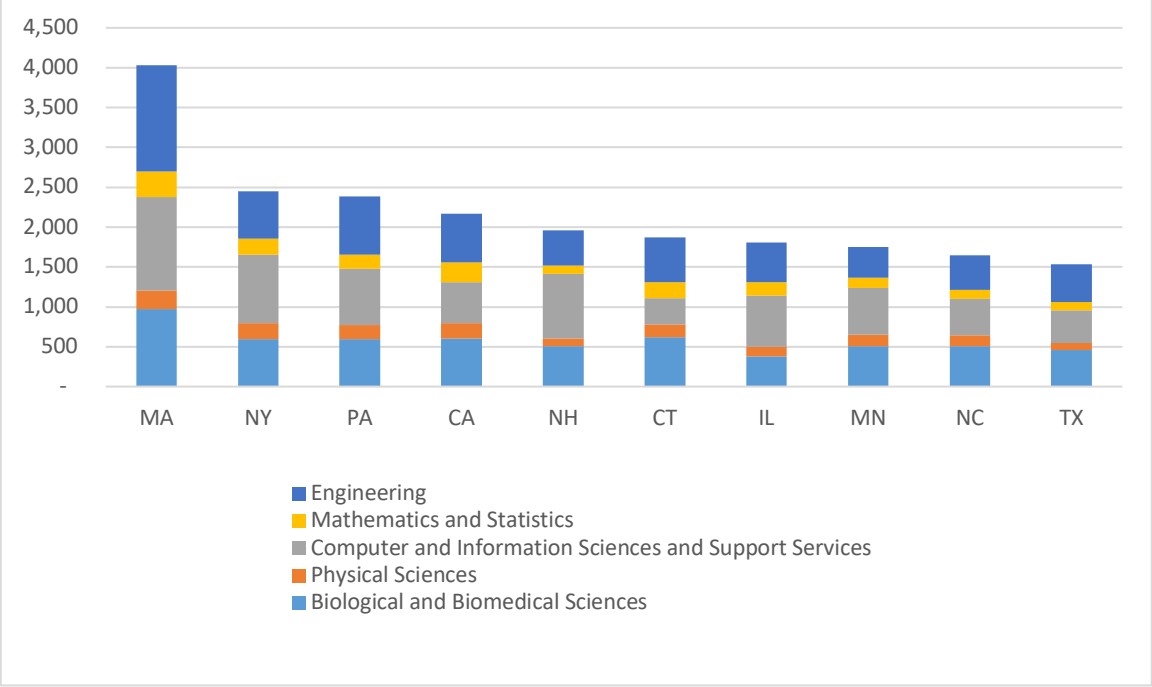


KEY TAKEAWAYS:

- Massachusetts leads in training knowledge workers. The Commonwealth has the highest number of degrees conferred per capita among the LTS (17.82 per 1,000 residents).
- Private, non-profit institutions grant 68% of degrees in the Commonwealth.
- The Commonwealth has the sixth highest level of state appropriations for higher education per student ($10,513) and the third largest increase (24.9%) among the LTS from 2017-2022.

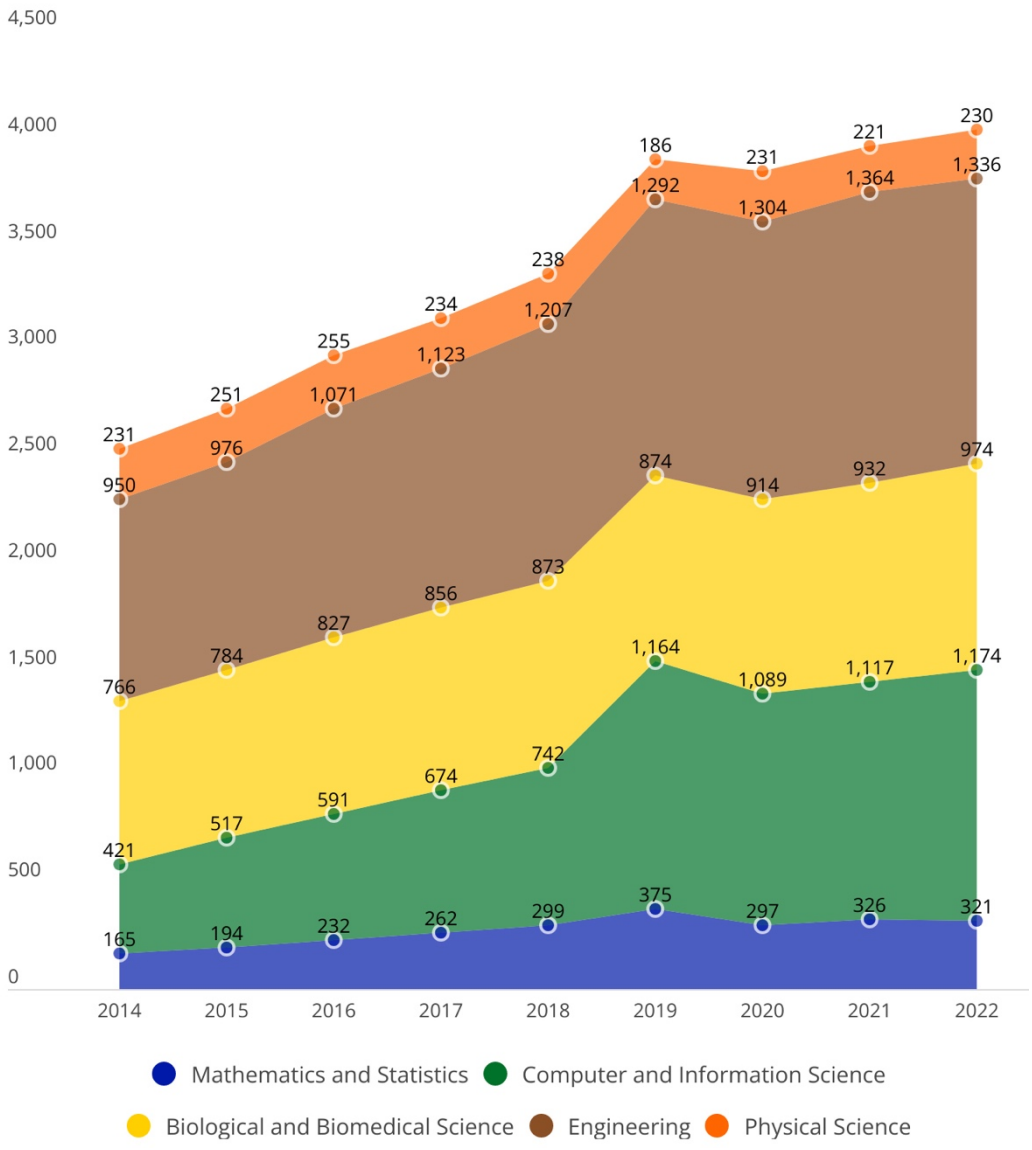
Science, technology, engineering and Math (STEM) education is a critical driver of the Massachusetts innovation economy as it provides skills that increase business productivity, leads to the creation of new technologies and high-growth companies, and establishes the basis for higher paying jobs. STEM degree holders also provide value beyond the tech sector, as more than 72% of graduates with STEM degrees work in non-STEM occupations such as law, management, and education[3]. Demand for innovation in industries across the economy will continue to blur the line between STEM and non-STEM skill sets as STEM skills become increasingly relevant in more occupations.

Degrees Granted in STEM Fields[4]
All Degrees Level per Million Residents
Massachusetts and LTS, 2021-2022



[3] https://www.census.gov/library/stories/2021/06/does-majoring-in-stem-lead-to-stem-job-after-graduation.html

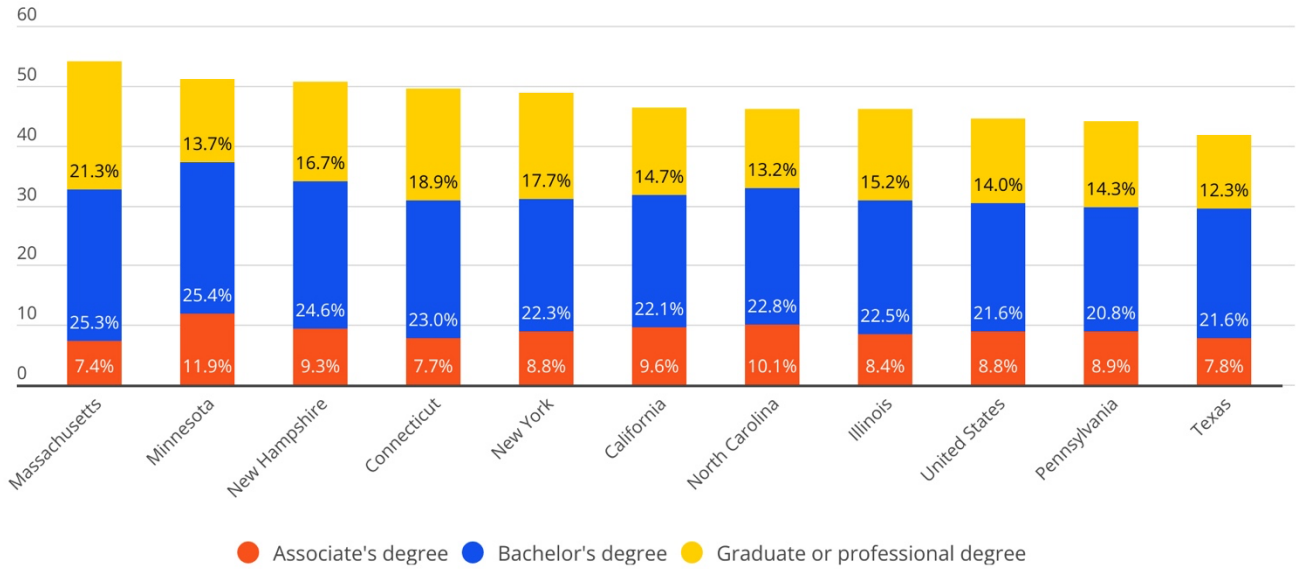
Massachusetts STEM Completions per Million Residents[4]
School Years 2014-2022 by End of School Year



KEY TAKEAWAYS:

- The Commonwealth grants far more STEM degrees per capita than the rest of the LTS, 64% more than the next closest state (NY).
- STEM degrees granted per capita in Massachusetts dipped during the 2020 school year (-1.1%) but have more than recovered by 2022 (+5%).
- Computer Science is the largest contributor to growth in STEM degrees (+179% since 2014).
- Massachusetts institutions grant more STEM degrees per capita in all STEM fields, with the largest area of over-performance being engineering (PA is the next closest state).
- Massachusetts has the highest percentage of working age adults with a college degree (54.2%) among the LTS and leads the LTS in percent of workers with a graduate or professional degree (21.3%).

Educational Attainment of Working Age Population[5]
Massachusetts, LTS and U.S., 2021



REFRESHING THE TALENT PIPELINE

Talent has long been a primary factor in the attractiveness of Massachusetts for new business development and a driver of the state's strong Innovation Economy. Continued investments in post-secondary education are critical to increase the ability of public academic institutions and non-degree

training programs to prepare students for skilled and well-paying employment. In addition, well-recognized public higher education programs enhance Massachusetts' distinctive ability to attract students from around the globe, many of whom choose to stay and work in the Commonwealth after graduation. Migration patterns are a key indicator of a region's attractiveness. Regions that are hubs of innovation have high concentrations of educated highly skilled workers and dynamic labor markets that are refreshed by inflows of talent. In-migration of well-educated individuals also fuels innovative industries with an infusion of diverse and high-demand skill sets.

From 2010-2019, international migration (people moving here from out of the country) has outpaced domestic out-migration (people moving within the country.) Prior to the pandemic, Massachusetts had seen much less domestic out-migration since 2010 than it did in the years preceding the Great Recession of 2007-2008, while international migration had increased as well. This indicates that Massachusetts was becoming a more attractive place to live and to work over the last decade, despite challenges with housing costs and transportation infrastructure. The population of Massachusetts also grew faster during the 2010s than any other New England state and achieved the second highest growth rate of any northeastern state, trailing only Delaware.

Population Change, 2022-2023[6]
Massachusetts, LTS, New England Region and U.S.

Geographic Area	2020	2022	2023	Percent Change 2020-2023	Percent Change 2022-2023
Texas	29,217,653	30,029,848	30,503,301	4.40%	1.58%
North Carolina	10,457,177	10,695,965	10,835,491	3.62%	1.30%
United States	331,501,080	333,271,411	334,914,895	1.03%	0.49%
Maine	1,362,280	1,389,338	1,395,722	2.45%	0.46%
Minnesota	5,707,165	5,714,300	5,737,915	0.54%	0.41%
Massachusetts	7,022,220	6,982,740	7,001,399	-0.30%	0.27%
Connecticut	3,600,260	3,608,706	3,617,176	0.47%	0.23%
New Hampshire	1,377,848	1,399,003	1,402,054	1.76%	0.22%
Rhode Island	1,096,229	1,093,842	1,095,962	-0.02%	0.19%
Vermont	642,495	647,110	647,464	0.77%	0.05%
Pennsylvania	12,989,625	12,972,091	12,961,683	-0.22%	-0.08%
California	39,499,738	39,040,616	38,965,193	-1.35%	-0.19%
Illinois	12,785,245	12,582,515	12,549,689	-1.84%	-0.26%
New York	20,154,933	19,673,200	19,571,216	-2.90%	-0.52%

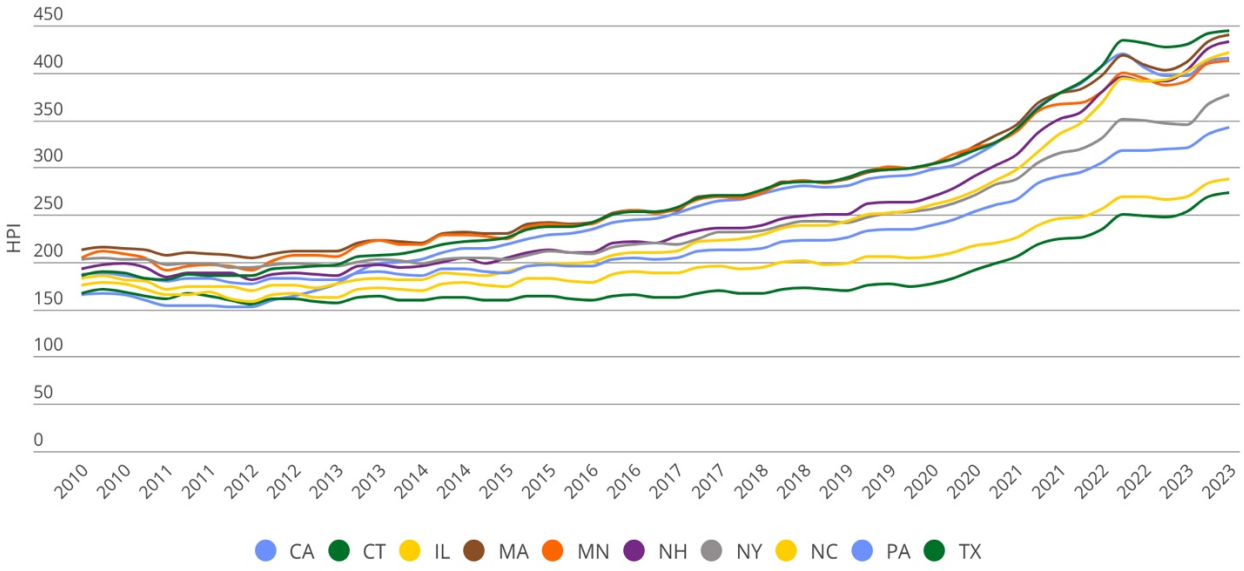
However, the pandemic introduced a major disruption to migration patterns of the past decade, with the international border all but closed to the new arrivals who previously had accounted for a significant portion of the Commonwealth's growth. Early indications are that net-migration[4] out of Massachusetts has increased, with a net 110,866 people leaving the Commonwealth for other U.S. states from 2020-2022, the fourth highest figure in the country. This is partially offset by a net addition of 61,263 people moving to Massachusetts from other countries, the fifth highest figure in the U.S. and the highest net

[4] Net-migration is the difference between people moving to/from Massachusetts and other U.S. states (domestic) and people moving to/from Massachusetts and other countries (international).

international migration rate in the country. The rise of remote work and hybrid work (mix of in-office and remote) has allowed people to move farther away from major tech hubs, for either lifestyle preferences or a lower cost of living. Massachusetts is a small state and thus it is feasible to commute to the Commonwealth from any state in New England, especially if the commute is not made daily. This appears in the migration data as all New England states other than Massachusetts and Rhode Island have registered a net gain in residents since 2020. It is still too early to know how long this new pattern will last or whether it will revert to historical trends, but will be among the most important data to monitor going forward. Fortunately, the most recent data from 2023 shows the Commonwealth's population grew faster than all New England states aside from Maine and faster than all but three LTS (Texan, North Carolina, Minnesota).

Some outmigration due to hybrid work making people's lifestyle preferences more compatible with their careers is unavoidable as the Commonwealth cannot completely replicate all desirable attributes or climate patterns in other states. However, cost of living is also a major driver of individual location decisions, particularly the cost of housing relative to income levels. The Commonwealth has more expensive housing than its neighboring states and much of the rest of the country.

Housing Price Index[26]
LTS, Q1 2010-Q3 2023



Percentage of Households Spending More Than 30% of Their Income on Housing[27]
Massachusetts, LTS and U.S., 2016-2021

Location	2017 Percent Homeowners	2017 Percent Renters	2022 Percent Homeowners	2022 Percent Renters	Percent Change Homeowners	Percent Change Renters
United States	23.00%	48.25%	23.47%	50.33%	0.48%	2.08%
California	32.35%	54.34%	31.80%	54.92%	-0.54%	0.58%
Connecticut	28.06%	50.20%	26.94%	52.10%	-1.12%	1.90%
Illinois	23.79%	47.97%	23.52%	48.90%	-0.27%	0.93%
Massachusetts	27.04%	48.83%	27.23%	52.58%	0.19%	3.75%
Minnesota	18.48%	44.77%	20.77%	48.68%	2.29%	3.91%
New Hampshire	24.68%	45.67%	26.01%	47.24%	1.33%	1.57%
New York	28.29%	51.83%	28.63%	51.71%	0.34%	-0.12%
North Carolina	19.97%	44.67%	19.78%	46.18%	-0.19%	1.52%
Pennsylvania	21.21%	46.53%	20.92%	46.86%	-0.29%	0.34%
Texas	20.92%	46.99%	23.54%	51.62%	2.62%	4.63%

KEY TAKEAWAYS:

- Massachusetts homeowners and renters face a high level of housing cost burden, despite the Commonwealth having one of the highest median household income levels in the country.
- In Massachusetts, 27.2% of homeowners and 52.6% of renters spend more than 30% of their income on housing. Both figures are above the national average and second among the LTS.
- The increase in the percentage of rent burdened households in Massachusetts (3.75%) was the third largest among the LTS from 2017-2022.
- The Commonwealth has historically had a higher Housing Price Index (measure of the rate of price increase) than most LTS. However, formally low-cost states such as Texas and North Carolina are rapidly catching up.

The cost of housing is a public policy challenge critical to the future of the Massachusetts Innovation Economy. A recent trend in workforce development efforts acknowledges the challenge of rising participant living expenses by adding supplemental stipends to previously uncompensated training and internship programs to maintain ongoing participation and retention. Addressing the cost of living, and housing will support the continued growth of the Commonwealth's Innovation Economy workforce as more people are able to afford to remain or move here to advance their careers and more people are able to access the many training opportunities that would enable them to pursue an Innovation

Economy career. The Commonwealth has prioritized housing development in its recent Economic Development Plan.

MAXIMIZING THE ECONOMIC POTENTIAL OF THE WORKFORCE THROUGH EQUAL OPPORTUNITY

Diversity is another important metric for talent in an innovation ecosystem as unequal representation in innovation-oriented occupations (represented by "Computer, Engineering and Science Occupations") likely indicates that not all people have the same opportunity to participate in the innovation economy. Over the past six years, the share of individuals in the Innovation Economy identifying as non-white has grown faster than the same share of the workforce as a whole; however, an opportunity remains to further strengthen participation in this sector. Tech industry leadership has repeatedly stated the goal of increasing the diversity of their workforce on the grounds of fairness, but also the strong business case that a more diverse workforce leads to increased creativity, more innovation, enhanced consumer understanding, richer brainstorming, and better decision making.

Demographics of Individuals Holding Computer, Engineering and Science Occupations[5] Massachusetts, 2015-2022

Demographic	2015	2016	2017	2018	2019	2021	2022
Male	71.6%	72.3%	71.9%	70.3%	70.6%	70.4%	70.4%
Female	28.4%	27.7%	28.1%	29.7%	29.4%	29.7%	29.6%
White; Not Hispanic or Latino	73.4%	71.5%	71.7%	69.1%	67.9%	65.9%	70.0%
Hispanic or Latino	3.9%	5.0%	5.5%	6.2%	6.1%	6.2%	6.9%
Asian	18.6%	18.7%	17.7%	18.6%	20.2%	21.1%	21.4%
Black or African American	2.3%	2.8%	3.2%	4.0%	3.7%	3.7%	4.2%
Some Other Race Alone	1.0%	1.8%	1.5%	1.6%	1.7%	2.2%	2.1%
Two or More Races	2.1%	2.0%	1.8%	2.7%	2.5%	6.2%	7.0%

Note: Data for 2020 is currently unavailable

Demographics of Individuals in the Workforce, All Occupations[7]
Massachusetts, 2015-2022

Demographic	2015	2016	2017	2018	2019	2021	2022
Male	50.8%	50.7%	51.0%	50.7%	50.9%	51.1%	51.2%
Female	49.2%	49.3%	49.0%	49.3%	49.1%	49.0%	48.8%
White; Not Hispanic or Latino	75.6%	75.3%	74.1%	73.2%	72.5%	69.8%	69.6%
Hispanic or Latino	9.6%	9.6%	10.3%	10.7%	11.0%	11.2%	11.9%
Asian	6.3%	6.4%	6.6%	6.9%	7.1%	7.5%	7.7%
Black or African American	6.9%	6.9%	7.4%	7.5%	7.6%	6.5%	6.8%
Some Other Race Alone	3.7%	3.9%	3.6%	4.3%	4.2%	5.4%	5.9%
Two or More Races	2.1%	2.4%	2.2%	2.7%	2.8%	9.4%	9.4%

Note: Data for 2020 is not currently available

KEY TAKEAWAYS:

- The Commonwealth's tech workforce is not representative of the demographics of the overall workforce, but it has become somewhat more diverse since 2015.
- 29.6% of the tech workforce is female vs. 48.8% of all occupations.
- 6.9% of the tech workforce identifies as Hispanic or Latino vs. 11.9% of all occupations.
- 4.2% of the tech workforce identifies as Black or African American vs. 6.8% of all occupations.
- The share of the tech workforce for the above groups grew faster than their share of all occupations in the Commonwealth from 2015-2022.

Research

Research activity is the second key pillar of the Massachusetts Innovation Economy. The Commonwealth benefits from a dense network of research universities and institutes performing cutting-edge science and blazing new trails in transformative fields such as artificial intelligence, biotechnology, quantum computing and robotics. Research and Development (R&D) performance provides an indicator of the size and health of the science and technology enterprise. Although not all new ideas or products emerge from defined R&D efforts, R&D performance provides a basis for estimating a region's general capacity for innovation and knowledge creation.

RESEARCH & DEVELOPMENT (R&D) FUNDING ENABLES NEW DISCOVERIES

KEY TAKEAWAYS:

- The Commonwealth continues to be a national leader in R&D performance, landing among the top states in terms of total R&D investment, intensity of R&D investment and growth of R&D investment.
- Massachusetts attracts more R&D investment ($44.9 billion in 2020) than any state among the LTS aside from California.
- R&D investment is equivalent to 7.67% of the Commonwealth's GDP (second nationally).
- R&D investment has grown 56.7% in Massachusetts since 2015 (third amongst LTS).

R&D occurs across the economy in a mix of entities that contribute to an innovative and diverse ecosystem. R&D entities are referred to as "performers" and fall into five categories: federal R&D, federally funded R&D centers, business R&D, university R&D, other non-profits R&D and state internal.

Total R&D Expenditures[8]
Massachusetts, U.S. and LTS, 2015 & 2020

State	2015 Total R&D Expenditure	2020 Total R&D Expenditure	Percent Change 2015-2020	2020 R&D as a Percent of GDP
U.S.	$495,144	$716,955	44.8%	3.40%
California	$125,056	$217,976	74.3%	7.22%
Massachusetts	$28,665	$44,907	56.7%	7.67%
New York	$22,401	$36,559	63.2%	2.10%
Texas	$23,668	$34,589	46.1%	1.93%
Pennsylvania	$14,839	$21,687	46.1%	2.81%
Illinois	$16,502	$19,203	16.4%	2.24%
North Carolina	$11,823	$18,064	52.8%	3.02%
Minnesota	$8,053	$10,301	27.9%	2.73%
Connecticut	$9,918	$9,486	-4.4%	3.43%
New Hampshire	$2,333	$3,332	42.8%	3.77%

Industry funding of academic research measures the ability to transfer academic research into the commercial market. Industry university research partnerships may result in advances in technology and industries by advancing research with potential commercial applications. Moreover, university research occurring in projects funded by industry strengthens education of individuals in areas directly relevant to current industry needs, enhancing the talent pipeline.

Industry Share of States' Total Academic R&D Funding in Science and Engineering (S&E) [9]
Massachusetts and LTS, 2021

State	Industry Share of States' Total Academic R&D Funding in S&E
U.S.	5.70%
California	6.52%
Connecticut	5.82%
Illinois	6.11%
Massachusetts	6.81%
Minnesota	4.20%
New Hampshire	2.51%
New York	6.57%
North Carolina	8.87%
Pennsylvania	6.91%
Texas	6.98%

National Institutes of Health (NIH) per Million GDP[15]
Massachusetts and LTS, 2021-2022

State	Dollar Value 2021	2021 Awards	2021 Award Dollars per GDP	Dollar Value 2022	2022 Awards	2022 Award Dollar Per GDP	Percent Change in Dollars	Percent Change in Awards
MA	$3,328,279,019	5,758	$5,623	$3,281,811,936	5,810	$5,430	-1.40%	-3.43%
NC	$2,411,545,433	2,742	$4,037	$2,164,552,282	2,860	$3,554	-10.24%	-11.97%
PA	$2,069,152,946	4,133	$2,706	$2,193,635,123	4,258	$2,840	6.02%	4.95%
CT	$691,868,051	1,420	$2,573	$725,219,999	1,475	$2,621	4.82%	1.86%
MN	$644,518,723	1,261	$1,720	$760,023,280	1,287	$2,005	17.92%	16.56%
NY	$3,662,420,303	6,061	$2,124	$3,436,575,824	6,259	$1,949	-6.17%	-8.24%
CA	$5,132,766,008	9,103	$1,631	$5,477,694,813	9,096	$1,729	6.72%	6.00%
US	$35,733,566,196	62,996	$1,669	$36,736,017,517	64,736	$1,683	2.81%	0.85%
IL	$1,116,993,470	2,251	$1,310	$1,197,971,579	2,343	$1,386	7.25%	5.83%
NH	$115,460,555	225	$1,284	$122,472,915	230	$1,359	6.07%	5.77%
TX	$1,643,831,655	3,411	$877	$1,783,589,827	3,567	$927	8.50%	5.65%

Massachusetts Research Organization Receiving $100M+ in NIH Funding, 2022[15]

Organizations Receiving $100M+ in NIH Funding	Awards	Funding
Massachusetts General Hospital	1,025	$559,991,048
Brigham and Women's Hospital	662	$381,969,300
Boston Children's Hospital	432	$215,757,651
Broad Institute, Inc.	98	$195,517,769
UMass Medical School – Worcester	349	$179,947,334
Boston University Medical Campus	307	$179,383,577
Harvard Medical School	362	$175,093,320
Dana-Farber Cancer Institute	252	$157,744,606
Harvard School Of Public Health	173	$139,146,846
Beth Israel Deaconess Medical Center	228	$126,775,422
Massachusetts Institute of Technology	269	$117,827,905

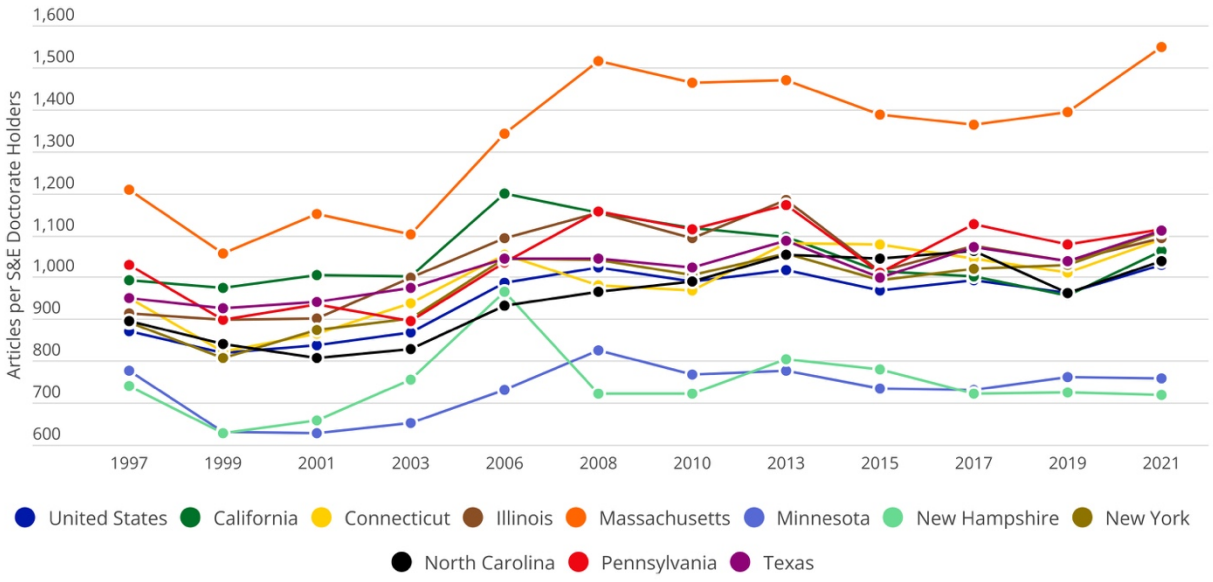
KEY TAKEAWAYS:

- Massachusetts is a leading hub for healthcare related research.
- In 2022, Massachusetts received $3.3 billion in National Institutes of Health (NIH) funding (third among LTS).
- Massachusetts received $5,430 of NIH funding per $1 million GDP (first in LTS).
- 11 research institutions in Massachusetts received more than $100 million in NIH funding in 2020. Massachusetts General Hospital alone attracted nearly $560 million through over 1,000 awards.

Science and Engineering (S&E) Academic Article Output per Million Residents[13] Massachusetts, U.S. and LTS, 2021

	S&E Article Output per Million Residents
United States	1,100
California	1,057
Connecticut	1,799
Illinois	1,203
Massachusetts	3,601
Minnesota	900
New Hampshire	985
New York	1,487
North Carolina	1,248
Pennsylvania	1,578
Texas	862

Science and Engineering (S&E) Academic Article Output per 1,000 S&E Doctorate Holders[13] Massachusetts and LTS, 1997-2021



INTELLECTUAL CAPITAL FUELS COMMERCIALIZATION AND COMPANY GROWTH

Utility patents provide a gauge of the innovation and unique idea generation present in an economy. High levels of patenting activity indicate an active R&D enterprise combined with the capacity to codify and translate research into ideas with commercial potential. While not all utility patents turn into new products, they often lead to new products or advanced versions of existing products or services. Further, in many cases, patented technology forms the basis for business creation. Technology patents are a subset of utility patents in fields that align with the innovation sectors tracked by the *Index* and can be of particularly high value for business growth as they are more likely to be applied to products with new capabilities not seen in the marketplace. Academic articles are an indicator of research activity at very early stages and sometimes prove to be the basis for a patented technology that is eventually commercialized.

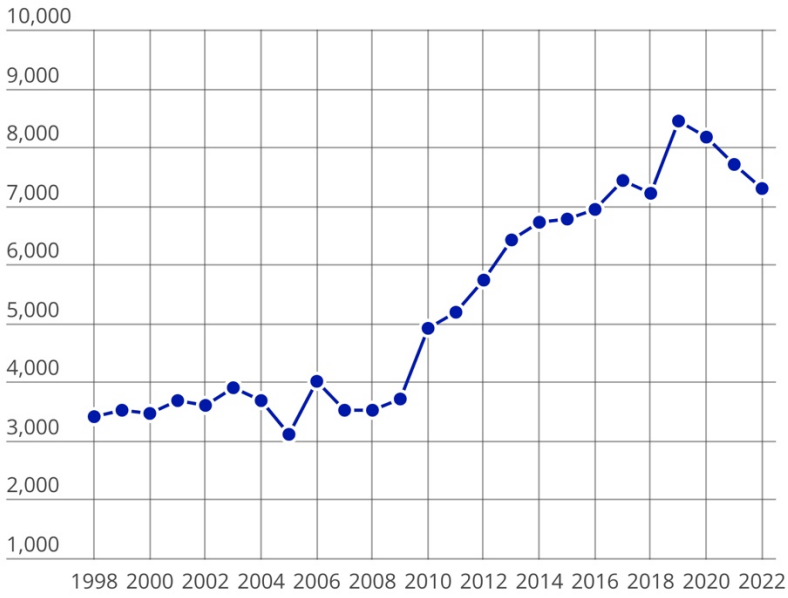
Percent Change in Utility Patents Issued per Million Residents[11]
Massachusetts, LTS and U.S., 2017-2022

State	2017 Utility Patents Per 1M Residents	2022 Utility Patents Per 1M Residents	Percent Change in Utility Patents 2017 - 2022
California	1,067	1,045	-2.11%
Connecticut	685	677	-1.18%
Illinois	402	351	-12.55%
Massachusetts	1,083	1,046	-3.41%
Minnesota	801	603	-24.71%
New Hampshire	763	579	-24.11%
New York	469	353	-24.64%
North Carolina	357	306	-14.12%
Pennsylvania	332	303	-8.62%
Texas	373	364	-2.37%

KEY TAKEAWAYS:

- 7,305 utility patents were issued in Massachusetts in 2022 (third in the LTS).
- After a dramatic increase in 2019 to 8,454 patents granted, patent activity in Massachusetts has gradually declined back to levels seen in the years prior to 2019 (down 13% 2019-2022).
- Massachusetts is the leading producers of patents per capita among the LTS, with 1,046 utility patents per million residents in 2022.
- The Commonwealth is also the top producer of technology patents among the LTS, with 871 per million residents.
- Massachusetts leads the LTS in all categories of technology patents per million residents aside from manufacturing and manufacturing processes.
- Massachusetts has led the LTS in Science and Engineering (S&E) articles produced per 1,000 S&E doctorate holders since 1997, producing 1,549 articles per 1,000 S&E doctorate holders in academia in 2021, 39% more than second place Pennsylvania.

Utility Patents Issued[11]
Massachusetts, 1998-2022



Capital

Capital is the third pillar of the Massachusetts Innovation Economy. While the Commonwealth is a national leader in the quality of its workforce and R&D, it faces fierce competition for these resources. Other states have skilled workforces and/or cutting-edge research institutions but very few states can combine these assets with access to capital. Capital is the critical factor that allows a skilled workforce to turn cutting-edge research into new or expanded businesses, thereby creating jobs and providing innovative products and services. Access to various sources of capital is important for the growth of innovative businesses whose needs vary at each stage of the growth cycle. Massachusetts performs well across the capital spectrum, from grant funding to seed and early-stage investments to growth capital and initial public offerings (IPOs).

SMALL BUSINESS INNOVATION RESEARACH AND SMALL BUSINESS TECHNOLOGY TRANSFER (SBIR & STTR) PROGRAMS ATTRACT PROOF OF CONCEPT CAPITAL

What is SBIR/STTR?

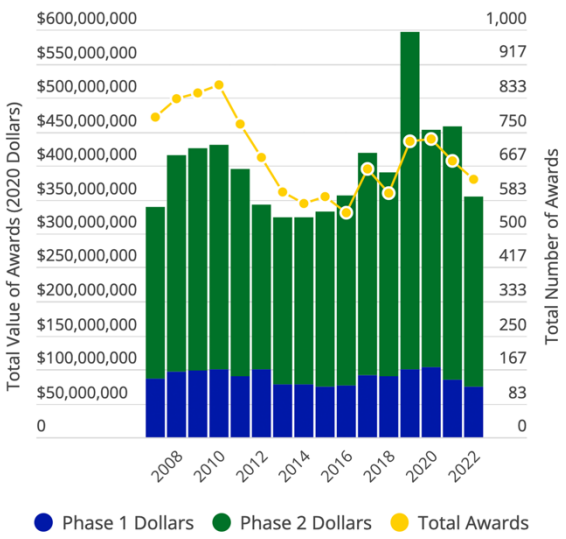
The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs are highly competitive federal grant programs that enable small companies to conduct proof-of-concept (Phase 1) research on technical merit and idea feasibility and prototype development (Phase 2) that builds on Phase 1 findings. Unlike many other federal research grants and contracts, SBIR and STTR grants are reserved for applicant teams led by for-profit companies with fewer than 500 employees. Participants in the SBIR and STTR programs are often able to use the credibility and experimental data developed through their research to design commercial products and to attract strategic partners and investment capital.

The number and value of Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards that go to the Commonwealth's businesses are excellent indicators of the ability of the R&D in Massachusetts to attract proof of concept capital.

KEY TAKEAWAYS:

- Massachusetts received the second most SBIR/STTR awards in the nation in 2022 with 634 awards totaling $353.6 million.
- Massachusetts received the highest SBIR/STTR award funding relative to GDP, with $585 worth of funding per $1 million in GDP. New Hampshire is second with $497 per $1 million GDP.

SBIR AND STTR Awards[17]
Total Number of Awards and Value (by Phase) of Awards Granted
Massachusetts, 2007-2022



Year	Phase 1 Dollars	Phase 2 Dollars	Total Awards
2007	$85,942,047	$253,160,803	784
2008	$96,388,879	$318,498,988	830
2009	$97,499,432	$327,691,064	844
2010	$99,446,782	$330,976,874	863
2011	$90,094,397	$305,526,503	769
2012	$99,986,939	$242,292,607	686
2013	$78,613,672	$245,049,425	603
2014	$77,373,046	$247,000,433	573
2015	$74,975,259	$257,211,070	591
2016	$76,003,487	$279,978,870	551
2017	$90,749,274	$327,436,563	659
2018	$89,173,362	$300,871,529	599
2019	$99,799,660	$497,132,392	726
2020	$103,372,532	$349,366,561	731
2021	$84,910,337	$372,401,050	679
2022	$74,878,377	$278,721,229	634

SBIR AND STTR Obligation Funding[17]
Massachusetts and LTS, 2022

State	2017 Total Funding	2022 Total Funding	2017 Funding Per $1M GDP	2022 Funding Per $1M GDP	2017 - 2022 Total Funding Percent Change	2017 - 2022 Per $1M GDP Percent Change
California	$810,969,307	$746,312,176	$258	$236	-7.97%	-8.59%
Massachusetts	$418,185,837	$353,599,606	$707	$585	-15.44%	-17.19%
Texas	$147,679,598	$203,151,163	$79	$106	37.56%	33.95%
Pennsylvania	$146,880,102	$179,532,189	$192	$232	22.23%	21.01%
New York	$153,871,365	$176,984,661	$89	$100	15.02%	12.47%
North Carolina	$118,423,993	$125,645,741	$198	$206	6.10%	4.05%
Illinois	$75,307,202	$98,252,106	$88	$114	30.47%	28.74%
Minnesota	$58,366,867	$51,082,737	$156	$135	-12.48%	-13.49%
New Hampshire	$56,855,821	$44,760,952	$633	$497	-21.27%	-21.50%
Connecticut	$32,269,979	$37,361,042	$120	$135	15.78%	12.50%

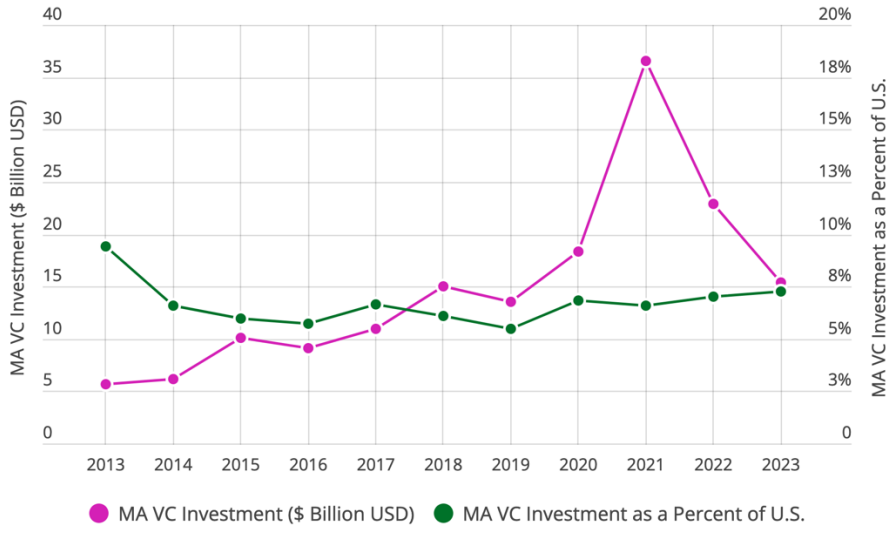
VENTURE CAPITAL (VC) ACCELERATES THE INNOVATION ECONOMY

The wealth of talent and R&D activity in the state makes Massachusetts an attractive destination for investors. VC firms provide an important source of funds for the creation and development of high-growth companies that accelerate the Massachusetts Innovation Economy. VC investment is a critical metric for the health of any innovation ecosystem as it signals the translation of new ideas into commercial products and services as well as their potential for growth. However, VC investment is subject to occasional boom and bust cycles, both overall and for certain technologies.

KEY TAKEAWAYS:

- The Commonwealth's share of U.S. VC investment has ticked up since 2009, rising from below 6% to nearly 8% in 2022.
- VC investment in Massachusetts has fallen from record highs in 2021, dropping by 58% to $15.33B in 2023. 2023 VC investment in Massachusetts is still higher than any year prior to 2020 and declined at a slightly slower rate than U.S. VC investment (down 61%).
- Only Massachusetts and California have higher levels of VC investment in 2023 than they did pre-pandemic with the Commonwealth being up most relative to 2019 (+13%).
- The Commonwealth is third nationally in VC investment, behind California and New York.
- Massachusetts is 4th among the LTS in both Angel/Crowdfunding investment dollar amount and number of deals over the last 5 years.

Venture Capital Investment[18]
Total ($ Billions) and as a percent of U.S.
Massachusetts, 2013-2023



Venture Capital Investment[18]
Massachusetts and LTS, 2013 and 2019-2023

State	2013	2019	2020	2021	2022	2023	2013-2023 Change	2019-2023 Change
California	$22.68B	$71.84B	$94.53B	$171.28B	$104.08B	$78.52B	246%	9.3%
New York	$4.53B	$31.15B	$25.71B	$73.31B	$31.29B	$17.28B	281%	-44.5%
Massachusetts	$5.70B	$13.58B	$18.39B	$36.60B	$22.94B	$15.33B	169%	12.9%
Texas	$3.75B	$6.95B	$8.19B	$16.09B	$11.34B	$6.96B	85%	0.1%
Illinois	$1.18B	$4.60B	$5.04B	$8.65B	$11.01B	$2.76B	133%	-40.1%
Pennsylvania	$954.59M	$4.63B	$3.28B	$6.66B	$5.03B	$2.02B	112%	-56.3%
North Carolina	$929.57M	$2.36B	$4.02B	$4.76B	$5.04B	$1.66B	78%	-29.9%
Minnesota	$612.85M	$2.14B	$2.78B	$3.57B	$2.16B	$1.16B	89%	-45.8%
Connecticut	$457.00M	$1.15B	$1.52B	$2.88B	$3.24B	$694.60M	52%	-39.6%
New Hampshire	$185.01M	$319.77M	$234.53M	$244.12M	$606.14M	$294.86M	59%	-7.8%

Venture Capital Investment: Crowdfunding and Angel Investing Number of Deals, Dollar Total of Deals and Average Deal Size[18]
Massachusetts and LTS, 2019-2023

State	Number of Deals	Dollar Total of All Deals	Average Deal Size
California	2,913	$2.55B	$0.88M
New York	1,219	$821.70M	$0.67M
Texas	882	$658.15M	$0.75M
Massachusetts	435	$238.55M	$0.55M
Illinois	325	$166.67M	$0.51M
Pennsylvania	318	$155.52M	$0.49M
North Carolina	305	$137.15M	$0.45M
Connecticut	138	$112.28M	$0.81M
Minnesota	178	$79.18M	$0.44M
New Hampshire	43	$33.69M	$0.78M

INITIAL PUBLIC OFFERINGS (IPOs) AND MERGERS AND ACQUISITIONS (M&As) INDICATE MATURATION OF INNOVATIVE COMPANIES

The exit of startups from their initial phases is also important information for venture capitalists. The prevalence of businesses that exit the startup lifecycle through IPOs or M&As can be an attractive metric as investors consider their return prospects. IPOs and M&As represent important business outcomes through which emerging companies can access capital, expand operations, and support business growth beyond their private funding rounds. IPOs and M&As are opportunities for early-stage investors to liquidate their investments and free up capital for future investment. IPOs of venture-backed companies can reflect investor confidence in the market.

Number of Companies Acquiring Others[19]
Massachusetts and LTS, 2018-2022

Number of Companies Acquiring Others by State	2018	2019	2020	2021	2022
California	848	845	825	1278	1140
Connecticut	72	48	64	98	84
Illinois	267	258	207	409	374
Massachusetts	280	265	260	412	314
Minnesota	97	75	60	119	85
North Carolina	99	94	82	187	127
New York	408	389	353	644	499
New Hampshire	17	10	14	18	13
Pennsylvania	146	150	119	211	172
Texas	334	268	238	456	409

Number of Companies Being Acquired[19]
Massachusetts and LTS, 2018-2022

Number of Companies Acquired by State	2018	2019	2020	2021	2022
California	881	806	747	1235	997
Connecticut	52	60	50	81	82
Illinois	166	148	155	259	226
Massachusetts	221	211	205	325	254
Minnesota	70	77	64	100	101
North Carolina	95	77	81	144	124
New York	231	227	203	388	241
New Hampshire	22	15	13	28	27
Pennsylvania	142	134	111	190	200
Texas	282	257	228	424	311

Number of Initial Public Offerings (IPOs) [19]
Massachusetts and LTS, 2019-2023

Number of IPOs by State	2019	2020	2021	2022	2023	2023 IPO Total Dollars
California	75	76	164	58	33	$3,243,260,004
Massachusetts	18	30	49	18	11	$918,715,000
Illinois	8	4	13	4	2	$0
New York	28	24	55	7	11	$1,307,065,013
Pennsylvania	14	11	15	4	4	$192,000,000
Texas	11	19	22	12	11	$513,716,139
North Carolina	2	1	8	3	2	$249,860,000
Minnesota	4	2	10	3	3	$30,430,000
Connecticut	7	1	7	1	2	$27,000,000
New Hampshire	1	2	0	0	2	$1,250,000

Note: The two IPOs for IL in 2023 don't have reported dollar totals

KEY TAKEAWAYS:

- Massachusetts is tied with New York and Texas for the second highest number of IPOs.
- In 2023, Massachusetts companies raised $918 million through IPOs, placing third among the LTS, behind California ($3.2 billion) and New York ($1.3 billion).
- The largest 2023 IPO in Massachusetts was for marketing automation company Klaviyo which raised $576,000,000.
- 307 Massachusetts companies acquired another firm in 2023. Since 2018, more Massachusetts companies have acquired another firm than been acquired themselves.

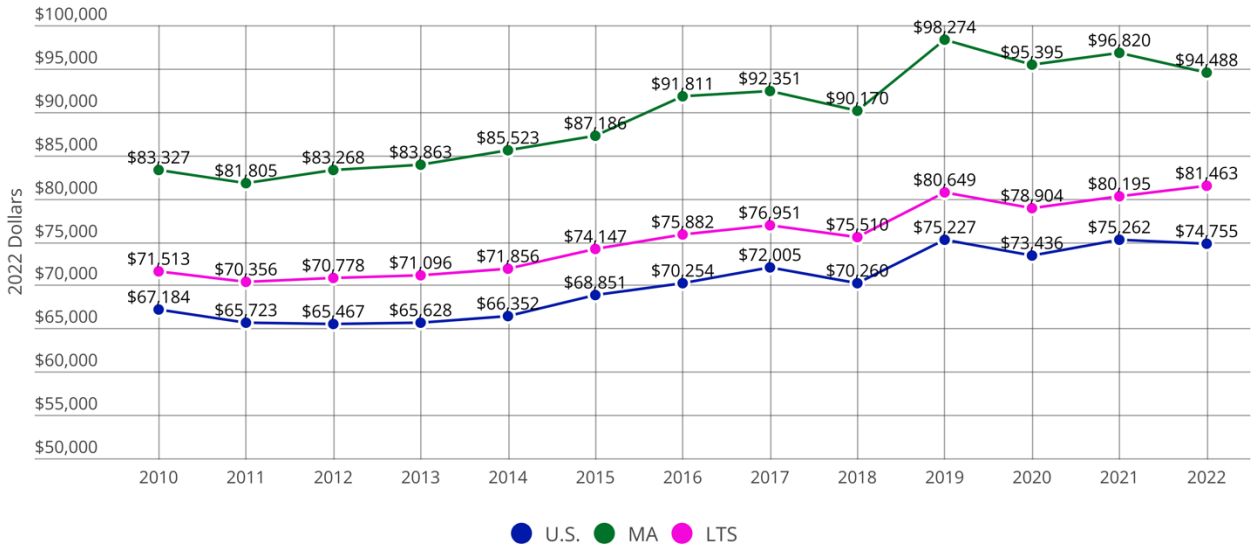
Economic Impact

The combination of world-class talent, R&D capabilities, and access to capital gives Massachusetts a competitive advantage among innovation ecosystems. This trifecta attracts business formation and expansion in the state and has considerable benefits for the economy and people of Massachusetts through higher incomes, new industry clusters and tax revenue to support public investments.

HIGH WAGES FOR MASSACHUSETTS RESIDENTS AND FAMILIES

The Innovation Economy tends to create jobs that pay more than positions in other sectors of the economy. Household income and wages in most occupations demonstrate this and are significantly higher than in the average LTS or the whole U.S.

Median Household Income[20]
Massachusetts, LTS and U.S., 2010-2022



Percentage of Households by Income Level[21]
Massachusetts, LTS and U.S., 2022

Household Income	MA	LTS Average	U.S.
Under $35,000	20.02%	22.21%	23.25%
$35,000- $99,999	32.29%	37.66%	39.72%
Above $100,000	47.69%	40.13%	37.03%

KEY TAKEAWAYS:

- The Commonwealth's median household income declined in real terms in 2022 to 94,488 (-2.4%) due to persistent inflation at the national level.
- Median household income in Massachusetts is significantly higher than both the U.S. median of $74,755 and the LTS average of $81,463. California ($91,551) is the only other state among the LTS to have a median household income above $90,000. This is offset partially by the Commonwealth's above average cost of housing.
- Despite the Commonwealth experiencing declining real household income since 2019, neither the LTS average nor U.S. median has reached that of the Commonwealths circa 2010.
- The percentage of households earning more than $100,000 (48%) is higher in Massachusetts than in any of the LTS and 10+ percentage points higher than the whole U.S.

Average Wages by Occupation[23]
Massachusetts, LTS and U.S., 2022

Occupation	Massachusetts	U.S.	LTS
All Occupations	$76,600	$61,900	$66,432
Arts and Media	$84,840	$76,500	$87,902
Construction and Maintenance	$70,428	$57,069	$60,468
Education	$75,950	$63,240	$68,169
Healthcare	$80,234	$70,515	$70,703
Computer and Mathematical	$118,510	$108,130	$116,486
Science, Architecture, and Engineering	$101,456	$90,850	$95,999
Other Services	$44,711	$39,287	$41,051
Community and Social Services	$58,470	$55,760	$59,139
Production	$49,200	$45,370	$46,403
Business, Financial, and Legal	$130,415	$109,771	$118,242
Sales and Office	$55,019	$47,545	$50,569

KEY TAKEAWAYS:

- Comparatively, wages in Massachusetts are generally higher than those of the U.S. and the LTS in 10 of the 11 occupational categories tracked by the *Index*, the only exception being Community and Social Services.
- The Commonwealth's high concentration of tech and other knowledge workers is a major driver of the high wage level in the state. The difference between overall wages in Massachusetts and the U.S. is higher than the difference for any individual occupation group aside from business, financial and legal.

INNOVATION ECONOMY EMPLOYMENT, WAGES AND OUTPUT: SEEING THE IMPACT OF THE PANDEMIC

Technology and knowledge-intensive industry sectors critical to the Innovation Economy lead the way in increasing prosperity through high-paying jobs across the state. Increased employment concentration in these sectors indicates a competitive advantage for Massachusetts and the potential for future economic growth.

Employment and Annual Average Wage in Key Sectors[23]
Massachusetts, 2017-2022 and 2021-2022

Sectors	2017 Employment	2021 Employment	2022 Employment	2017-2022 Percentage Employment Change	2021-2022 Percentage Employment Change	2017 Average Wage	2021 Average Wage	2022 Average Wage	2017-2022 Percentage Wage Change	2021-2022 Percentage Wage Change
Advanced Materials	28,399	27,219	27,755	-2.30%	2.00%	$2,006,874,549	$2,138,548,444	$2,257,685,337	12.50%	5.60%
Biopharma & Medical Devices	74,829	97,640	106,569	42.40%	9.10%	$11,056,436,710	$20,608,330,101	$20,638,981,621	86.70%	0.10%
Business Services	156,487	157,276	158,509	1.30%	0.80%	$17,828,942,539	$21,285,883,512	$21,999,336,472	23.40%	3.40%
Computer & Communications Hardware	33,494	29,040	28,234	-15.70%	-2.80%	$4,338,053,220	$4,132,452,451	$4,015,632,572	-7.40%	-2.80%
Defense Manufacturing & Instrumentation	35,803	36,538	36,068	0.70%	-1.30%	$4,115,402,094	$4,708,324,767	$4,633,520,197	12.60%	-1.60%
Diversified Industrial Manufacturing	38,041	36,176	37,278	-2.00%	3.00%	$3,097,901,878	$3,301,232,797	$3,504,611,779	13.10%	6.20%
Financial Services	160,186	156,839	157,372	-1.80%	0.30%	$24,616,646,679	$28,839,433,847	$30,833,496,982	25.30%	6.90%
Healthcare Delivery	390,697	387,648	392,015	0.30%	1.10%	$27,490,065,120	$31,184,189,496	$32,891,950,439	19.70%	5.50%
Postsecondary Education	158,667	156,686	164,838	3.90%	5.20%	$10,820,848,460	$12,003,141,115	$12,961,708,089	19.80%	8.00%
Scientific, Technical & Management Services	90,873	109,370	115,678	27.30%	5.80%	$10,998,917,726	$15,855,109,026	$17,749,507,071	61.40%	11.90%
Software & Communications Services	176,487	184,615	189,627	7.40%	2.70%	$23,025,111,226	$31,448,690,550	$31,957,217,724	38.80%	1.60%

KEY TAKEAWAYS:

- Innovation economy employment grew by 2.5% in Massachusetts in 2022, sixth among the LTS.
- Employment grew in nine of 11 Innovation economy sectors in Massachusetts. Five states experienced employment growth across all sectors (California, New Hampshire, New York, Pennsylvania, Texas).
- Inflation adjusted wages rose in nine of 11 Innovation economy sectors in Massachusetts 2022 and are higher than the Commonwealth's median household income in seven of 11 sectors.
- Inflation adjusted wages are up in 10 of 11 innovation economy sectors in Massachusetts since 2017, all by double digits.
- Biopharmaceuticals and Medical Devices wages are up nearly 87% since 2017.

Employment Growth in Key Sectors[22]
Massachusetts and LTS, 2021-2022

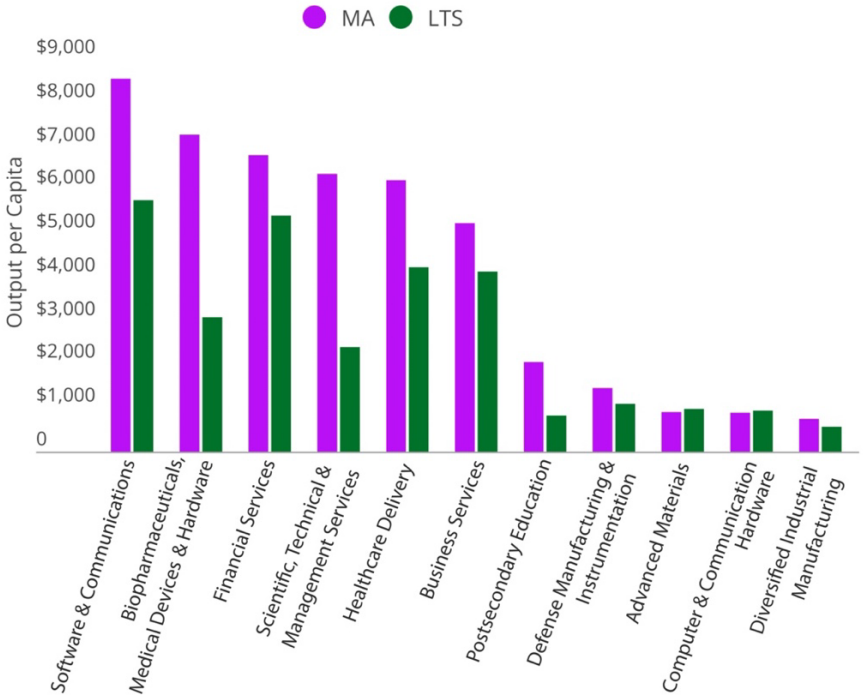
Employment Growth in Key Sectors
Massachusetts & LTS, 2021 - 2022

State	Advanced Materials	Biopharma and Medical Devices	Business Services	Computer and Communications Hardware	Defense Manufacturing and Instrumentation	Diversified Industrial Manufacturing	Financial Services	Healthcare Delivery	Postsecondary Education	Scientific, Technical and Management Services	Software and Communications Services	Total IE
California	3.1%	5.4%	2.7%	4.5%	6.9%	3.7%	1.5%	2.2%	5.3%	8.4%	2.7%	3.6%
Connecticut	1.7%	4.7%	1.9%	2.4%	0.1%	2.5%	-0.2%	1.5%	4.1%	6.8%	-1.8%	1.6%
Illinois	2.6%	2.5%	1.3%	-0.1%	1.1%	1.8%	1.2%	1.9%	2.6%	5.8%	4.0%	2.3%
Massachusetts	2.0%	9.1%	0.8%	-2.8%	-1.3%	3.0%	0.3%	1.1%	5.2%	5.8%	2.7%	2.5%
Minnesota	2.6%	5.7%	0.3%	1.0%	2.8%	4.8%	-1.8%	-0.1%	2.4%	8.3%	2.6%	1.4%
New Hampshire	1.7%	6.4%	7.5%	2.6%	2.8%	5.2%	13.3%	1.5%	0.8%	11.3%	5.5%	4.8%
New York	3.5%	6.0%	4.0%	2.5%	2.4%	3.3%	2.8%	3.2%	3.8%	8.6%	2.4%	3.6%
North Carolina	5.2%	7.2%	6.2%	4.5%	-10.9%	1.6%	6.9%	1.0%	3.7%	8.8%	9.2%	4.4%
Pennsylvania	4.0%	3.7%	3.4%	0.2%	0.5%	2.7%	1.0%	1.4%	3.7%	8.1%	5.2%	2.8%
Texas	5.9%	5.5%	8.2%	6.9%	3.7%	9.4%	7.4%	3.0%	4.3%	11.1%	12.2%	6.5%

Output in Key Sectors[24]
Massachusetts, 2019, 2021 and 2022
$ Millions

Key Sectors	2019	2021	2022	2019-2022 Dollars Growth	2021-2022 Dollars Growth	2019-2022 Percentage Growth	2021-2022 Percentage Growth
Software and Communication Services	$45,381	$56,792	$59,782	$14,401	$2,990	31.7%	5.3%
Biopharmaceuticals, Medical Devices and Hardware	$41,963	$48,479	$50,816	$8,853	$2,338	21.1%	4.8%
Financial Services	$45,101	$45,914	$47,528	$2,427	$1,614	5.4%	3.5%
Scientific, Technical and Management Services	$33,921	$42,427	$44,515	$10,594	$2,088	31.2%	4.9%
Healthcare Delivery	$41,869	$43,120	$43,510	$1,641	$390	3.9%	0.9%
Business Services	$34,377	$36,417	$36,622	$2,244	$205	6.5%	0.6%
Postsecondary Education	$14,236	$13,615	$14,354	$118	$739	0.8%	5.4%
Defense Manufacturing and Instrumentation	$10,513	$10,382	$10,210	-$303	-$172	-2.9%	-1.7%
Advanced Materials	$6,360	$6,695	$6,352	-$9	-$343	-0.1%	-5.1%
Computer and Communication Hardware	$6,580	$6,446	$6,240	-$339	-$205	-5.2%	-3.2%
Diversified Industrial Manufacturing	$5,287	$5,427	$5,235	-$52	-$192	-1.0%	-3.5%

Output per Capita in Key Industry Sectors[24]
Massachusetts and LTS, 2022



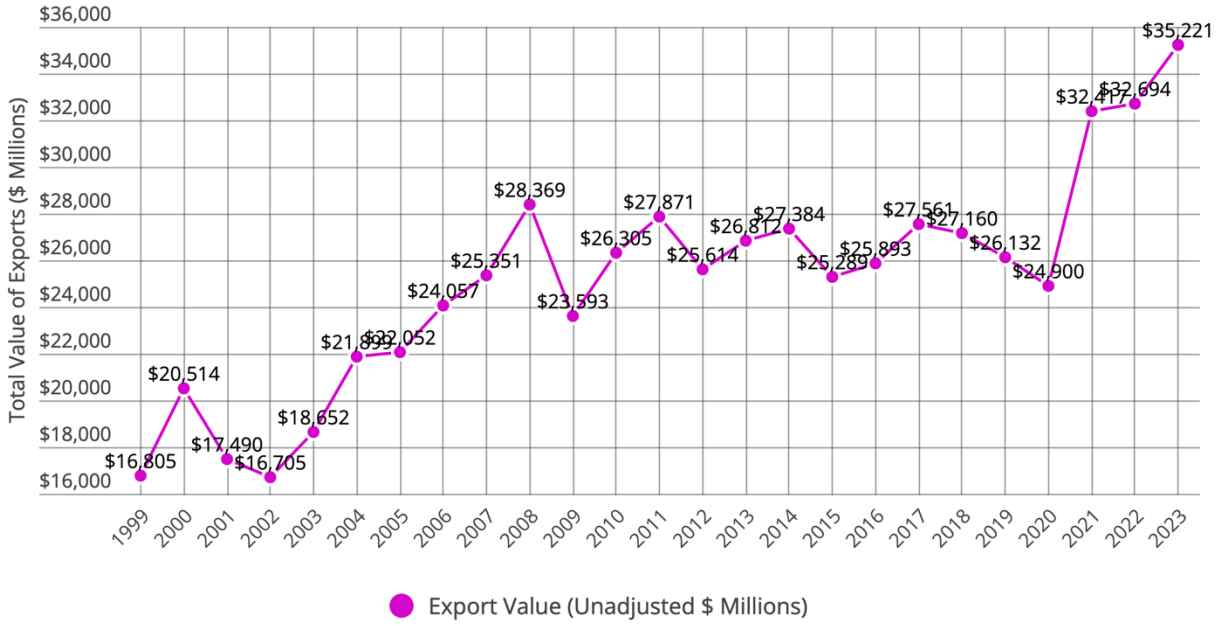
KEY TAKEAWAYS:

- Massachusetts Innovation Economy output grew in seven of 11 sectors tracked by the *Index* in 2022. Output is still below 2019 in four sectors.
- The Commonwealth's GDP grew by 2.1% in 2022 and is 6.6% larger than it was pre-pandemic.
- Five of the Commonwealth's Innovation economy sectors grew faster than the economy in 2022.
- Innovation Economy output per capita in Massachusetts is higher than the LTS average in nine of 11 sectors with the exceptions being Advanced Materials, and Computer and Communications Hardware Manufacturing.

EXPORTS BRING MASSACHUSETTS' INNOVATIONS TO THE WORLD

Exports are an indicator of global competitiveness and selling into global markets can bolster growth in sales and employment. In addition, diversity in export markets and products can offset domestic economic downturns. Nearly all of Massachusetts' top 25 exports are produced within the Innovation Economy. Export data do not capture the full extent of the Commonwealth's global reach. These data have historically struggled to capture service exports, such as software design and technical consulting. Additionally, people from around the world travel to Massachusetts for education and health care, activities that are functionally similar to exports but are not captured in the data.

Total Value of Exports[25]
Massachusetts, 1999-2021
Unadjusted ($ Millions)



KEY TAKEAWAYS:

- Exports reached their highest level on record in 2023, largely due to a more than $7 billion increase in pharmaceutical exports. Two of the primary COVID-19 vaccines used in the United States and globally, Moderna and Pfizer, are manufactured in the Commonwealth.
- Pharmaceuticals have grown from 8% of the Commonwealth's exports in 2020 to more than 25% in 2023.

Appendix

The 2023 edition of the *Index* (data gathered 2023 and earlier) tracks a selection of categories that MassTech and its *Index* Advisory Committee view as being the most comprehensive set of data for benchmarking the Innovation Economy. Category choices can change from year-to-year as new data sources become available and best-practices in tracking economic data are updated. MassTech and the *Index* Advisory Committee review the selection of categories each year to determine whether to add or remove any sections and whether better sources of data are available.

Data Sources for Categories and Selection of Leading Technology States (LTS)

I. **Note on Data Availability:** Categories are calculated with data from proprietary and other existing secondary sources. In most cases, data from these sources were organized and processed for use in the *Index*. Since these data are derived from a wide range of sources, content of the data sources and timeframes are not identical and cannot be compared without adjustments. This appendix provides information on the data sources for each category. The *Index* always displays the most recent year of data available for data at the time of writing.

II. **Note on Price Adjustment:** The *Index* uses inflation-adjusted figures for most data. Dollar figures represented in this report, where indicated, are 'chained' (adjusted for inflation) to the latest year of data unless otherwise indicated. Price adjustments are according to the Consumer Price Index for all urban consumers, U.S. city average, all items, not seasonally adjusted. Bureau of Labor Statistics, U.S. Department of Labor (bls.gov/data).

III. **Note on Per-Capita Comparisons:** The *Index* makes frequent use of per-capita metrics to make meaningful comparisons between states of vastly different sizes since the Leading Technology States (LTS) range from roughly one million people to nearly 40 million.
Per-capita or "as a percent of" metrics allow the *Index* to make comparisons on density in certain measures, which MassTech views as crucial to cluster formation and growth. Where performance is less tied to a state's population, the *Index* includes absolute figures as well.

IV. **Note on Selection of LTS for Benchmarking Massachusetts' Performance:** The *Index* benchmarks Massachusetts' performance against other leading states and nations to provide the basis for comparison. In 2023, the LTS were chosen using three criteria: (i) by the number of select key industry sectors with a high concentration (10% above average) of employment, (ii) the percent of employment in these sectors, and (iii) the size of each states' Innovation Economy (measured by number of employees). The sectors used to represent the Innovation Economy include:
    - **a** Advanced Materials
    - **b** Biopharma & Medical Devices
    - **c** Business Services
    - **d** Computer & Communication Hardware
    - **e** Defense Manufacturing & Instrumentation
    - **f** Diversified Industrial
    - **g** Financial Services
    - **h** Healthcare Delivery
    - **i** Postsecondary Education
    - **j** Scientific, Technical, & Management Services

k Software & Communications Services.

The sector employment concentration for each state measures sector employment as a percent of total employment to the same measure for the U.S. This ratio, called the "Location Quotient" (LQ), is above average if greater than one. The three criteria are assessed simultaneously and with equal weighting. The score assigned to each state for each criterion is between zero and one, with one going to the leading state and zero going to the bottom state. The scores for the rest of the states are determined by their relative position within the spread of data. The criteria scores are added together to get an overall score. The states with the 10 highest overall scores are then chosen for the LTS. The Innovation Economy Score is used only to select the LTS as described above, it does not reflect performance on all data used in the *Index*.

V. **Note on Selection of Comparison Nations:** For all the data that include international comparisons, countries displayed on the table are the top performers for that measure. Some countries were excluded from comparison due to a lack of data reported for required years.

VI. **Note on Data Timeframes:** The *Index* uses multiple time intervals when looking at data within the categories, but generally shows five years or 10 years of change from a base year (i.e. 2010-2015 or 2005-2015). Depending upon space and data availability, sometimes all data collected by MassTech from a series are displayed.

Leading Technology States (LTS), 2023

State	LTS Score	Number of IE Jobs	Percent of Jobs in IE	Number of Key Sectors with LQ Above 1.1
Massachusetts	2.26	1,413,943	39.32%	8
California	2.15	5,346,270	29.86%	5
Pennsylvania	1.96	1,985,273	33.86%	7
New York	1.85	3,194,162	34.48%	4
Texas	1.59	4,097,760	30.93%	5
North Carolina	1.56	1,525,013	32.45%	4
Minnesota	1.49	950,825	33.32%	4
Illinois	1.45	1,863,352	31.48%	5
New Hampshire	1.41	231,372	34.50%	5
Connecticut	1.38	576,366	35.09%	5

CATEGORY: TALENT

PUBLIC INVESTMENT IN EDUCATION

[1]Per Pupil Spending in K-12

Public elementary and secondary school finance data is from the U.S. Census Bureau, "Per Pupil (PPCS) Amounts and One-Year Percentage Changes for Current Spending of Public Elementary-Secondary School Systems by State." Figures are presented in current dollars. Data excludes payments to other school systems and non-K-12 programs (ncsesdata.nsf.gov).

[2]State Higher Education Appropriations per Full-Time Equivalent (FTE)

Data on public higher education appropriations per full-time equivalent (FTE) student is provided by the State Higher Education Executive Office (shef.sheeo.org). The data considers only educational appropriations, state and local funds available for public higher education operating expenses, excluding spending for research, agriculture, and medical education, and support to independent institutions and students. The State Higher Education Finance Report employs three adjustments for purposes of analysis: Cost of Living Adjustment (COLA) to account for differences among the states, Enrollment Mix Index (EMI) to adjust for the different mix of enrollments and cost among types of institutions across the states, and the Higher Education Cost Adjustment (HECA) to adjust for inflation over time. More detailed information about each of these adjustments can be found on the State Higher Education Executive Officers (SHEEO) website.

[3]4th and 8th Grade Science and Mathematics Performance

National Science Foundation's State Indicators for Science and Engineering (2015|2017).

[4]SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) CAREER CHOICES AND DEGREES

STEM degrees data about degrees conferred by field of study are from National Center for Education Statistics (NCES), Integrated Postsecondary Education Data System (IPEDS) Completions Survey using the NSF population of institutions (nces.ed.gov/ipeds/use-the-data). Fields are defined by two-digit Classification of Instructional Program (CIP), listed below:

- Biological and Biomedical Sciences
- Physical Sciences
- Computer and Information Science and Support Services
- Engineering
- Mathematics and Statistics

STEM degrees and International Science & Engineering data for STEM degrees and Science and Engineering (S&E) talent are provided by the Institute of Education Sciences (IES) through the Integrated Postsecondary Education Data System (IPEDS), using the National Science Foundation's (NSF) population of institutions by searching completions by non-residents and filtering for STEM classification codes.

[5]EDUCATIONAL ATTAINMENT

For this indicator, the workforce is defined as the population ages 18 and over. Data on educational attainment of this population is from the U.S. Census Bureau (data.census.gov/mdat/#/), American Community Survey. College degrees conferred data for the U.S. states come from the National Center for Education Statistics using the sum of all degrees conferred at the bachelor's level or higher.

[6]TALENT FLOW AND ATTRACTION

Relocations to LTS by College Educated Adults data on population mobility come from the U.S. Census Bureau, American Community Survey; Geographic Mobility in the Past Year by Educational Attainment, one-year estimate. This is the number of people moving in and includes no information about the number moving out. It can be used as a measure of the ability to attract talent. Net migration figures are derived from the U.S. Census Bureau's population estimates program using annual data.

[7]DIVERSITY

Demographics of Individuals in the Workforce, All Occupations, comes from the U.S. Census Bureau, American Community Survey; Occupation by Sex for the Civilian Employed Population 16 Years and Over. This is the percentage of individuals 16 years and older in the workforce that hold computer, engineering, and science occupations by sex.

CATEGORY: RESEARCH

RESEARCH AND DEVELOPMENT

[8]Research and Development (R&D) Performed
Data is from the National Science Foundation (NSF), "Table: U.S. Research and Development Expenditures, by State, Performing Sector and Source of Funding." Data used are the totals for all R&D, Federal, Federally Funded R&D Centers and Universities, Business, Universities and Colleges, and Other Nonprofit. (ncsesdata.nsf.gov/webcaspar/ and new ones will be at ncsesdata.nsf.gov/).

[9]Industry Performed Research and Development (R&D) as a Percent of Industry Output
Data on Industry Performed R&D are from the NSF Science and Engineering Indicators, "Table 8-45: Business-Performed R&D as a Percentage of Private-Industry Output, by State."

[10]Research and Development (R&D) as a Percent of Gross Domestic Product (GDP)
Data for Massachusetts' R&D as a percent of GDP is from the NSF, "Table: U.S. Research and Development Expenditures, by State, Performing Sector, and Source of Funding" and the Bureau of Economic Analysis (bea.gov). Data for the LTS are from the NSF National Patterns of R&D Resources, "Table - Research and Development Expenditures, by State, Performing Sector, and Source of Funds." Data used are the totals for all R&D, Federal, FFRDCs, Business, U&C and Other Nonprofit. (https://ncsesdata.nsf.gov/explorer).

[11]UTILITY PATENTS United States Patent and Trademark Office (USPTO) Patents Granted
The count of patents granted by state are from the U.S. Patent and Trademark Office (USPTO). Patents granted are a count of Utility Patents only. The number of patents per year are based on the date patents were granted (uspto.gov). Population estimates are from the U.S. Census Bureau, Population Estimates Branch (data.census.gov/).

[12]TECHNOLOGY PATENTS

The count of patents granted by state and patent class is from the U.S. Patent and Trademark Office (uspto.gov), Patenting by Geographic Region, Breakout by Technology Class. State population data come from the U.S. Census Bureau, Population Estimates Branch. (data.census.gov). The number of patents per year is based on the date the patents were granted. Patent categories were developed by the Innovation Institution at MassTech where they were not already defined by the USPTO.

[13]ACADEMIC ARTICLE OUTPUT

LTS data is from the NSF "Table 8-49 - Academic Science and Engineering Article Output per $1 million of Academic S&E R&D, by State and Table 8-48- Academic S&E Articles per 1,000 S&E Doctorate Holders in Academia by state." International data is from the NSF, "Table 5-27 - S&E Articles in All Fields, by Region/Country/Economy." The NSF obtained its information on science and engineering articles from the Thomson Scientific ISI database. LTS population data are from the U.S. Census Bureau (census.gov/programs-surveys/popest).

FEDERAL FUNDING FOR ACADEMIC AND HEALTH R&D

[14]Federal Expenditures for Academic and Nonprofit Research and Development (R&D)
Data is from the NSF, "Federal Obligations for Research and Development for Selected Agencies, by State and Other Locations and Performer" (ncsesdata.nsf.gov/explorer). Data used are the entries for federal funding for universities and nonprofits, excluding university and nonprofit federally funded research and development centers (FFRDCs).

[15]National Institutes of Health (NIH) Funding per Capita, per GDP and Average Annual Growth Rate
Data on federal health R&D is from the NIH (report.nih.gov/award/index.cfm). The NIH annually computes data on funding provided by NIH grants, cooperative agreements and contracts to universities, hospitals and other institutions. The figures do not reflect institutional reorganizations, changes of institutions, or changes to award levels made after the data are compiled. Population data are from U.S. Census Bureau (data.census.gov/). GDP data are from Bureau of Economic Analysis (bea.gov), U.S. Department of Commerce.

[16]INDUSTRY FUNDING OF ACADEMIC RESEARCH

Data is from the NSF Survey of Research and Development Expenditures at Universities and Colleges and Survey of Research and Development Expenditures at Universities and Colleges, Business Financed Higher Education R&D Expenditures for S&E (ncsesdata.nsf.gov/explorer). Since FY98, respondents have included all eligible institutions. Population data are from U.S. Census Bureau (data.census.gov).

CATEGORY: CAPITAL

[17]SMALL BUSINESS INNOVATION RESEARCH (SBIR) AND TECHNOLOGY TRANSFER (STTR) AWARDS

This includes SBIR award and STTR award data. SBIR/STTR award data are from U.S. Small Business Administration (sbir.gov/sbirsearch/award/all), state population data come from the U.S. Census Bureau, Population Estimates Branch (data.census.gov) and GDP Data is from U.S. Bureau of Economic Analysis (bea.gov).

[18]VENTURE CAPITAL (VC)

Data for total VC investments, VC investments by industry activity, and distribution by stage of financing is provided by Pitchbook (pitchbook.com). VC is collected for All Stages, All Round, All Series for the LTS.

[19]INITIAL PUBLIC OFFERINGS AND MERGERS AND ACQUISITIONS

Initial Public Offerings (IPOs) IPO data is pulled from crunchbase.com, includes all listed as of January 1, 2023. Mergers & Acquisitions (M&As) Data on M&As are from Crunchbase.com. Crunchbase.com data tends to focus more on innovation economy companies and is less likely to capture mergers of financial holding companies.

HOUSEHOLD INCOME

[20]Median Household Income

Median household income data is from the U.S. Census Bureau, American Community Survey. (data.census.gov).

[21]Income Distribution

Data for Distribution of Income is from the American Community Survey from the U.S. Census Bureau (data.census.gov). Income is the sum of the amounts reported separately for the following eight types of income: wage or salary income; net self-employment income; interest, dividends, or net rental or royalty income from estates and trusts; Social Security or railroad retirement income; Supplemental Security Income; public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income.

[22]INDUSTRY SECTOR EMPLOYMENT AND WAGES

Data on sector wages is from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (bls.gov/cew). This survey derives employment and wage data from workers covered by state unemployment insurance laws and federal workers covered by the Unemployment Compensation for Federal Employees program. Wage data denote total compensation paid during the four calendar quarters regardless of when the services were performed. Wage data include pay for vacation and other paid leave, bonuses, stock options, tips, the cash value of meals and lodging, and contributions to deferred compensation plans.

[23]OCCUPATIONS AND WAGES

The U.S. Bureau of Labor Statistics, Occupational Employment Estimates (OES) (bls.gov/oes) program estimates the number of people employed in certain occupations and wages paid to them.

The OES data include all full-time and part-time wage and salary workers in non-farm industries.

Self-employed persons are not included in the estimates. The OES uses the Standard Occupational Classification (SOC) system to classify workers. MassTech aggregated the 22 major occupational categories of the OES into 11 occupational categories for analysis. The occupational categories in the *Index* are:

- Arts & Media: Arts, design, entertainment, sports and media occupations.
- Construction and Maintenance: Construction and extraction occupations; installation, maintenance and repair occupations.
- Education: Education, training and library occupations.
- Health care: Health care practitioner and technical occupations; Health care support occupations.
- Computer and Mathematical: Computer and mathematical occupations.
- Science, Architecture and Engineering Occupations: Architectural and engineering occupations; life, physical and social science occupations.
- Business, Financial and Legal Occupations: Management occupations; business and financial operations occupations; and legal occupations.
- Production: Production occupations.
- Sales & Office: Sales and related occupations; office and administrative support occupations.
- Community and Social Service: Community and social service occupations.
- Other Services: Protective service occupations; food preparation and serving related occupations; building and grounds cleaning and maintenance occupations; personal care and service occupations; transportation and material moving occupations; farming, fishing and forestry occupations.

[24]OUTPUT

Output Industry output data is obtained from the Moody's economy.com Data Buffet. Moody's estimates are based on industry output data for two and three digit North American Industry Classification System (NAICS) produced by the Bureau of Economic Analysis. (economy.com/products/tools/data-buffet).

[25]EXPORTS

Exports data is from the U.S. Census Bureau, Foreign Trade Division. Currency data from xe.com. (census.gov/foreign-trade).

CATEGORY: CHALLENGES HOUSING AFFORDABILITY

[26]Housing Price Index

Housing price data is from the Federal Housing Finance Agency's Housing Price Index (HPI) (fhfa.gov/). Figures are four quarter percent changes in the seasonally adjusted index. The HPI is a broad measure of the movement of single-family house prices. The HPI is a weighted, repeat-sales index that is based on repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975.

[27]Housing Affordability

Housing affordability figures are from the U.S. Census Bureau, American Community Survey, "Percent of Mortgaged Owners Spending 30% or More of Household Income on Selected Monthly Owner Costs" and "Percent of Renter-Occupied Units Spending 30 Percent or More of Household Income on Rent and Utilities". Median Household Income data are from U.S. Census Bureau, American Community Survey, "Median Household Income in the Past 12 Months," three-year estimate (data.census.gov).

DEFINITIONS

The *Index* makes us of four, five and six digit North American Industry Classification System (NAICS) codes to define key industry sectors of the Massachusetts Innovation Economy. The *Index's* key industry sector definitions capture traded sectors that are known to be individually significant in the Massachusetts economy. Consistent with the innovation ecosystem framework, these sector definitions are broader than "high-tech." Strictly speaking, clusters are overlapping networks of firms and institutions which would include portions of many sectors, such as Postsecondary Education and Business Services. For data analysis purposes the *Index* has developed NAICS-based sector definitions that are mutually exclusive.

Modification to Sector Definitions

The 11 key industry sectors as defined by the *Index* reflect the changes in employment concentration in the Massachusetts Innovation Economy over time. For the purposes of accuracy, several sector definitions were modified for the 2007 edition. The former "Health care Technology" sector was reorganized into two new sectors:

"Biopharmaceuticals, Medical Devices and Hardware" and "Health care Delivery." The former "Textiles and Apparel" sector was removed and replaced with the "Advanced Materials" sector. While "Advanced Materials" does not conform to established criteria, it is included to quantify and assess innovative and high-growing business activities from the former "Textiles and Apparel" sector.

Except for Advanced Materials, sectors are assembled from those interrelated NAICS code industries that have shown to be individually significant according to the above measures. In the instance of the Business Services sector, it is included because it represents activity that supplies critical support to other key sectors. In the 2009 *Index*, the definition of Business Services was expanded to include 5511-Management of Companies and Enterprises. According to analysis by the Bureau of Labor Statistics, this category has at least twice the all-industry average intensity of technology-oriented

workers. All time-series comparisons use the current sector definition for all years, and, as such, may differ from figures printed in prior editions of the *Index.* The slight name change in 2009 of the Biopharma and Medical Device sector does not reflect any changes in the components that define the sector.

Advanced Materials

3133 Textile and Fabric Finishing and Fabric Coating Mills
3222 Converted Paper Product Manufacturing
3251 Basic Chemical Manufacturing
3251 Resin, Synthetic Rubber and Artificial and Synthetic Fibers and Filaments Manufacturing
3255 Paint, Coating and Adhesive Manufacturing
3259 Other Chemical Product and Preparation Manufacturing
3261 Plastics Product Manufacturing
3261 Rubber Product Manufacturing
3312 Steel Product Manufacturing from Purchased Steel
3312 Alumina and Aluminum Production and Processing
3312 Nonferrous Metal (except Aluminum) Production and Processing

Biopharmaceuticals, Medical Devices and Hardware

3254 Pharmaceutical and Medicine Manufacturing
3391 Medical Equipment and Supplies Manufacturing
6215 Medical and Diagnostic Laboratories
42345 Medical Equipment and Merchant Wholesalers
42345 Ophthalmic Goods Merchant Wholesale
541711 R&D in Biotechnology
334510 Electro Medical Apparatus Manufacturing
334517 Irradiation Apparatus Manufacturing

Business Services

5411 Legal Services
5413 Architectural, Engineering and Related Services
5418 Advertising and Related Services
5511 Management of Companies
5614 Business Support Services

Computer and Communications Hardware

3341 Computer and Peripheral Equipment Manufacturing
3342 Communications Equipment Manufacturing
3343 Audio and Video Equipment Manufacturing
3344 Semiconductor and Other Electronic Component Manufacturing
3346 Manufacturing and Reproducing Magnetic and Optical Media
3359 Other Electrical Equipment and Component Manufacturing

Defense Manufacturing and Instrumentation

3329 Other Fabricated Metal Product Manufacturing
3336 Engine, Turbine and Power Transmission Equipment Manufacturing
334511 Search, Detection, Navigation, Guidance, Aeronautical and Nautical System and Instrument Manufacturing
334512 Automatic Environmental Control, Manufacturing for Residential, Commercial and Appliance Use
334513 Instruments and Related Products, Manufacturing for Measuring, and Controlling Industrial Process Variables
334514 Totalizing Fluid Meter and Counting Device Manufacturing
334515 Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
334516 Analytical Laboratory Instrument Manufacturing
334518 Watch, Clock and Part Manufacturing
334519 Other Measuring and Controlling Device Manufacturing
3364 Aerospace Product and Parts Manufacturing

Diversified Industrial Manufacturing

3279 Other Nonmetallic Mineral Product Manufacturing
3321 Forging and Stamping
3321 Cutlery and Hand tool Manufacturing
3326 Spring and Wire Product Manufacturing
3328 Coating, Engraving, Heat Treating and Allied Activities
3332 Industrial Machinery Manufacturing
3332 Commercial & Service Industry Machinery Manufacturing
3335 Metalworking Machinery Manufacturing
3339 Other General-Purpose Machinery Manufacturing
3351 Electric Lighting Equipment Manufacturing
3353 Electrical Equipment Manufacturing
3399 Other Miscellaneous Manufacturing

Financial Services

5211 Monetary Authorities - Central Bank
5231 Depository Credit Intermediation
5231 Securities and Commodity Contracts, Intermediation and Brokerage
5239 Other Financial Investment Activities
5241 Insurance Carriers
5241 Agencies, Brokerages and Other Insurance Related Activities
5251 Insurance and Employee Benefit Funds
5259 Other Investment Pools and Funds

Healthcare Delivery

6211 Offices of Physicians
6212 Offices of Dentists
6213 Offices of Other Health Practitioners
6214 Outpatient Care Centers
6216 Home Health Care Services
6219 Other Ambulatory Health Care Services
622 Hospitals

Postsecondary Education

6112 Junior Colleges
6113 Colleges, Universities and Professional Schools
6114 Business Schools and Computer and Management Training
6115 Technical and Trade Schools
6116 Other Schools and Instruction
6117 Educational Support Services

Scientific, Technical and Management Services

5416 Management, Scientific and Technical Consulting Services
5417 Scientific Research and Development Services (minus the portion apportioned to the Bio sector)
5419 Other Professional, Scientific and Technical Services

Software and Communications Services

5111 Newspaper, Periodical, Book and Directory Publishers
5112 Software Publishers
5171 Wired Telecommunications Carriers
5172 Wireless Telecommunications Carriers (except Satellite)
5174 Satellite Telecommunications
5179 Other Telecommunications
5182 Data Processing, Hosting and Related Services
5415 Computer Systems Design and Related Services
8112 Electronic and Precision Equipment Repair and Maintenance
51913 Internet Publishing and Broadcasting and Web Search Portal

Acknowledgements

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