

# The Northeast Massachusetts Innovation Economy and Workforce Landscape

Identifying opportunities to leverage regional industry  
and better engage underutilized and  
underrepresented workers

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Donahue Institute  
Economic and  
Public Policy Research

# The Northeast Massachusetts Innovation Economy and Workforce Landscape

Prepared by the UMass Donahue Institute's  
Economic & Public Policy Research Group

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## Acknowledgments

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In 2023, the North Shore Tech Council (NSTC) identified the issue of workforce as one of the key challenges facing the tech industry in the region North of Boston and in collaboration with the John Adams Innovation Institute at the Massachusetts Technology Collaborative (Innovation Institute), Essex County Community Foundation, and the UMass Donahue Institute scoped out an in-depth study of the regional innovation economy and its challenges, recognizing that such a study would help the region develop a better understanding of how to best address these challenges.

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## Executive Summary

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The MassTech Collaborative (MassTech), the Essex County Community Foundation (ECCF), and the North Shore Technology Council (NSTC) commissioned the UMass Donahue Institute to conduct a study of the Northeast Massachusetts innovation economy with a particular focus on workforce. The NSTC identified the need for an in-depth analysis of the region's innovation economy and workforce situation in order to inform strategies to move the region forward in coming years. MassTech and the ECCF agreed to provide the support that made this study possible. Masstech in particular played a key role in overseeing the project and securing input from a diverse advisory committee. The study utilized local expertise by tapping into the insights of workforce groups, higher education institutions, non-profit groups, and a number of area businesses through a series of interactions and interviews.

The region encompasses an area that includes Essex County and stretches westward to include Greater Lowell. Perhaps not as well-known as the Boston-Cambridge technology cluster, Northeast Massachusetts in its own right is a leader in a number of advanced industries, including semiconductor manufacturing equipment, medical devices, computer hardware and software, and aircraft engines. As such, this project seeks to further support innovation and the growth of these industries. Today and looking into the future, a healthy workforce will be a critical contributor to ensure Northeast Massachusetts and its tech industries continue to thrive amidst strong domestic and global competition. With this in mind, this study seeks to identify innovative solutions to the labor challenges faced by Northeast Massachusetts in regard to technology-related occupations and industries. The project has a particular focus on looking for ways to increase labor force participation, raise skill levels, and develop career paths for groups including, but not limited to, immigrants, minorities, and women – all groups that are critical for providing capable workers to Northeast Massachusetts' leading industries in coming years.

### Northeast Massachusetts Demographic Trends

Several demographic factors undergird labor availability and talent that businesses in Northeast Massachusetts need to thrive. Key demographic findings include:

**Northeast Massachusetts is experiencing steady but slowing population growth.** The region's population reached over 1.1 million people in 2020, accounting for just under one in seven Massachusetts residents. However, looking into the future, the region is projected to add only 60,000 net new residents by 2050.

**Low population growth will put a fundamental strain on the growth of the region's labor force.** The region's labor force will increase in size by about 30,000 people between 2020 and 2050, reaching just under 700,000. This represents significantly slower growth than in previous decades.

**The Northeast Massachusetts labor force will become older.** Nearly all the labor force growth in coming decades will be in the 65+ category. Older people will comprise approximately 22 percent of the region's workforce in 2050 compared to 17 percent today. Core workers in the 25 to 64 group are projected to remain relatively constant in size while the young labor force (less than 24) is current



forecast to decline in size. The aging of the workforce largely mirrors the trend towards an older population, overall.

**The foreign-born population in Northeast Massachusetts is large and growing.** Between 2011 and 2021, foreign-born residents grew from 14.7 percent to 18.0 percent of the population in the region. Foreign-born people account for a higher share of the total population in Northeast Massachusetts than in the state (17.3 percent) and the nation (13.6 percent). Foreign-born residents accounted for 55 percent of growth in the past decade.

**People of Hispanic, Black, and Asian descent are leading population growth in Northeast Massachusetts.** People of Hispanic, Black, and Asian descent as well as people classifying themselves as one or more races experienced share population growth in Northeast Massachusetts between 2010 and 2020 while the largest group, the White population, saw a small decrease. Workforce programs and initiatives will need to cater to raising the skill levels of minority populations now and in the future to provide Northeast Massachusetts businesses with the workers they will need to expand and grow.

**Northeast Massachusetts' Asian and White populations lead in educational attainment.** Over two-fifths of the region's 25 and older population have a bachelor's degree or higher. For Asian and White residents, educational attainment is even higher at 49 percent and 47 percent, respectively. By contrast, only slightly more than 15 percent of Hispanic residents have a bachelor's degree in Northeast Massachusetts. As a growing demographic in the region, initiatives to put minority populations, including Hispanic people, into higher education and career pathways will be an imperative for Northeast Massachusetts.

## Northeast Massachusetts Economy and Tech Trends

Northeast Massachusetts is situated within the metropolitan Boston area, one of the largest economies in the United States. The region generally follows state and national cycles in economic growth but has a distinct economy of its own with a particular concentration in manufacturing and with much of that related to tech industries.

**Northeast Massachusetts overall jobs growth has been slower than the state's and nation's.** The growth in jobs in the region was solid during the 2010s but has not yet recovered completely to pre-pandemic levels. In recent years, both the state and the U.S. have been seeing faster growth in jobs.

**Northeast Massachusetts has a significant job market as well as a large number of commuters who work outside the region.** 195,000 people both live and work in Northeast Massachusetts, with 143,000 commuting into the region from elsewhere (e.g., southern New Hampshire). Significantly, 223,000 people reside within Northeast Massachusetts but commute to jobs outside the region. The "hub and spoke" MBTA commuter rail system, including branches to Lowell, Haverhill, Newburyport, and Rockport facilitates the large number of commuters from Northeast Massachusetts into Boston. Outbound commuters represent an opportunity for Northeast Massachusetts, as talented people working in the Boston-Cambridge hub are often not aware of the job opportunities available within the region. These same people can be a source of business innovation and enterprise development for Northeast Massachusetts.

**Northeast Massachusetts industry mix – the region is strong in the economic sectors that support a tech-oriented, innovation economy.** Northeast Massachusetts possesses strengths (as measured by industry jobs concentration relative to the country’s) in three key sectors, namely manufacturing, professional and business services, and education and healthcare, that are foundational to a thriving innovation economy. Professional and business services represents such areas as research & development, engineering, and computer systems design. Manufacturing includes the suppliers and finished goods for semiconductor manufacturing equipment, jet engines, medical equipment, and pharmaceuticals, among many others. Education and healthcare, a large and diverse sector, includes the key educational institutions like UMass Lowell, Salem State University, Endicott College, and community colleges that lead in the development and testing of new technologies as well as skills development for the Northeast Massachusetts workforce.

**Northeast Massachusetts performance in the tech, life sciences, and advanced manufacturing sectors.** The study takes a deeper focus on these three areas following standard sector definitions, noting that tech and life sciences are hybrids comprised of many industries (CompTIA is used for the tech definition and MassBio for life sciences).

- **Tech.** This sector combines selected industries in manufacturing (e.g., computers, laboratory equipment, etc.) and services (e.g., software, computer systems design). Northeast Massachusetts has specific strengths in analytical laboratory instruments, electromedical devices, and semiconductor machinery.
- **Life Sciences.** Massachusetts is a recognized global leader in life sciences and has seen strong growth in this sector over the past decade. The Northeast Massachusetts region is participating in this growth, notably in the areas of research & development in biotechnology, biological product manufacturing, and medicinal manufacturing.
- **Advanced Manufacturing.** Massachusetts manufacturing production was valued at \$56.6 billion in 2023. As a high-cost state, Massachusetts and Northeast Massachusetts tend to specialize in the production of advanced products and parts requiring high levels of training and the application of specialized skills and machinery. Inclusive of Northeast Massachusetts concentrations in tech and life sciences-related manufacturing (above), the region is also strong in fabricated metals (frequent suppliers to other industries), aircraft engines, radars, and semiconductor equipment. Food is emerging as a growing industry and the region remains very strong in leather products (including shoes), a legacy industry for the area.

**Northeast Massachusetts is well-positioned to take a lead role in climate tech and the transition to clean energy.** Massachusetts is in the midst of a long-term transition to clean energy, with hundreds of millions of dollars pledged (through the Mass Leads Act) to reach the goal of net-zero carbon emissions. Governor Healey outlined an approach to add “climate tech” to the key strategic industries that Massachusetts holds a competitive edge in, specifically mentioning advanced manufacturing and life sciences as two sectors that can be leveraged to build said competitive edge. As Northeast Massachusetts already has a high concentration of employment in these industries, the regional workforce is well positioned to take advantage of the influx of investment and attention to the climate tech industry in the state, particularly the ongoing development of the Salem Offshore Wind Terminal.

## Innovation in Northeast Massachusetts

Northeast Massachusetts innovation is supported by academic institutions and businesses that are engaged in discovering, applying, and commercializing breakthrough technologies. This is reflected in U.S. Patent Office awards, as well as competitive funding from the National Institutes of Health (NIH) and the Small Business Administration (SBA) which oversees both the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. The awarded patents and research funding in Northeast Massachusetts form the seeds for innovation, entrepreneurialism, business formation, and future economic growth in the region.

- **Patents awarded.** Between 2013 and 2022, Northeast Massachusetts businesses and institutions received between 650 to 800 patents annually, accounting for approximately 7 to 8 percent of all Massachusetts patents. Organizations involved in medical equipment, electronics, and life sciences tended to be leaders in patents awarded.
- **National Institutes of Health (NIH) funding.** During the 2013 period, Northeast Massachusetts received nearly \$150 million in funding through 293 awards. Optics, DNA, brain trauma, diabetes prevention, and orthopedic implant materials are among the many areas of focus for the funding.
- **Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding.** Combined, these two U.S. Small Business Administration programs provided 1,249 awards and about \$580 million in funding to Northeast Massachusetts organizations, institutions, and businesses between 2013 and 2022. Defense technology-related awards are particularly prominent in the region. Examples include sonobuoys for anti-submarine warfare, propulsion technologies, antennas, and aerodynamics. Dual use and civilian technologies include advanced materials, robotics, carbon management, medical devices, and particle/chemical detection.

## Innovation Economy Occupational Analysis

Northeast Massachusetts combines economic strengths in high-tech, life sciences, and advanced manufacturing with entrepreneurial businesses and academia that are successful in earning patent awards and securing funding to support research & development. In turn, the innovation economy supports generally high wages and situates Northeast Massachusetts for future technology-led economic growth. In order for this dynamic to be fully realized, however, Northeast Massachusetts needs to fill positions and provide its changing population with the skills needed to progress in the innovation-related jobs made available by the region's growing businesses and institutions.

- **High Tech Manufacturing.** Since 2012, jobs in tech-related manufacturing occupations in Northeast Massachusetts have remained relatively steady. Looking into the future, that overall trend is currently projected to remain the same. Top professions at the region's tech manufacturers include electromechanical assemblers, software developers, industrial engineers, assemblers, and operations managers. Underscoring demand, monthly unique jobs postings in tech-related manufacturing in Northeast Massachusetts tended to be in the 2,000 to 5,000 range during the 2018-2023 period. Depending on the position, entry-level educational requirements range from high school to at least a bachelor's degree. However, when looking at jobs postings, more than two-thirds of the positions are asking for a bachelor's degree or higher.

- **High Tech Services.** Although Northeast Massachusetts posted a decline in high-tech services occupations between 2012 and 2022, growth is currently projected through 2032. Top professions at the region’s tech services providers include software developers, operations managers, and various types of computer systems specialists. Monthly jobs postings in high-tech services were generally in the 2,000 to 6,000 range between 2018 and 2023. Depending on the position, entry-level educational requirements range from high school to at least a bachelor’s degree. Similar to high-tech manufacturing, employers are showing a preference for highly-educated jobs candidates – over 60 percent of postings are for a bachelor’s degree or higher.
- **Life Sciences.** Life sciences are a fast-growing industry in Northeast Massachusetts, and that is reflected in the occupational data. Leading professions in the sector include medical scientists, biochemists, operations managers, technicians, and engineers. Occupational projections indicate that over 3,200 net new positions (excludes turnover and retirements) will need to be filled in the industry through 2032. Life sciences jobs tend to require high levels of education and about 80 percent of jobs postings are asking for a bachelor’s degree or higher in Northeast Massachusetts.
- **Advanced Manufacturing.** Manufacturing is very concentrated in Northeast Massachusetts, and the number of occupations within the sector has remained steady over the past decade and is projected to grow through 2032. Leading occupations in the sector include fabricators, assemblers, software developers, operations managers, and engineers. Monthly jobs postings in manufacturing in Northeast Massachusetts were generally in the 8,000 to 12,000 range between 2018 and 2023, reflecting a high level of employer demand. Nearly two-thirds of manufacturing jobs postings in Northeast Massachusetts are asking applicants for a bachelor’s degree or higher even though typical entry levels for manufacturing occupations in the region indicate that less than a bachelor’s degree is adequate.

## Northeast Massachusetts Business and Workforce Strengths and Weaknesses

### *Immigrants Are a Key Component of the Future Workforce*

- **Immigrants supplement the labor pool.** Immigrants play a pivotal role in stabilizing the workforce in Massachusetts, including the Northeast Massachusetts region, particularly in the tech industries. Immigrants and foreign nationals have potential to not only contribute to the innovation economy by starting companies but also by filling essential positions, especially on factory floors where they already constitute a significant portion of the workforce.
- **Language barriers cause underemployment.** Language is a significant obstacle to accessing this workforce. One employer relayed that they had prospective employees who already knew how to use their equipment from a job they had held in their country of origin, and that the lack of language skills was the only barrier to them being able to solve their employment crunch on the spot.
- **Training programs are not reaching immigrants communities.** Transportation barriers, including access to cars and public transit connectivity, between immigrant communities in the Greater Lowell area and the North Shore hinder access to training programs and job opportunities. Additionally, most employment and training opportunities are only advertised online, so even if translated to Spanish and other languages, they often miss lower income residents of communities that lack internet access. 1 in 5 Essex County residents have no

internet connected devices, and this ratio is even lower in areas with a large Spanish speaking population.

- **Workforce development programs are integrating ESOL (English to Speakers of Other Languages).** Institutions like the North Shore Community College are taking proactive steps by developing dual-language degree programs and providing support services tailored to immigrant communities, and multiple organizations are looking into providing transportation from more diverse cities like Lowell to bring employees to jobs, education, and training opportunities. However, many interviewees believe greater state involvement in preparing new immigrants for the workforce is necessary, emphasizing language proficiency as a prerequisite for most training programs for the foreseeable future.

### ***From Manufacturing to a “Maker’s Economy”***

- **Manufacturing needs a rebrand.** A nearly universal call from educators, employers, and workforce development specialists was the need to counteract the negative perceptions that persist around manufacturing jobs. Interviewees have heard from parents and educators that they view manufacturing as undesirable or inaccessible, either due to its perceived hazards or the misconception that it requires advanced technical skills or degrees. We identified many ongoing initiatives to address these perceptions, but nevertheless interviewees continue to describe a need to effectively communicate the significant training and career opportunities available in modern, advanced manufacturing, a strength of the Northeast Massachusetts economy.
- **Addressing these challenges requires early intervention.** Initiatives like community labs, field trips to Northeast Massachusetts tech companies, and volunteer programs aim to spark interest in science and technology during elementary to middle school years, paving the way for future career exploration. This would lean into engaging students in hands-on learning experiences during high school and college, including internships and experiential programs where educators can provide firsthand exposure to the realities and opportunities available in manufacturing.
- **Employers have a role to play in making the field more accessible.** Some interviewees remarked that job postings use education requirements to pre-screen applicants even when that level of education isn’t necessary. A good example of how to address this issue and transition to a more skills-based hiring system is the governor’s recent order to remove degree requirements from most state government job listings. Instead, managers are instructed to consider the “full set of competencies” that prospective employees have rather than just their educational attainment. Skills based hiring can both help employers address the challenge of finding qualified workers while also broadening access to good jobs.

### ***Northeast Massachusetts as a Place to Grow and Expand***

- **The region’s cost of living advantage is eroding.** Before the pandemic, the region experienced a surge in interest from companies looking to establish or expand their presence, drawn by lower costs compared to the Boston-Cambridge hub and the promise of a burgeoning life sciences sector. However, this surge has somewhat eroded Northeast Massachusetts’ competitive advantage pricewise, with cost of living frequently coming up as a barrier, though more to prospective employees than to employers.

- **Pandemic driven shifts to remote work threaten the Northeast’s geographic advantage.** The ability of companies across the country to hire Massachusetts graduates without requiring them to move has diminished the local advantages employers once enjoyed by being around so many top universities in Massachusetts. Some interviewees also expressed concern that remote work is somewhat reducing the in-person “water-cooler” style melding of ideas and technologies that resulted from so many high-tech employees being clustered in office parks and buildings across the region.
- **Entry-level workers see the most demand but face the biggest hurdles.** Issues such as housing costs, transportation accessibility, affordable/reliable childcare, and digital infrastructure gaps in communities like Lowell, Lynn, Lawrence, and to some extent the region as a whole remain persistent concerns especially for entry level workers. This workforce by all accounts is seeing the greatest demand, but they are the most likely to be driven out of the area by rising prices as wealthier remote employees, who once had to accept high prices in Boston-Cambridge, move to the North Shore and Greater Lowell while continuing to work for companies in Boston.
- **Northeast Massachusetts still boasts a diverse ecosystem of businesses.** The region has a particularly notable presence of small and medium-sized enterprises in the tech and life sciences sectors. Several significant sources of new funding to the area, especially Massachusetts’ designation as a semiconductor hub under the CHIPS Act and the Salem Offshore Wind project, offer enormous potential to solidify the area’s attractiveness as a tech destination. However, the decline of former anchor companies like General Electric (at least in terms of job numbers), coupled with lingering perceptions of parts of the region as “blue-collar” and economically depressed, may discourage the area’s attractiveness to outside companies that might otherwise consider relocating or expanding to the area.

### ***Organized Regionalism – Some Strengths as Well as Some Weaknesses***

- **Institutions are willing and able to effectively collaborate, but the region lacks an overall development strategy.** Stakeholders across sectors advocated for a concerted effort to elevate the region’s profile and implement more cohesive economic development approaches and strategies. A significant obstacle to regional collaboration identified during our conversations was the lack of a county government in Essex and Middlesex. Rather than needing one or two governments to sign on to an economic development strategy, Northeast Massachusetts would require dozens of municipalities to approve any official strategy. We heard some concerns that this leads to competition among municipalities that has made collective action more difficult and led to wasted resources.
- **Organizations focused on regional collaboration could serve as a convener to develop a regional strategy.** The North Shore Alliance and the Essex County Community Foundation, which provide a forum for governments, businesses, schools, and NGOs to coordinate economic and community development efforts. Regional organizations could leverage existing educational programs and strategic alliances between institutions that demonstrate a willingness to pool resources and expertise for mutual benefit. These connections, especially the many collaborations between tech schools, community colleges, and businesses, could provide the backbone for larger regional collaboration.
- **Collaboration is needed to establish a regional identity.** Another common theme in our interviews was a pressing need to establish a recognizable regional identity and vision to attract external investment and secure government funding for the region. Some suggestions we

received are to learn from regional branding efforts like “Metro West” and to take advantage of the global name recognition of Boston by emphasizing Northeast Massachusetts’ proximity and accessibility to the city.

### ***Match Teaching and Training to Employer Needs***

- **Graduates from traditional schools are often unprepared for the innovation economy.** The IT and advanced manufacturing sectors in particular were identified as not keeping up with new and emerging technologies. Employers told us that they often must retrain new hires after discovering that they were trained in an out-of-date coding language or retired manufacturing processes. This process is a significant investment that often results in a well-trained employee who immediately leaves for a better paying position, leaving little incentive for employers to hire inexperienced employees. One employer specifically said they are now forced to hire apprentices that they wouldn’t even have interviewed a decade ago, simply because the labor pool is so dry.
- **Young people face challenges entering the manufacturing industry.** Alongside previously stated biases many young people have towards manufacturing, many employers do not want to hire people under 18 due to extra labor regulations or safety concerns, and those who do told us of students struggling with the basic math and statistics necessary to operate modern advanced manufacturing equipment. This lack of basic skills in the workforce extends past high schoolers, as we heard from multiple employers and workforce development specialists that new employees lack soft skills, and, at times, even the ability to show up on time or at all.
- **Workforce programs need to accommodate low-income trainees.** Many people cannot afford to take several weeks or months off work to attend even a free program, and programs with tuition are practically out of reach. Some workforce programs have begun to recognize this issue, with the Gloucester Marine Genomics Institute (GMGI) in particular offering free tuition and income-based stipends to participants so they can focus purely on their studies. They have seen no reduction in student quality after going tuition-free. GMGI also updates their training on a quarterly basis to make sure they are keeping up with the latest developments in biotech, addressing the other major issue employers flagged.

### ***Massachusetts Workforce Training Initiatives Need Continuity to Best Serve Employers in Tech and Advanced Manufacturing***

Crucially, Massachusetts workforce training initiatives need to be able to meet employer needs in terms of both skills and scale. However, aspects of the state’s workforce training delivery system are fragmented, making it more difficult to keep up with jobs needs of Northeast Massachusetts employers in tech and advanced manufacturing.

- **A grants-based system requiring annual renewals is cumbersome and impedes continuity in programming.** This structure creates a constant need for workforce agencies to apply for grants, including renewals for initiatives such as paid apprenticeships for manufacturing training and stipend programs. An unintended consequence of the current system is a lack of continuity year-to-year, making it challenging to plan for the longer time horizons needed to introduce more people, especially young people, to advanced manufacturing.

- **Predictable, multi-year funding for training programs offers tangible advantages.** Longer-term funding (five years as opposed to one) for the Advanced Manufacturing Training and Expansion Program (AMTEP) has resulted in curriculum development to better meet industry standards, reinforced communications channels with companies to match employer needs with skills training, and is feeding Northeast Massachusetts businesses with workers and on a large scale (hundreds of job placements, thus far) to help fill positions, including those coming from a wave of retirements.

### ***Northeast Massachusetts Offers Strong Innovation Assets***

Northeast Massachusetts is well positioned to further progress as an increasingly formidable player in the global innovation economy, anchored by leading academic and research institutions both in the region and close by, as well as advanced manufacturing and biotech industry clusters. Massachusetts and the Northeast region in particular offer a range of resources and programs to support entrepreneurship, technology development, and economic growth that, while often underutilized, are key to the sector's continued growth.

- **Universities and colleges serve as a bridge between ideation and commercialization.** UMass Lowell is the premier research university in the region, and particularly focuses on bringing locally developed technologies to a point where they can be commercialized. This process involves both technical assistance in how to establish and operate a new business, as well as access to state-of-the-art equipment that start-ups are typically unable to afford. The role of UMass Lowell in innovation is further underscored by the Cambridge-based research nonprofit Draper Laboratories decision to move its microelectronics division to Lowell to anchor a major new mixed-use development (the Lowell Innovation Network Corridor, or LINC) planned on the university's East Campus. Other local education institutions like Endicott College's Science Center Incubator and engineering facilities coordinate between the business and STEM programs to assist entrepreneurs, with initiatives like the "Spark Tank" offering engaging ways for student innovators to present their ideas before a friendly audience.
- **The Life Sciences Consortium of the North Shore provides an anchor for biotech in the region.** The Consortium, consisting of Endicott College, Gloucester Marine Genomics Institute, Gordon College, North Shore Community College (NSCC), Salem State University, Essex North Shore Agricultural & Technical School, and InnoVenture Labs, provides life sciences education, training, and business. Similar to UMass Lowell, each member also provides access to otherwise cost-prohibitive machinery for startups. The Consortium model allows them to coordinate purchases and submit combined proposals that they would be unable to win as individual institutions, such as a recent \$5 million grant from Mass Life Sciences Center to fund new equipment purchases.
- **The Advanced Manufacturing Training and Expansion Program (AMTEP) is one of the largest workforce training programs outside of Boston.** AMTEP is a special project derived from the Northeast Advanced Manufacturing Consortium and funded by a grant from the GE Foundation and managed by the Essex County Community Foundation and Northshore MassHire. It runs in-person training programs at Lynn Vocational Tech, Gloucester High CTE, and Essex Tech in areas such as manual and CNC machining, welding, and electromechanical assembly. They also hold virtual education programs run by NSCC to help students learn the math skills necessary for modern advanced manufacturing practices. The extra funding from the GE foundation allows AMTEP to run 8-10 training cycles per year, compared to 1-2 in other workforce areas.



## Opportunities to Further Strengthen the Northeast Massachusetts Innovation Economy

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This report defines several areas for further exploration and potential action, all of which should be considered by regional stakeholders as they work to bring people into and grow the Northeast Massachusetts innovation economy into the future:

- Technical schools in the region, including Lynn Tech and Essex Tech, are heavily integrated into advanced manufacturing training and have collaborations with multiple workforce development organizations, presenting an opportunity for them to serve as the anchor for future collaboration. These institutions can also serve as a sort of “bridge” between early education and the workforce, making them essential to any efforts to drive interest in and knowledge of tech and advanced manufacturing among younger people. In a similar vein, the region’s universities, community colleges, and higher education institutions can work collaboratively with each other and the Northeast Massachusetts business community to get middle school and high school students “on board” with the region’s career pathways in technology and manufacturing.
- Immigrants from Spanish-speaking countries are currently the main driver of population growth in Northeast Massachusetts, and essential for the region’s labor force to remain stable now and into the future. Workforce development organizations, academia, and training providers should consider permanently including an English language learning component in any future programs to ensure this population is able to fully participate.
- Northeast Massachusetts is well positioned as a location to grow the emerging sectors seen as priority areas for the Massachusetts economy, including life sciences and healthcare, advanced manufacturing and robotics, and climate tech (e.g., Salem Offshore Wind). Northeast Massachusetts combines innovation, a foundation of businesses and suppliers, and educational and research resources to nourish the growth and competitiveness of these industries. Collaborations such as the Life Sciences Consortium, additionally, help support entrepreneurialism, cutting-edge technology application, and growth. An appreciable recent development for Northeast Massachusetts is the Lowell Innovation Network Corridor situated in the East Campus area of UMass Lowell. Cambridge-based Draper Labs plans to expand to the corridor, potentially bringing in hundreds of staff focused on applied research and engineering related to microelectronics. The combination of Draper, UMass Lowell, and the presence of a cluster of regional tech businesses will help further cement Northeast Massachusetts as an innovation hub. Leveraging this new development, from the standpoints of workforce and economic development, represents a strategic opportunity for the region.
- Northeast Massachusetts’ proximity to Boston-Cambridge presents complementary opportunities to attract workers and businesses from one of the world’s premier innovation hubs by capitalizing on the region’s comparatively lower costs of living and doing business combined with noteworthy quality of life attributes (e.g., outdoor recreation, history, cultural activities, sports, etc.).

- Northeast Massachusetts would benefit from a concerted effort to improve the area's name recognition and guide future economic development. Organizations such as the North Shore Alliance and the Essex County Community Foundation provide an avenue for regional collaboration that in other regions would be served by a county government.

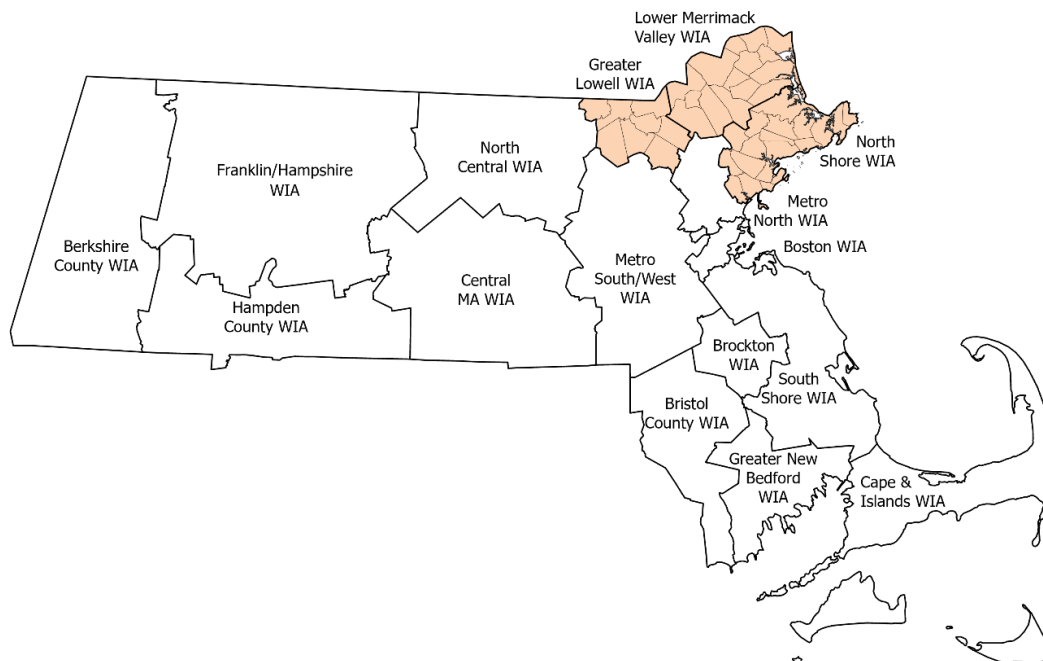
## Introduction

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The MassTech Collaborative (MassTech), the Essex County Community Foundation (ECCF), and the North Shore Technology Council (NSTC) commissioned the UMass Donahue Institute to conduct a study of the Northeast Massachusetts innovation economy with a particular focus on workforce. The NSTC identified the need for an in-depth analysis of the region's innovation economy and workforce situation in order to inform strategies to move the region forward in coming years. MassTech and the ECCF agreed to provide the support that made this study possible. MassTech in particular played a key role in overseeing the project and securing input from a diverse advisory committee. The study utilized local expertise by tapping into the insights of workforce groups, higher education institutions, non-profit groups, and a number of area businesses through a series of interactions and interviews.

The region encompasses an area that includes Essex County and stretches westward to include Greater Lowell. Perhaps not as well-known as the Boston-Cambridge technology cluster, Northeast Massachusetts is a leader in a number of advanced industries, including semiconductor manufacturing equipment, medical devices, computer hardware and software, and aircraft engines. As such, this project seeks to further support innovation and the growth of these industries. Today and looking into the future, workforce will be a critical contributor to ensure Northeast Massachusetts and its tech industries continue to thrive amidst strong domestic and global competition. With this in mind, our project seeks to identify innovative solutions to the labor challenges faced by Northeast Massachusetts in regard to technology-related occupations and industries. The project has a particular focus on looking for ways to increase labor force participation, raise skill levels, and develop career paths for groups including, but not limited to, immigrants, minorities, and women – all groups that are critical for providing capable workers to Northeast Massachusetts' leading industries in coming years.

**Figure 1 The Northeast Massachusetts Region**



The Northeast Massachusetts region encompasses 42 towns and cities in Essex and Middlesex counties that are divided into three workforce areas:

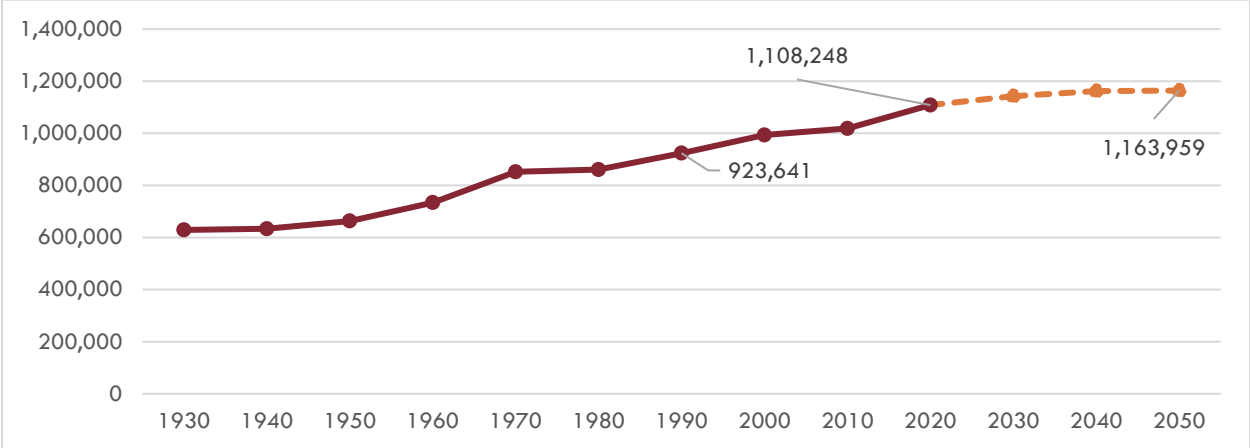
- Greater Lowell Workforce Board
- Merrimack Valley Workforce Board
- North Shore Workforce Board

Much of Northeast Massachusetts is within easy commuting distance of Boston’s urban core via roadway or rail. With a land area of about 700 square miles, the Northeast Massachusetts region is relatively affordable compared to Boston/Cambridge and the inner Boston suburbs. The combination of highway, airport, and transit availability make the region accessible for business activity, workers, students, and visitors. The region is a hub for advanced manufacturing, notably in a wide range of defense applications, electronics, plastics, and medical equipment and is the home of a leading research university, the University of Massachusetts at Lowell. Access to recreation, the Atlantic coastline, and historic cities also makes the region a popular destination for visitors. The combination of its industrial legacy, the presence of leading-edge companies, infrastructure, workforce, and quality of life have helped give Northeast Massachusetts rise as a center of innovation.

# Northeast Massachusetts Demographic Trends

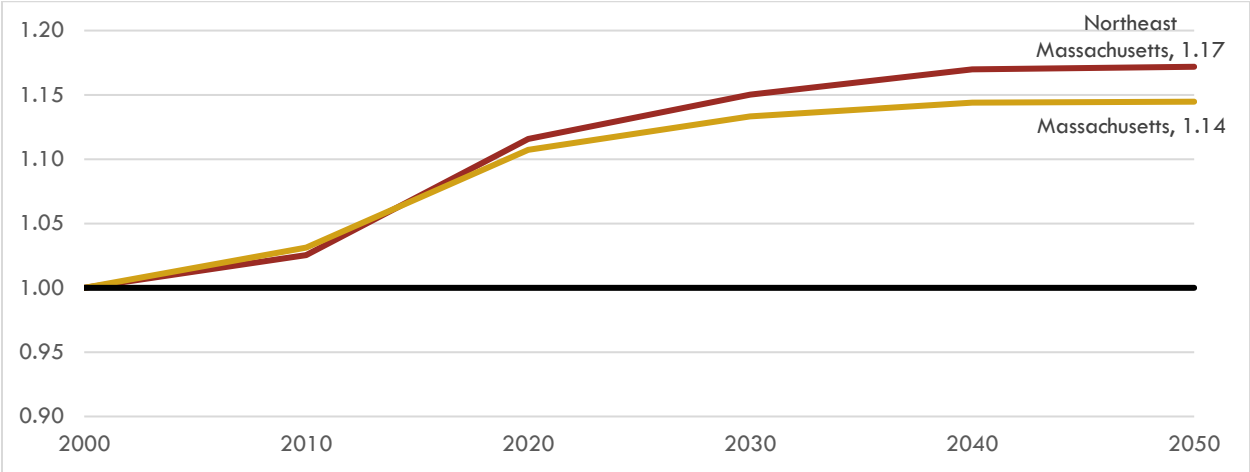
A number of demographic factors undergird labor availability and talent that businesses in Northeast Massachusetts need to thrive. In terms of overall population, Northeast Massachusetts is experiencing steady but slowing growth. The region’s population reached over 1.1 million people in 2020, accounting for just under one in seven Massachusetts residents. However, growth in Northeast Massachusetts is projected to slow over the next thirty years, with the region projected to add 60,000 net new residents by 2050, compared to almost 200,000 new residents in the previous thirty years (1990-2020). This slowdown is not exclusive to Northeast Massachusetts, with the state as a whole expected to experience an even more significant slowdown over the same time frame.

**Figure 2 Population in Northeast Massachusetts 1930 – 2050 (2020-2050 Projected)**



Sources: U.S. Census Bureau and UMass Donahue Institute V2020 Population Projections

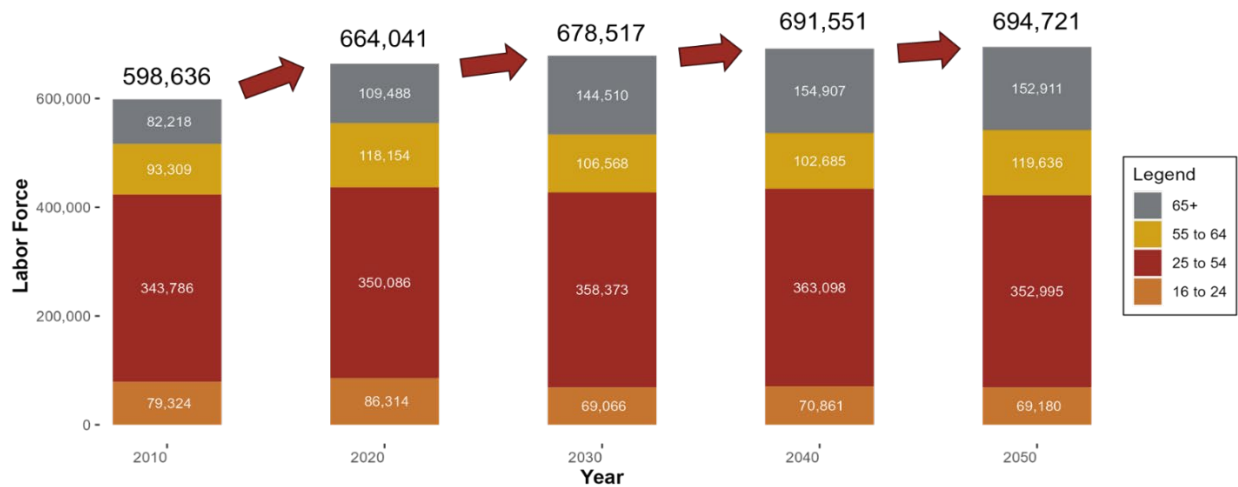
**Figure 3 Population Growth Index (2000 = 1.00), 2000 to 2050, Northeast Massachusetts Compared to State**



Sources: U.S. Census Bureau and UMass Donahue Institute V2020 Population Projections

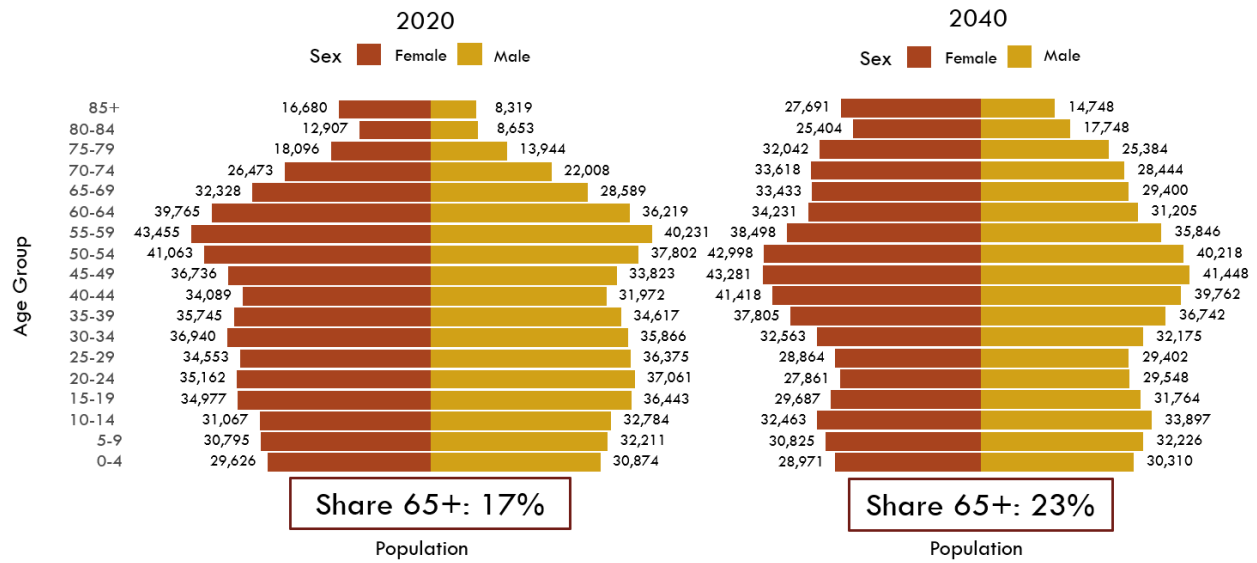
Low population growth will put a fundamental strain on the growth of the region’s labor force. The region’s labor force will increase in size by about 30,000 people between 2020 and 2050, reaching just under 700,000. This represents significantly slower growth than in previous decades. A tech manufacturer interviewed for this study described the Northeast Massachusetts labor force as “dried up”, indicating at least through their own perspective that the region is at 100 percent employment – people who want jobs already have them. Additionally, the Northeast Massachusetts labor force will become older, with nearly all of the labor force growth in coming decades expected to be in the 65+ category. The same tech manufacturer also mentioned that their workers are becoming older, especially among machinists. Older people will comprise approximately 22 percent of the region’s workforce in 2050 compared to 17 percent today. Core workers in the 25 to 64 group are projected to remain relatively constant in size while the young labor force (less than 24) is current forecast to decline in size. The aging of the workforce largely mirrors the trend towards an older population overall, and the Northeast Massachusetts population is projected to age more quickly than the state overall (43 percent growth in the 65+ age bracket between 2020 and 2040 vs 36 percent).

**Figure 4 Projected Labor Force Size in Northeast Massachusetts through 2050**



Sources: ACS 2010 and 2020 5YR, UMDI V2020 Population Projections

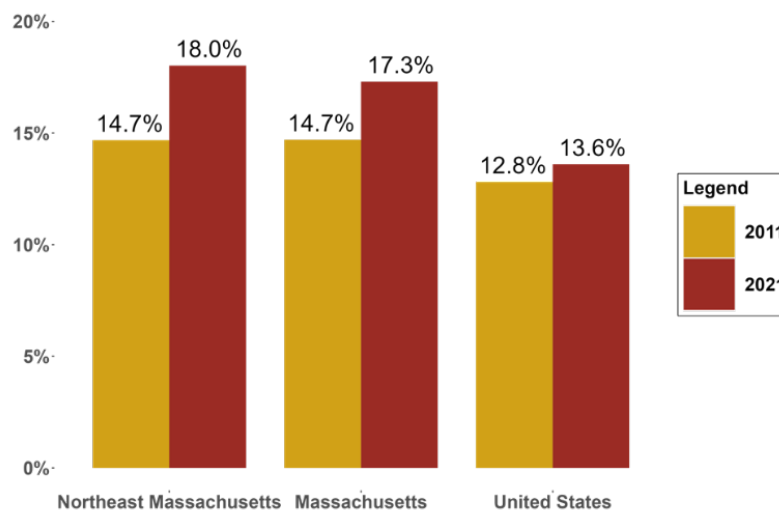
**Figure 5 Population Pyramid of Northeast Massachusetts With Projections**



Source: UMDI V2020 Population Projections

The foreign-born population in Northeast Massachusetts is large and growing. Between 2011 and 2021, the share of foreign-born residents grew from 14.7 percent to 18.0 percent of the population in the region. Foreign-born people account for a higher share of the total population in Northeast Massachusetts than in the state (17.3 percent) and the nation (13.6 percent). As a popular destination for immigrants, particularly from the Americas and Asia, national immigration policy will have a bearing on future population growth in Northeast Massachusetts. Nearly 55% of population growth in the region occurred among the foreign-born population. With overall population growth already projected to slow considerably, any reduction in foreign immigration to the region would pose a considerable threat to future labor force growth.

**Figure 6 Share of Population that is Foreign-Born, 2011 and 2021**



Source: U.S. Census Bureau American Community Survey

**Table 1 Region of Origin for Foreign-Born Population, 2021**

Region of Origin, 2021	Africa	Americas	Asia	Europe	Oceania
<b>Northeast Massachusetts</b>	7.8%	52.8%	25.1%	14.0%	0.3%
<b>Massachusetts</b>	9.4%	40.1%	30.8%	19.3%	0.3%
<b>United States</b>	5.5%	51.9%	31.2%	10.8%	0.6%

Source: U.S. Census Bureau American Community Survey

Population growth in Northeast Massachusetts from 2010 to 2020 was driven primarily by the Hispanic or Latino population, which grew 50 percent during the time frame. Northeast Massachusetts residents of Black, and Asian descent, as well as residents classifying themselves as two or more races, also saw significant growth. This growth was somewhat offset by declines in the largest population group, the White population, which saw a small decrease. The significant growth in the Hispanic population tracks with previously mentioned trends in foreign born population and region of origin.

**Table 2 Population Growth by Race and Ethnicity, 2010 - 2020**

Race or Ethnicity	2010	2020	% Change
<i>Total Population</i>	1,003,709	1,108,234	10%
Hispanic or Latino	143,853	216,194	50%
Not Hispanic or Latino:	869,443	892,040	3%
White alone	767,990	727,314	-5%
Black or African American alone	27,801	42,321	52%
American Indian and Alaska Native alone	1,204	1,027	-15%
Asian alone	54,284	72,211	33%
Native Hawaiian and Other Pacific Islander alone	213	201	-6%
Some Other Race alone	4,319	10,526	144%
Two or More Races	13,632	38,440	182%

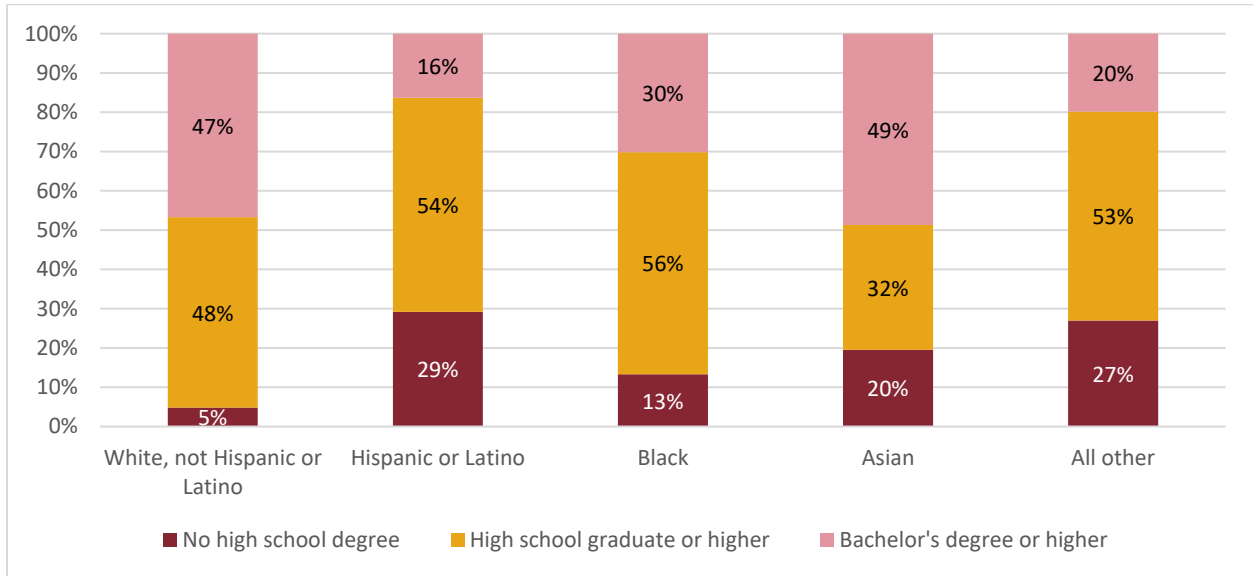
Source: U.S. Census Bureau

The population groups that growth has been concentrated in have lower levels of educational attainment on average when compared to the overall population. Residents of Northeast Massachusetts who are Hispanic or Latino and those who classify themselves as Some Other Race Alone or Two or More Races tend to have especially low rates of bachelor's degree attainment and especially high rates of not graduating high school. These race and ethnicity groups tend to have high levels of foreign born



residents, suggesting that in order to maintain a healthy labor force, the region will need to do more to boost the skills and educational attainment of these groups, especially language training.

**Table 3 Educational Attainment by Race in Northeast Massachusetts, Population 25 and older, 2022**

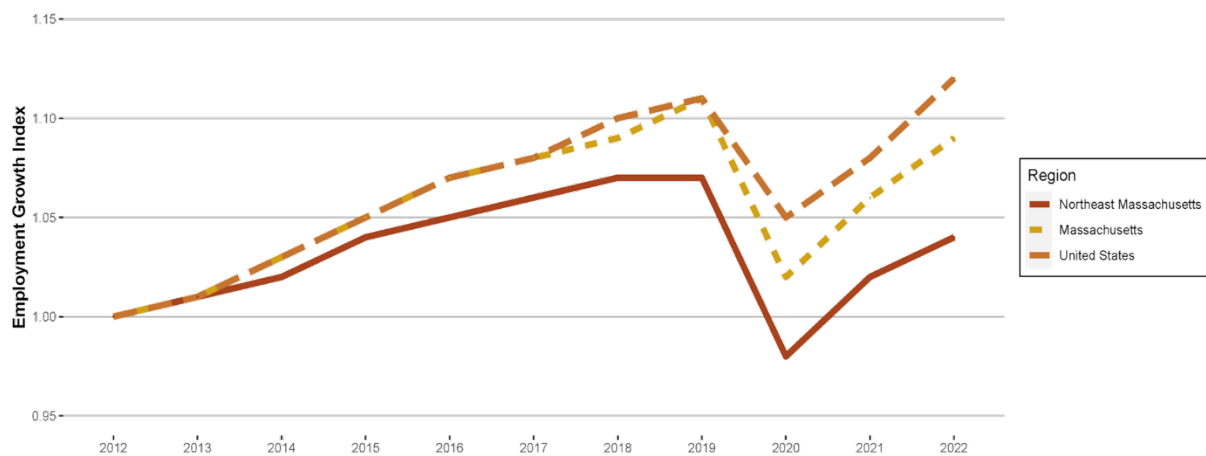


Source: U.S. Census Bureau

# Northeast Massachusetts Economy and Tech Industry Trends

Northeast Massachusetts is situated within the metropolitan Boston area, one of the largest economies in the United States. The region generally follows state and national cycles in economic growth but has a distinct economy of its own with a particular concentration in manufacturing. Northeast Massachusetts overall jobs growth has been somewhat slower than the state's and nation's since 2013, but still experienced steady growth during the 2010s. However, the pandemic hit the region particularly hard, with employment in 2020 dropping below our 2012 baseline. Northeast Mass has also been much slower to recover, with employment in 2022 still significantly below pre-pandemic levels.

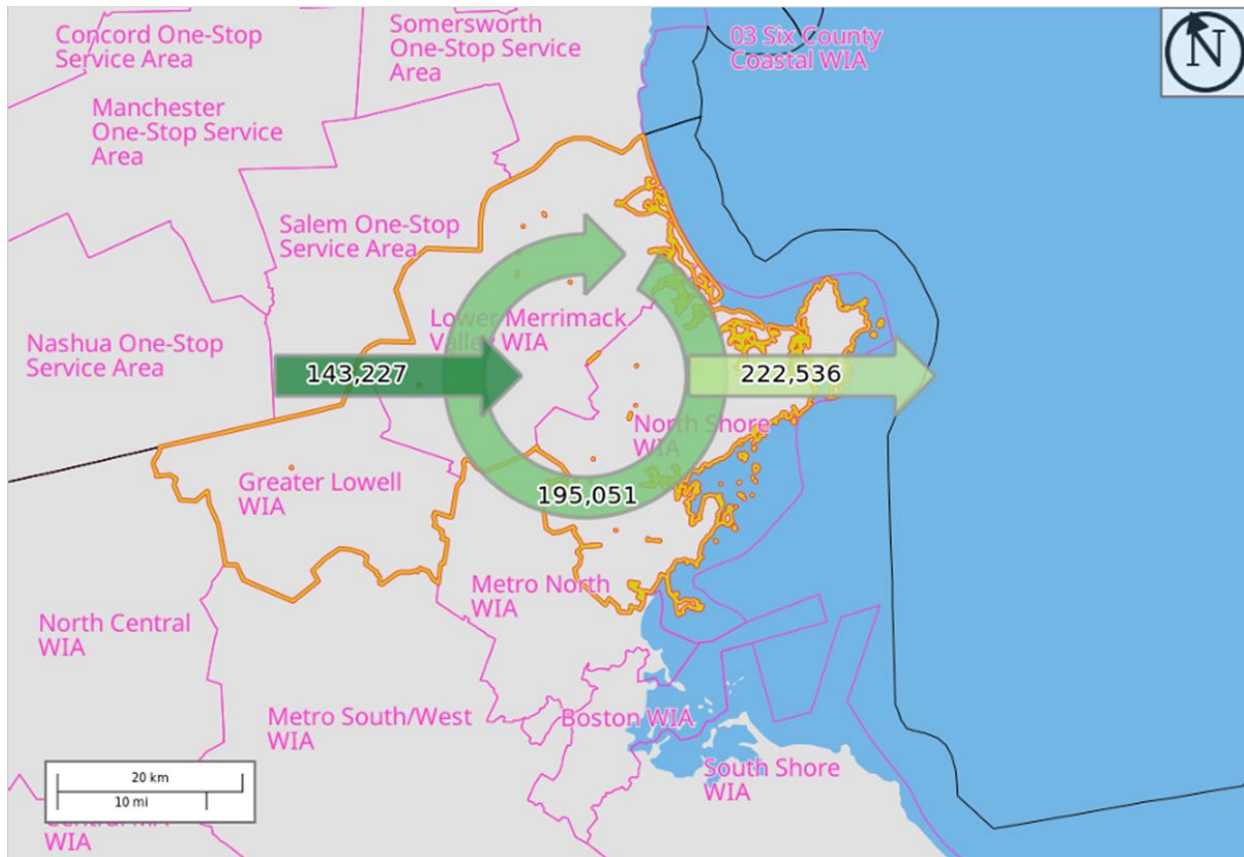
**Figure 7 Employment Growth Slower in Northeast Massachusetts than the State and U.S.**



Source: Lightcast

Northeast Massachusetts experiences a significant inflow and outflow of work in the region. While 195,000 people both live and work in Northeast Massachusetts, an additional 143,000 people work in the region but live elsewhere (e.g., southern New Hampshire). Due to the region's proximity to significant employment hubs in Boston and Cambridge, 223,000 people reside within Northeast Massachusetts but commute to jobs outside the region. The "hub and spoke" MBTA commuter rail system, including branches to Lowell, Haverhill, Newburyport, and Rockport facilitates the large number of commuters from Northeast Massachusetts into Boston, but does not connect those cities to each other. Outbound commuters represent an opportunity for Northeast Massachusetts as talented people working in the Boston-Cambridge hub are often not aware of the job opportunities available within the region. These same people can be a source of business innovation and enterprise development for Northeast Massachusetts and working closer to home would be a significant incentive.

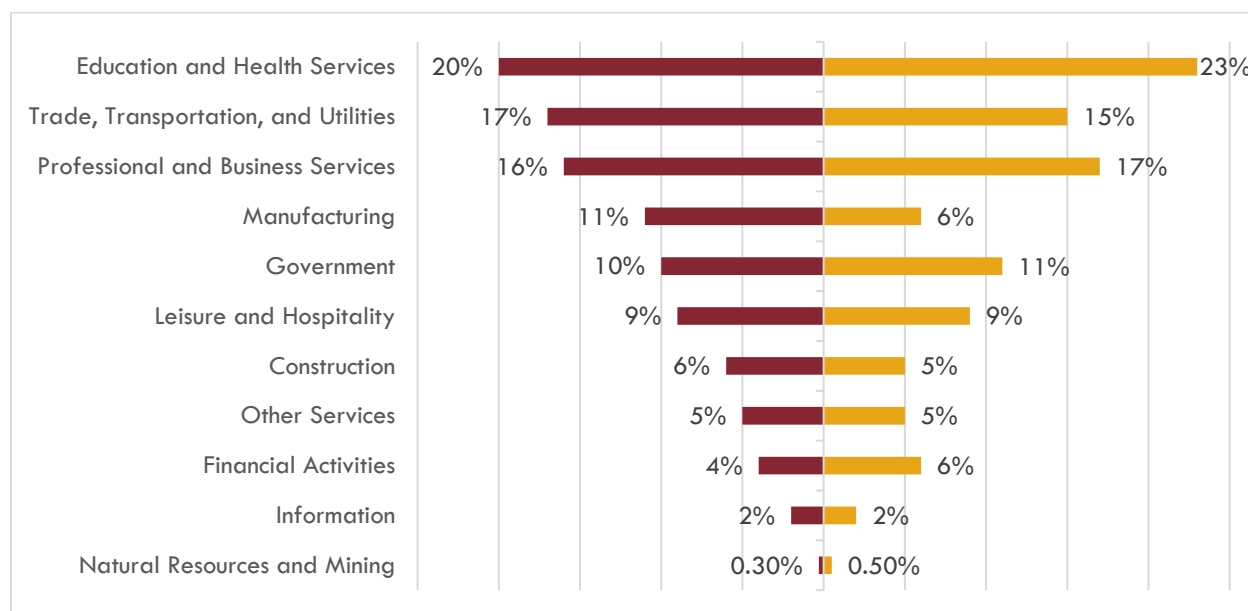
**Figure 8 Northeast Massachusetts Commuting Patterns**



Source: U.S. Census Bureau, 2020

Northeast Massachusetts possesses strengths (as measured by industry jobs concentration relative to the country's) in key sectors—namely manufacturing, professional and business services, trade, transportation, and utilities, and education and healthcare—that are foundational to a thriving innovation economy. Manufacturing includes the suppliers and finished goods for semiconductor manufacturing equipment, jet engines, medical equipment, and pharmaceuticals, among many others, and makes up 11 percent of the industry mix, nearly double the share in the state as a whole. The professional and business services industry represents such areas as research & development, engineering, and computer systems design, and makes up 16 percent of the industry mix, similar to Massachusetts overall. Trade, transportation, and utilities makes up 17 percent and represents the infrastructure necessary to deliver raw materials and intermediate goods to and from manufacturers and is especially important in the biotech space, where rapid delivery of sensitive materials is a daily requirement. Education and healthcare, a large and diverse sector, includes the key educational institutions like UMass Lowell, Salem State University, Endicott College, and community colleges that lead in the development and testing of new technologies as well as skills development for the Northeast Massachusetts workforce. This is the largest industry group despite being slightly smaller as a percentage of the overall workforce compared to the state as a whole.

**Figure 9 Industry Mix – Northeast Massachusetts Compared to Massachusetts, 2022**



Source: Lightcast

**Table 4 Northeast Massachusetts Industry Mix, 2012-2022**

INDUSTRY	2012 Jobs	2022 Jobs	2012-2022 Change (N)	2012-2022 Change (%)	2022 Share of Total (%)	2022 Location Quotient
Education and Health Services	90,309	102,262	11,953	13.2%	20.3%	1.32
Trade, Transportation, and Utilities	80,269	83,017	2,749	3.4%	16.5%	0.91
Professional and Business Services	69,924	77,984	8,059	11.5%	15.5%	<b>1.04</b>
Manufacturing	59,256	56,759	-2,497	-4.2%	11.3%	<b>1.46</b>
Government	55,907	49,139	-6,767	-12.1%	9.8%	0.68
Leisure and Hospitality	44,413	46,096	1,684	3.8%	9.1%	0.94
Construction	23,261	30,413	7,152	30.7%	6.0%	1.05
Other Services	28,037	26,303	-1,734	-6.2%	5.2%	1.04
Financial Activities	19,814	20,250	436	2.2%	4.0%	0.69
Information	10,710	9,957	-753	-7.0%	2.0%	<b>1.04</b>
Natural Resources and Mining	1,545	1,757	212	13.7%	0.3%	0.23
<b>Total</b>	<b>483,444</b>	<b>503,938</b>	<b>20,494</b>	<b>4.1%</b>	<b>100%</b>	<b>-</b>

Source: Lightcast

## The Innovation Economy

After establishing an overview of the Northeast Massachusetts regional economy, we focused in on the region's performance in what we deemed the three pillars of the "innovation economy": tech,<sup>1</sup> life sciences,<sup>2</sup> and advanced manufacturing sectors. The study takes a deeper focus on these three areas following standard sector definitions, noting that high-tech and life sciences are hybrids comprised of many industries.

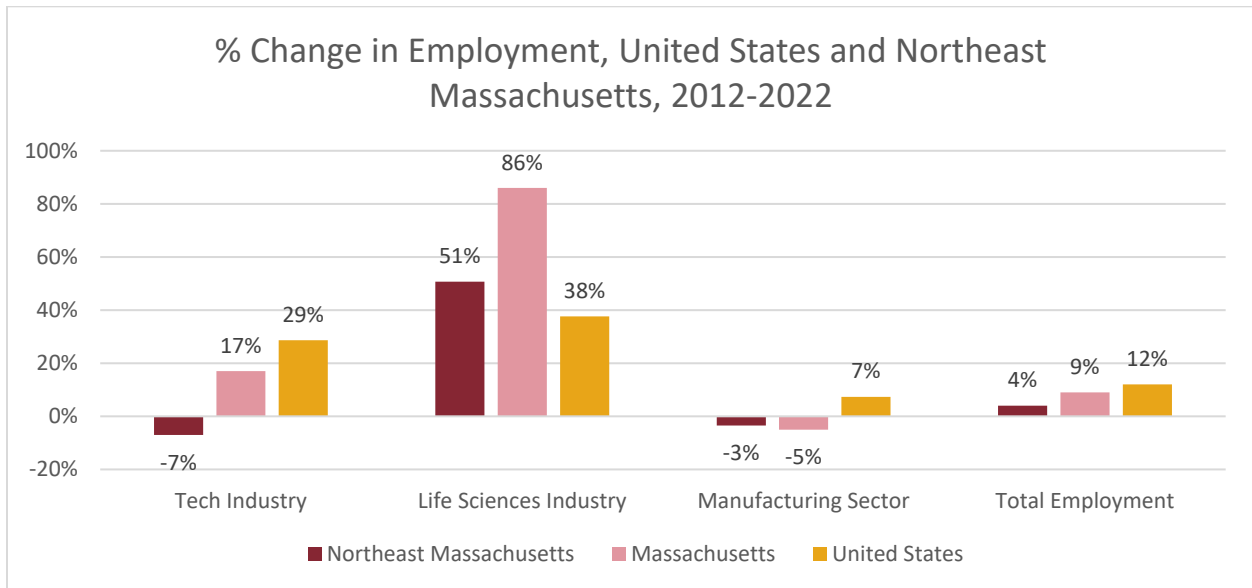
- **Tech.** This sector combines selected industries in manufacturing (e.g., computers, laboratory equipment, etc.) and services (e.g., software, computer systems design). Northeast Massachusetts has specific strengths in analytical laboratory instruments, electromedical devices, and semiconductor machinery.
- **Life Sciences.** Massachusetts is a recognized global leader in life sciences and has seen strong growth in this sector over the past decade. The Northeast Massachusetts region is participating in this growth, notably in the areas of research & development in biotechnology, biological product manufacturing, and medicinal manufacturing.
- **Advanced Manufacturing.** Massachusetts manufacturing production was valued at \$56.6 billion in 2023. As a high-cost state, Massachusetts and Northeast Massachusetts tend to specialize in the production of advanced products and parts requiring high levels of training and the application of specialized skills and machinery. Inclusive of Northeast Massachusetts concentrations in tech and life sciences-related manufacturing (as referenced above), the region is also strong in fabricated metals (fabricated metal manufacturers are frequently second and third-tier suppliers to other industries like robotics, medical equipment, submarines, etc.), aircraft engines, and missiles. Food is emerging as a growing industry and the region remains very strong in leather products (including shoes), a legacy industry for the area.

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<sup>1</sup> As defined in the CompTIA State of the Tech Workforce 2023 Report

<sup>2</sup> As defined by the 2022 MassBio Life Sciences Workforce Analysis Report

**Figure 10 Trends in Innovation Industry Employment, 2012-2022, Northeast Massachusetts Compared to Massachusetts and U.S.**



Source: Lightcast

Employment in the tech industry and manufacturing sector both shrank slightly during the decade from 2012 to 2022, but this job loss was offset by rapid growth in the Life Sciences industry. The region experienced over 50 percent growth in employment in said industry, and while eclipsed by statewide growth of 86 percent, was still much faster than the national rate of 38 percent. This growth was enough to offset the losses in tech and manufacturing, leading to an overall increase in innovation industry employment of 4 percent, but was still less than half of the growth rate seen statewide and a third of the rate seen nationwide.

## Tech

**Table 5 Northeast Massachusetts Tech Sector Trends by Key Industry, 2012-2022**

Description	2012 Jobs	2022 Jobs	2012 - 2022 Change	2012 - 2022 % Change	2012 Employment Concentration	2022 Employment Concentration
Tech Manufacturing	20,393	20,294	(99)	(0.5%)	5.74	6.09
Tech Services	17,833	15,144	(2,689)	(15%)	1.38	1.00
<b>Total</b>	<b>38,227</b>	<b>35,440</b>	<b>(2,787)</b>	<b>(7%)</b>	<b>2.43</b>	<b>1.88</b>

Source: Lightcast

Diving a little deeper into the tech sector, the decline in employment from 2012-2022 was driven largely by double digit rates of decrease in the service side of the sector, particularly software development and IT support employment. The number of tech-related manufacturing jobs in the region remained largely unchanged over the timespan. On the services side of the sector, management level positions experienced the most growth, a trend we will continue to see across the innovation economy, followed by sales positions. Despite the downward trend in the software industry, software developers themselves remain the largest single occupation group in the tech sector and numbers are expected to recover from the last decade of employment losses over the next decade. This holds true for most

computer related occupations that declined over the past decade, with all projected to reverse the trend and begin to grow again over the next ten years. Only tech-related customer service jobs are projected to continue trending down.

**Table 6 Northeast Massachusetts Tech Services Top Ten Occupations 2012-2022**

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2022)	Employed in Industry Group (2032)	Projected Net New Jobs (2022-2032)	Historical Growth (2012-2022)	Projected Growth (2022-2032)	Annualized Median Earnings	Typical Entry Level Education
15-1252	Software Developers	2,528	2,134	2,559	426	(16%)	20%	\$134,035	Bachelor's degree
11-1021	General and Operations Managers	385	598	625	27	55%	5%	\$118,629	Bachelor's degree
41-3091	Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	438	584	593	9	33%	2%	\$72,524	High school diploma or equivalent
15-1232	Computer User Support Specialists	711	576	634	59	(19%)	10%	\$65,433	Some college, no degree
11-3021	Computer and Information Systems Managers	506	571	634	62	13%	11%	\$167,122	Bachelor's degree
43-4051	Customer Service Representatives	612	425	398	(26)	(31%)	(6%)	\$43,622	High school diploma or equivalent
15-1211	Computer Systems Analysts	784	366	408	42	(53%)	12%	\$104,420	Bachelor's degree
15-1299	Computer Occupations, All Other	228	315	338	23	38%	7%	\$95,497	Bachelor's degree
15-1253	Software Quality Assurance Analysts and Testers	192	278	318	40	45%	15%	\$111,703	Bachelor's degree
13-1082	Project Management Specialists	132	277	313	35	111%	13%	\$99,660	Bachelor's degree
00-0000	Other	9,778	7,508	7,957	449	(23%)	6%	\$88,780	Bachelor's degree
<b>00-0000</b>	<b>Total</b>	<b>16,292</b>	<b>13,631</b>	<b>14,778</b>	<b>1,147</b>	<b>(16%)</b>	<b>8%</b>	<b>\$98,632</b>	<b>Bachelor's degree</b>

Source: Lightcast

Tech manufacturing saw significant growth in occupations that typically require specialized training but not a college degree, namely electronics assemblers, miscellaneous assemblers and fabricators, and inspectors, testers, sorters, samplers, and weighers. Jobs typically requiring a college degree were more of a mixed bag, with the number of industrial engineers nearly doubling while software developers, electrical engineers, mechanical engineers, and architectural and engineering managers saw double digit rates of decline in terms of employment. General managers and first line supervisors also saw large increases in employment, similar to other innovation industries. The sector is expected to stagnate over the next ten years, with no occupations projected to significantly grow or decline.

**Table 7 Northeast Massachusetts Tech Manufacturing Top Ten Occupations 2012-2022**

SOC	Description	Employed	Employed	Employed	Projected	Historical	Projected	Annualized Median Earnings	Typical Entry Level Education
		in Industry Group (2012)	in Industry Group (2022)	in Industry Group (2032)	Net New Jobs (2022- 2032)	Growth (2012- 2022)	Growth (2022- 2032)		
51-2028	Electrical, Electronic, and Electromechanical Assemblers, Except Coil Winders, Tapers, and Finishers	1,628	2,319	2,266	(53)	42%	(2%)	\$47,039	High school diploma or equivalent
15-1252	Software Developers	2,183	1,545	1,646	102	(29%)	7%	\$134,035	Bachelor's degree
17-2112	Industrial Engineers	548	1,092	1,163	71	99%	7%	\$105,356	Bachelor's degree
51-2098	Miscellaneous Assemblers and Fabricators	804	976	879	(96)	21%	(10%)	\$39,124	High school diploma or equivalent
11-1021	General and Operations Managers	424	663	633	(30)	56%	(5%)	\$118,629	Bachelor's degree
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	359	534	532	(2)	49%	(0.4%)	\$52,005	High school diploma or equivalent
17-2071	Electrical Engineers	864	467	466	(1)	(46%)	(0.2%)	\$128,793	Bachelor's degree
17-2141	Mechanical Engineers	543	438	450	12	(19%)	3%	\$103,367	Bachelor's degree
51-1011	First-Line Supervisors of Production and Operating Workers	305	427	433	6	40%	1%	\$70,130	High school diploma or equivalent
11-9041	Architectural and Engineering Managers	635	389	387	(1)	(39%)	(0.3%)	\$172,274	Bachelor's degree
00-0000	Other	12,470	11,856	11,578	(278)	(5%)	(2%)	\$83,396	Bachelor's degree
<b>00-0000</b>	<b>Total</b>	<b>20,762</b>	<b>20,705</b>	<b>20,433</b>	<b>(272)</b>	<b>(0.3%)</b>	<b>(1%)</b>	<b>\$85,333</b>	<b>Bachelor's degree</b>

Source: Lightcast

## Life Sciences

Unlike the tech sector, the Life Sciences sector experienced significant growth over the past decade, with most of the major industries experiencing double- to triple-digit rates of employment growth, translating to thousands of new jobs. The majority of growth occurred in the two largest research and development industries, and both have very high employment concentrations, indicating how much more likely someone is to be employed in a specific industry in Northeast Massachusetts compared to the United States overall. Medicinal and botanical manufacturing had the highest relative growth at over 1100 percent. Though small in terms of total employment, the employment concentration shows that the region is now punching well above its weight in the industry.



**Table 8 Northeast Massachusetts Life Sciences Sector Trends by Key Industry, 2012-2022**

NAICS	Description	2012 Jobs	2022 Jobs	2012 - 2022 % Change	2012 Employment Concentration	2022 Employment Concentration	Current Wages
541714	Research and Development in Biotechnology (except Nanobiotechnology)	3,894	5,158	32%	8.60	6.14	\$213,841
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	1,766	3,833	117%	1.31	2.46	\$276,600
621511	Medical Laboratories	644	568	(12%)	1.13	0.77	\$86,094
325414	Biological Product (except Diagnostic) Manufacturing	256	478	86%	2.97	3.66	\$241,806
325412	Pharmaceutical Preparation Manufacturing	447	441	(1%)	0.68	0.65	\$163,552
325411	Medicinal and Botanical Manufacturing	23	284	1111%	0.37	2.29	\$63,105
541713	Research and Development in Nanotechnology	44	93	113%	0.58	1.21	\$163,901
325413	In-Vitro Diagnostic Substance Manufacturing	158	45	(71%)	2.58	0.47	\$163,821
000000	<b>Total</b>	<b>7,234</b>	<b>10,900</b>	<b>51%</b>	<b>2.18</b>	<b>2.57</b>	<b>\$223,881</b>

Source: Lightcast

The growth in life sciences employment is well-distributed among the top occupations in the sector, with medical scientists and biochemist and biophysicists adding hundreds of jobs. Biochemists and biophysicists showed particularly rapid growth, moving from the fourth largest occupation in 2012 to the second in 2022. Unlike in the tech industry, the number of software developers working in the life sciences industry grew by nearly 50% over the past decade, becoming the third largest occupation in the sector. Continuing the trend we remarked on in the tech sector, management level occupations continue to be among the fastest growing, with natural science managers, general and operations managers, and project management specialists seeing triple digit growth over the past ten years. All occupation groups are projected to continue growing significantly over the next ten years, though the rapid growth over the past decade is expected to cool from 47 percent to 27 percent over the next.

**Table 9 Northeast Massachusetts Top 10 Life Sciences Sector Occupations, 2012-2022**

SOC	Description	Employed in Industry Group (2012)	Employed in Industry Group (2022)	Employed in Industry Group (2032)	Projected Net New Jobs (2022-2032)	Historical Growth (2012 - 2022)	Projected Growth (2023-2032)	Annualized Median Earnings	Typical Entry Level Education
19-1042	Medical Scientists, Except Epidemiologists	744	869	1,170	427	17%	35%	\$130,878	Doctoral or professional degree
19-1021	Biochemists and Biophysicists	291	701	863	573	141%	23%	\$112,313	Doctoral or professional degree
15-1252	Software Developers	304	446	688	385	47%	54%	\$134,035	Bachelor's degree
11-9121	Natural Sciences Managers	149	433	551	403	192%	27%	\$227,584	Bachelor's degree
11-1021	General and Operations Managers	128	431	539	411	235%	25%	\$118,629	Bachelor's degree
19-2031	Chemists	227	367	423	196	62%	15%	\$112,055	Bachelor's degree
19-4021	Biological Technicians	334	295	390	56	(12%)	32%	\$67,429	Bachelor's degree
29-2018	Clinical Laboratory Technologists and Technicians	226	274	314	89	21%	15%	\$57,571	Bachelor's degree
17-2112	Industrial Engineers	89	223	280	191	150%	26%	\$105,356	Bachelor's degree
13-1082	Project Management Specialists	53	209	276	223	291%	32%	\$99,660	Bachelor's degree
00-0000	Other	5,440	7,485	9,450	1,965	38%	26%	\$92,899	Bachelor's degree
00-0000	<b>Total</b>	<b>7,985</b>	<b>11,732</b>	<b>14,947</b>	<b>3,215</b>	<b>47%</b>	<b>27%</b>	<b>\$103,847</b>	<b>Bachelor's degree</b>

Source: Lightcast

## **Manufacturing**

The number of manufacturing jobs in Northeast Massachusetts shrank slightly over the past decade, but the sector still employs nearly 60,000 people in the region, and enjoys a high concentration of skilled manufacturing employees compared to the country overall. Essentially holding steady over the past decade, computer and electronic product manufacturing dominates the sector, providing almost a third of all jobs and while paying the highest average salary. Legacy industries like printing, textile, paper, appliance, and apparel manufacturing saw large declines in employment, but still make up significant parts of overall employment. Food manufacturing saw its already large employment footprint continue

to grow, adding over 1,000 jobs between 2012 and 2022, while beverage and tobacco manufacturing employment more than doubled in size.

**Table 10 Northeast Massachusetts Manufacturing Sector Trends by Key Industry, 2012-2022**

NAICS	Description	2012 Jobs	2022 Jobs	2012 - 2022 % Change	2012 Employment Concentration	2022 Employment Concentration	Current Wages
334	Computer and Electronic Product Manufacturing	18,584	18,256	(2%)	5.31	5.63	\$144,831
336	Transportation Equipment Manufacturing	8,591	7,171	(17%)	1.83	1.4	\$138,060
311	Food Manufacturing	5,830	6,980	20%	1.23	1.36	\$60,630
332	Fabricated Metal Product Manufacturing	5,265	5,304	1%	1.16	1.23	\$87,091
333	Machinery Manufacturing	4,288	4,510	5%	1.21	1.36	\$122,124
339	Miscellaneous Manufacturing	3,666	4,307	18%	1.85	2.15	\$95,079
325	Chemical Manufacturing	3,225	2,872	(11%)	1.27	1.07	\$128,603
323	Printing and Related Support Activities	2,713	2,284	(16%)	1.77	1.94	\$79,446
335	Electrical Equipment, Appliance, and Component Manufacturing	2,605	1,345	(48%)	2.18	1.11	\$99,024
326	Plastics and Rubber Products Manufacturing	913	948	4%	0.44	0.43	\$83,779
316	Leather and Allied Product Manufacturing	821	844	3%	7.95	9.19	\$107,763
337	Furniture and Related Product Manufacturing	590	529	(10%)	0.49	0.44	\$65,291
313	Textile Mills	784	440	(44%)	1.99	1.48	\$89,543
312	Beverage and Tobacco Product Manufacturing	156	421	169%	0.25	0.43	\$39,966
327	Nonmetallic Mineral Product Manufacturing	438	412	(6%)	0.36	0.33	\$67,788
315	Apparel Manufacturing	576	409	(29%)	1.10	1.3	\$42,990
322	Paper Manufacturing	548	381	(30%)	0.45	0.35	\$74,007
321	Wood Product Manufacturing	232	367	58%	0.20	0.27	\$66,749
331	Primary Metal Manufacturing	225	188	(16%)	0.17	0.17	\$77,269
314	Textile Product Mills	226	187	(17%)	0.58	0.55	\$51,056
324	Petroleum and Coal Products Manufacturing	134	165	23%	0.37	0.53	\$112,923
000	<b>Total</b>	<b>60,409</b>	<b>58,321</b>	<b>(3%)</b>	<b>1.54</b>	<b>1.51</b>	<b>\$112,578</b>

Source: Lightcast

The top two occupations in the manufacturing sector are lower paying jobs that do not require a bachelor's degree, but do often require some form of specialized training. These jobs are typically able to advance to first-line supervisor positions, a much better paying occupation that also does not require a degree, and which saw steady growth alongside the aforementioned industries. Similar to the tech sector, manufacturing overall saw an increase in industrial engineering positions and management jobs, while experiencing steady declines in software developer roles. The manufacturing sector is projected to grow slightly over the next ten years, with food batchmakers expected to be the fastest growing occupation. This occupations rapid growth over the past decade aligns with the increases in food

manufacturing we saw in our industry analysis above, and suggests that this will continue to be a robust and growing sector of the Northeast Massachusetts manufacturing sector.

**Table 11 Northeast Massachusetts Top Ten Manufacturing Sector Occupations, 2012-2022**

SOC	Description	Employed in Industry (2012)	Employed in Industry (2022)	Employed in Industry (2032)	Projected Net New Jobs (2022-2032)	Historical Growth (2012-2022)	Projected Growth (2022-2032)	Annualized Median Earnings	Typical Entry Level Education
51-2098	Miscellaneous Assemblers and Fabricators	2,642	2,951	2,759	(192)	12%	(7%)	\$39,124	High school diploma or equivalent
51-2028	Electrical, Electronic, and Electromechanical Assemblers	2,107	2,876	2,820	(56)	37%	(2%)	\$47,039	High school diploma or equivalent
17-2112	Industrial Engineers	1,276	2,369	2,528	159	86%	7%	\$105,356	Bachelor's degree
15-1252	Software Developers	2,771	2,026	2,146	120	(27%)	6%	\$134,035	Bachelor's degree
11-1021	General and Operations Managers	1,304	1,938	1,964	26	49%	1%	\$118,629	Bachelor's degree
51-1011	First-Line Supervisors of Production and Operating Workers	1,541	1,762	1,868	106	14%	6%	\$70,130	High school diploma or equivalent
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,271	1,699	1,725	26	34%	2%	\$52,005	High school diploma or equivalent
51-4041	Machinists	1,664	1,488	1,620	133	(11%)	9%	\$57,814	High school diploma or equivalent
51-3092	Food Batchmakers	317	1,341	1,535	194	323%	15%	\$33,061	High school diploma or equivalent
11-3051	Industrial Production Managers	661	1,117	1,136	19	69%	2%	\$131,587	Bachelor's degree
00-0000	Other	45,268	39,225	40,136	911	(13%)	2%	\$71,070	High school diploma or equivalent
<b>00-0000</b>	<b>Total</b>	<b>60,822</b>	<b>58,791</b>	<b>60,238</b>	<b>1,447</b>	<b>(3%)</b>	<b>3%</b>	<b>\$72,779</b>	<b>High school diploma or equivalent</b>

Source: Lightcast

## Climate Tech

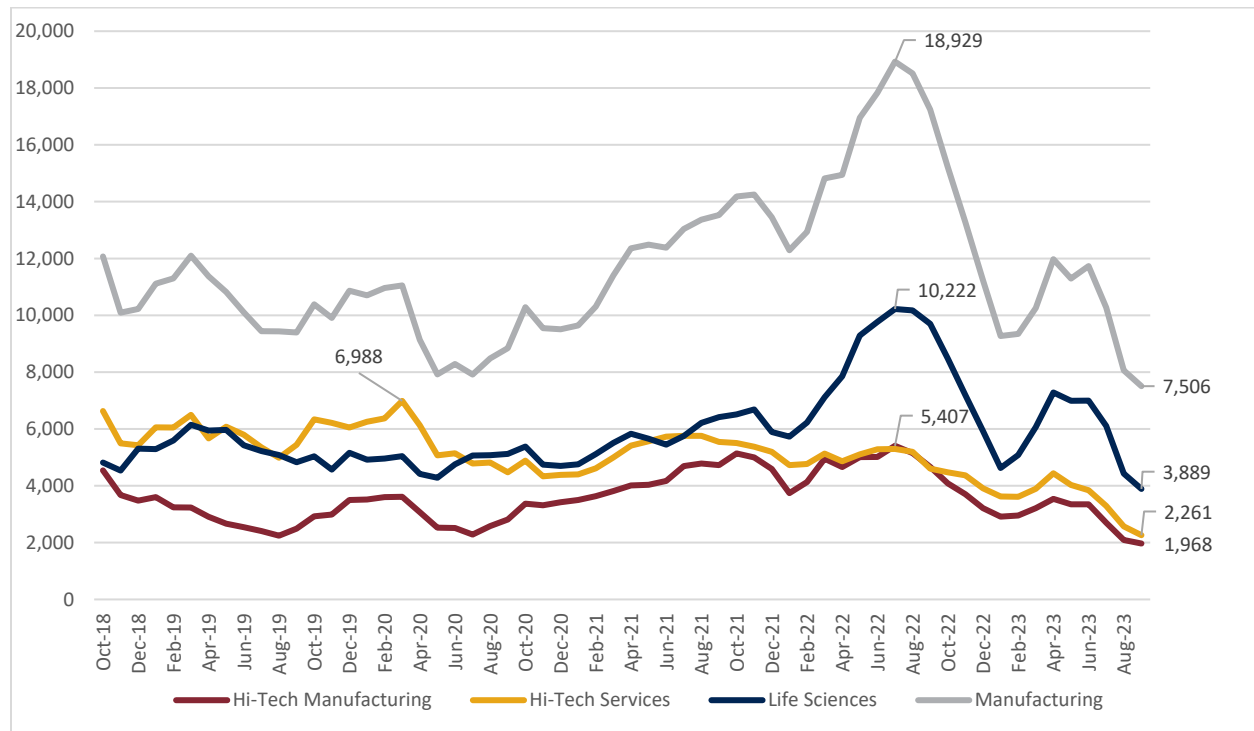
Massachusetts is in the midst of a long-term transition to clean energy, with hundreds of millions of dollars pledged (as part of the Mass Leads Act) to reach the goal of net-zero carbon emissions. Governor Healey outlined an approach to add climate tech to the industries that Massachusetts holds a competitive edge in, specifically mentioning advanced manufacturing and life sciences as two sectors that can be leveraged to build a globally competitive edge for Massachusetts. Similar to the successful effort to grow the Massachusetts life sciences industry into a global leader, the new climate tech initiative also supported by funds to develop a climate tech workforce in the state, is aimed to propel Massachusetts as a national and world leader to compete in the emerging clean energy sector. As Northeast Massachusetts already has a high concentration of employment in these industries, the regional workforce is well positioned to take advantage of the influx of investments and attention to the climate tech industry in the state.

One of the premier upcoming clean tech projects in Northeast Massachusetts is the Salem Offshore Wind terminal. This project will transform existing infrastructure to create a deep-water port capable of constructing and installing floating offshore wind in the Gulf of Maine. Construction is expected to create over 120 new jobs prior to operations and sustain up to 200 new jobs during operation. The company behind the project plans to work with local high schools, colleges, and nonprofits to provide Global Offshore Wind training and other workforce development programs necessary for the Offshore Wind Terminal to be able to hire locally once completed. Associated positive effects such as making Salem accessible to cruise ships and building local supply chains will likely provide further employment opportunities. An interviewee mentioned to us that a local company was in the midst of designing ocean gliders to collect and analyze data concerning the environmental effects of installed offshore wind facilities, and we expect that the project will create many more similar opportunities in the region.

## Demographics of the Innovation Workforce

The overall number of job postings in innovations industries peaked in mid-2022 and have been declining since. However, the peak in 2022 was well above the five-year average and may have been due to the influx of pandemic relief funding and the ongoing tech boom, meaning the subsequent decline in postings could represent a return to the mean. Tech services was the only sector not to experience its five-year peak in 2022, instead peaking just before the pandemic hit in March 2020, possibly due to companies stocking up on IT staff with the expectation of most jobs going remote for the foreseeable future.

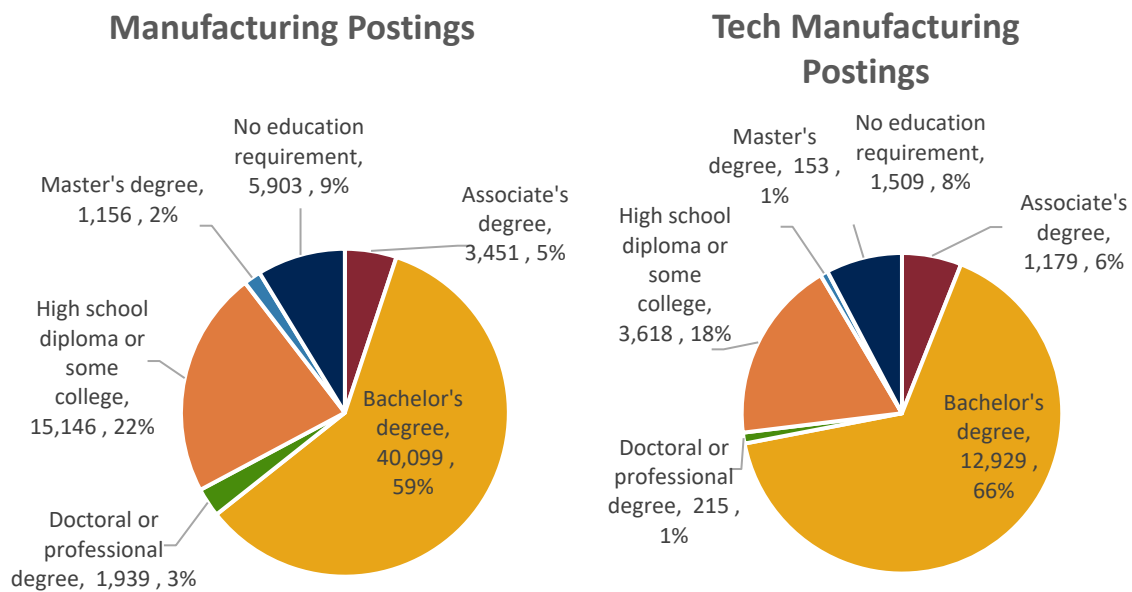
**Figure 11 Job Posting by Month in Northeast Massachusetts Innovation Industries, 2018-2023 (September)**



Source: Lightcast

Nearly 60 percent of manufacturing job postings in Northeast Massachusetts require a bachelor’s degree, reflecting the highly educated population of the region and the dominance of advanced manufacturing industries like semiconductors over traditional industries like textiles. For manufacturing industries that we identified as falling under the “tech” umbrella, a slightly higher percentage of postings require bachelor’s degrees at the expense of positions requesting high school degrees, but because of the how much of the overall manufacturing industry is already tech-related, the ratios are not too dissimilar.

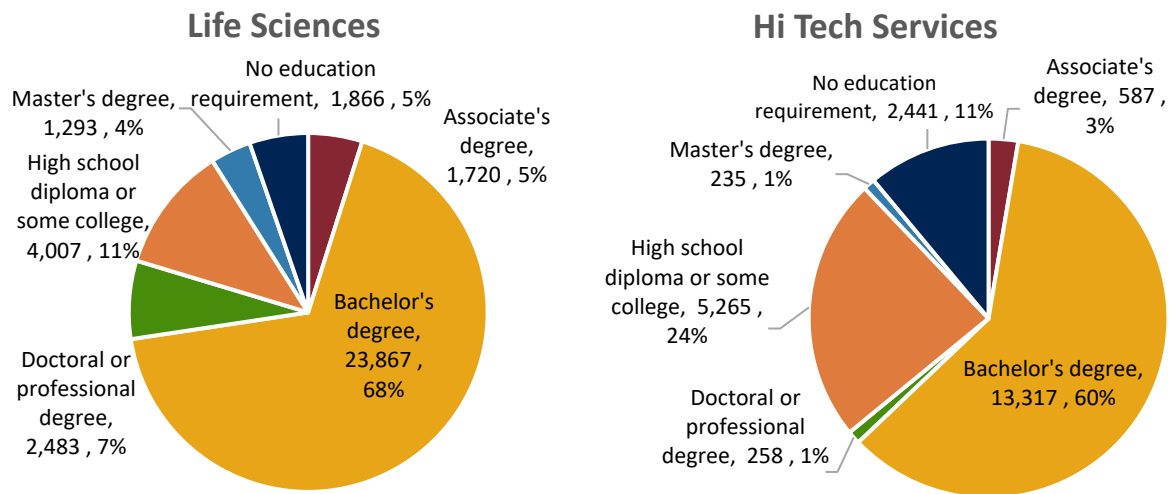
**Figure 12 Manufacturing (all) and Tech Manufacturing Jobs Postings by Educational Requirement in Northeast Massachusetts, 2022**



Source: Lightcast

Tech Services sees a similar split in education requirements to manufacturing, with a slightly higher percentage of postings requiring only a high school diploma or no education requirement at all. This likely reflects the customer service and call center positions available in tech support industries, while the still high requirements for bachelor’s degrees reflects the dominance of software development occupations in the sector. Life sciences has the most unique split out of our innovation sectors, with more than ten percent of postings requiring an advanced degree, and only 16 percent of industries requiring a high school diploma or less education, compared to 31 percent in manufacturing and 35 percent in tech services.

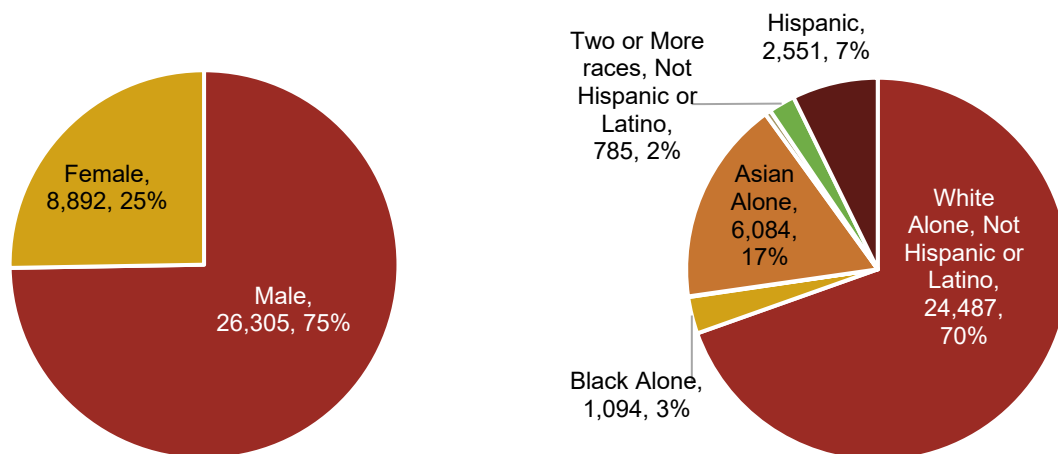
**Figure 13 Life Sciences and Tech Services Jobs Postings by Educational Requirement in Northeast Massachusetts, 2022**



Source: Lightcast

Looking deeper into the workforce of these industries, Census estimates show that 75 percent of workers in “Computer, Engineering, and Science Occupations” are male and 25 percent are female, reflecting historical trends in STEM occupations. The majority of employees are white, roughly in line with the overall population breakdown (70% vs. 66% in the overall population) while the share of employees who are Asian is more than twice that of the general population (17% vs. 7% overall). The percentage of black employees roughly aligns with the overall population (3% vs 4%) while the Hispanic population of the region is severely underrepresented in the field (7% vs. 20% of the overall population). As Hispanic or Latino residents continue to be the primary drivers of labor force growth in the region, efforts will need to be made to make STEM occupations more accessible to maintain Northeast Massachusetts’ edge in innovation industries.

**Figure 14 Race and Gender Composition of Computer, Engineering, and Science Occupations in Northeast Massachusetts, 2021**



Source: U.S. Census Bureau

# Innovation in Northeast Massachusetts

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Growth in the Northeast Massachusetts innovation economy will rely on the continued support of academic institutions and businesses engaged in discovering, applying, and commercializing breakthrough technologies. This is reflected in U.S. Patent Office awards, as well as competitive funding from the National Institutes of Health (NIH) and the Small Business Administration (SBA) which oversees both the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. The awarded patents and research funding in Northeast Massachusetts form the seeds for innovation, entrepreneurialism, business formation, and future economic growth in the region.

## Higher Education Institutions

### Colleges/Universities

- Endicott College
- Gordon College
- Merrimack College
- North Shore Community College
- Northern Essex Community College
- Salem State University
- Middlesex Community College
- University of Massachusetts-Lowell
- Cambridge College-Lawrence (to be acquired by Bay Path University)

### Vocational High Schools

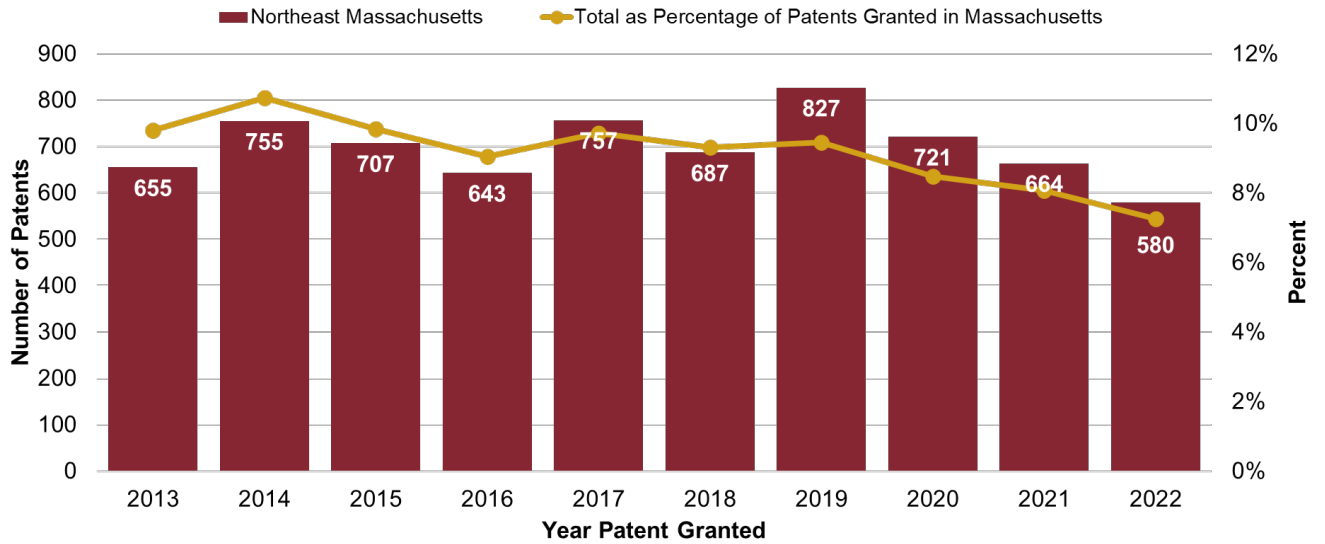
- Essex North Shore Agricultural and Technical School
- Greater Lawrence Regional Vocational Technical
- Lynn Vocational Technical Institute
- Greater Lowell Regional Vocational Technical
- Nashoba Valley Technical High School
- Northeast Metro Regional Vocational
- Shawsheen Valley Vocational Technical School
- Whittier Regional Vocational Technical High School

## Patents

Between 2013 and 2022, Northeast Massachusetts businesses and institutions received between 650 to 800 patents annually, typically accounting for approximately 9 to 10 percent of all Massachusetts patents, though it has dipped to around 7 percent in recent years as the overall number of patents granted to organizations in the region post-pandemic. Patent earning organizations tended to be clustered around in the Greater Lowell area, with nearly 50 percent of patents going to organizations in Billerica and Chelmsford. Andover was a standout in the Lower Merrimack Valley, as was Gloucester in the North Shore.

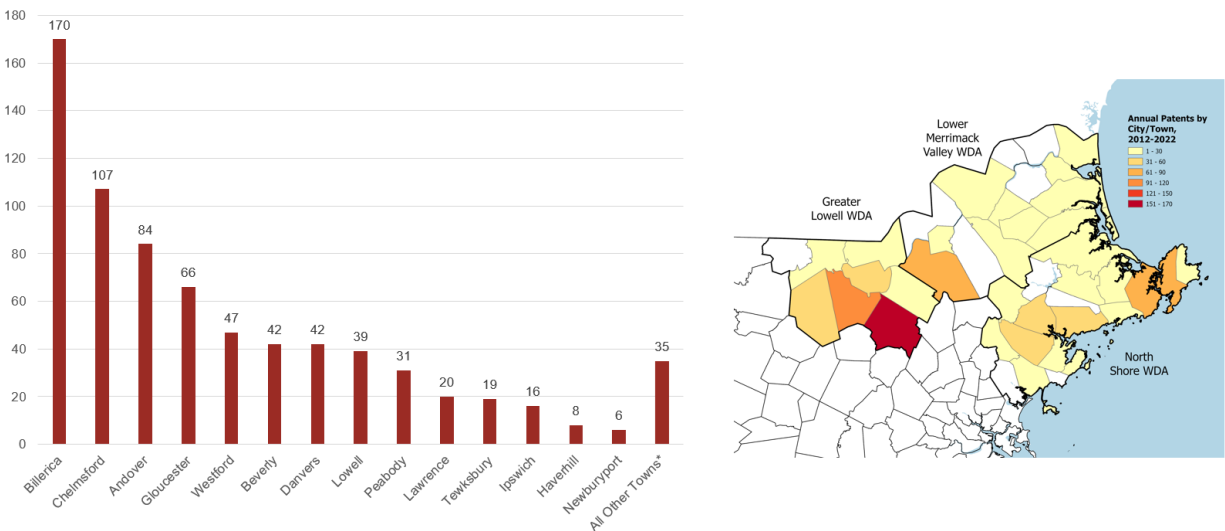


**Figure 15 Number of Patents Granted in Northeast Massachusetts and Share of State Total, 2013-2022**



Source: U.S. Patent and Trade Office

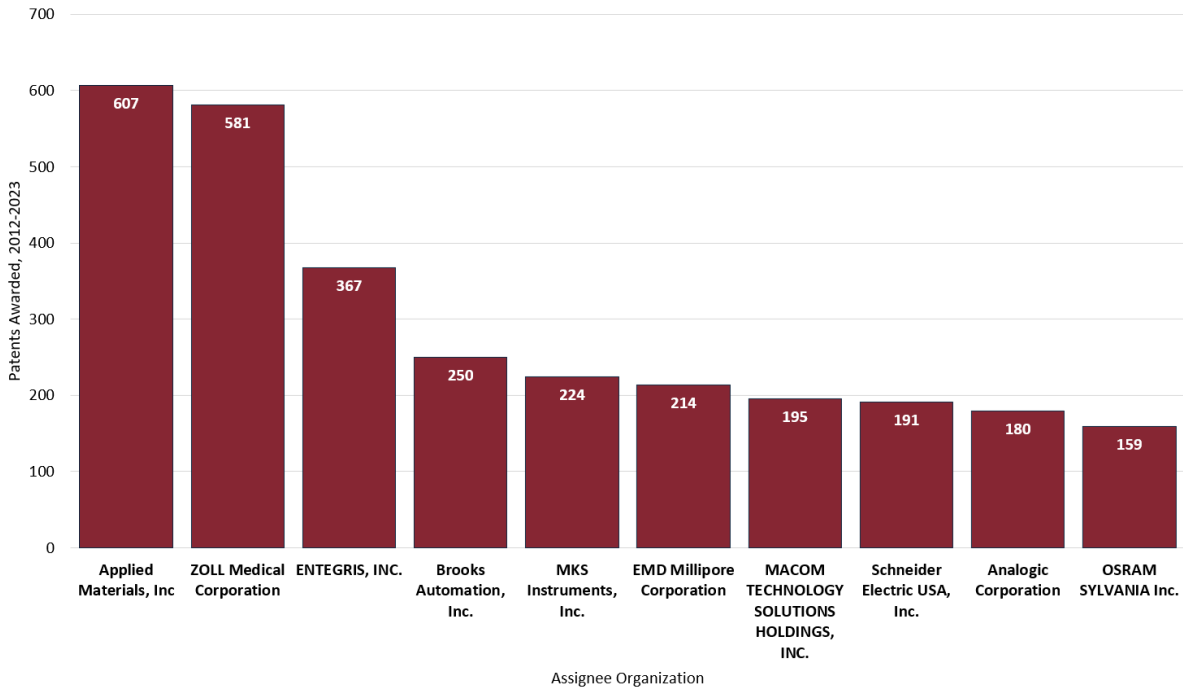
**Figure 16 Patents Granted in Northeast Massachusetts by City and Town, 2012-2022**



Source: U.S. Patent and Trade Office (annual average); \*Includes Boxford, Marblehead, Salem, Rowley, Georgetown, Groveland, Lynn, Lynnfield, Middleton, Tyngsborough, Dracut, Essex, Hamilton, Manchester-by-the-Sea, Nahant, Newbury, Rockport, and Salisbury.

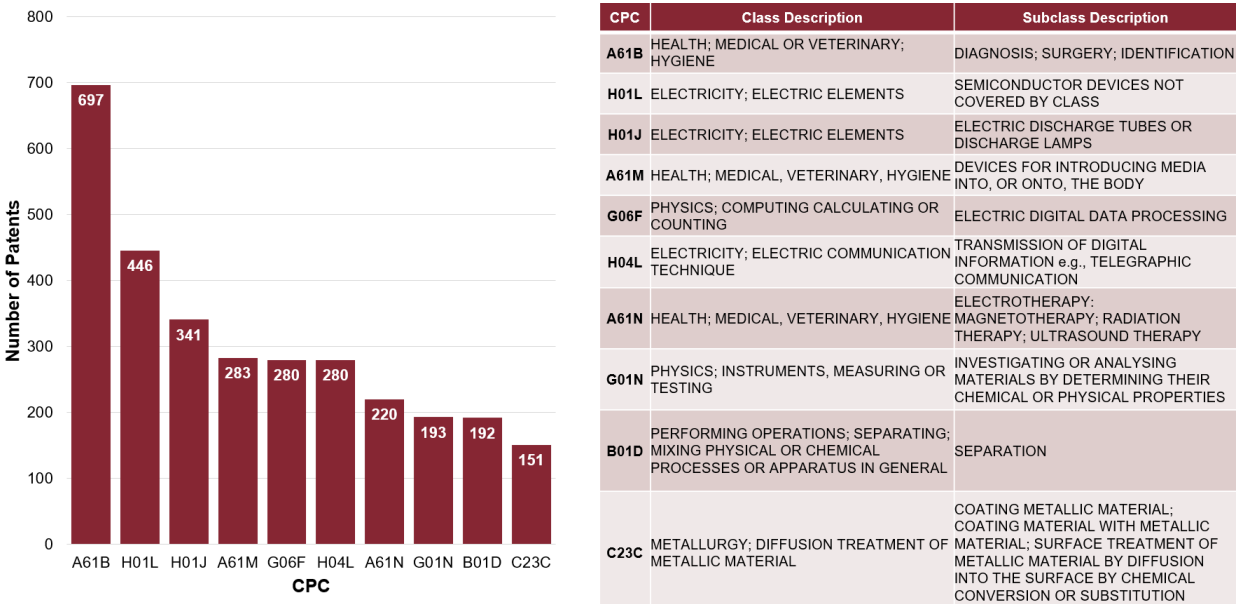
Applied Materials and Zoll Medical Corporation were by far the two largest patent awardees over the past decade, with each earning around 600 patents. However, the spread of patents across the region was overall robust, with the top ten awardees each earning at least 150 patents in the time frame. Patents awarded to these organizations fit with our initial scope of the innovation economy, showing medical devices, semiconductors, and electronics as the dominant patent classifications.

**Figure 17 Leading Companies in Awarded Patents in Northeast Massachusetts, 2012-2023**



Source: U.S. Patent and Trade Office

**Figure 18 Top Patent Classifications in Northeast Massachusetts**



Source: U.S. Patent and Trade Office

## SBIR, STTR, and NIH Awards

During the decade between 2013 and 2022, Northeast Massachusetts received nearly \$150 million in funding through 293 awards from the National Institutes of Health. Optics, DNA, brain trauma, diabetes prevention, and orthopedic implant materials are among the many areas of focus for the funding. Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding also provided a key flow of income into the region. Combined, these two U.S. Small Business Administration programs provided 1,249 awards and about \$580 million in funding to Northeast Massachusetts organizations, institutions, and businesses between 2013 and 2022. Defense technology-related awards are particularly prominent in the region. Examples include sonobuoys for anti-submarine warfare, propulsion technologies, antennas, and aerodynamics. Dual use and civilian technologies include advanced materials, robotics, carbon management, medical devices, and particle/chemical detection.

**Table 12 SBIR, STTR, and NIH Awarded to Northeast Massachusetts, 2013-2022**

Award Type	Number of Awards	Total Funding
National Institutes of Health (NIH)	293	\$148,617,176
Small Business Innovation Research (SBIR)	1,099	\$515,969,216
Small Business Technology Transfer (STTR)	160	\$63,843,403
<b>TOTALS</b>	<b>1,552</b>	<b>\$728,429,795</b>

Source: National Institutes of Health and the Small Business Administration

## Putting People on Pathways for Jobs in the Northeast Massachusetts Innovation Economy

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Through the data collection process and numerous interviews with businesses, regional organizations, and academia, several approaches for bringing people into the Northeast Massachusetts innovation economy were identified. Many successful initiatives are already in place, some needing wider marketing and scaling to maximize effectiveness.

### *Immigrants Are a Key Component of the Future Workforce*

A key theme that emerged from our discussions is that the influx of foreign migration to Massachusetts should be treated as an asset rather than a liability. Immigrants play a pivotal role in stabilizing the workforce in Massachusetts, particularly in the tech industries. Immigrants and foreign nationals have potential to not only contribute to the innovation economy by starting companies but also by filling essential positions, especially on factory floors where they already constitute a significant portion of the workforce. These jobs, often overlooked or stigmatized (as will be elaborated upon later), serve as entry points to pathways for further career advancement.

Language is a significant obstacle to accessing this workforce. One employer relayed that they had prospective employees who already knew how to use their equipment from a job they had held in their country of origin, and that the lack of language skills was the only barrier to them being able to solve their employment crunch on the spot. Several organizations have identified the importance of language skills, with efforts to bridge linguistic barriers expanding. Initiatives such as dual language training, technical courses offered in Spanish, and wrap-around support (e.g., case managers, jobs placement specialists, resume assistance, etc.) are gaining traction, facilitating immigrants' integration into the workforce.

Despite the strong demand for workers, particularly in underserved communities like Lawrence and Lowell, challenges remain in increasing the supply of skilled labor. Transportation barriers, including access to automobiles and public transit connectivity, hinder access to training programs and job opportunities in Northeast Massachusetts. Language constraints bleed into most other systemic barriers, particularly concerning marketing jobs and job training. Most employment and training opportunities are only advertised online, so even if they are translated to Spanish and other languages, they often miss lower income residents of Northeast Mass communities that lack internet access. One in five Essex County residents have no internet connected devices, and this ratio is even worse in areas with a large Spanish speaking population. In Lynn, for example, 40 percent of the population speaks Spanish, and an estimated 35 percent of residents have no access to the internet. Offering courses specifically to Spanish speakers would allow knowledge of these programs to spread by word of mouth into underserved communities.

Institutions like the North Shore Community College are taking proactive steps by developing dual-language degree programs and providing support services tailored to immigrant communities, and multiple organizations are looking into providing transportation from more diverse cities like Lowell to bring employees to jobs, education, and training opportunities in the region. However, many

interviewees believe greater state involvement in preparing new immigrants for the workforce is necessary, emphasizing language proficiency as a prerequisite for most training programs for the foreseeable future. As one biotech training facility put it, many of the more advanced biotech and manufacturing techniques have never had their documentation translated out of English and would require someone to be both an expert translator and an expert in their field to produce such a translation, a task that is basically impossible for a technical school or community college.

Several large life sciences training programs already exist nearby that Northeast Massachusetts could learn from. The Boston Life Sciences Workforce Initiative prioritizes training programs that offer residents without four-year degree specialized training that fits the demands of life sciences companies, who intern commit to hiring trainees once their training is complete. Immigrants are a key demographic that the program is targeting, and recognizing the issues with reaching immigrant communities the initiative also funds an advertising campaign to increase awareness of the new initiative in Boston neighborhoods. Roxbury Worx is another life sciences workforce development initiative focused on what they call “hidden” workers, a group that often includes recent immigrants who previously have not had access to life sciences careers. Roxbury Worx is developing a workforce development model specific to its neighborhood to address resident-defined barriers, a model that could be replicated in areas like Lynn and Lawrence with both low internet access and lower levels of English proficiency.

### ***From Manufacturing to a “Maker’s Economy”***

A nearly universal call from educators, employers, and workforce development specialists was the need to counteract the negative perceptions that have long surrounded manufacturing jobs. This is becoming increasingly important as workers with manufacturing experience are aging out of the labor force and cannot readily be replaced, at least in part due to a decades-long emphasis on college education rather than the trades. In response to the shortage, Massachusetts manufacturers are introducing higher levels of automation but that does not negate the high levels of demand seen for manufacturing workers for both new jobs and “replacement” jobs (i.e., replacing those retiring out of the labor force) in the state and the Northeast Massachusetts region.

Many parents and educators view manufacturing as undesirable or inaccessible, either due to its perceived hazards or the misconception that it requires advanced technical skills or degrees. Interviewees describe an ongoing struggle to effectively communicate the opportunities available in modern manufacturing, with many people still assuming it is a dangerous or dirty job, rather than a technical one often requiring cleanrooms and computer skills. The director of an entrepreneurial support organization in the region believed manufacturing needed a full rebrand to escape the negative connotations around the name, suggesting a rebrand to calling manufacturing the “maker’s economy.” Similar sentiments were echoed by an executive at a regional organization, stating that “Manufacturing needs a rebrand. People think of it as grueling, dirty work. They don’t realize how high tech it is now.” Interviewees describe a pressing need to showcase the diverse career paths and benefits associated with manufacturing jobs, including opportunities for travel and professional growth within major corporations. Moreover, individuals seeking career guidance require accessible resources that outline the specific job prospects, salaries, required training, and career pathways associated with different educational levels so that they can make an informed decision on whether to go the route of vocational school or college.

## ***Early Exposure to STEM Fields and Trades Is Critical for Introducing People to Career Opportunities***

Another key theme we heard repeatedly in interviews was that addressing the challenges of getting people into advanced manufacturing and the innovation economy requires an “early intervention”. Initiatives like community labs, field trips to Northeast Massachusetts tech companies, and volunteer programs aim to spark interest in science and technology, including advanced manufacturing, during elementary to high school years, paving the way for future career exploration. This would lean into engaging students in hands-on learning experiences during high school and college (in some instances), including internships and experiential programs where educators can provide firsthand exposure to the realities and opportunities available in advanced manufacturing in Northeast Massachusetts. Career and Technical Education (CTE) programs housed in vocational schools and high schools in Northeast Massachusetts do provide training and exposure to advanced manufacturing and trades career possibilities. Both middle school and high school age students need to be aware of CTE programs and the career opportunities they provide.

Efforts to build pathways into biotech and manufacturing could look for guidance from the Massachusetts Life Sciences Center (MLSC) Pathmaker Program, which allocates up to \$750,000 per project in direct funding to support organizations capable of building and scaling career pathways that effectively prepare students for in-demand opportunities in the life sciences sector. The program aims to develop training programs addressing critical skills and talent supply gaps in areas like biomanufacturing and medtech manufacturing, two large and growing industries in Northeast Massachusetts.

## ***Paid Internships for Young People Provide Invaluable Experience and Broadens the Labor Pool***

Internship programs for high school aged students in STEM and trade-related fields can provide experience in entry-level tech professions and teach young people about critical customer service skills. Internships are more effective when they are paid for a couple of reasons: (1) many students need to be earning money to help support themselves and potentially, others. A paid internship may be the difference between a job with limited long-term opportunities and putting a student on a living wage career trajectory by learning tech-related skills; and (2) employers that pay interns are also more likely to fully engage with the students as a contributing member of their respective company.

In Northeast Massachusetts’ tight labor market, active involvement with the area’s high schools to attract interns is also a means for casting a wider net to bring in more workers. Another advantage of internships is that they help to keep young people engaged and attending school. While paid internships have positive impacts on students and companies, an issue is scale. If the internship program is supported by local and state governments (i.e., public agencies pay for all or part of the internship wages), is the funding the funding will need to be adequate to cover a large number of students. Northeast Massachusetts has thousands of students and employers, and as can be seen in the jobs postings data, employers have a need for many more workers that could match up with the supply of students. Scale is important and paid internships are a tool for expanding economic opportunity. Expanding the pool of employers that take in interns would also help with scale by providing students with more places to gain valuable learning experiences and technical skills. An issue that came up in

interviews is that smaller companies are less likely to participate than larger ones which already have the infrastructure in place to accommodate interns and high school age students.

### ***Free Tuition and Income-Based Stipends to Support Students in Skills Development for Tech Jobs***

Based on our interviews, a significant constraint to the labor pool (and the inability of prospective and even active students to attend regular training sessions) is due to programs being unable to accommodate low-income trainees. Many people cannot afford to take several weeks or months off of work to attend even a free training program, and programs with tuition are practically out of reach. Some workforce programs have begun to recognize this issue, with the Gloucester Marine Genomics Institute (GMGI) in particular offering free tuition and income-based stipends to participants in their “Biotechnology Certificate Program” so they can focus purely on their studies. They have seen no reduction in student quality after going tuition free.

### ***Clear Options Need to Be Available for Those Not Pursuing a College Degree to Learn and Apply Skills in Advanced Manufacturing and STEM Fields***

Those not seeking to obtain a college degree could be supported by an option for skills training and/or apprenticeship in the many advanced manufacturing and STEM occupations that do not require a formal college degree. As an example of a well-developed and successful program catering to those who may not necessarily pursue a college degree, the largest advanced manufacturing training program in the North Shore is the Advanced Manufacturing Training and Expansion Program (AMTEP), a special project derived from the Northeast Advanced Manufacturing Consortium (NAMC) and funded by a grant from the GE Foundation and managed by the Essex County Community Foundation and Northshore MassHire. AMTEP runs in person training programs at Lynn Vocational & Technical High School (Lynn Voc Tech), North Shore Community College, Gloucester High CTE, and Essex Tech in areas such as manual and CNC machining, welding, and electromechanical assembly. They also hold virtual education programs to help students learn the math skills necessary for modern advanced manufacturing practices. The extra funding from the GE Foundation allows AMTEP to run 8-10 training cycles per year, compared to 1-2 in other workforce areas.

An issue that came up in interviews is that workforce development providers and manufacturers (reaching out to schools) are not able to expose every student to the opportunities for pursuing a tech or manufacturing career, “in general we find that most school staff are not aware of post-high school options and they are not being shared within the schools unless MassHire is sharing it. Schools share post-secondary information regularly and it is really only based on college.” In these types of circumstances, non-college bound students will not be aware of the types of careers with living wage jobs that may be available to them, with training and skills development, often within a short driving distance from where they live in Northeast Massachusetts.

### ***Massachusetts Workforce Training Initiatives Need Continuity to Best Serve Employers in Tech and Advanced Manufacturing***

Tech and advanced manufacturing are lynchpins of the Northeast Massachusetts economy and there is a “chain of need” to expand the labor force to meet the needs of these growing businesses. Cutting edge

industries such as aerospace, robotics, medical equipment, life sciences, and semiconductors all have a significant presence in the region, along with suppliers to these industries (e.g., companies making sophisticated fabricated metals and plastics components). We heard from representatives across these industries that they are confronting challenges to maintain and expand their respective workforces to accommodate customer orders and meet rising demand. Crucially, Massachusetts workforce training initiatives need to be able to meet these needs in terms of both skills and scale, now and in coming years. Even with the identified needs, however, aspects of the state's workforce training delivery system are fragmented, making it more difficult to keep up with jobs needs of Northeast Massachusetts employers in tech and advanced manufacturing.

The Massachusetts workforce system tends to be grant-based with renewals required on an annual basis. This structure creates a constant need for workforce agencies to apply for grants, including renewals for initiatives such as paid apprenticeships for manufacturing training and stipend programs. An unintended consequence of the current system is a lack of continuity year-to-year, making it challenging to plan for the longer time horizons needed to introduce more people, especially young people, to advanced manufacturing and to provide them the training and skill sets that match the scale of labor demand seen among Northeast Massachusetts employers in advanced manufacturing.

The advantages of longer term, predictable funding streams can be seen in the Advanced Manufacturing Training and Expansion Program (AMTEP – also noted, previously, as an example of workforce program providing career pathways for those not necessarily bound for a four-year college degree), funded by the General Electric Aerospace Foundation via the Essex County Community Foundation, which received guaranteed funding for five years. The longer-term predictability has allowed curriculum development to better meet industry standards and the opening of communications channels to match employer needs with skills training. The continuity in training provides the infrastructure to keep on feeding Northeast Massachusetts employers with workers and on a large scale (e.g., AMTEP has enrolled 400 students thus far) to help fill positions, including those coming from a wave of retirements.

### ***Firms Should Downplay Education Requirements and Shift to Skills-based Hiring***

Employers themselves have a role to play, with some interviewees relaying that many job postings use education requirements to pre-screen applicants even when high levels of education are not necessary to perform the particular job. A good example of how to address this issue and transition to a more skills-based hiring system is the governor's recent order to remove degree requirements from most state government job listings. Instead, managers are instructed to consider the "full set of competencies" that prospective employees have rather than just their educational attainment. Skills based hiring can both help employers address the challenge of finding qualified workers while also broadening access to higher quality, living wage jobs and stronger careers for a wider range of people.

### ***Match Teaching and Training to Employer Needs***

We interviewed key members of both workforce training programs and the employers that they are preparing their students for. While there currently exist multiple successful training programs that prepare students for the innovation economy, especially in advanced manufacturing, we identified several sticking points that are preventing the sector from reaching its full potential. This was reflected by our discussions with employers, who relayed that there is near full employment in their industry and

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few new people entering the labor pool, leading to increasing hiring costs and further automation in the sector. Training programs point to a struggle to find instructors that can teach up to date skills and difficulties attracting lower-income trainees as key obstacles to being able to meet the needs of employers.

IT and advanced manufacturing training were two in particular that were identified as not keeping up with new and emerging technologies. Employers told us that they often must retrain new hires after discovering that they were trained in an out-of-date coding language or retired manufacturing processes. This process is a significant investment that often results in a well-trained employee who leaves shortly for a better paying position, thus reducing the incentive for employers to hire and train inexperienced employees. One employer specifically said they are now forced to hire apprentices that they wouldn't even have interviewed a decade ago, simply because the labor pool is so dry.

In terms of making sure training is as relevant as possible for employers, there are approaches now in practice in Northeast Massachusetts. The Gloucester Marine Genomics Institute updates their training on a quarterly basis to make certain they are staying abreast of the latest developments in biotech workforce needs and technology applications, and thus ensuring that they are teaching the skills that are needed by Northeast Massachusetts employers. In a similar vein, Middlesex Community College brings employers in to advise on curriculum to make sure it is the most relevant.

As discussed earlier, solving this issue requires addressing the perceptions of industries in the innovation economy among young people, such as manufacturing being dirty and biotech being only for people holding PhDs, but also faces hurdles getting high schoolers into pre-apprenticeships and other early programs. Many employers do not want to hire people under 18 due to extra labor regulations or safety concerns, and those who do told us of students struggling with the basic math and statistics necessary to operate modern advanced manufacturing equipment. This lack of basic skills in the workforce extends past high schoolers, as we heard from multiple employers and workforce development specialists that new trainees and employees lack soft skills, including the ability to show up on time or at all.

### ***Strong Company Cultures Help Retain Talented Staff***

Northeast Massachusetts needs to cultivate clear career pathways to raise skill levels and bring people from all communities into STEM occupations and tech industries. Even with focused efforts to increase labor supply, however, retaining the talented employees that companies already have is crucial for business stability and growth in the region. Several employers interviewed for this study indicated that they have successfully maintained low turnover rates by a combination of competitive wage levels and benefits (e.g., healthcare, retirement contributions, profit-sharing, etc.) as well as by nourishing corporate cultures that make workers feel like they are part of the company. Employee retention requires a concerted approach in fomenting core values like humility, having passion for what the company does, being genuine, and showing everyone can contribute. A guiding principle for one interviewed company is “to make the company a destination, not a steppingstone in a career”, underscoring the importance of both worker support and career advancement to attract and to retain employees.

## ***Northeast Massachusetts Offers Strong Innovation Assets Supported by Academia, Research Labs, and Directed Training***

Northeast Massachusetts is well positioned to become a progressively stronger player in the global innovation economy, anchored by leading academic and research institutions both in the region and close by, as well as advanced manufacturing and biotech industry clusters. Massachusetts and the Northeast region in particular offer a range of resources and programs to support entrepreneurship, technology development, and economic growth that are key to the sector's continued success.

As the only R1 research university in the region, UMass Lowell serves as an anchor for STEM related industries in Northeast Massachusetts. The university particularly focuses on bringing locally developed technologies to a point where they can be commercialized. This process involves both technical assistance in how to establish and operate a new business, as well as access to state-of-the-art equipment that start-ups are typically unable to afford. The role of UMass Lowell in innovation is further underscored by the Cambridge-based research nonprofit Draper Laboratories decision to move its microelectronics division to Lowell to anchor a major new mixed-use development (the Lowell Innovation Network Corridor, or LINC) planned on the university's East Campus. Other local education institutions like Endicott College's Science Center Incubator and engineering facilities coordinate between the business and STEM programs to assist entrepreneurs, with initiatives like the "Spark Tank" offering engaging ways for student innovators to present their ideas before a friendly audience.

Endicott is also part of the Life Sciences Consortium of the North Shore along with Gloucester Marine Genomics Institute (GMGI), Gordon College, North Shore Community College (NSCC), Salem State University, Essex North Shore Agricultural & Technical School (Essex Tech), and InnoVenture Labs, a biotech and cleantech startup incubator providing lab space and business development expertise. Each member provides life sciences education, training, and business, and almost all provide access to machinery that would otherwise be inaccessible to startups. In addition, the Consortium allows them to coordinate purchases and submit combined proposals that they would be unable to win as individual institutions, such as a recent \$5 million grant from Mass Life Sciences Center to fund new equipment purchases. InnoVenture Labs is of particular note in that it offers an alternative to Boston-Cambridge area innovation hubs, providing affordable lab space and support for businesses across various sectors, from medical technology to robotics, and can provide "three years of lab space for the cost of 10 months elsewhere."

## ***Northeastern Massachusetts as a Place to Grow and Expand***

The economic landscape for businesses and employees in Northeast Massachusetts presents a dynamic mix of challenges and opportunities. A strong legacy in manufacturing, defense, and high tech has translated into advantages for the region that include, as one tech manufacturer said, "a workforce that grew up with technology" as well as both supplier and customer bases located within the region. Before the pandemic Northeast Massachusetts experienced a surge in interest from companies looking to establish or expand their presence in the region, drawn by lower costs compared to the Boston-Cambridge hub and the promise of a burgeoning life sciences sector. However, this surge has somewhat eroded Northeast Massachusetts' competitive advantage, with the associated surge in cost of living frequently coming up as a barrier to employees relocating to the area. The pandemic-induced shift to remote work poses additional challenges to innovation and collaboration, diminishing the local

advantages employers once enjoyed by being around so many top universities in Massachusetts, and somewhat reducing the in-person “water-cooler” style melding of ideas and technologies that resulted from so many high-tech employees being clustered in office parks and buildings across Northeastern Massachusetts.

Issues such as housing costs, transportation accessibility, affordable/reliable childcare, and digital infrastructure gaps (noting that the Massachusetts Broadband Institute at MassTech is working to close this gap by making high-speed Internet access available throughout the state) in communities like Lowell, Lynn, Lawrence, and to some extent all of Essex County remain persistent concerns especially for entry level workers. This workforce by all accounts is seeing the greatest demand, but they are the most likely to be driven out of the area by rising prices as wealthier remote employees who once had to accept high prices in Boston-Cambridge flee to the North Shore and Greater Lowell while continuing to work for companies in Boston.

An additional issue brought up by a growing multinational tech manufacturer in Northeast Massachusetts is the availability of suitable sites for large-scale expansions. The company had experienced significant growth and found it challenging to find land available for a needed expansion. With a number of its suppliers and customers located in Northeast Massachusetts, the company did not want to leave the area and wished to remain within a 12-mile radius of its now former location. Eventually, the company did find success in finding a new location and stayed in the area by being able to build on a new site. Northeast Massachusetts’ leadership may need to consider putting systems into place that expedite the processes for companies to expand within the region, including an adequate supply of shovel-ready sites. This would also include strategies to match vacated (or about to be vacated) existing building space with businesses interested in relocation or expansion within Northeast Massachusetts.

Amidst these challenges, Northeast Massachusetts still boasts a diverse ecosystem of businesses, with a notable presence of small and medium-sized enterprises in the tech and life sciences sectors. Several significant sources of new funding to the area, especially Massachusetts’ designation as a semiconductor hub under the CHIPS Act and the Salem Offshore Wind project, offer enormous potential to solidify the area’s attractiveness as a tech destination. However, the decline of former anchor companies like General Electric (at least in job numbers), coupled with lingering perceptions of the region as “blue-collar” and economically depressed, may potentially lessen the area’s attractiveness to companies from out of state and out of country that might otherwise consider expanding or relocating to the area if they had a greater awareness of Northeast Massachusetts’ attributes. Initiatives like those led by the Gloucester Marine Genomics Institute (GMGI) to hold conferences and tours that specifically aim to showcase the region's viability as a (in GMGI’s case) biotech hub and attract attention from global players are needed to ensure the area is seen in a positive light.

### ***Northeast Massachusetts Needs to Redouble Efforts Towards Organized Regionalism***

Regional collaboration was a frequent topic in our conversations with stakeholders. Many different collaborations between individual institutions were highlighted, especially in the area of workforce development, but interviewees also identified the need for greater overall collaboration across the

entire region. Stakeholders across sectors advocated for a concerted effort to elevate the region's profile and implement a cohesive economic development strategy that would connect previously siloed industries.

A significant obstacle to regional collaboration identified during our conversations was the lack of a county government in Essex and Middlesex. Rather than needing one or two governments to sign on to an economic development strategy, Northeast Massachusetts would require dozens of municipalities to approve any official strategy. We heard some concerns that this leads to competition among municipalities that has made collective action more difficult and led to wasted resources. However, less formal regional collaborative organizations already exist such as the North Shore Alliance and the Essex County Community Foundation, which provide a forum for regional governments, businesses, schools, and NGOs to coordinate economic and community development efforts. Regional organizations could leverage existing educational programs and strategic alliances between institutions that demonstrate a willingness to pool resources and expertise for mutual benefit. These connections, especially the many collaborations between tech schools, community colleges, and businesses, could provide the backbone for larger regional collaboration.

Outside of coordinating resources and training, there is a pressing need to establish a recognizable regional identity and vision to attract external investment and secure government funding for the region. Some suggestions we received is to learn from regional rebranding efforts like the rebranding of the Framingham-Marlborough area to "Metro West" and taking advantage of the global name recognition of Boston by emphasizing Northeast Massachusetts' proximity and accessibility to the city.

## Conclusions and Opportunities to Further Strengthen the Northeast Massachusetts Innovation Economy

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This report has provided an overview of the Northeast Massachusetts innovation economy, highlighting a number of strengths in life sciences, semiconductor manufacturing equipment, medical devices, defense (e.g., radars and sensors), robotics, aerospace, information technology, and research and development activities. A talented workforce and the strength of the region's institutions underpin the historical success the region has experienced in industrial growth focused on the development and application of advanced technologies. Looking into the future, there are both opportunities for the region to continue to grow and challenges to be overcome, most notably to find and develop skilled workers to meet the demands of employers.

This report defines several areas for further exploration and potential action, all of which should be considered by regional stakeholders as they work to bring people into and grow the Northeast Massachusetts innovation economy into the future:

- Technical schools in the region, including Lynn Tech and Essex Tech, are heavily integrated into advanced manufacturing training and have collaborations with multiple workforce development organizations, presenting an opportunity for them to serve as the anchor for future collaboration. These institutions can also serve as a sort of “bridge” between early education and the workforce, making them essential to any efforts to drive interest in and knowledge of tech and advanced manufacturing among younger people. In a similar vein, the region's universities, community colleges, and higher education institutions can work collaboratively with each other and the Northeast Massachusetts business community to get middle school and high school students “on board” with the region's career pathways in technology and manufacturing.
- Immigrants from Spanish-speaking countries are currently the main driver of population growth in Northeast Massachusetts, and essential for the region's labor force to remain stable now and into the future. Workforce development organizations, academia, and training providers should consider permanently including an English language learning component in any future programs to ensure this population is able to fully participate.
- Northeast Massachusetts is well positioned as a location to grow the emerging sectors seen as priority areas for the Massachusetts economy, including life sciences and healthcare, advanced manufacturing and robotics, and climate tech (e.g., Salem Offshore Wind). Northeast Massachusetts combines innovation, a foundation of businesses and suppliers, and educational and research resources to nourish the growth and competitiveness of these industries. Collaborations such as the Life Sciences Consortium, additionally, help support entrepreneurialism, cutting-edge technology application, and growth. An appreciable recent development for Northeast Massachusetts is the Lowell Innovation Network Corridor situated in the East Campus area of UMass Lowell. Cambridge-based Draper Labs plans to expand to the corridor, potentially bringing in hundreds of staff focused on applied research and engineering related to microelectronics. The combination of Draper, UMass Lowell, and the presence of a

cluster of regional tech businesses will help further cement Northeast Massachusetts as an innovation hub. Leveraging this new development, from the standpoints of workforce and economic development, represents a strategic opportunity for the region.

- Northeast Massachusetts' proximity to Boston-Cambridge presents complementary opportunities to attract workers and businesses from one of the world's premier innovation hubs by capitalizing on the region's comparatively lower costs of living and doing business combined with noteworthy quality of life attributes (e.g., outdoor recreation, history, cultural activities, sports, etc.).
- Northeast Massachusetts would benefit from a concerted effort to improve the area's name recognition and guide future economic development. Organizations such as the North Shore Alliance and the Essex County Community Foundation provide an avenue for regional collaboration that in other regions would be served by a county government.