

Boston's Economy 2018



The Boston Planning & Development Agency

We strive to understand the current environment of the city to produce quality research and targeted information that will inform and benefit the residents and businesses of Boston. Our Division conducts research on Boston's economy, population, and commercial markets for all departments of the BPDA, the City of Boston, and related organizations.

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Introduction

Since the late twentieth century, Boston has been a nationwide leader in medicine, technology, and higher education. In recent years, the city has encouraged further growth in the technology sector by designating an Innovation District in the South Boston Waterfront, attracting startups and major corporations alike. The dense network of financial institutions, tech incubators, and research institutes has made Boston a destination for companies ranging from General Electric, Reebok, and Amazon to newer cybersecurity and biotech startups. This innovative atmosphere allowed Boston to recover from the 2008 recession at a rapid pace and makes the city one of the best places in the U.S. to live, work, and do business.

The 2018 Economy Report details Boston's impressive economic growth, covering trends in employment, wages, housing prices, and real estate. The Spotlight section takes a deep dive into Boston's growing tech industry by examining job openings in biotech, green jobs, and cybersecurity. It also analyzes the 'middle skill' jobs that make Boston's growth accessible to residents without higher education. Finally, the Forecast section describes the outlook for Boston's economic future, hinting at continued growth.

Below are the highlights of this year's Economy Report:

1. Summary of Recent Trends in Boston's Economy

- **Economic growth:** Boston's economy grew by 2.1 percent from 2015 to 2016 as measured by Gross City Product (GCP), continuing an upward trajectory in GCP since 2013. Per capita income for Boston residents grew by 5.0 percent to \$40,000.
- **Unemployment:** The annual unemployment rate in 2017 was 3.4 percent, a slight decrease from 2016 and a continuation of the downward trend since the 2009 high of 7.6 percent. Boston's unemployment continues to be well below the state and national levels.
- **Job growth:** From 2015 to 2016, Boston's total payroll and non-payroll jobs increased 3.2 percent to 794,038, continuing the trend of strong job growth since 2010.¹ The health care and social assistance industry continues to employ the largest number of people in Boston, 18.3 percent of total jobs, while the professional and technical services industry added the most jobs from 2015 to 2016, with 5,000 new jobs.
- **Wages and Rents:** The average weekly payroll wage² in Boston in 2016 was \$1,491, an increase of 3.5 percent in real terms over 2015.³ The median gross rent in Boston in 2016 was \$1,491, an increase of 3.9 percent in real terms over 2015.
- **Real Estate**
 - **Commercial:** Boston's commercial real estate market has been strong since 2014 with growing inventory, falling vacancy rates, and rising rents. The Seaport District saw the most square footage added since 2014, while Back Bay continues to have the highest rents.
 - **Housing:** Despite growing housing stock, vacancy rates are falling while rents and sales prices are growing. Housing prices reached new highs in 2017, with 11.7 percent price growth in single family market and 8.3 percent price growth for condominiums over 2016.⁴
 - **Construction Activity:** There were over 3.8 million construction man hours worked in 2017 on Article 80 development projects, an increase of 19.8 percent and almost 634,000 man hours over 2016.⁵
- **Looking ahead:** Boston's strong growth is likely to continue, buoyed by a favorable short term national economic outlook, and the city's strengths in growing industries such as health care and technology. With unemployment already at low levels, continued job growth will depend on the ability of the region to accommodate new population and housing.

¹ U.S. Bureau of Economic Analysis (BEA), Massachusetts Executive Office of Labor and Workforce Development (EOLWD), BPDA Research Division Analysis. Note: The State has revised prior job estimates for Boston upwards since the BPDA's 2017 Economy Report.

² Total compensation, including bonuses, stock options, severance pay, profit distributions, cash value of meals and lodging, tips and other gratuities, and, in some States, employer contributions to certain deferred compensation plans such as 401(k) plans, according to the Quarterly Census of Employment and Wages.

³ U.S. Census Bureau, 2015 & 2016 1-year American Community Surveys, BPDA Research Division Analysis.

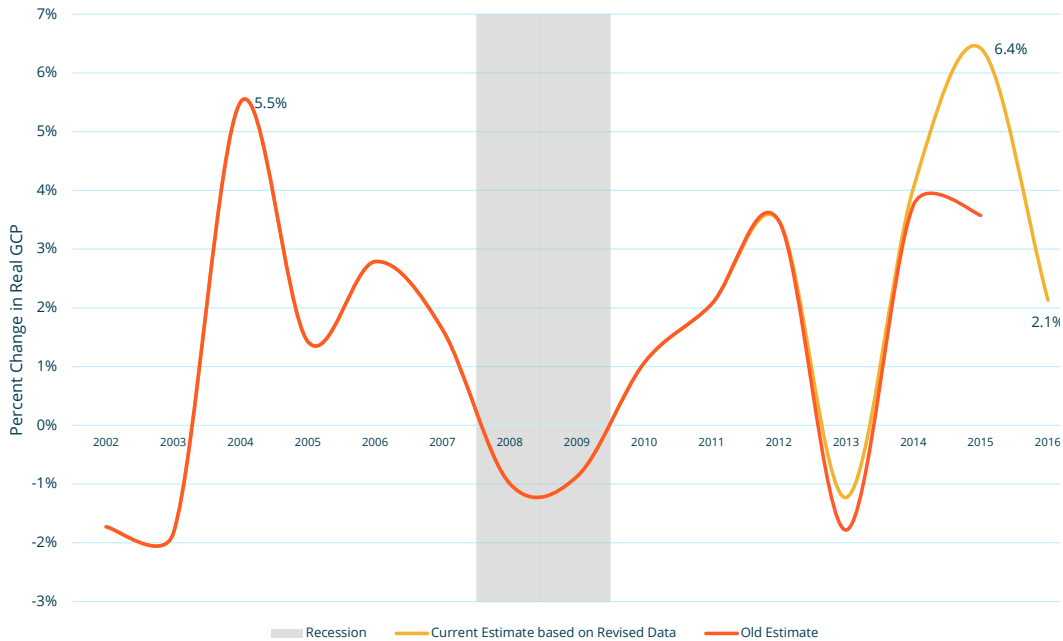
⁴ City of Boston, Department of Neighborhood Development (DND) using Banker & Tradesman data, January 2018.

⁵ City of Boston, "Boston Resident Job Policy Compliance Reports Database", 2018. Article 80 development projects are large projects that must be approved by the BPDA Board.

2. Economic Growth

Building on strong growth from the prior year, Boston's economy grew by 2.1 percent from 2015 to 2016 as measured by Gross City Product (GCP).⁶ These numbers reflect revised historical estimates for Boston's GCP. In 2017, the Bureau of Economic Analysis (BEA) revised GDP statistics for the period 2014 to 2016 to incorporate methodological improvements. These BEA data series are direct inputs to the GCP and jobs estimates for Boston. Figure 1 shows Boston's real GCP growth rate since 2012, with the BEA revisions.

FIGURE 1 Boston's Real GCP Growth Rate, 2002-2016



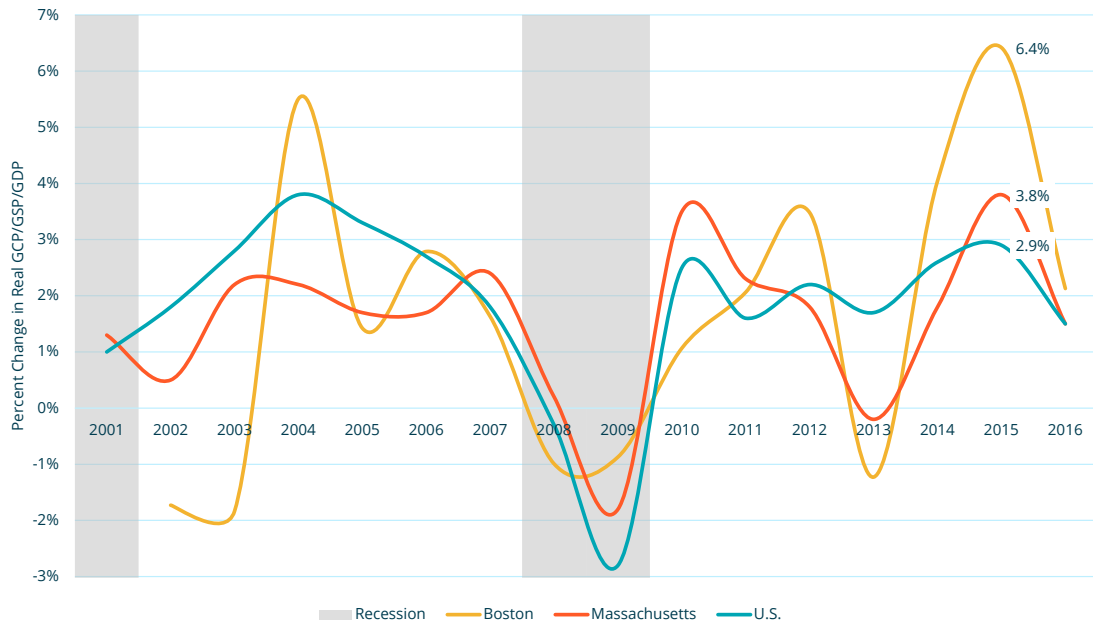
Source: BEA and Massachusetts Executive Office of Labor and Workforce Development (EOLWD), BPDA Research Division Analysis.

Since 2010, Boston's share of statewide economic activity has been slowly increasing, from 21.7 percent to 23.6 percent in 2016. After briefly dipping below the national and state growth rates in 2013, Boston's economic growth in each of the past three years surpassed the U.S. and Massachusetts, both of which saw only a 1.5 percent increase in economic activity from 2015 to 2016. Figure 2 shows the economic growth rates for Boston, Massachusetts, and the U.S. From 2010 to 2016, Boston averaged 2.6 percent annual growth, compared to 2.1 percent growth at the national and state levels.

Boston's 2016 GCP represents an estimated \$119.1 billion in economic activity generated in Boston in 2016 dollars. Figure 3 depicts Boston's GCP from 2002 to 2016 in 2015 chained dollars to show the comparison with the old estimate which was calculated in 2015.

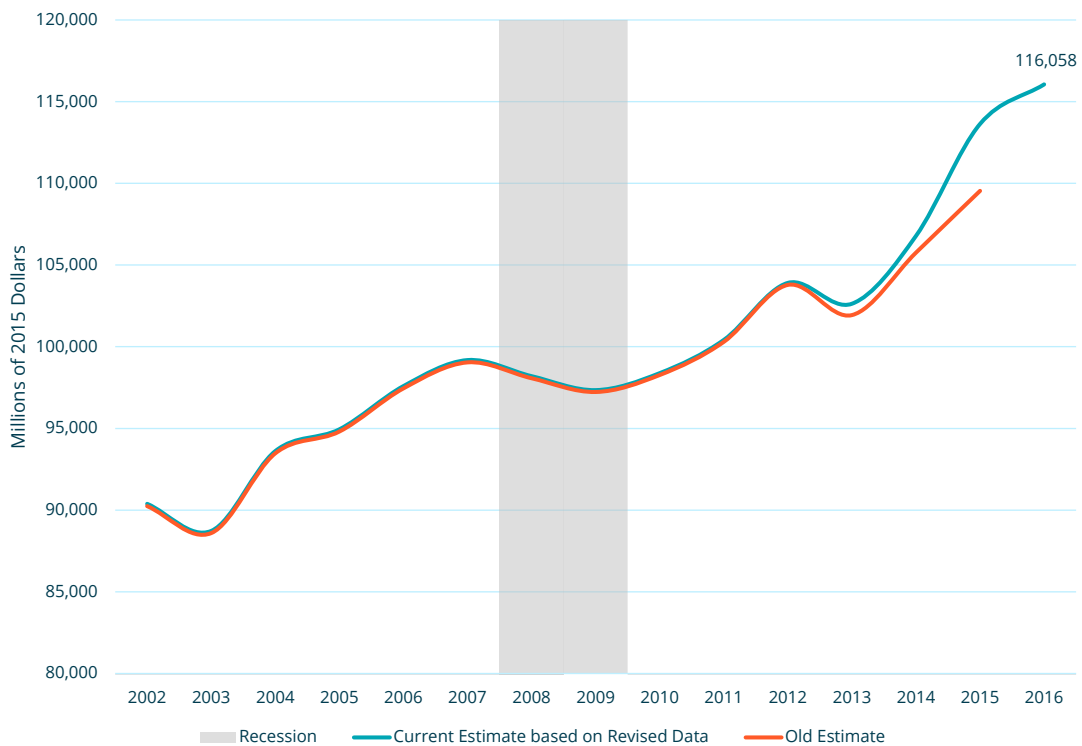
⁶ Gross City Product (GCP) is an aggregate measure of economic activity, analogous to national Gross Domestic Product (GDP). GCP is reported in Real Chained Dollars.

FIGURE 2 Change in Real GCP Growth Rate for Boston, Massachusetts, and the U.S., 2001 to 2016



Source: BEA and EOLWD, BPDA Research Division Analysis

FIGURE 3 Boston's Real GCP 2002 to 2016 in millions of 2015 chained dollars



Source: BEA and EOLWD, BPDA Research Division Analysis

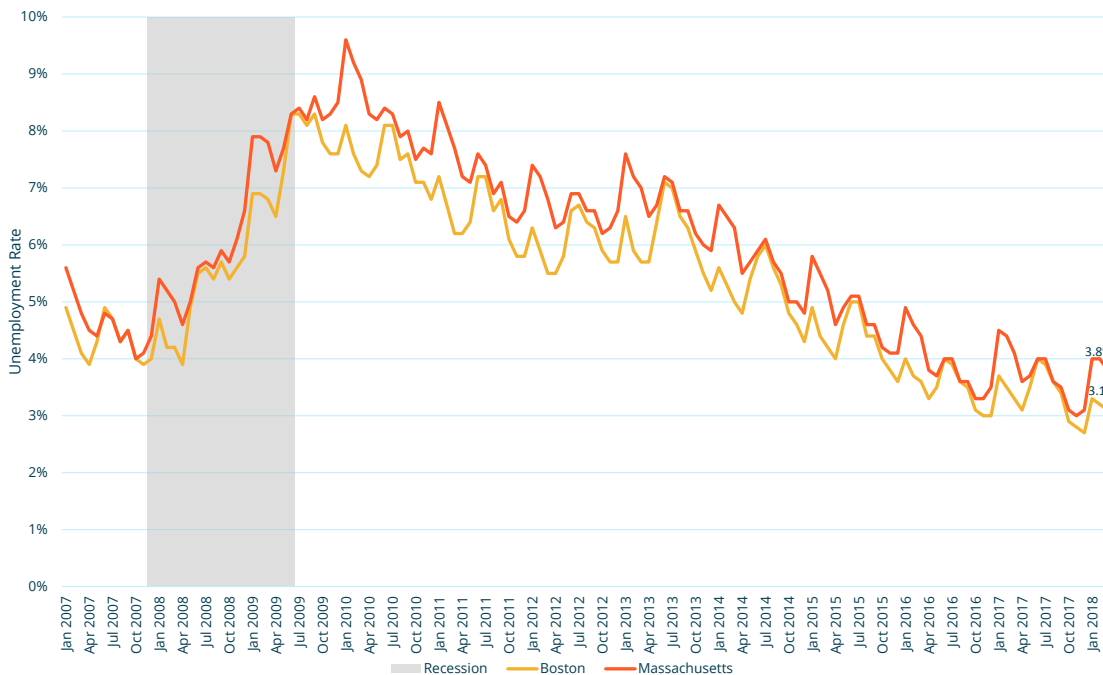
3. Unemployment and Wages

Annual economic growth data for 2017 are not yet available for Massachusetts or Boston. At the national level, annual real GDP growth picked up slightly in 2017, rising to 2.3 percent after growing only 1.5 percent in 2016. The Congressional Budget Office (CBO) projects further acceleration this year, with growth of 3.0 percent in 2018 and 2.9 percent in 2019, before slowing somewhat. The New England Economic Partnership (NEEP) projects steady growth of around two percent for Massachusetts over the next four years. Looking ahead, Boston hopes to continue its recent three year streak of exceeding these national and state benchmarks.

Unemployment

Boston residents continue to enjoy historically low levels of unemployment. The most recent estimate for March 2018 has Boston's unemployment rate at 3.1 percent. Monthly unemployment rates for Boston have remained under five percent since August of 2015, and below four percent since July 2017. Since 2008, Boston's unemployment rate has generally been less than Massachusetts, though the state and city rates were the same for parts of the summer in 2009, 2016, and 2017. The unemployment rate for 2017 fluctuated with a low of 2.7 percent in December and a high of 4.0 percent in June. On average Boston's resident labor force grew by more than 5,500 people from 2016 to 2017.⁷

FIGURE 4 Monthly Unemployment Rates in Boston and Massachusetts, January 2007-March 2018



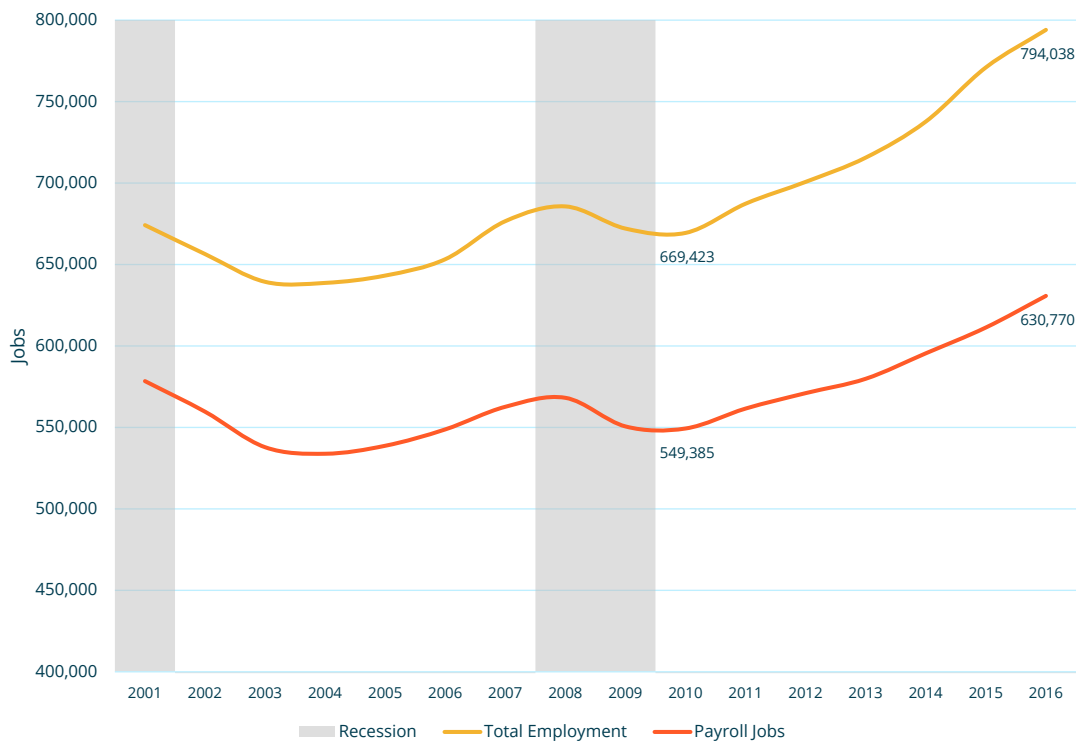
Source: Labor Force and Unemployment Data, Executive Office of Labor and Workforce Development (EOLWD)

⁷ Labor Force and Unemployment Data, Executive Office of Labor and Workforce Development (EOLWD)

Jobs Located in Boston

Job growth has provided low unemployment for Boston residents, but Boston is a major regional employment center, and jobs in Boston also provide employment for workers throughout the region. Jobs located in Boston have risen to their highest level since employment data became available in 1969. From 2015 to 2016, Boston's total payroll and non-payroll jobs increased 3.2 percent to 794,038, continuing the trend of strong job growth since 2010,⁸ and outperforming both Massachusetts and the nation.

FIGURE 5 Boston's Total Payroll and Non-Payroll Jobs, 2001 to 2016



Source: U.S. Bureau of Economic Analysis (BEA), Massachusetts Executive Office of Labor and Workforce Development (EOLWD), BPDA Research Division Analysis.

The latest payroll data provided by Massachusetts Executive Office of Labor and Workforce Development (EOLWD) show payroll jobs for the city reached a total of 630,770 in 2016.⁹ Non-payroll employment rose by 2.3%, to 163,268. Non-payroll employment made up 20.6% of total jobs in 2016, down from 23.9% in 2015.

⁸ U.S. Bureau of Economic Analysis (BEA), Massachusetts Executive Office of Labor and Workforce Development (EOLWD), BPDA Research Division Analysis. Note: The State has revised prior job estimates for Boston upwards since the BPDA's 2017 Economy Report.

⁹ The BPDA Research Division uses the BEA definition of total employment, which includes both payroll and non-payroll jobs. The BEA releases county-level estimates by industry. The BPDA Research Division apportions Suffolk County non-payroll employment to Boston based on the city's fraction of county payroll employment as estimated using unemployment insurance data (ES-202) made available at the city and county level by the Massachusetts EOLWD.

Jobs by Industry

The largest industry in Boston is health care and social assistance with nearly 145,000 jobs, 18.3 percent of total employment, as shown in Table 1. Four of the ten largest employers in Boston are hospitals: Massachusetts General Hospital, Brigham and Women’s Hospital, Children’s Hospital, and Beth Israel Deaconess Medical Center. Professional, scientific, and technical services, which covers a variety of industries including computer systems design, scientific research and development, management consulting, architecture, and law comprises the second largest share of Boston’s employment. Finance and insurance firms such as State Street Bank, Fidelity Investments, Liberty Mutual, and John Hancock also employ large numbers of people in Boston.

TABLE 1 Boston’s Total Payroll and Non-payroll Jobs by Industry, 2016

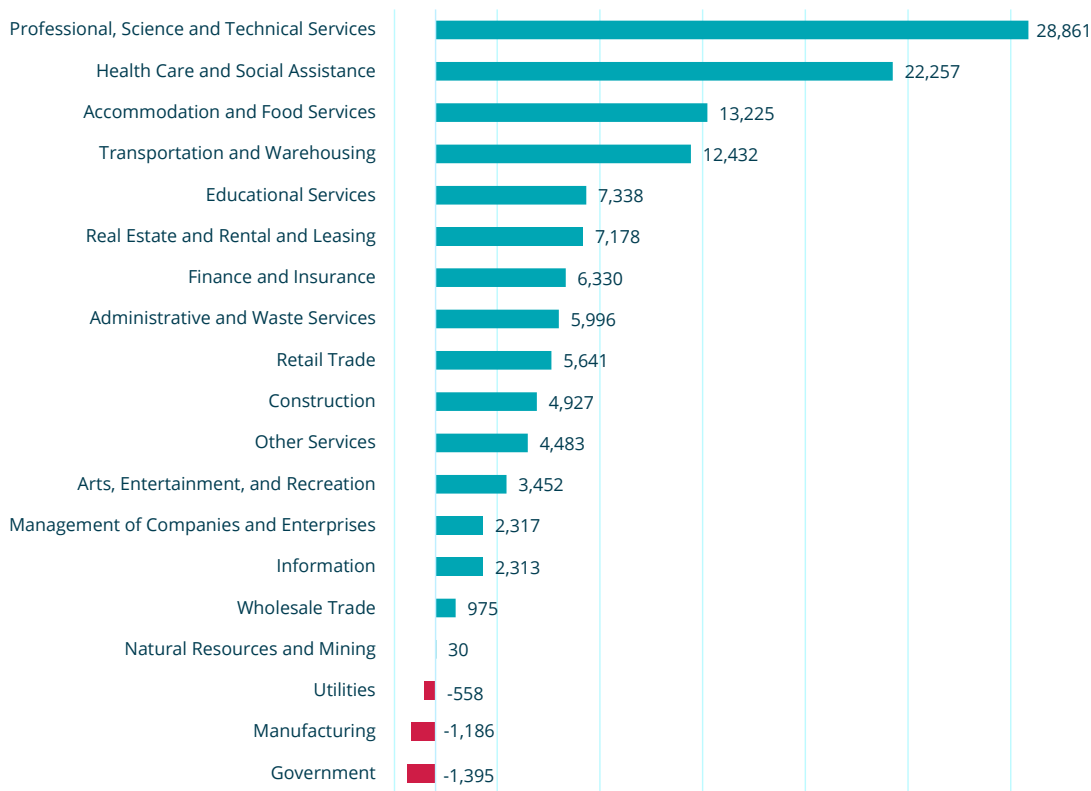
INDUSTRY	2016	%
Health Care and Social Assistance	144,957	18.3%
Professional, Scientific, and Technical Services	98,933	12.5%
Finance and Insurance	91,323	11.5%
Government	76,940	9.7%
Accommodation and Food Services	62,609	7.9%
Educational Services	59,414	7.5%
Administrative and Waste Services	39,183	4.9%
Real Estate and Rental and Leasing	36,235	4.6%
Retail Trade	35,536	4.5%
Other Services	33,853	4.3%
Transportation and Warehousing	30,942	3.9%
Construction	18,776	2.4%
Information	18,320	2.3%
Arts, Entertainment, and Recreation	17,820	2.2%
Wholesale Trade	10,262	1.3%
Management of Companies and Enterprises	8,776	1.1%
Manufacturing	7,916	1.0%
Utilities	1,878	0.2%
Natural Resources and Mining	367	0.1%
Total	794,038	100%

Source: U.S. Bureau of Economic Analysis (BEA), Massachusetts Executive Office of Labor and Workforce Development (EOLWD), BPDA Research Division Analysis.

From 2015 to 2016, Boston’s job growth was positive across all industries except utilities, manufacturing, natural resources and mining, and other services. Growth was mostly concentrated in professional, scientific and technical services (5,025 new jobs) and health care and social assistance (4,215 new jobs).

Professional, scientific, and technical services, health care and social assistance, and accommodation and food services added the most jobs from 2010 to 2016, as shown in Figure 6, government, manufacturing, and utilities saw a decline in jobs from 2010 to 2016. High tech industries, here classified as a subset of professional, scientific, and technical services, information, and manufacturing with a high percentage of their workforce in science, technology, engineering and math (STEM) occupations, averaged 11 percent job growth each year between 2010 and 2016.¹⁰ The Spotlight Section offers a closer look at the industries, occupations, and employers in Boston that are hiring workers with skills in three high-tech fields: biotech, green jobs, and cybersecurity.

FIGURE 6 Boston’s Total Job Growth, 2010 and 2016



Source: U.S. Bureau of Economic Analysis (BEA), Massachusetts Executive Office of Labor and Workforce Development (EOLWD), BPDA Research Division Analysis.

¹⁰ The BPDA uses a definition of high tech industries originally developed by the Bureau of Labor Statistics (BLS). See BPDA Research Division “High Tech Industries in Boston” 2015. High tech employment growth was estimated using ES-202 payroll employment data from the Massachusetts EOLWD.

Wages by Industry

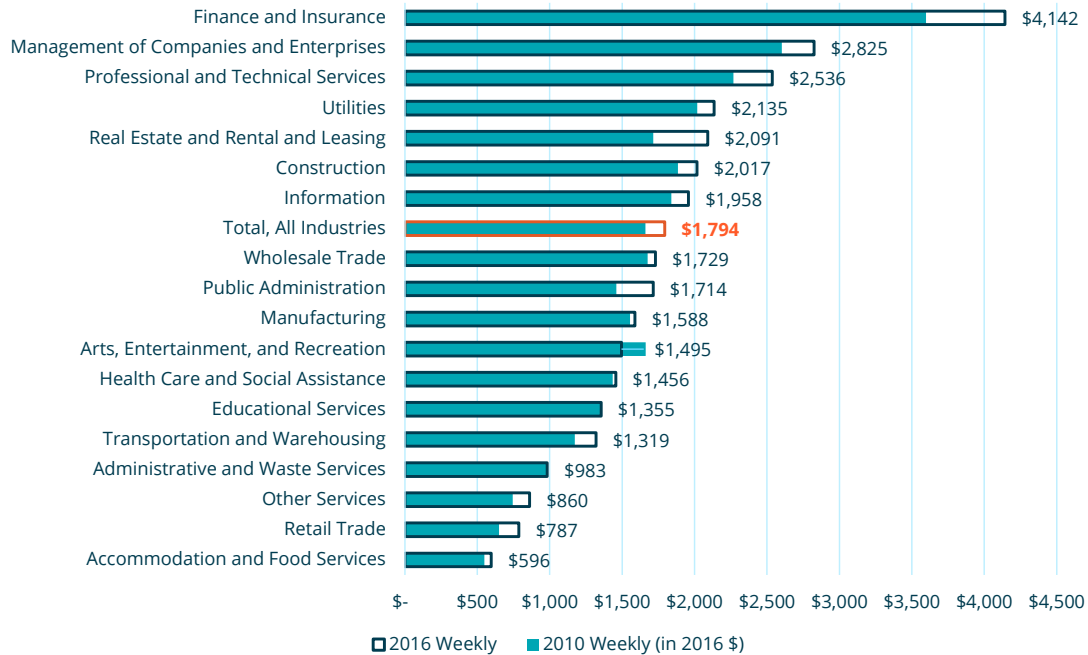
Average weekly payroll compensation in Boston rose 1.4 percent in 2016 to \$1,794 according to data compiled by the Massachusetts Executive Office of Labor and Workforce Development (EOLWD) based on employer filings. This measure of compensation includes bonuses, stock options, severance pay, travel reimbursement, tips and other gratuities, and employer contributions to certain deferred compensation plans, such as 401(k) plans. Because these employer filings represent the most comprehensive source of employment data at the local level, they are the best source for tracking year-to-year changes in local wages, particularly when disaggregating to the industry level.

Annualizing this weekly wage over a 52 weeks yields an estimate of \$93,288. This likely substantially overstates the annual pay of the typical worker for a number of reasons. First, the mean average, unlike the median, is pulled up by the high pay of top earners. Second, many non-salaried workers are not typically employed for the full 52 weeks, even in an economic climate with low unemployment. Only about two thirds of workers in Suffolk County were employed 50 weeks or more in 2016, according to the American Community Survey (ACS), while a quarter were employed for 40 weeks or fewer. Accommodation and food services, arts, recreation and entertainment, retail, education, and construction all have below average rates of full-year employment. Across all industries, the ACS reports that the median annual wage earnings in 2016 for individuals working in Boston was \$55,419.

According to the EOLWD data, the highest wages were in finance and insurance (\$4,142/week), management (\$2,825/week), and professional, scientific, and technical services (\$2,135/week). The lowest wages were in retail (\$787/week) and accommodation and food services (\$596/week). While the accommodation and food service industry provides a large number of jobs, low wages are a concern, as the industry average wage barely clears the living wage as defined by Boston's Living Wage Ordinance.¹¹

¹¹ Boston's Living Wage Ordinance requires most firms receiving city contracts or loans to pay a Living Wage of \$14.23 an hour to all employees. This amount, updated annually is based on the federal poverty guidelines for a family of four. The Living Wage of \$14.41 is in effect through June 30, 2018, and will increase to \$14.82 effective July 1st, 2018. Massachusetts minimum wage is \$11 per hour.

FIGURE 7 Average weekly wages for 2010 and 2016 by industry in Fixed 2016 Dollars



Source: EOLWD, Employment and Wages Report (ES-202), BPDA Research Division Analysis.

Average weekly payroll wages increased by 1.4 percent between 2015 and 2016, in line with recent trends; the average weekly payroll wage for Boston jobs rose an average of 1.3 percent a year in real terms from 2010 to 2016.¹² Wage increases have not kept pace with increases in housing costs. Median gross rents have grown by 1.6 percent a year in real terms from 2010 to 2016, and by 3.5% in one year from 2015 to 2016.¹³ Single family housing prices have gone up by 5.7 percent per year in real terms from 2010 to 2017, while condo prices increased by 5.4 percent per year.¹⁴

The most highly paid industries saw the greatest gains in real wages from 2010 to 2016. Finance and insurance gained an extra \$544/week, real estate gained \$376/week, and professional, scientific, and technical services gained \$268/week. Real wages in accommodation and food services, the lowest paid industry, grew by only \$47/week from 2010 to 2016. Health care and social assistance, Boston’s largest industry, maintained flat wages, gaining only \$21 in real terms to reach \$1,456/week. Wages in arts, entertainment, and recreation fell by 1.8 percent per year to \$1,495 in 2016.

¹² U.S. Census Bureau, 2015 & 2016 1-year American Community Surveys, BPDA Research Division Analysis

¹³ The Executive Office of Labor and Workforce Development (EOLWD), Employment and Wages Report (ES-202), BPDA Research Division Analysis.

¹⁴ City of Boston, Department of Neighborhood Development using Banker & Tradesman data, January 2018.

4. Real Estate Market

Commercial Office Market Trends

Citywide inventory of commercial office space grew 5.2 percent from 2014 to 2017 to a total of 66.4 million square feet. The Financial District remains Boston's largest commercial office market with 34.9 million square feet, followed by Back Bay with 12.7 million square feet and the Seaport with 9.5 million square feet. The Seaport added the most new office space between 2014 and 2017, building 1.9 million square feet, an increase of 25 percent.

TABLE 2 Inventory of Commercial Real Estate in Millions of Square Feet, 2014 to 2017

Neighborhood	2014	2015	2016	2017
Back Bay	12.9	12.9	12.7	12.7
Charlestown	2.8	2.8	1.9	1.9
Fenway	1.8	2.1	2.2	2.2
Financial District	33.8	33.8	34.9	34.9
North Station	1.9	2.1	2.8	2.8
Seaport District	7.6	8.0	9.5	9.5
South Station	1.2	1.2	2.3	2.3
Boston	63.1*	63.9*	66.4	66.4

* Totals for 2014 and 2015 include an additional Crosstown market designation that was dropped in later years.
Source: Office Statistics: Boston, Jones Lang LaSalle

The three largest submarkets account for 87 percent of Boston's commercial office inventory, and have recently seen several large deals. Amazon leased 150,000 square feet at 253 Summer Street in the Seaport and then signed a lease for first building in potential two-step expansion at Seaport Square (1 million SF). MassMutual leased 300,000 sq ft of new construction on Fan Pier in the Seaport. WeWork leased 200,000 sq ft combined in Back Bay (501 Boyston Street) and Financial District (33 Arch Street). PTC and Alexion Pharmaceuticals leased space at 121 Seaport Boulevard in the Seaport for a combined total of approximately 400,000 square feet.

Fourth quarter office vacancies were 6.7 percent citywide, and continued the trend of declining vacancies year-over-year since 2014. Within the city's submarkets tracked by Jones Lang LaSalle (JLL), all showed a decline in vacancy rates with the exception of Back Bay, which increased to 8.7 percent, and South Station, which remained the same at 2.7 percent.

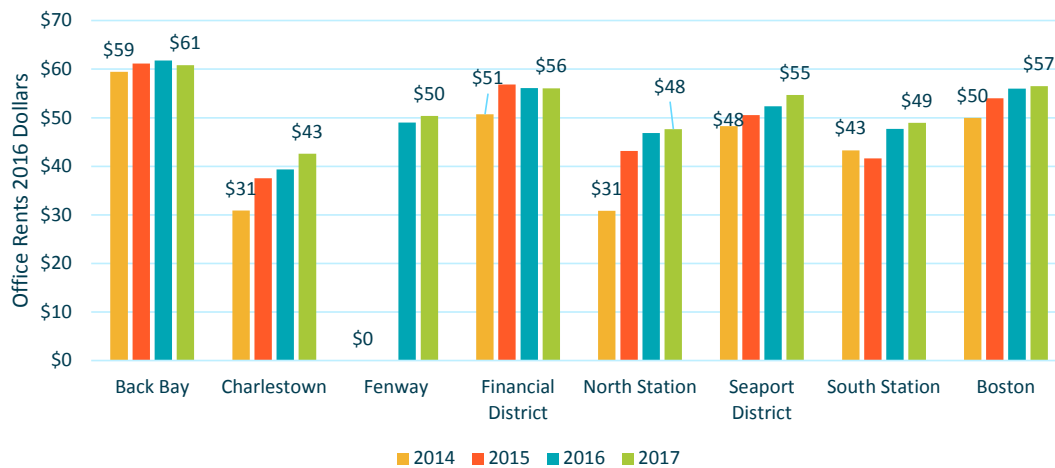
TABLE 3 Office Vacancy Rates by Neighborhood, 2014 to 2017

Neighborhood	2014	2015	2016	2017
Back Bay	11.2%	11.0%	7.0%	8.7%
Charlestown	11.9%	5.8%	3.7%	3.3%
Fenway	5.5%	14.5%	2.6%	1.4%
Financial District	12.7%	8.8%	8.8%	7.5%
North Station	4.5%	4.3%	4.3%	2.7%
Seaport District	7.3%	7.3%	7.3%	5.5%
South Station	6.9%	7.4%	2.7%	2.7%
Boston	10.9%	8.9%	7.5%	6.7%

Source: Office Statistics: Boston, Jones Lang LaSalle

Despite the increase in vacancies, the Back Bay office submarket continues to command the highest rents in the city at \$62 per square foot, though this is a slight decrease from 2016.¹⁵ Companies show continued interest in Back Bay, including Manulife/ John Hancock which in 2018 announced plans to move 1,100 employees from the Seaport to Back Bay. Overall in Boston, rent per square foot increased slightly to \$57.68, with Charlestown seeing the largest rent increase from 2016. Rents in the Financial District remained stable at \$57, while rents in the Seaport rose two dollars per square foot to \$55.80, closing the gap in rent between the two submarkets.

FIGURE 8 Office Asking Rents by Neighborhood in 2016 Dollars



Source: Office Statistics: Boston, Jones Lang LaSalle. All rents were converted to 2016 dollars.

¹⁵ All asking rents in Figure 8 were converted into 2016 dollars for comparison across time, but rents cited for 2017 in the text reflect nominal dollars.

According to city permit data, from January 2014 through the end of December 2017, 6.9 million square feet of office and 3.7 million square feet of institutional space were built. These numbers represent gross new square footage and do not account for renovations or demolitions, whereas the prior JLL data capture net total office inventory.

Major Recent Commercial and Institutional Completions:

- New England Conservatory opened the Student Life and Performance Center at 241 Saint Botolph Street, a 200,000 square foot building featuring a 225-seat black box theater, rehearsal and recording studios and a large orchestral room.
- BU opened the 145,000 square foot Center for Integrated Life Sciences and Engineering at 610 Commonwealth Ave in September.
- Hotel room supply for the city increased in 2017 to 20,143 from 19,817 in 2016. In 2017, the 326 room YOTEL opened in the Seaport District and the 205 room AC Hotel by Marriot opened in March 2018 in the South End. As of December 2017, Boston had 83 hotels, with 70 percent rated as upper midscale or above, and an average daily rate of \$259 a night.
- In 2017, Trader Joe's opened its second Boston location in the lobby of the Continuum apartment building in Allston.

Real estate analysts believe new commercial office space clusters will form in the future in other Boston neighborhoods such as Dorchester, East Boston, Charlestown, and Allston/Brighton.¹⁶ Harvard's development plans and the relocation of the Mass Pike will create potential office/institutional space in Allston, while the redevelopment of Suffolk Downs will bring commercial office opportunities to East Boston, with or without Amazon's HQ2.

Residential Real Estate Market

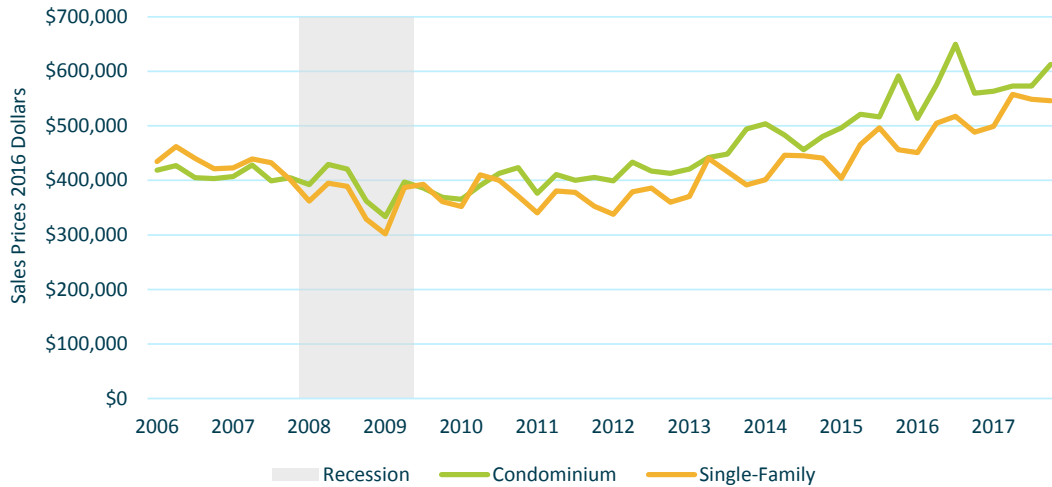
Despite growing housing stock, residential vacancy rates are falling while rents and sales prices are increasing. The number of housing units in Boston has grown by 6.8 percent over the past five years to 288,716 units. Despite this growth, the overall vacancy rate fell to 7.3 percent in 2016 from 8.6 percent in 2015. Housing units marked as vacant include those for rent, for sale, rented or sold but not occupied, and those for occasional use. Only about two percent of all residential units are for rent and half a percent are for sale at any one time.¹⁷ This tight real estate market has been driving up prices.

Housing prices reached new highs in 2017, with 11.7 percent price growth in single family market and 8.3 percent price growth for condominiums over 2016. Since 2012, the real median price of single-family homes in Boston increased by 52 percent to \$557,500. The median condominium sales price in Q4 2017 was \$625,000, a increase of 48 percent in real terms over Q4 2012 prices.

¹⁶ Colliers International "Greater Boston Market Viewpoint Q1 2018" p. 3.

¹⁷ City of Boston, DND using Banker & Tradesman data, January 2018 and U.S. Census Bureau 2012 to 2016 1-year estimates, BPDA Research Division Analysis.

FIGURE 9 Median Residential Sales Prices, 2016 Dollars



Rounded to the nearest multiple of 50 and in 2016 dollars. Source: City of Boston, Department of Neighborhood Development using Banker & Tradesman Data (January 2018).

Rents have risen more slowly than sales prices over recent years. The American Community Survey housing data show the median gross monthly rent (for existing renters rather than advertised rents) was \$1,491 in 2016, up 15.6 percent in real terms since 2012 and up 3.5 percent over 2015.¹⁸ Gross rents are tenants' out-of-pocket costs in both market rate and subsidized housing units and are typically lower than advertised market rents for newly available units. The median advertised rent for an apartment in Boston was \$2,300 per month between the fourth quarter of 2016 and the third quarter of 2017, up three percent over the prior year.¹⁹

From January 2014 through the end of December 2017, 20.9 million square feet of large projects with a residential component were completed. Major completions:

- The construction of an 18-story, 375-bed residence hall of Emerson College located at 2 Boylston Place was completed in summer 2017. In addition to student residences, this project created student social-space.
- Boston University completed the renovation of the 203,000 square foot Myles Standish Hall at 610 Beacon Street, which will house 730 students.
- Construction of the Nashua Street Residences finished in 2017, with the development of 503 residential units in the West End.
- In March 2018, 295 residential units were recently completed at 125 Guest Street in Brighton. Near the Boston Landing development, the 17-story mixed use development also includes about 16,000 square feet of retail.

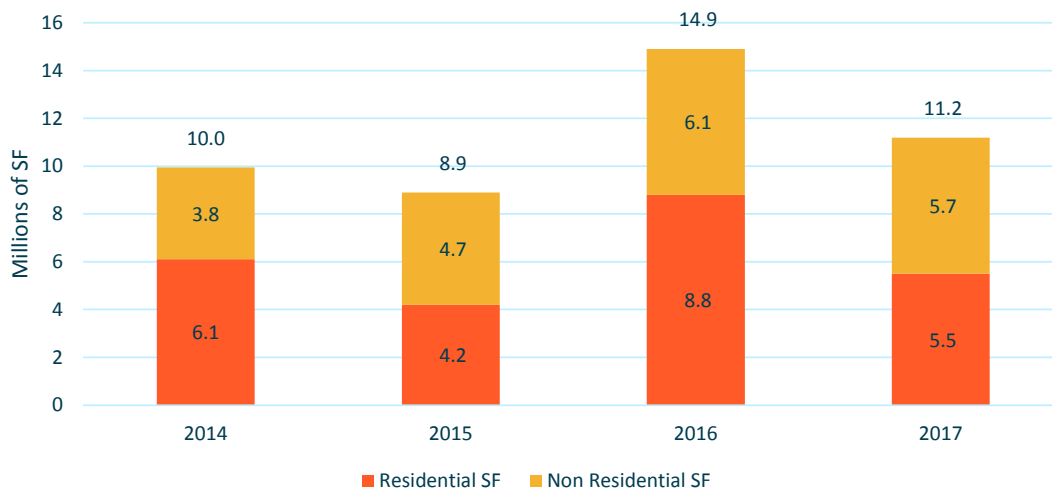
¹⁸ U.S. Census Bureau, 2015 & 2016 1-year American Community Surveys, BPDA Research Division Analysis

¹⁹ Source: City of Boston, Department of Neighborhood Development using Multiple Listing Service (MLS) and Rental Beast, January 2018.

Development Pipeline Snapshot

The BPDA oversees a development review process (Article 80) that requires BPDA Board approval of all development projects larger than 20,000 square feet, or residential projects with 15 or more units. The volume of projects approved by the BPDA Board is an indicator of future real estate growth. 9.2 million square feet of office and 3.1 million square feet of institutional were approved by the BPDA Board from January 2014 through December 2017, adding to the pipeline of office and institutional space that will likely come online in the next few years. Another 25.1 million square feet of Article 80 projects with a residential component were approved by the BPDA Board during the same time period.

FIGURE 10 Millions of Article 80 Square Feet Approved by the BPDA Board 2015 through 2017



Source: BPDA Pipeline Database, BPDA Research Division Analysis.

Construction job data for Boston suggest the level of construction activity is strong, as construction employment is approaching levels close to the Big Dig era of the early 2000s. There were over 3.8 million construction hours worked in 2017 on Article 80 development projects,²⁰ an increase of 19.8 percent and almost 634,000 hours over 2016. Building permits in FY17 generated \$62 million in revenues, an increase of 16 percent over the previous year.²¹ New property tax levies also grew 58.6 percent from FY16 to FY17 due to major commercial developments added to the tax rolls.²²

In 2017 alone, the BPDA Board approved 11.2 million square feet of development including 5.5 million square feet of new residential development for a total of 6,522 potential new housing units across the city. Of these units, 756 will be affordable units. The largest projects by number of units include Tremont Crossing in Roxbury (727 units), Seaport Square in South Boston Waterfront (700 units), and new residential buildings near St Gabriel's Monastery

²⁰ Boston Job Policy Compliance Reports Database, <https://data.boston.gov/dataset/boston-jobs-policy-compliance-reports>.

²¹ Potential construction activity is estimated by dividing permit revenues by 0.85 percent, which is the midpoint between permit fees calculated at 0.7 percent of the first \$100,000 estimated value of development cost, and one percent for the remainder of development cost.

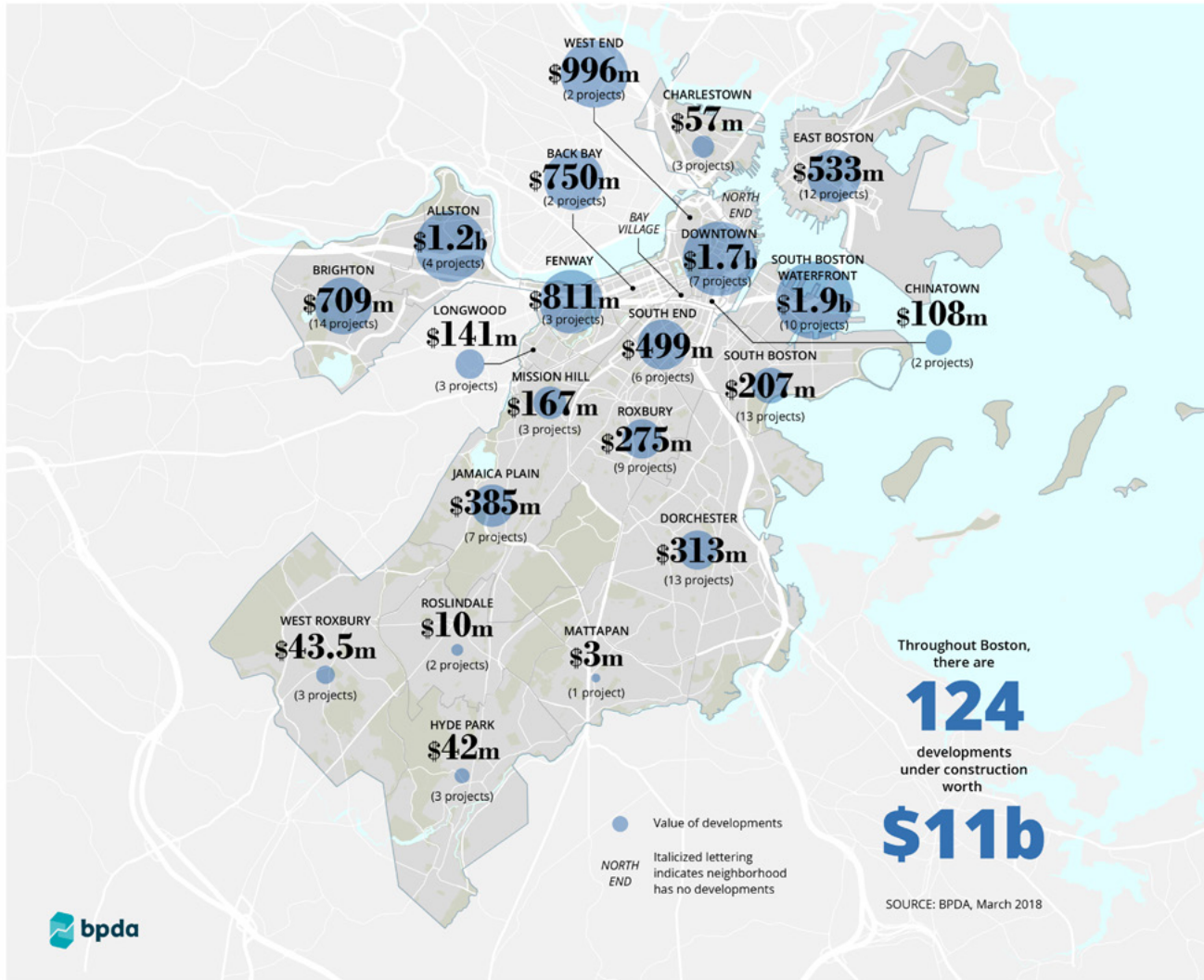
²² Residential properties in Boston are taxed at \$10.48 per thousand dollars in assessed value, after the residential exemption. Commercial properties are taxed at \$25.20 per thousand dollars. Proposition 2½, a state ballot initiative passed in 1980, prohibits increases in property tax levies of more than 2.5 percent per year, with the exception of new development. The annual increase in property tax levies is therefore a indication of the value of new development coming on line in the city.

and Church in Brighton (652 units). In 2017, ten of the projects approved by the BPDA included new office space, totaling 3.5 million new square feet. The new office developments will be located across the city: three in South Boston Waterfront, and one each in Back Bay, Charlestown, Dorchester, East Boston, Fenway, Jamaica Plain and Roxbury. In addition, about five hundred thousand square feet of institutional development were approved city-wide.

The map on the following page shows the neighborhood distribution of the 124 Article 80 developments under construction throughout the city as of March 2018.

Some noteworthy developments underway include:

- **General Electric** broke ground on its new 388,000 square foot headquarters overlooking Boston's Fort Point Channel.
- **South Bay** began construction in the first quarter of 2017 on five 6-story buildings in Dorchester including commercial and retail space, a 12 screen cinema, a 130 room hotel, and approximately 475 units of housing.
- **General Heath Square** is a 56,290 square foot, 4-story transit-oriented structure in Jamaica Plain that will provide 47 affordable housing units.
- Phase I of the **Fenway Center** will contain two buildings with a combined 346,000 square feet and 312 residential units, served by a newly upgraded Yawkey MBTA commuter rail station.
- The **Hub on Causeway** is finishing construction on its first phase of the 1.87 million square feet development, with Boston's largest Star Market (60,000 square feet) expected to be complete by late 2018. The second phase of construction started in June 2017 and includes a 38-level residential tower with 440 apartment units.
- Construction of the three mixed-use towers on **Parcel M** of the Seaport Square began in late 2017. Together, these towers include about 1 million square feet of residential and retail space, along with 735 units.
- Beginning construction in May 2017, four buildings containing 478 residential units are expected to open in Fall 2018 as part of the **Clippership Wharf** development.
- A new 16-story development in East Boston, with 224 residential units at **6-26 Newbury Street**, broke ground in October 2016 and was completed in April 2017.



Map created by BPDA Office of Digital Cartography and GIS
 Source: BPDA Pipeline Database, BPDA Research Division Analysis.

5. Spotlight Section: Job Openings

Technological developments ranging from renewable energy and genetic modification to artificial intelligence and machine learning offer new approaches to environmental, health, and security-related challenges. Companies seek employees with specialized skillsets in the emerging fields of biotechnology, green jobs, and cybersecurity. Online job postings reveal how Boston and other cities across the U.S. use these skillsets in different industries and occupations. While these high-skill fields are growing, they currently compose only a small subset of total job listings. As a counterpoint, the Spotlight Section also analyzes openings for “middle-skill” jobs – those that require less education but offer lower pay – within the health care, finance and insurance, and transportation industries.

Nationally, biotech jobs are most prevalent within health care, manufacturing (particularly pharmaceutical manufacturing), and scientific research and development. Common biotech occupations include natural and medical scientists, chemists, and computer and statistical analysts, and require skills ranging from clinical research to data analysis and programming. Green jobs are found in higher education, architecture and engineering firms, utility companies, and government agencies. Green occupations include maintenance and repair workers, sales representatives, and engineers and require skills such as energy efficiency, natural gas extraction, and knowledge of environmental regulations. Cybersecurity jobs are prevalent within finance, insurance, transportation manufacturing, and national security. The most common cybersecurity occupations are computer-based jobs, especially information security analysts, software developers, and computer systems architects, and require skills ranging from knowledge of operating systems and programming languages to techniques like cryptography.

Compared to traditional employment data, online job postings data provide more specific detail on employers and the skillsets they are seeking to hire in a more up-to-date timeframe. The Spotlight Section uses data from Burning Glass Technologies’ Labor Insight software, which uses machine learning and web-crawling techniques to collect, parse, and categorize listings posted on major job boards as well as on company websites. The software categorizes the industry, occupation, employer, and requested skills and education for millions of job listed across the nation over the past decade. This report identifies trends in demand by industry and occupation in Boston and other major cities using Burning Glass’ skill-based filters for biotech jobs, green jobs, and cybersecurity jobs, as well as the education and wage-based filter for middle skill jobs.²³

The findings suggest that Boston is one of the best places in the U.S. to search for a job in the biotech field, due to the high concentration of state-of-the-art hospitals and research institutions where interdisciplinary medical, technical, and engineering skills are in high demand. Despite the recent arrival of General Electric, Boston fares less well in the green jobs field, lagging behind the national growth rate, although there is a high volume of openings for engineering managers and environmental researchers at local institutions. Though Boston has yet to catch up to Washington DC in the cybersecurity field, cybersecurity jobs within the finance and insurance industries are common. Finally, though middle skill jobs are not as prevalent in Boston as elsewhere in the US, opportunities do exist within the health care and services industries.

²³ Individual job listings may be included in more than one of these filters. The numbers reported here do not adjust for this double-counting.

5.1 Biotechnology Jobs Postings

Biotechnology is a quickly growing hybrid field that involves modifying or adapting biological systems for applications in engineering, medicine, agriculture, and industry. Burning Glass defines biotech jobs as those requiring knowledge of scientific fields such as biochemistry and genetics, laboratory techniques such as chromatography and clinical research, and/or experience with technology that incorporates biological processes such as biosensors and bio-chips.²⁴ Although biotech jobs at the national level tended to be concentrated in health care occupations, biotech jobs in three biotech centers – Boston, San Francisco, and San Diego - were found primarily in the management of clinical research and pharmaceutical development.

While biotech listings accounted for only two percent of job listings nationwide in 2017, listings have grown 28 percent since 2012 (Table 4). In 2017, Boston had 9,333 postings for biotech jobs, fourth among all U.S. cities and six percent of total listings in the city. Cambridge had the second most postings nationally, making Boston-Cambridge-Nashua the metropolitan region with the highest density of listings.²⁵ Boston's jobs were concentrated within the city's hospitals and focused on clinical trials and medical research, with a particular focus on cancer treatment. While the Boston metro area leads the biotech field on the East Coast, California is home to two other major biotech centers. San Diego, where biotech jobs accounted for six percent of total listings, had the third most postings and third-highest metro-level density. Individuals with training in biology and chemistry could find plenty of openings in San Diego's pharmaceutical and medical technology companies. San Francisco ranked fifth in overall postings and second in density; however, only four percent of its total listings were for biotech occupations. San Francisco offered more opportunities for employees with computer and programming skills than the other two cities, particularly within the university system. Biotech listings in San Diego and San Francisco have both grown at a faster rate than in Boston or the nation over the past five years, posing a threat to Boston's dominance of this industry going forward.

TABLE 4 Biotech Job Listings

	Nationwide	Boston	San Diego	San Francisco
Biotech Jobs Listed in 2017	442,440	9,333	9,855	8,389
Percent Change since 2012	28.1%	28.7%	78.7%	38.1%
Rank by Volume (Among All Cities)	-	4th	3rd	5th
Percent of Listings that are Biotech	2.0%	5.5%	5.9%	3.6%
Postings per 10,000 Employed at Metro Level*	-	133	86	114
Rank by Density (Among Metros with >5,000 Listings)*	-	1st	3rd	2nd

* Boston-Cambridge-Nashua, MA-NH (Metropolitan NECTA), San Diego-Carlsbad, CA (Metropolitan Statistical Area), San Francisco-Oakland-Hayward, CA (Metropolitan Statistical Area). Jobs listed within the last 12 months. Source: Burning Glass Technologies Labor Insight Jobs, Top Locations, 2012 and 2017. Downloaded April 23-27, 2018, BPDA Research Division Analysis.

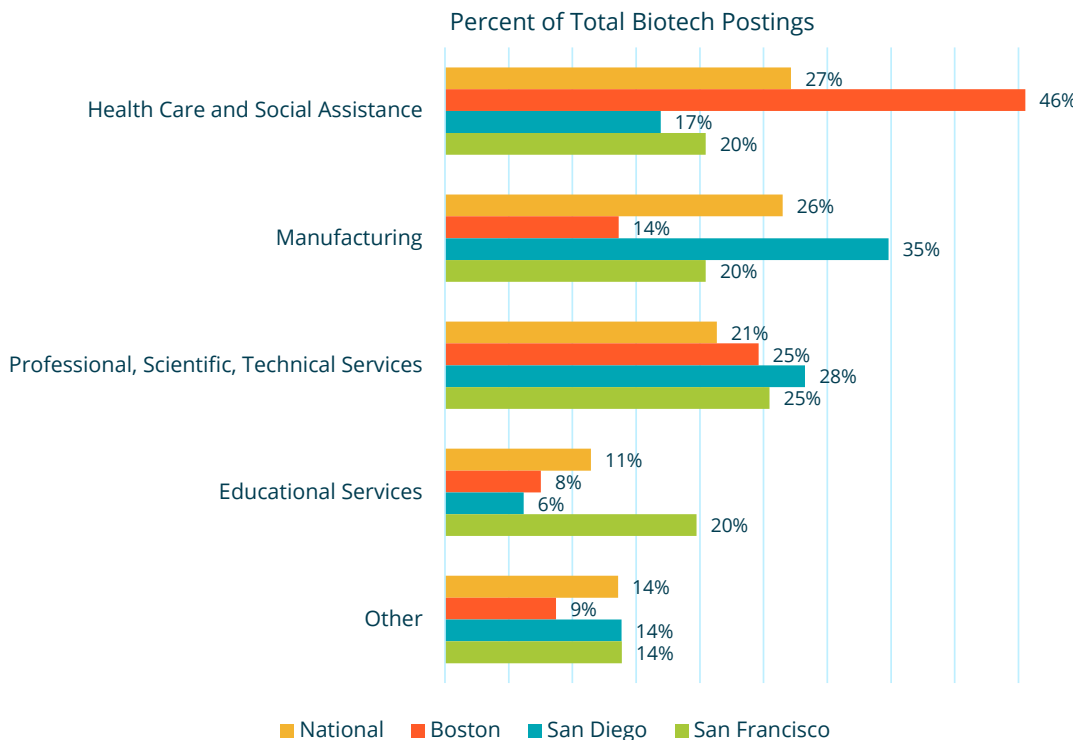
²⁴ In addition to Burning Glass's filter definition, jobs listed in the Elementary and Secondary Schools Industry sub-category (NAICS 6111) were excluded due to a large volume of postings in this category being apparently incorrectly classified as biotech jobs.

²⁵ Among metropolitan regions with more than 5,000 listings in 2017.

Biotech Industries and Top Employers

Nationally, the following industries posted the most biotech listings in 2017: health care and social assistance (27% of biotech listings), manufacturing (26%), and professional, scientific, and technical services (21%) (Figure 11). Of jobs in the manufacturing industry, 60 percent were posted by pharmaceutical manufacturers, with the largest being Pfizer, Merck & Co, and Johnson & Johnson.

FIGURE 11 2017 Biotech Postings by Industry



* Industry Categories based upon 2-digit NAICs codes.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed Industries in Biotech Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 23-27, 2018, BPDA Research Division Analysis.

Boston far surpassed San Diego and San Francisco in the percentage and number of biotech jobs within the health care and social assistance industry (46%), of which 81 percent were posted by hospitals. Six of the top ten Boston employers seeking to fill biotech jobs in 2017 were hospitals or health care networks, with Partners HealthCare and Massachusetts General Hospital²⁶ each posting over one thousand jobs (Table 5). Another 25 percent of jobs were posted by firms in the professional, scientific, and technical services industry, particularly in scientific research and scientific and technical consulting. While pharmaceutical manufacturing still accounted for the majority of Boston's manufacturing jobs, the manufacturing industry made up the smallest share of total jobs compared to the other two cities, at only 14 percent.

²⁶ Partner's HealthCare is a network of Massachusetts hospitals and care facilities, of which MassGeneral Hospital is a founding member. Partners has both direct employees and employees through its associated hospitals. We count job postings based on the organization directly listing the opening. The total jobs listed by each entity are distinct.

TABLE 5 Employers with Most Biotech Job Postings in 2017

Nationwide		Boston		San Diego		San Francisco	
Employer	Listings	Employer	Listings	Employer	Listings	Employer	Listings
Pfizer	7,160	Partners HealthCare	1,300	University Of California	758	University Of California	1,133
Merck & Company	4,158	Massachusetts General Hospital	1,056	Pfizer	419	Dignity Health	237
Johnson & Johnson	4,083	Boston University	395	Illumina Incorporated	310	Pfizer	193
Grifols	3,979	Dana Farber Cancer Institute	382	Celgene Corporation	188	Amgen	139
Amgen	2,914	Boston Medical Center	251	Scripps Health	130	Genentech	137

Source: Burning Glass Technologies Labor Insight Jobs, Employers with the Most Job Openings in Biotech Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 23-27, 2018, BPDA Research Division Analysis.

Of the three cities, San Diego had the largest share of biotech postings within the manufacturing industry (35%), with more openings in pharmaceutical and medicine manufacturing (1,330) than either San Francisco (932) or Boston (799). Although the University of California was the single largest employer, the pharmaceutical companies Pfizer, Celgene, Takeda Pharmaceuticals, and Johnson & Johnson were all among the top ten. San Diego also had a larger share of manufacturing jobs in the measuring and medical instruments manufacturing industry (17%) than either Boston or San Francisco, with the genomic sequencing company Illumina posting most of these openings.

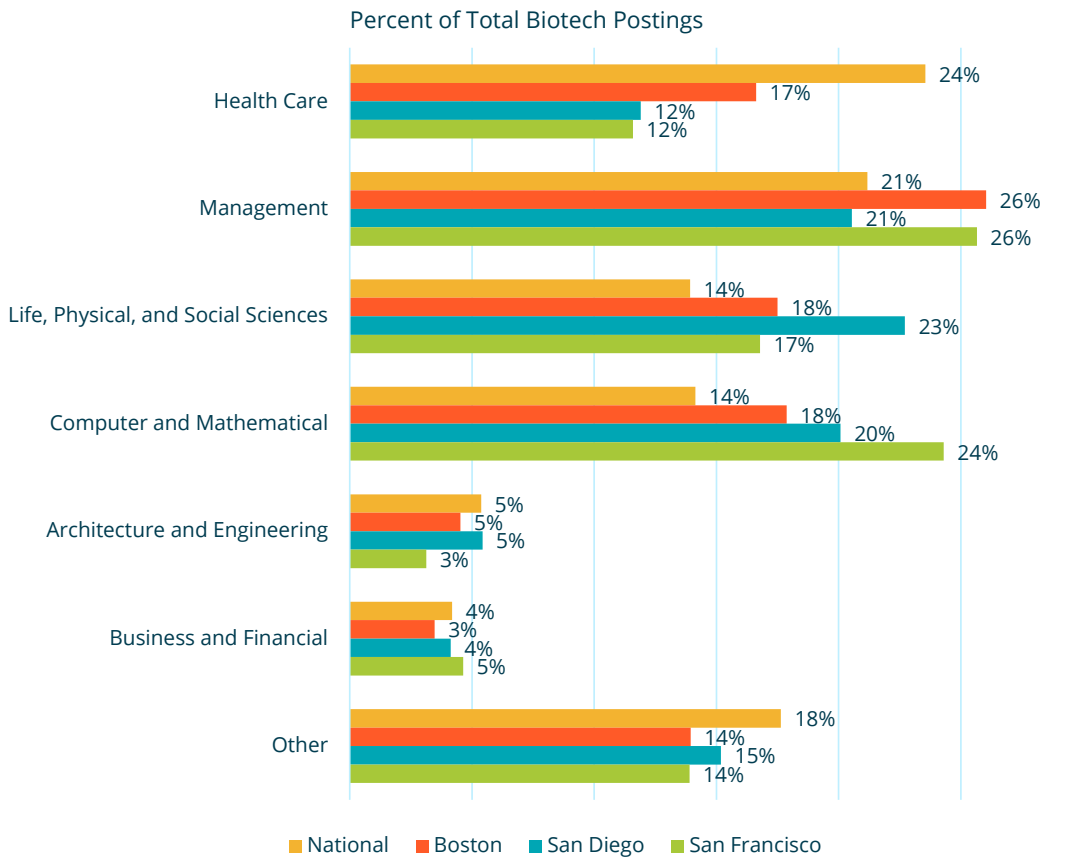
San Francisco had the highest share of biotech job listings within the education industry, at 20 percent. The University of California was the largest employer, posting more than four times the next largest employer, Dignity Health. Colleges and universities in San Francisco posted more than twice the number of biotech jobs posted by colleges and universities in Boston or San Diego. Although San Francisco had an edge over Boston and San Diego in the education industry, the professional, scientific, and technical services industry accounted for the largest share of listings (25%). 79 percent of postings in this industry were for scientific research and development companies; of these companies, the genetic engineering and medical research company Genentech posted the most openings.

Biotech Occupations and Skills

Health care occupations made up 24 percent of biotech job listings nationally, followed by management positions at 21 percent (Figure 12). The most commonly listed occupation was natural science manager, followed by registered nurse, operations research analyst, and medical and health services manager. Some of the most commonly specified skills in nationwide biotech postings were clinical research, project management, chemistry, biology, clinical trials, and oncology. In Boston, San Diego, and San Francisco, fewer than 18 percent of listings were for health care occupations. Instead, all three cities had a higher percentage of listings for scientific and computer occupations than the nation overall, suggesting that these biotech centers are oriented towards research and development as opposed to medical care.

Management positions made up the largest share of Boston's biotech postings, at 26 percent, with the most common occupations in this category being natural science managers and medical and health services managers. The top listed biotech occupation in Boston was medical scientist, with hospitals listing the majority of these positions.

FIGURE 12 2017 Biotech Postings by Occupation Category



* Occupation Categories based upon 2-digit O*Net codes.
 Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*Net Occupations in Biotech Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 23-27, 2018, BPDA Research Division Analysis.

Although registered nurses accounted for five percent of biotech postings in Boston, more than either San Diego or San Francisco, they were advertised less often than medical scientists, research analysts, and natural science and medical services managers, emphasizing that biotech positions are oriented more towards clinical research and management than patient care. Biotech postings in Boston in 2017 were more likely to request experience in clinical research (25%), clinical trials (15%) and cancer knowledge (12%) than in either San Francisco or San Diego, suggesting that the development and testing of therapeutic treatments was a prominent source of biotech jobs.

San Francisco's proximity to Silicon Valley produced high demand for employees that can utilize computer and mathematical skills in biotech roles. 24 percent of all listings requiring biotech skills in San Francisco were for computer and mathematical occupations, primarily software developers, compared to 12 percent in Boston and 13 percent in San Diego. These biotech-computer occupations specified typical programming skills such as software development and knowledge of programming languages like Python and SQL, as well as clinical research skills, knowledge of medical procedures, and knowledge of the biologics industry. However, the largest share of listings were for management occupations, as in Boston, at 26 percent of all listings.

Scientific occupations made up the largest portion of San Diego's biotech listings, more than either Boston or San Francisco at 23 percent. San Diego had the largest number of listings for chemists and biologists of the three cities, as well as lower skill positions like medical and clinical lab technicians and biological technicians. Employers in San Diego were most likely to require skills in particular scientific disciplines, including molecular biology and biochemistry, as well as Good Manufacturing Practices and drug discovery, emphasizing that biotech openings in San Diego are oriented towards in lab based scientific research.



Longwood Medical Area
©2014 Alex MacLean/Landslides Aerial Photography

5.2 Green Jobs Postings

In response to a combination of government regulation, resource constraints, and consumer demand, employers increasingly seek to reduce energy and resource consumption and limit their impact on the environment. This has led to new employment opportunities in green jobs, defined by Burning Glass as those requiring environment-based skills and expertise such as energy efficiency, fuel cell testing, LEED-building certification, and environmental regulation.²⁷ Although postings for green jobs currently make up less than two percent of national job listings, they have increased by 26 percent since 2012, reaching a total of 339,023 postings in 2017.

Boston's performance in the green jobs sector over the past five years has lagged behind the national level, decreasing by seven percent to 2,325 postings in 2017 (Table 6). Despite the recent arrival of General Electric and environmental research efforts under way at local universities, Boston does not have as many green jobs opportunities in fields such as engineering, architecture, and manufacturing as Denver and Detroit; instead, most of Boston's green jobs are in management. Denver, typically thought of as a 'Green' city due to its proximity to outdoor amenities and natural parks, had the sixth most postings of all US cities (3,276) but a slower rate of growth than the nation, increasing only one percent since 2012. Green jobs accounted for two percent of all listings in Denver and the Denver metro area had the highest concentration of green jobs among the largest metros in the nation. Denver posted a particularly large share of openings for the design, construction, and maintenance of energy efficient buildings as well as has in natural resource protection. Unlike Denver, Detroit is often associated with its industrial manufacturing past. However, Detroit's auto manufacturing industry has produced opportunities in the production and sale of energy efficient vehicles as well as the production of renewable energy sources, particularly natural gas. Green job listings in Detroit grew 96 percent over the past five years to 1,779, the second fastest rate of growth of the top twenty-five green job cities.

TABLE 6 Green Job Listings

	Nationwide	Boston	Denver	Detroit
Green Jobs Listed in 2017	339,023	2,325	3,276	1,779
% Change Since 2012	26.1%	-7.3%	1.1%	95.7%
% Total Jobs that are Green	1.5%	1.4%	2.3%	1.9%
Rank by Volume (Among all Cities)	-	15th	6th	21st
Jobs per 10,000 Employed at Metro Level*	-	33	46	43
Rank by Density (Among Metros with >5,000 listings)*	-	5th	1st	3rd

* Boston-Cambridge-Nashua, MA-NH NECTA, Denver-Aurora-Lakewood, CO MSA, Detroit-Warren-Dearborn, MI MSA. Postings over the past 12 months.

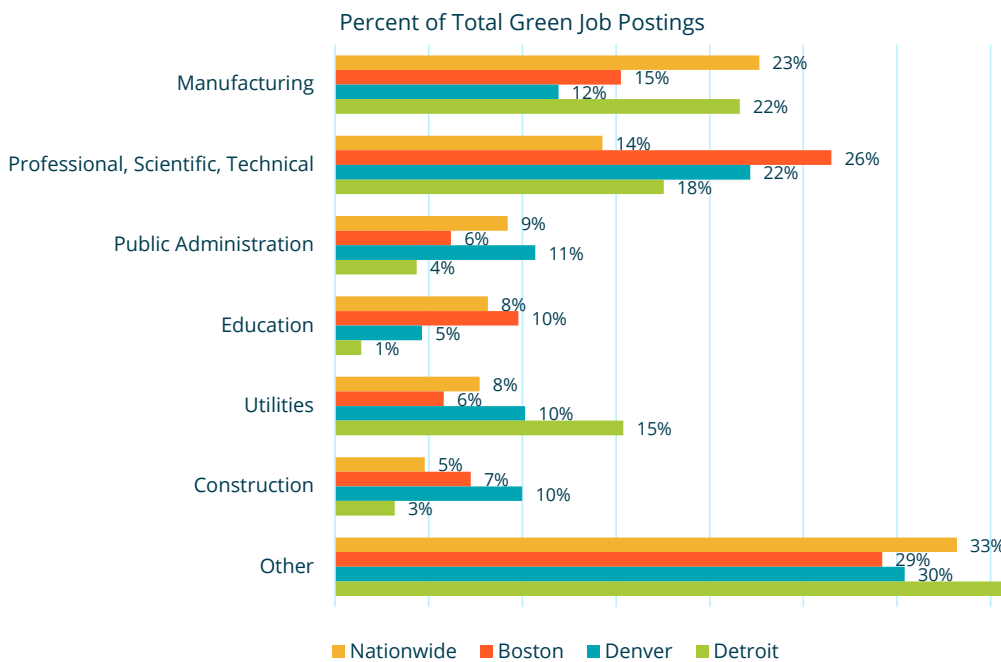
Source: Burning Glass Technologies Labor Insight Jobs, Top Locations, 2012 and 2017. Downloaded April 23, 2018, BPDA Research Division Analysis.

²⁷ While these skills may be applied in a range of industries and occupations, Burning Glass excludes Health Care and IT occupations. The Health Care and Social Assistance industry (NAICS 62) was also excluded from analysis for this section, due to a large number of listings that appeared to be inaccurately categorized as green jobs.

Green Job Industries and Top Employers

Nationally, the manufacturing industry posted the most green jobs at 23 percent, primarily in the manufacture of pharmaceutical and medical products, aerospace parts, and navigational, measurement, and control instruments (Figure 13). 17 percent of listings came from the professional, scientific and technical industry, 46 percent of which were for architecture and engineering positions. Public administration also accounted for nine percent of postings, while education accounted for eight percent.

FIGURE 13 2017 Green Job Postings by Industry



* Industry Categories based upon 2-digit NAICs codes.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed Industries in Green Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 23, 2018, BPDA Research Division Analysis.

Boston had the largest share of green jobs postings within the professional, scientific, and technical industry at 26 percent, more than Denver, Detroit, and the nation overall. Employers in this industry seeking to fill green jobs included EnerNOC, an energy management and technology services company, and AECOM, an infrastructure architecture and engineering firm (Table 7). Although education made up a relatively small percentage of Boston's total listings at ten percent, this was larger than in either Denver or Detroit. Boston University accounted for the majority of these listings, advertising academic research positions in industrial hygiene, climate policy, and environmental health. Boston's largest green jobs employer overall was General Electric, which began moving its headquarters to the city in 2016.

Like Boston, Denver's professional, scientific, and technical industry accounted for the largest share of green jobs postings, at 22 percent. Of these, 58 percent were in the architecture and engineering industry, more than Boston. Denver had a higher share of postings within the public administration sector than either Boston, Denver, or the nation overall, at eleven percent. The Colorado Department of Public Safety was the single largest employer, post-

TABLE 7 Employers with Most Green Jobs Postings in 2017

Nationwide		Boston		Denver		Detroit	
Employer	Listings	Employer	Listings	Employer	Listings	Employer	Listings
General Electric Company	4,922	General Electric Company	81	Colorado Department Of Public Safety	132	Dte Energy	152
Minstar Transport	4,449	Boston University	69	Xcel Energy, Inc.	110	Accenture	70
Pep Boys	3,758	Ceres	37	General Electric Company	75	General Motors	46
Marriott International Incorporated	3,685	Enernoc Incorporated	34	Colorado State	57	City of Detroit	43
AECOM Technology Corporation	2,675	Dana Farber Cancer Institute	31	Rk	48	AECOM Technology Corporation	25

Source: Burning Glass Technologies Labor Insight Jobs, Employers with the Most Job Openings in Green Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 23, 2018, BPDA Research Division Analysis.

ing 132 green jobs, while the Colorado State government posted the fourth most listings. Denver also had a higher share of jobs within the construction industry (10%) than either Boston or Detroit, with 60 percent of these in nonresidential building construction, suggesting that the development of energy-efficient offices and retail stores created high demand for labor with green skills.

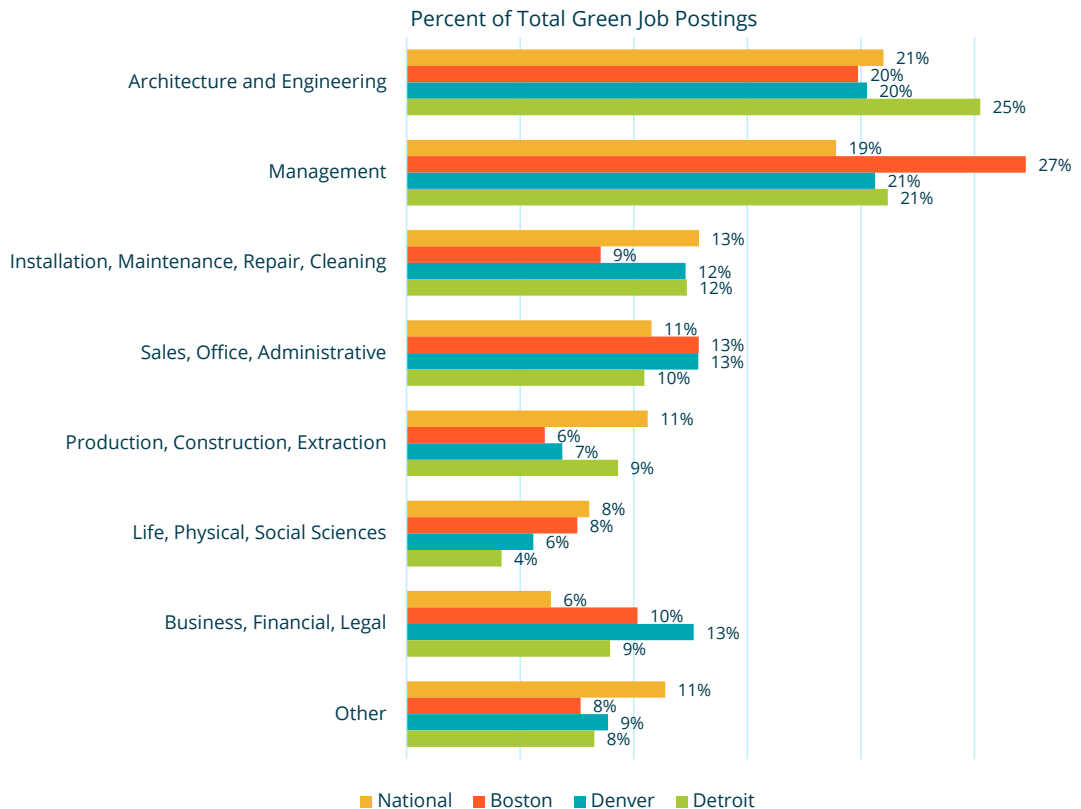
The largest proportion of Detroit’s green jobs were posted by the manufacturing industry (22%), with transportation equipment manufacturing accounting for the largest subsector. American Axle & Manufacturing, an automotive technology and parts manufacturer, listed the most openings within this subsector. The retail trade industry was also most prominent in Detroit, at seven percent of all listings, in large part due to openings at the automotive dealers General Motors and Toyota, both in Detroit’s top ten green jobs employers. Detroit had more listings and a greater share of green jobs in the utilities industry than the nation, Boston, or Denver, at 15 percent. The natural gas and electric company Dte Energy posted the most jobs of any employer, and more than twice as many as the next largest employer, the consulting company Accenture.

Green Job Occupations and Skills

Nationally, architects and engineers accounted for the largest share of green jobs in 2017, at 21 percent (Figure 14). Of these, 17 percent were civil engineers, 13 percent were mechanical engineers, ten percent were electrical engineers, and nine percent were environmental engineers. Management positions were the second most frequently listed green occupation nationwide, at 19 percent of jobs, while installation, maintenance, repair, and cleaning positions made up 13 percent. Some of the most commonly requested skills in green jobs listings were environmental health and safety, water treatment, environmental laws and regulations, energy management, and natural gas.

Management positions accounted for the most listings in Boston at 27 percent, with ten percent of these seeking architecture or engineering managers. Boston had a lesser share of green job listings for architects or engineers (20%) than either Denver or Detroit, though it had the most listings for electrical engineers of the three cities. Additionally, 53 openings in Boston requested LEED (Leadership in Energy and Environmental Design) certifications, almost as many as in Denver (62) and far more than in Detroit (17). General Electric, the largest green employer in Boston in 2017, most frequently sought management and sales employees.

FIGURE 14 2017 Green Job Postings by Occupation Category



* Occupation Categories based upon 2-digit O*Net codes.
 Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*Net Occupations in Green Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 23, 2018, BPDA Research Division Analysis.

Denver’s most advertised occupational category was management (21%), followed by architecture and engineering (20%). In addition, Denver had a larger share of postings for installation/maintenance/repair and cleaning occupations than Boston, both 12 percent, suggesting that green jobs in the construction field were open to both high and low skilled employees. Among installation and repair occupations, commonly requested skills included HVAC training, energy management, water treatment, and energy conservation, emphasizing that the maintenance of energy-efficient buildings contributed green jobs to Denver’s economy. While most green jobs in Denver were focused on the built environment, the ten percent of jobs in public administration centered on the preservation of natural resources, including positions such as ‘Energy & Water Conservation Manager,’ ‘Park Ranger,’ ‘Environmental Protection Specialist,’ and ‘Wildlife Manager/Aquatic Biologist.’

Detroit had a larger share of architects and engineers than either city or the nation overall, at 25 percent, though still a lesser quantity of listings for these positions than Denver. Electric power companies posted 12 percent of the architect and engineering openings, and automobile dealers and parts manufacturers posted another 8 percent. Utility companies, which accounted for 15 percent of Detroit’s green jobs listings, were most likely to request environmental engineers and marketing specialists. Additionally, 35 percent of listings by utility companies requested natural gas extraction skills. Among green jobs posted by automotive dealers in Detroit, lawyers were the most in demand occupation, specifically those with emissions and regulatory expertise.

5.3 Cybersecurity Jobs Postings

As companies and government agencies increasingly store sensitive consumer and citizen data online, cyberattacks have become a more frequent and risky occurrence. High-profile data breaches at private companies (Target, Uber), financial institutions (Equifax, JP Morgan), and governmental and political entities (Democratic National Convention, National Security Agency) have spurred demand for employees with cybersecurity skills to protect information and defend against attacks.

Burning Glass defines cybersecurity jobs as those that require cybersecurity and information system certifications and various software development and cryptography skills, or have job titles related to “application integrity”, “information security”, and “network security.” Since 2012, cybersecurity listings have increased 61 percent in the US to 375,728 (Table 8). While cybersecurity positions are predominantly computer and mathematical roles, a comparison of Boston, Washington DC, and Atlanta highlights the different industries in which cybersecurity jobs can be found.

TABLE 8 Cybersecurity Job Listings

	Nationwide	Boston	Washington DC	Atlanta
Cybersecurity Jobs Listed in 2017	375,728	3,761	11,182	7,072
Percent Change since 2012	60.5%	80.8%	115.0%	17.2%
% of All Jobs that are Cybersecurity	1.7%	2.2%	7.0%	3.2%
Rank by Volume (Among All Cities)	-	15th	2nd	5th
Postings per 10,000 Employed at Metro Level*	-	41	174	49
Rank by Density (Among Metros with >5,000 Listings)*	-	9th	1st	7th

* Boston-Cambridge-Nashua, MA-NH NECTA, Washington-Arlington-Alexandria, DC-VA-MD-WV MSA, Atlanta-Sandy Springs-Roswell, GA MSA. Postings over the past 12 months.

Source: Burning Glass Technologies Labor Insight Jobs, Top Locations, 2012 and 2017. Downloaded April 30, 2018, BPDA Research Division Analysis.

Cybersecurity jobs accounted for two percent of Boston’s total listings in 2017, but grew 81 percent from 2012 to 2017, faster than the national growth rate. Though Boston had only the fifteenth most listings among all cities in 2017, the Boston-Cambridge-Nashua metropolitan area had the ninth highest concentration of jobs (Table 8). Openings were particularly prominent in Boston’s finance and insurance industry. Washington DC, capitalizing upon the prevalence of engineering, IT, and consulting contracting opportunities with federal defense and intelligence agencies, had the second most cybersecurity listings among all cities in 2017. Openings grew 115 percent over the past five years and made up seven percent of all listings, suggesting that DC’s dominance will continue in this field. Atlanta has been identified as a potential cybersecurity center due to an active venture capital scene²⁸ and the presence of Georgia Tech, whose eleven cybersecurity labs and centers received \$83 million in research funds in 2016.²⁹ However, while Atlanta had more than 800 more listings than DC in 2012, the rate of growth in the city was much lower, increasing only 17 percent and falling to fifth in overall postings. Cybersecurity openings in Atlanta included jobs in telecommunications, manufacturing, and finance.

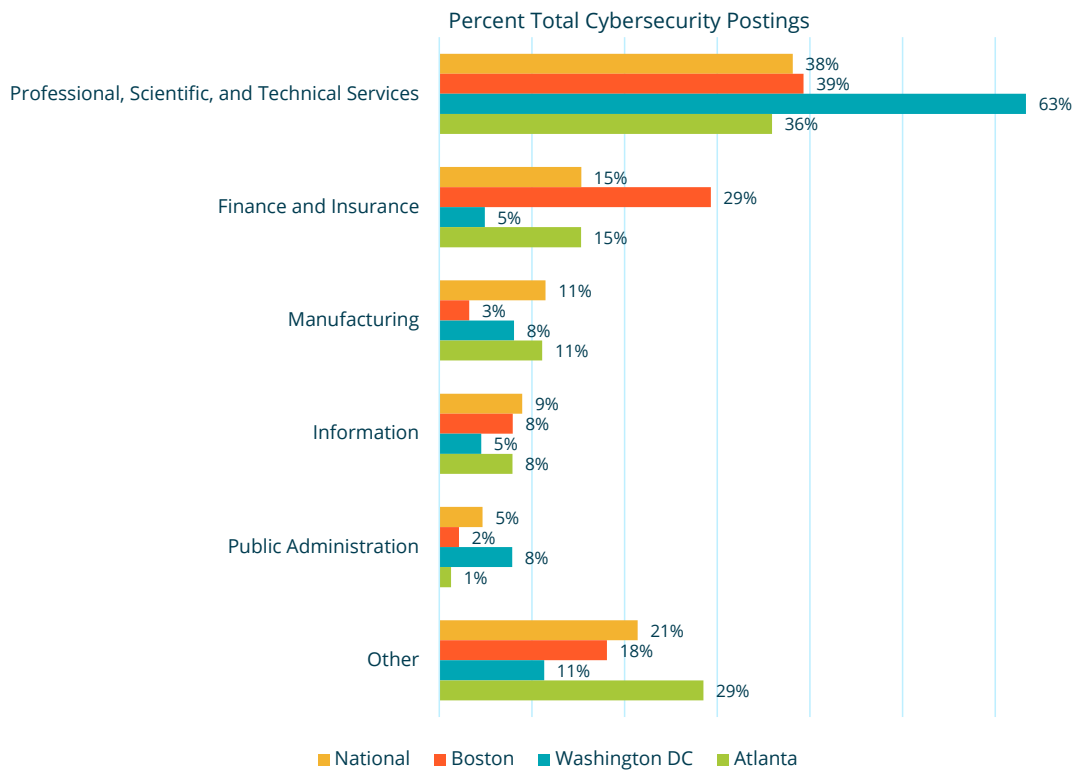
²⁸ <http://fortune.com/2017/04/06/cyber-security-cities/>

²⁹ <http://www.georgia.org/industries/information-technology/cybersecurity/>

Cybersecurity Industries and Employers

Nationwide, cybersecurity listings were most common within the professional, scientific, and technical industry, at 38 percent of all listings (Figure 15). Within this industry, management consulting firms, accounting and tax preparation services, and computer systems design companies were the most likely to be hiring. Finance and insurance companies accounted for another 15 percent of listings, with insurance carriers being the single largest group within any industry. Manufacturing services also accounted for 11 percent of cybersecurity listings, while information services and public administration round out the top five.

FIGURE 15 2017 Green Job Postings by Industry



* Industry Categories based upon 2-digit NAICs codes.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed Industries in Cybersecurity Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 30, 2018, BPDA Research Division Analysis.

Boston's finance and insurance industry accounted for 29 percent of cybersecurity postings in 2017, a higher share than in either DC or Atlanta. State Street Bank posted the most cybersecurity openings of all Boston companies, while Santander Bank and U.S. Bancorp were also in the top five. 39 percent of cybersecurity openings were in the professional and scientific industry, primarily in management, scientific and technical consulting (10%), accounting and tax preparation (8%), and computer systems design (5%). The largest employers in this category were the consulting firms Accenture and Deloitte.

TABLE 9 Top Five Employers for Cybersecurity Jobs in 2017

Nationwide		Boston		Washington DC		Atlanta	
Employer	Listings	Employer	Listings	Employer	Listings	Employer	Listings
Booz Allen Hamilton Inc.	8,566	State Street Bank	145	Booz Allen Hamilton Inc.	1,104	Dell	187
Jones Lang Lasalle Incorporated	8,180	Deloitte	89	General Dynamics	324	Accenture	146
General Dynamics	5,785	Accenture	85	Leidos	223	Deloitte	137
Accenture	4,402	Santander Bank	141	Mantech International Corp.	186	Suntrust Banks	124
Oracle	4,350	U.S. Bancorp	53	SAIC	177	Anthem Blue Cross	96

Source: Burning Glass Technologies Labor Insight Jobs, Employers with the Most Job Openings in Cybersecurity Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 30, 2018, BPDA Research Division Analysis.

More than half (63%) of DC’s listings were posted by companies within the professional and scientific industry, primarily consulting firms, computer systems companies, and architecture and engineering firms. The employer with the most openings in 2017 was Booz Allen Hamilton, a consultant specializing in cyber defense that recently signed a \$620 million contract with the Department of Homeland Security to enhance cybersecurity across the federal government.³⁰ Other large employers included General Dynamics, an aerospace and defense manufacturing company that secured IT and engineering contracts with the US Army and Navy,³¹ and Leidos, an IT and engineering firm that has provided security services to the FBI.³² Eight percent of cybersecurity listings were posted directly by government entities in Washington DC, including the Army, CIA and FBI, more than in either Boston or Atlanta.

While Atlanta is similar to Boston and Washington DC in that the largest share of its postings were within the professional, scientific and technical industry (36%), Atlanta had higher demand for cybersecurity jobs in the manufacturing industry (11%) than Boston or DC. This is in large part due to openings at the computer and electronics manufacturer Dell, which posted the most listings overall. The information industry accounted for eight percent of cybersecurity listings, more than DC and comparable to Boston, primarily due to the presence of large telecommunications companies such as Cox Communications, AT&T, and Time Warner. Thanks to openings in the cybersecurity labs at the Georgia Institute of Technology, the Institute was the seventh largest cybersecurity employer, listing 76 cybersecurity openings in 2017.

Cybersecurity Occupations and Skills

Computer and mathematical positions made up 70 percent of cybersecurity listings nationwide, with the following occupations most frequently advertised: information security analysts, software application developers, computer network architects, and network and computer systems administrators. At the national level, employers sought skills and experience in the UNIX and LINUX operating systems, cryptography, and the coding languages SQL, JAVA, and Python.

Boston had fewer listings for computer-based occupations than Washington DC and Atlanta, at 65 percent. The fact that computer occupations in Boston have decreased as a share of total listings over the past two years while

³⁰ <https://www.boozallen.com/e/media/press-release/dhs-selects-booz-allen-to-advance-flagship-cybersecurity-program.html>

³¹ <https://gdit.com/cyber-security/>

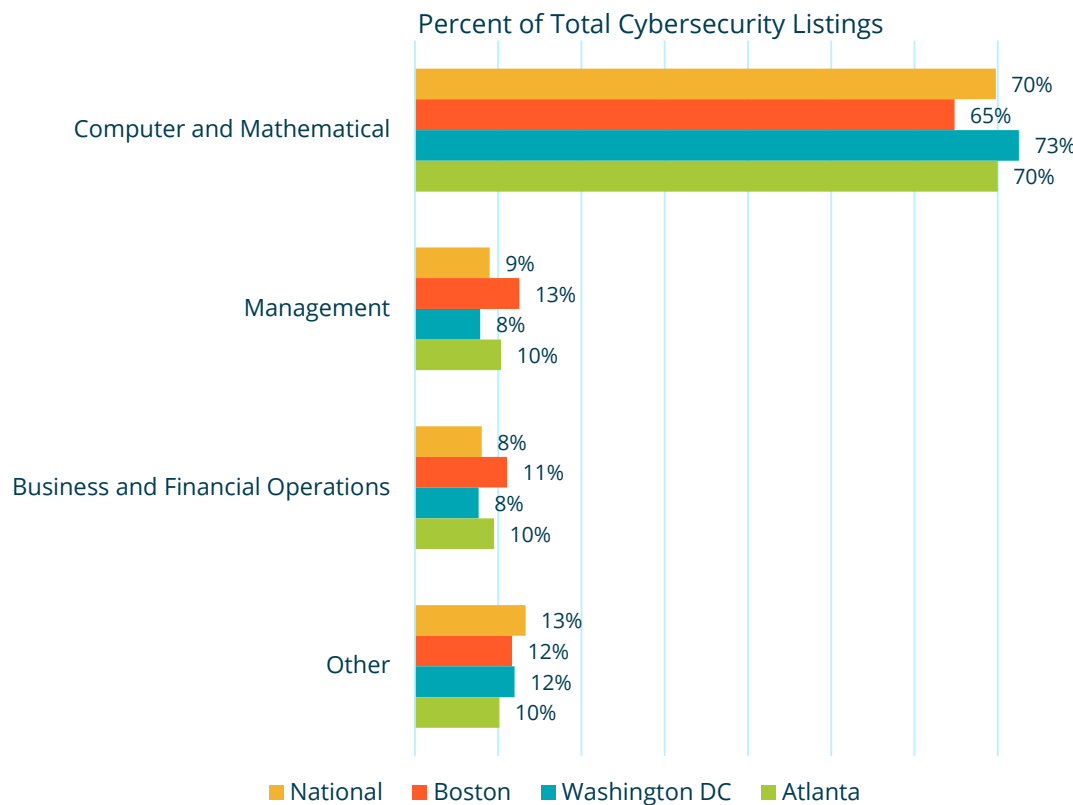
³² <https://www.leidos.com/federal-cybersecurity>

the share of cybersecurity listings has increased suggests that cybersecurity jobs are found outside programming specific roles. Accountants and auditors were one of the most frequently listed cybersecurity positions in Boston and the city had the largest share of cybersecurity sales positions, particularly sales engineers, specialized positions for the sale of engineering and technical products.

DC had the largest percentage of computer and mathematical occupations at 73 percent, around two thousand more listings than in Atlanta or Boston. Listings for information security analysts, software developers, and computer network architects were all most prevalent in Washington DC, while network and systems administrators and computer user support specialists made up a larger percentage of listings in DC than in Boston or Atlanta. DC also had the most listings for protective service occupations, with 120 listings for detectives and criminal investigators with cybersecurity skills, within both government agencies and private companies.

70 percent of cybersecurity postings in Atlanta were computer and math occupations, with another ten percent in management and ten percent in business and finance. Of the three cities, Atlanta had the most listings for accountants and auditors with cybersecurity skills (216), while Boston had the second most (162), consistent with both cities having many postings within the financial industry. Atlanta also had the highest percentage of software developers of the three cities.

FIGURE 16 2017 Cybersecurity Postings by Occupational Category



* Occupation Categories based upon 2-digit O*Net codes.

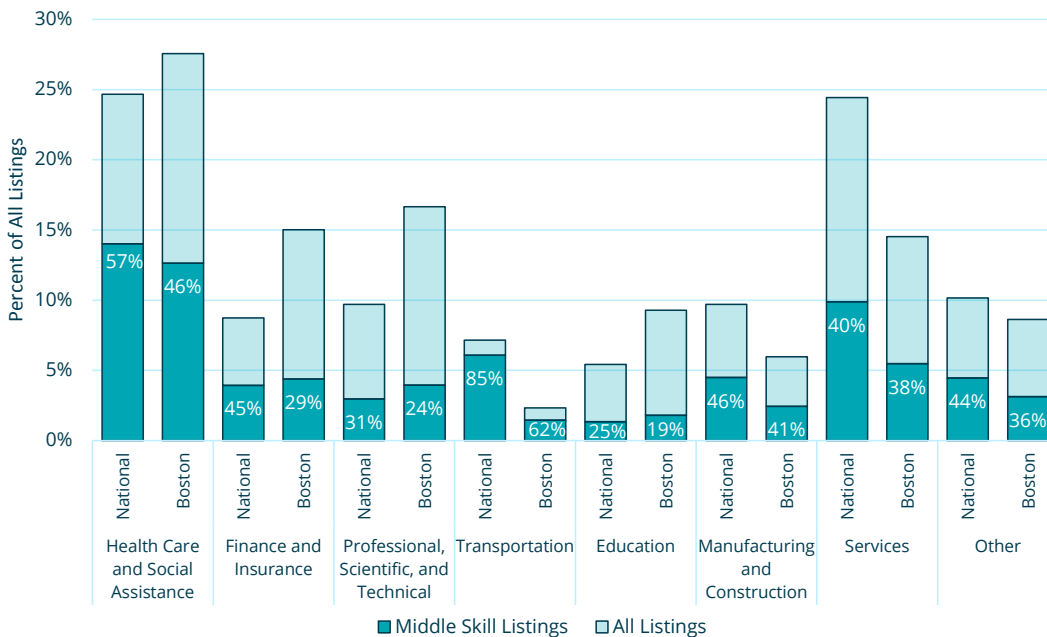
Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*Net Occupations in Cybersecurity Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 30, 2018, BPDA Research Division Analysis.

5.4 Middle Skill Jobs Postings

While biotech, cybersecurity, and green jobs are growing throughout the U.S., each accounts for five percent or less of Boston's total listings and less than two percent of postings nationwide. Additionally, while these high-tech fields offer high salaries, they are accessible primarily to those with advanced degrees. Opportunities for employees with less education remain essential, especially as automation threatens to replace millions of jobs and workplace activities over the next several decades.³³ Although the deindustrialization of American cities during the middle of the twentieth century shifted the urban labor force from lower skilled manufacturing jobs towards the knowledge- and service- sectors, urban centers still accommodate a range of education levels.

Burning Glass defines middle skill jobs as those occupations that, at the national level, are open to individuals with less than a bachelor's degree (at least 20 percent of listings request an Associate's degree or less) and that pay an average of approximately \$15 per hour.³⁴ Because these jobs are defined at the national level, some jobs that are listed as middle skill may require a higher level of education or pay more than \$15 per hour within Boston. Additionally, this definition excludes jobs that are low-paying, focusing instead on jobs that offer a moderate income without higher education. Nevertheless, they provide a counterpoint to the job categories outlined in the previous sections.³⁵

FIGURE 17 2017 Job Postings by Industry Share and Percentage Middle Skill



* Industry Categories based upon 2-digit NAICS codes.

** Percentages show the percent of listings within each industry that are middle skill.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed Industries in Middle Skill Jobs and All Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

³³ <https://www.mckinsey.com/global-themes/future-of-organizations-and-work/what-the-future-of-work-will-mean-for-jobs-skills-and-wages>

³⁴ According to Occupational and Employment Statistics (OES) data from the Bureau of Labor Statistics.

³⁵ Registered Nurses in particular are one job category that are considered Middle Skill at the national level, but in Boston overwhelmingly require a Bachelor's Degree.

Nationally, the industries most likely to offer middle skill openings in 2017 were health care and social assistance (57% middle skill) and transportation (85%) (Figure 17). Jobs in the professional, scientific, and technical industry (31% middle skill) and education (25%) were least likely to have openings for middle skill employees. Because the health care and social assistance industry and the service industry³⁶ each made up about a quarter of all US job postings in 2017, middle skill health care and service jobs were the most prevalent by total number of listings.

As in the U.S. overall, in Boston, middle skill health care and middle skill service jobs accounted for the largest quantity of middle skill listings in 2017. However, the percentage of total jobs made up by middle skill service positions in Boston was much lower than the national level, due to the service sector’s relatively small presence in Boston (15% of total jobs). Conversely, though listings in finance and insurance, professional, scientific, and technical services, and education were less likely to be middle skill in Boston than nationally, because these industries together made up 41 percent of Boston’s overall listings, middle skill listings within each industry made up a larger share of Boston’s total postings.

Comparing Boston to other large urban centers reveals that middle skill opportunities are less prevalent in Boston than in other major cities, but that opportunities are growing moderately and that middle skill jobs are even increasing as a share of the total labor market. Out of 25 of the largest cities in the U.S.,³⁷ Boston ranked twenty-first in the proportion of jobs posted in 2017 that could be classified as middle skill (Appendix A). Only 35 percent of Boston’s jobs were middle skill, in contrast to 46 percent at the national level. Boston was ahead of four other, similarly tech-oriented and highly educated cities: San Jose, New York City, San Francisco, and Washington DC. Except for Baltimore, all other 24 large cities had a lower share of middle skill jobs than the national average, confirming that large urban centers across the U.S. currently tend to attract employers seeking highly educated workers. Of the top 25 cities, the five cities with the most overall middle skill listings were New York City, Los Angeles, Houston, Chicago, and Phoenix, consistent with the large overall quantity of postings in these cities (Table 10). Boston had the fourteenth most postings overall.

TABLE 10 Top 5 Cities by Number of Middle Skill Listings

City	2017 Middle Skill Listings	Rank out of Top 25
Nationwide	10,331,015	-
New York, NY	209,178	1
Los Angeles, CA	111,773	2
Houston, TX	100,886	3
Chicago, IL	98,196	4
Phoenix, AZ	83,662	5
Boston, MA	56,747	14

Source: Burning Glass Technologies Labor Insight Jobs, Top Cities in Middle Skill Jobs, 2012 and 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

³⁶ Including Accommodation and Food Services (NAICS Code #72), Administrative and Support and Waste Management and Remediation Services (56), Retail Trade (44-45), and Other Services except Public Administration (81).

³⁷ These cities are the same 25 included in the Spotlight Section of the 2017 Economy Report published by the BPDA’s Research Division, selected because of their high metropolitan population and comparable levels of education.

However, when it came to the cities that had the largest percentage of middle skill jobs out of all postings, Houston and Phoenix remained in the top five and were joined by Baltimore, Detroit, and Portland (Table 11).

TABLE 11 Top 5 Cities by Percentage of Total Jobs that are Middle Skill

	% Middle Skill 2017	Rank out of Top 25
Nationwide	46%	-
Baltimore, MD	46%	1
Phoenix, AZ	45%	2
Houston, TX	44%	3
Detroit, MI	44%	4
Portland, OR	43%	5
<i>Boston, MA</i>	33%	21

Source: Burning Glass Technologies Labor Insight Jobs, Top Cities in Middle Skill Jobs, 2012 and 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Middle skill listings nationally increased 76 percent between 2012 and 2017, but St. Louis, San Diego, San Jose, Philadelphia, and Portland each had a faster rate of growth, while Boston was fourteenth at 57 percent (Table 12).

TABLE 12 Top 5 cities by Percent Increase in Number of Middle Skill Jobs, 2012-2017

	% Change in Middle Skill Listings, 2012-2017	Rank out of Top 25
Nationwide	76%	-
Saint Louis, MO	274%	1
San Diego, CA	130%	2
San Jose, CA	116%	3
Philadelphia, PA	109%	4
Portland, OR	99%	5
<i>Boston, MA</i>	57%	14

Source: Burning Glass Technologies Labor Insight Jobs, Top Cities in Middle Skill Jobs, 2012 and 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Middle skill jobs also grew as a percentage of total listings, with the national share of middle skill openings increasing 11 percent over the past five years. San Jose, San Diego, Pittsburgh, Baltimore, and Houston were the top five cities in this regard, while Boston cracked the top ten with an eight percent increase (Table 13).

TABLE 13

Top 5 cities by Percent Increase in Share of Middle Skill Jobs out of All Listings, 2012-2017

	% Change in Share of Middle Skill Listings, 2012-2017	Rank out of Top 25
Nationwide	11%	-
San Jose, CA	35%	1
San Diego, CA	18%	2
Pittsburgh, PA	10%	3
Baltimore, MD	9%	4
Houston, TX	9%	5
Boston, MA	8%	9

Source: Burning Glass Technologies Labor Insight Jobs, Top Cities in Middle Skill Jobs, 2012 and 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Middle Skill Industry Trends in Select Cities

A closer look at the industries hiring middle skill employees across several major cities reveals the variety in middle skill opportunities across the US. The following section compares middle skill openings in Boston to the following cities: Baltimore, the city with the highest share of middle skill jobs out of the 25 large cities; Houston, a city with one of the largest quantities and percentages of middle skill jobs; Denver, a city with a similar quantity of middle skill listings to Boston but less growth in number of listings; and San Francisco and Washington DC, the two cities with the lowest percentage of middle skill jobs.

TABLE 14

Percent of Jobs Posted within Each Industry in 2017 that were Middle Skill

Industry*	National	Boston	Baltimore	Houston	Denver	San Francisco	Washington DC
Health Care and Social Assistance	57%	46%	54%	57%	56%	50%	53%
Finance and Insurance	45%	29%	41%	46%	43%	30%	31%
Professional, Scientific, and Technical	31%	24%	33%	30%	32%	24%	22%
Transportation	85%	62%	77%	69%	69%	43%	56%
Education	25%	19%	32%	27%	23%	27%	22%
Manufacturing and Construction	46%	41%	50%	50%	53%	36%	38%
Services	40%	38%	44%	44%	42%	34%	33%
Other	44%	36%	47%	43%	43%	30%	32%
Total**	47%	35%	47%	46%	45%	34%	32%

* Industry Categories based upon 2-digit NAICS codes.

** Percentages of total listings are taken from all listings with a specified industry, and therefore may not match the percentages listed in Tables 10-13, which were taken from all listings including those without a specified industry.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed Industries in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Baltimore's listings were 47 percent middle skill, the largest share out of 25 peer cities and equivalent to the national average (Table 14). Baltimore's finance and insurance, transportation, and education industries in particular were much more likely to post middle skill jobs than in Boston. Baltimore had the most middle skill health care, education, and transportation jobs as a percentage of total listings of any of the six cities (Table 15). Baltimore also had 980 more middle skill transportation listings and 240 more middle skill education listings than did Boston, despite having 50,400 fewer listings overall.

Close behind Baltimore, 46 percent of **Houston's** listings were for middle skill jobs. Like Baltimore, all eight industries had a greater share of middle skill listings than Boston. In particular, a greater percentage of listings within Houston's health care and social service and finance and insurance industries were middle skill compared to Boston. Houston had the most middle skill manufacturing and construction jobs as a percentage of total listings of any of the cities compared, and was tied with Denver in the percentage of total listings made up by middle skill service jobs.

Denver also outperformed Boston in percentage of middle skill listings, at 45 percent of all listings, despite having had a slower rate of growth in middle skill listings over the past five years. The percentage of middle skill openings in all eight industries was higher in Denver than in Boston, and Denver had a larger quantity of middle skill listings in the professional/scientific/technical, transportation, manufacturing and construction, and services industries, despite having 18,700 fewer listings overall. Boston slightly outperformed Denver in middle skill education openings, which made up two percent of Boston's total listings compared to one percent in Denver. In quantity, Boston also had 1,370 more listings for middle skill education jobs.

San Francisco was one of four cities that had a lesser share of middle skill openings than Boston, at 34 percent. Manufacturing and construction jobs, service jobs, and, to a larger degree, transportation jobs were less likely to be middle skill in San Francisco than in Boston, though transportation listings made up a very small portion of total openings in both cities. Although health care and education listings were both more likely to be middle skill in San Francisco than in Boston, these industries made up a large enough share of Boston's overall listings that Boston had more middle skill health care and middle skill education jobs than San Francisco. In all other industries, San Francisco had a larger volume of middle skill openings than Boston, and also had the largest percentage of listings made up by middle skill finance and insurance positions of any of the six cities.

Only 32 percent of total listings in **Washington DC** were for middle skill jobs, with professional, scientific, and technical, transportation, manufacturing and construction, and services jobs all being less likely to be middle skill than in Boston. Although health care jobs were more likely to be middle skill in DC than in Boston, because they make up a smaller proportion of DC's overall listings, Boston had 7,300 more middle skill health care listings than DC. The only industry in which DC had a larger volume of middle skill jobs was in professional, scientific, and technical services, where DC had 2,500 more listings than in Boston. In fact, Washington DC had the most middle skill professional, scientific and technical postings as a portion of total openings among all six cities.

TABLE 15 2017 Middle Skill Listings by Industry

Industry*	Nationwide		Boston		Baltimore		Houston		Denver		San Francisco		Washington DC	
	Middle Skill as % of All Listings	Middle Skill Listings	% of All Listings	Middle Skill Listings	% of All Listings	Middle Skill Listings	% of All Listings	Middle Skill Listings	% of All Listings	Middle Skill Listings	% of All Listings	Middle Skill Listings	% of All Listings	
Health Care and Social Assistance	14%	16,570	13%	14,364	18%	22,931	13%	13,931	12%	12,997	8%	9,298	8%	
Finance and Insurance	4%	5,752	4%	2,408	3%	6,500	4%	4,656	4%	7,382	5%	2,740	2%	
Professional, Scientific, and Technical	3%	5,183	4%	2,769	3%	7,139	4%	5,647	5%	6,547	4%	7,676	7%	
Transportation	6%	1,912	1%	2,893	4%	5,098	3%	3,428	3%	2,255	1%	1,203	1%	
Education	1%	2,370	2%	2,613	3%	2,777	2%	998	1%	2,107	1%	1,663	1%	
Manufacturing and Construction	4%	3,196	2%	3,169	4%	10,211	6%	5,129	5%	3,232	2%	2,367	2%	
Services	10%	7,173	5%	6,385	8%	15,500	9%	9,863	9%	10,346	7%	6,046	5%	
Other	4%	4,116	3%	3,383	4%	10,265	6%	7,055	6%	7,375	5%	6,781	6%	
Total Middle Skill**	47%	46,272	35%	37,984	47%	80,421	46%	50,707	45%	52,241	34%	37,774	32%	
All Listings**		131,056		80,624		175,307		112,342		154,830		117,410		

* Industry categories based upon 2-digit NAICS codes

**Totals only include listings with specified industry, and therefore do not equal totals in Table 7

Green highlights indicate the cities with the largest percentage of middle skill job in each industry category

* Industry categories based upon 2-digit NAICS codes

**Totals only include listings with specified industry, and therefore do not equal totals in Table 10

Green highlights indicate the cities with the largest percentage of middle skill job in each industry category.

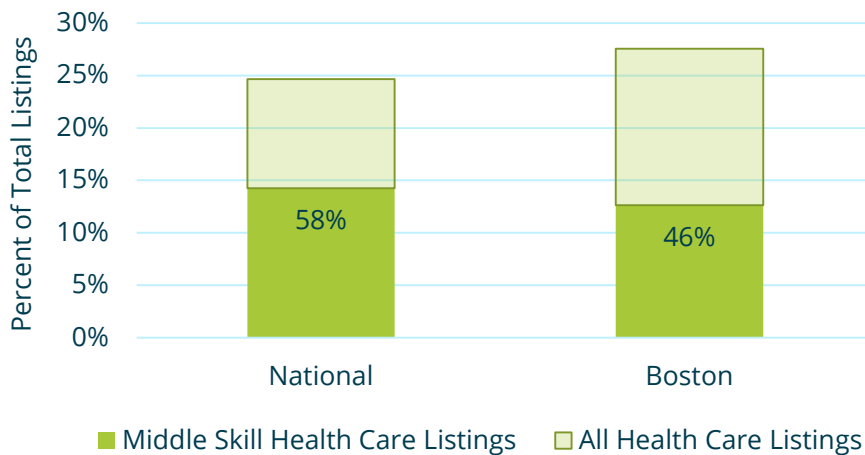
Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed Industries in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Middle Skill Occupation Trends in Boston

Compared to other major cities in the US, fewer job openings are available in Boston to applicants without college degrees. Compared to the national level as well, Boston has a lower percentage of middle skill openings within all eight industry categories. In particular, the health care and social assistance, finance and insurance, and transportation and warehousing industries had the largest gap in percentage of job openings that were middle skill in Boston compared to the national level. A closer look at the occupations advertised within these three industries can help explain this gap, by showing how listings in Boston skew towards highly-skilled jobs that require extensive educational training, while middle skill openings are underrepresented. However, even within these industries, it is possible to identify opportunities that are open to applicants in Boston with lesser training and education.

Boston's health care and social assistance industry composed 28 percent of all job listings in 2017, the largest of all industry categories and larger than the national share. However, only 46 percent of these listings were for middle skill occupations, compared to 58 percent at the national level (Figure 18). The breakdown of occupations within this industry shows that Boston had more demand for high-skill health care positions like surgeons and physicians (15 percent) and health care managers (nine percent) than the nation overall (9% and 6%, respectively) (Figure 19). However, openings for registered nurses have seen a particularly large increase in the past two years, suggesting that Boston's health care industry might be shifting slightly away from high-skill jobs.

FIGURE 18 2017 Listings that are Health Care and Middle Skill Health Care Occupations



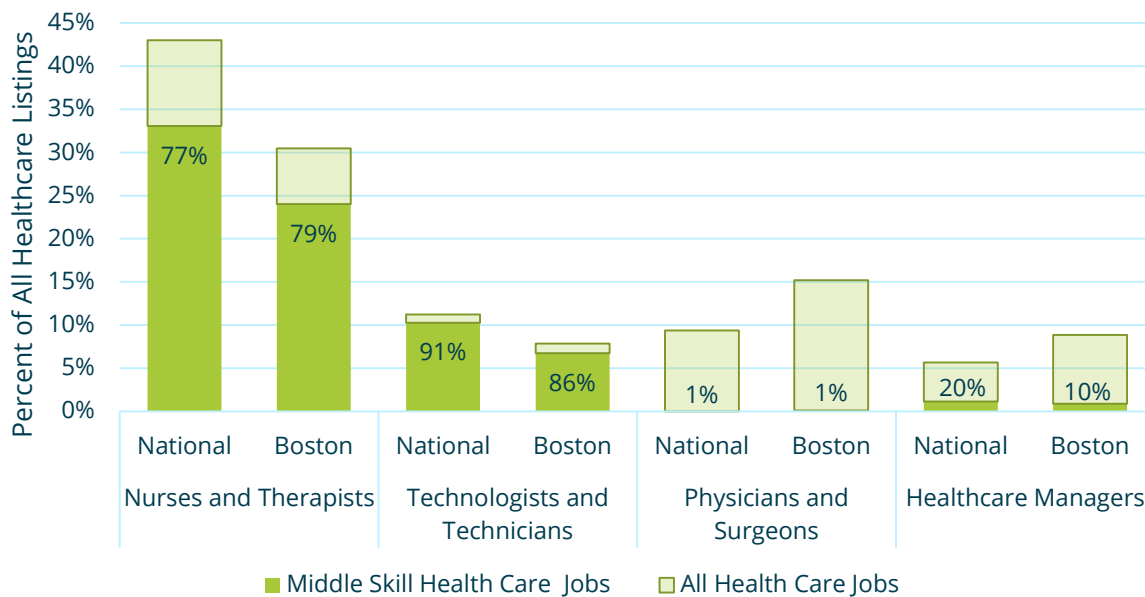
* Percentages show the percent of health care listings that are middle skill.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*NET Occupations in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

On the other hand, Boston had a smaller share of postings for predominantly middle-skill occupation categories, most prominently nurses and therapists. Though at the national level middle skill nurses and therapists made up 33 percent of health care listings, in Boston only 24 percent of listings were for middle skill nurses and therapists. Middle skill technologists and technicians, the second largest occupational category nationwide at eleven percent of total health care listings, made up only eight percent of Boston's health care listings.

While they make up a smaller portion of Boston's overall health care listings, other opportunities for middle skill employment in Boston's health care field include secretaries and administrative assistants (three percent) and medical assistants and massage therapists (two percent).

FIGURE 19 2017 Health Care Listings by Occupation and Percent Middle Skill



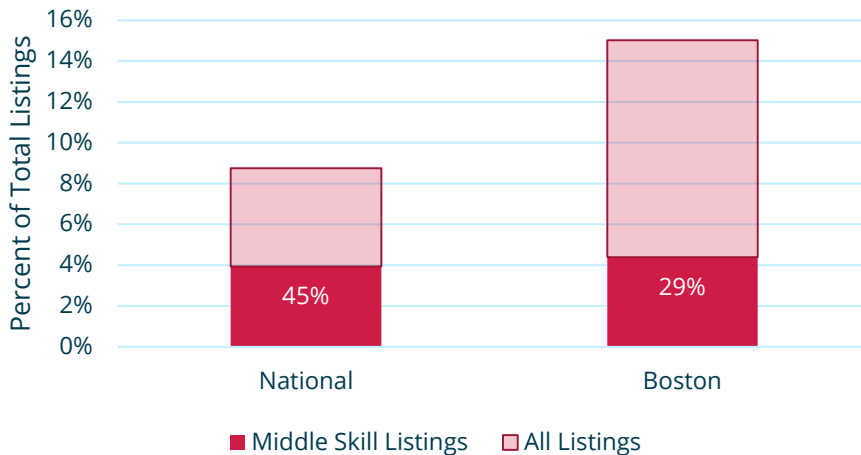
*Categories based on aggregation of listings at the 4-digit SOC code level.

** Percentages show percent of listings in each category that are middle skill occupations, as defined at the national level.

Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*NET Occupations in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Boston's finance and insurance industry posted primarily high-skill jobs, with only 29 percent open to middle skill applicants compared to 45 percent at the national level (Figure 20). Nationwide, three of the top five advertised occupational categories were for primarily middle-skill occupations: securities, commodities and financial services sales agents (seven percent); insurance sales agents (six percent); and sales representatives in wholesale and manufacturing (five percent) (Figure 21). All three of these occupations were more than 85 percent middle skill. In Boston, only two percent of finance and insurance listings were for financial services sales agents, one percent was for insurance sales agents, and three percent were for wholesale and manufacturing sales representatives.

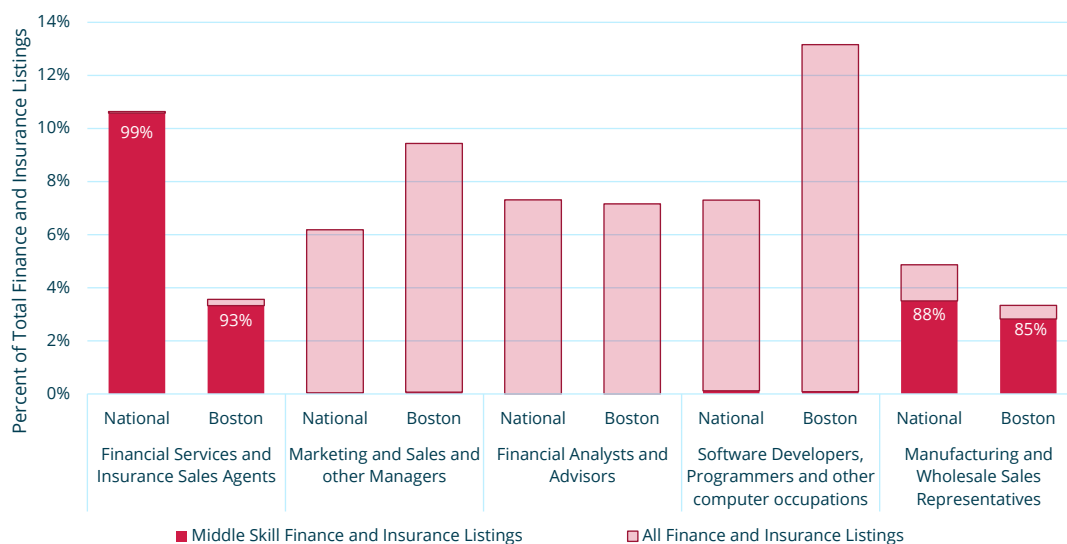
FIGURE 20 Share of 2017 Listings that are Finance and Insurance and Middle Skill Finance and Insurance Occupations



** Percentages show percent of finance and insurance listings that are middle skill.
 Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*NET Occupations in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

In Boston, none of the top five most listed occupational categories were primarily middle skill occupations. Software developers, programmers and other computer occupations made up 13 percent of finance and insurance listings, followed by financial analysts and advisers (seven percent), and marketing, sales and other managers (nine percent). Although they constituted a small percentage of total listings, middle skill opportunities in Boston's finance and insurance industry existed for general and operations managers (three percent), secretaries and administrative assistants (two percent) and bookkeeping, accounting, and auditing clerks (two percent).

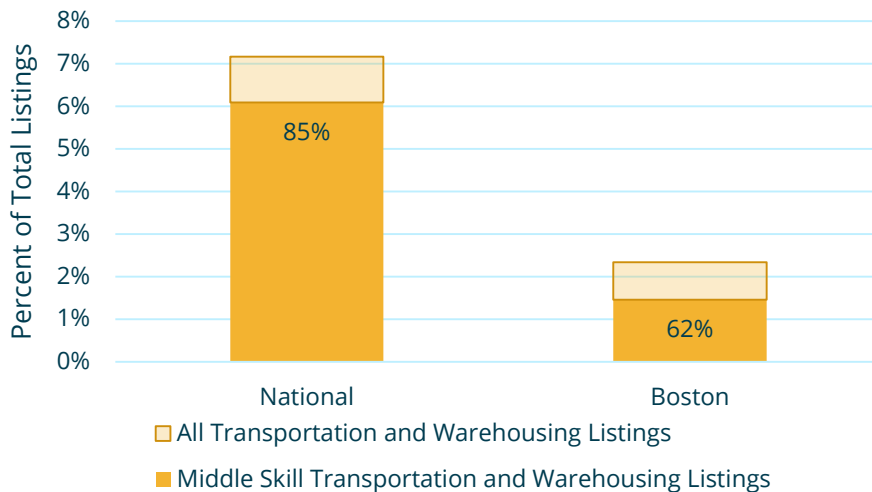
FIGURE 21 2017 Finance and Insurance Listings by Occupation and Percent Middle Skill



* Categories based on aggregation of listings at the 5-digit SOC level
 ** Percentages show percent of listings in each category that are middle skill occupations, as defined at the national level.
 Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*NET Occupations in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Middle skill opportunities within the transportation and warehousing industry were in short supply in Boston, where transportation listings made up only two percent of the total listings and only 62 percent of these were for middle skill positions (Figure 22). Nationally, seven percent of all listings were for transportation jobs, while 85 percent of these were middle skill occupations. Listings for middle skill drivers, primarily long-haul truck drivers, made up 73 percent of transportation listings nationally, the largest occupational category by far (Figure 23). In Boston, drivers were also the most frequently listed transportation occupation, but middle skill drivers comprised only 35 percent of total transportation listings. At the national level, customer service representatives and insurance sales agents were the third and fourth most frequently listed middle-skill occupations within the transportation/warehousing industry, accounting for one percent each of total listings. In Boston, middle-skill customer services representatives made up a slightly larger share of total listings at three percent, and insurance agents made up one percent.

FIGURE 22 Share of 2017 Listings that are Transportation and Warehousing and Middle Skill Transportation and Warehousing Occupations

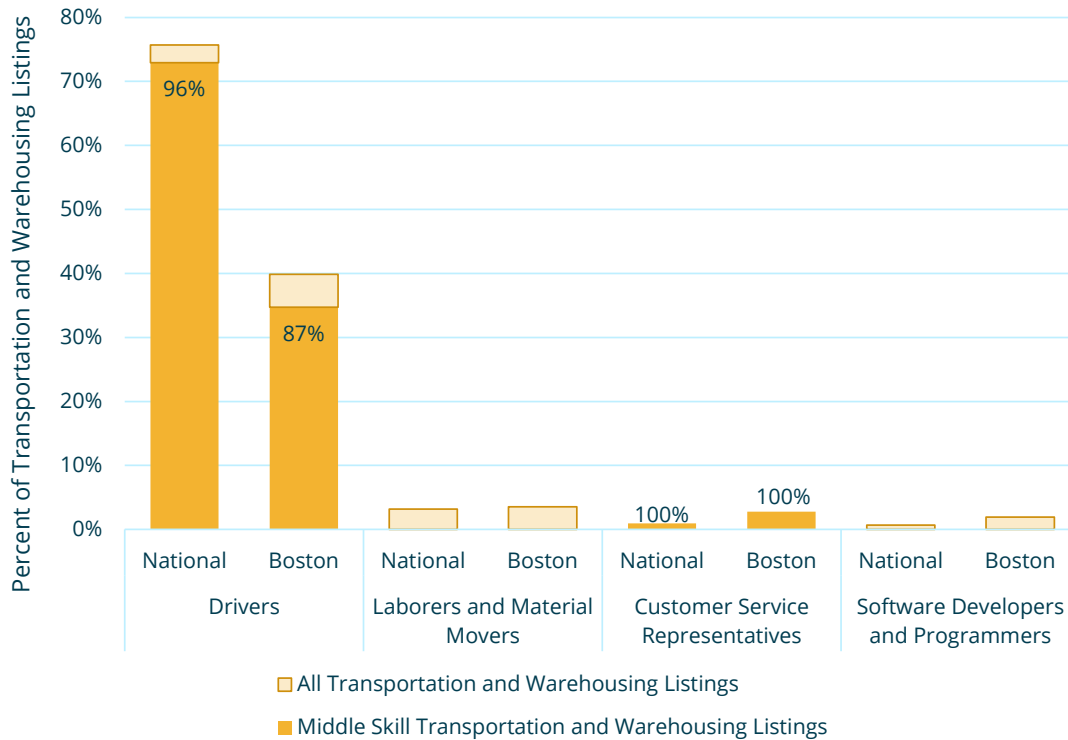


*Percentages show percent of transportation and warehousing listings that are middle skill.
 Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*NET Occupations in Middle Skill Jobs, Jan 1, 2017 – Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

The second most frequently advertised transportation and warehousing category nationally and in Boston were laborers and material movers, which, though accounting for three percent of national listings and four percent of Boston’s listings, earn below \$15 per hour on average, and therefore would be considered ‘low-skill’ jobs. The third most advertised occupation in transportation and warehousing in Boston were software developers and programmers, accounting for three percent of listings, most of which were posted by Uber and none of which were middle skill. Nationally, this occupation category made up only one percent of listings. While transportation jobs skew either towards the low-skill or high-skill in Boston, other middle-skill opportunities include general and operations managers (two percent of total transportation/warehousing listings) and sales representatives for wholesale and manufacturing (two percent).

FIGURE 23

2017 Transportation and Warehouse Listings by Occupation and Percent Middle Skill



* Categories based on aggregation of listings at the 5-digit SOC level

** Percentages show percent of listings in each category that are middle skill occupations, as defined at the national level. Source: Burning Glass Technologies Labor Insight Jobs, Top Detailed O*NET Occupations in Middle Skill Jobs, Jan 1, 2017 - Dec 31, 2017. Downloaded April 9 - 13, 2018, BPDA Research Division Analysis.

Although in general middle skill jobs are harder to come by in Boston than nationally, the following occupations offer opportunities for middle skill workers. Listings for middle skill registered nurse accounted for 16 percent of all middle skill listings, and seven percent of Boston's listings overall. Sales representatives, particularly within wholesale and manufacturing, accounted for seven percent of middle skill listings, and two percent of listings overall. In addition, middle skill listings for secretaries and administrative assistants, customer service representatives, and human resources specialists, and general and operations managers each accounted for two percent of all listings. Middle skill job postings in Boston have also increased 57 percent since 2012, and account for an eight percent larger share of Boston's listings than they did in 2012. Finally, although the share of jobs within Boston's industries that are open to middle skill employees is lower than the national average, Boston nevertheless offers more opportunities by volume of listings than many other cities, including Baltimore, Detroit, Miami, St. Louis, Austin, Pittsburgh, Minneapolis, Raleigh, Charlotte, San Jose, and Washington DC. In particular, middle skill jobs in the finance and insurance industry and the education industry are more plentiful in Boston than many other major cities.

Online Jobs Postings Reflect Trends in Boston's Economy

Cities across the US are working to attract businesses on the cutting edge of new technological fields, including biotechnology and bioengineering, energy efficiency and the renewable energy production, and cybersecurity. Companies working in these markets attract employees with highly specialized skillsets, contributing to the overall competitiveness of the city's economy. This section has highlighted cities across the US that are thriving in the biotech, green jobs, and cybersecurity fields, while also drawing attention to places where 'middle skill' employees can find opportunities.

Nationally, the number of biotech, green, and cybersecurity positions posted online has grown over the past five years, with the quantity of cybersecurity positions growing more than twice as fast as the other two fields. Cybersecurity listings also compose a larger share of all job postings than they did in 2012, although this share is still less than two percent of all jobs. Biotech jobs and green jobs, on the other hand, make up a lesser share of total listings nationwide than they did five years ago, both falling to just below two percent. These trends suggest that while high-tech and high-skill jobs are frequently identified as forces that divert opportunities away from the lower-skilled, less educated workforce, these particular sectors are not likely to completely overtake the job market in the near future. In fact, openings for individuals with less education and training still compose just under half of all job postings, and are growing both in number of listings and in share of total job postings.

With the rapid rate of technological change, the skills demanded by the jobs created in the next ten years are likely to be very different than those in demand today. However, the rate at which a city's predominant industries change appears to occur more slowly, suggesting that Boston's medical, financial, and educational institutions will likely continue to be prominent employers, even as they seek employees with up-to-date skillsets. It remains to be seen where the nation's next high-tech center will emerge, but Boston appears to be on good footing to adapt to changing job demands.

6. Looking Forward: Boston's Economic Forecast

Boston's economy looks primed to continue its robust recent growth over the coming years. Optimism stems both from a strong short term national economic outlook, and Boston's dominant position in key growth sectors such as health care and technology. Sources of risk in the short term include uncertainty over national policy surrounding immigration and trade. Over the medium to long term, growth may be expected to slow somewhat as the national economy reaches full employment, and Boston grapples with the challenge of continuing to expand its labor force amidst a surge of retirements among the Baby Boom cohort.

Nationally, consensus projections foresee strong growth continuing through 2018 and 2019 and beginning to slow in 2020. The median forecast from The Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters (SPF) projects real GDP growth of 2.8 percent in 2018, 2.5 percent in 2019, and 2.0 percent in 2020.³⁸ The U.S. Congressional Budget Office (CBO) is slightly higher in the short term, at 3.0 percent in 2018 and 2.9 percent in 2019, before slowing to 2.0 percent in 2020.³⁹ Both forecasts see the next two years exceeding the 1.5 percent and 2.3 percent annual growth rates experienced in 2016 and 2017, respectively.⁴⁰ Short term forecasts have been revised upwards in recent months to reflect the initial stimulating impact of the deficit-financed tax cuts passed at the end of 2017.

These forecasts reflect the belief that there remains room for the economy to continue to add jobs, even with the national unemployment rate at 4.1 percent and the length of the current economic recovery, which began in June 2009, nearing ten years. The CBO projects the unemployment rate will average 3.8 percent for 2018, falling to 3.3 percent for 2019, and 3.6 percent in 2020, representing the lowest levels of unemployment since the late 1960s. The only year since 1970 when national unemployment averaged below 4 percent was 2000, when unemployment averaged 3.9 percent.

Labor market conditions in Massachusetts, and particularly Boston, are even tighter. Unemployment in Boston has hovered around three percent since mid-2016 and the state's unemployment rate has been consistently 0.5 to 1 percent below the national level in recent years. In the New England Economic Partnership (NEEP) forecast, Alan Clayton-Matthews observes that at nearly full employment, Massachusetts has little capacity to expand employment any faster than its rate of population growth. He projects state labor force growth to decelerate in 2018 to 0.6 percent off its 2017 pace of 1.6 percent, and expects it to further decline to 0.4 percent in 2019.⁴¹

Low unemployment levels have contributed to strong recent wage growth, with the national average hourly earnings up 2.7 percent in 2017 over the 2016 annual average. That increase delivered real buying power to workers, exceeding the two percent growth in prices as measured by the change in the annual average Consumer Price Index (CPI). Questions remain as to whether the economy can continue to deliver sustained wage growth without triggering rising inflation. The Federal Reserve's preferred inflation benchmark, which excludes the volatile prices of food and energy, remains below their 2 percent target, but three hikes in the Federal Funds rate are anticipated

³⁸ Federal Reserve Bank of Philadelphia, "Survey of Professional Forecasters, First Quarter 2018". Released February 9, 2018.

³⁹ Congressional Budget Office, "The Budget and Economic Outlook, 2018-2028". Released April 2018.

⁴⁰ U.S. Bureau of Economic Analysis (BEA), Table 1.1.1. Percent Change From Preceding Period in Real Gross Domestic Product, accessed May 2, 2018.

⁴¹ New England Economic Partnership, "Charting Economic Policy: The New Normal in Non-normal Times", November 2017 Economic Outlook Conference, November 28, 2017.

in 2018, including the 0.25 point March increase.⁴² A pickup in inflation could trigger the Fed to raise rates more quickly, potentially curbing investment and slowing the forecasted pace of growth.

NEEP projects robust wage growth in Massachusetts, with anticipated increases of 2.9 percent in 2018 and 3.3 percent in 2019. Sectors with the strongest projected employment growth in Massachusetts over the next five years include construction, with average annual growth of 1.7 percent, education and health care (1.4 percent) and professional and business services (1.3 percent). The latter two have disproportionate representation in Boston, whereas construction employment is more prevalent outside of the city.⁴³

Feeding the demand for construction employment is a strong pipeline of large residential and commercial projects in Boston. The BPDA board approved 71 projects in 2017, anticipated to deliver 5,766 residential units and 5.8 million square feet of commercial space upon completion. A total of 124 projects are currently under construction throughout the city, with another 207 approved by the BPDA and awaiting groundbreaking.

These residential units will contribute to meeting the City's goal of 53,000 new units of housing by 2030, specified in the 2014 plan "Housing a Changing City: Boston 2030." Housing is also a focus at the state level, with Governor Baker announcing an initiative in December to create 135,000 across the state by the year 2025.

These plans focus on the need to add housing to the city and region to accommodate increasing population growth while lessening price pressure in the real estate market. According to Zillow.com, housing prices in Boston rose 7.2 percent between January 2017 and 2018, with rents increasing by 2.9 percent. Zillow projects an increase in housing prices of less than half that size (3.3 percent) in 2018. The strong local economy continues to fuel demand for both ownership and rental units. Price growth may be slowed somewhat by rising interest rates and less favorable tax treatment for housing, both at the top of the market, where the cap on the mortgage interest deduction is falling from \$1,000,000 to \$750,000, and towards the bottom, where the doubling of the standard deduction will render moot the benefit of itemizing deductions and claiming the mortgage interest deduction.

Risks facing the Boston economy include the uncertain policy environment at the national level. Recently proposed tariffs on aluminum and steel could prove costly the Massachusetts economy, which has few firms engaged in primary metal manufacturing, but many downstream users, including the construction industry.

Significant uncertainty surrounds the future of immigration policy, with potentially dire consequences for Boston's economy. Twenty-eight percent of the city's workforce is foreign-born,⁴⁴ and their contributions are felt across the full spectrum of industries in the city. In a region already struggling to maintain labor force growth, being able to draw on the talents of people coming to Boston from all over world remains vital to shared prosperity.

⁴² Federal Reserve Board, "Economic projections of Federal Reserve Board members and Federal Reserve Bank presidents under their individual assessments of projected appropriate monetary policy, March 2018". Released March 21, 2018.

⁴³ New England Economic Partnership, "Charting Economic Policy: The New Normal in Non-normal Times", November 2017 Economic Outlook Conference, November 28, 2017.

⁴⁴ U.S. Census Bureau, 2016 1-year American Community Survey. Number reflects the share of all people working in Suffolk County who are foreign-born.

APPENDIX

APPENDIX A: Ranking of Top 25 Major Cities by Percentage of Middle Skill Jobs in 2017

City	2017 Middle Skill Listings	% Middle Skill 2017	% Increase in Middle Skill Listings, 2012-2017	% Change in Share of Middle Skill Listings, 2012-2017
Baltimore, MD	45,530	46%	38%	9%
Phoenix, AZ	83,662	45%	57%	2%
Houston, TX	100,886	44%	29%	9%
Detroit, MI	41,121	44%	98%	9%
Portland, OR	59,149	43%	99%	8%
Denver, CO	62,608	43%	40%	3%
Miami, FL	45,536	43%	82%	3%
Dallas, TX	75,044	41%	25%	2%
Los Angeles, CA	111,773	40%	9%	7%
Saint Louis, MO	35,432	40%	274%	1%
San Diego, CA	65,932	39%	130%	18%
Pittsburgh, PA	33,952	39%	86%	10%
Austin, TX	54,832	39%	31%	7%
Minneapolis, MN	53,834	39%	74%	7%
Philadelphia, PA	57,217	39%	109%	8%
Raleigh, NC	22,737	38%	10%	2%
Atlanta, GA	81,991	37%	-16%	-7%
Charlotte, NC	47,376	36%	65%	-6%
Seattle, WA	62,647	35%	53%	1%
Chicago, IL	98,196	35%	94%	5%
Boston, MA	56,747	33%	57%	8%
San Jose, CA	28,200	32%	116%	35%
New York, NY	209,178	32%	68%	6%
San Francisco, CA	69,985	30%	83%	2%
Washington, DC	48,435	30%	23%	-2%
Nationwide	10,331,015	46%	76%	11%

Source: Burning Glass Technologies Labor Insight Jobs, Top Cities in Middle Skill Jobs, 2012 and 2017. Downloaded April 9 - 13, 2018.

