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# A Profile of Advanced Manufacturing in the Berkshire Region: Key Industry and Occupational Trends

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# A Profile of Advanced Manufacturing in the Berkshire Region: Key Industry and Occupational Trends July 2014

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## Executive Summary

This report provides a detailed examination of Advanced Manufacturing in the Berkshire region. This report is part of an eight-part series, each focusing on different areas of the Commonwealth. It examines recent employment and earnings trends; analyzes key occupations in Advanced Manufacturing's subsectors, looking for common labor needs and comparing wages to similar workers in other industries; identifies the most common and critical skills needed by employers; and offers a detailed demographic profile of Advanced Manufacturing to highlight areas of critical concern for the future health of the industry.

The Advanced Manufacturing sector in the Berkshires is the second smallest of the seven regions, exceeding only the Cape and Islands where manufacturing is all but non-existent. Yet it accounts for just under 4,000 employees or roughly six percent of the region's entire employment base—a notable share for a region otherwise dominated by the low-wage sectors such as hospitality, trade and services. The Advanced Manufacturing sectors importance to the regional economy is further underscored by the fact that it is the highest paying of all the major sectors in the Berkshires. The region's largest and most highly specialized subsectors are Paper and Printing and Chemicals and Plastics. The region has relatively few businesses or workers in Medical Equipment and Supplies, Computers and Electronics, and Food Processing.

Advanced Manufacturing has struggled over the past several decades, but there are signs of hope. Since 2001, the region has lost nearly half of its entire Advanced Manufacturing employment base. The relative burden of these losses have been far worse than any other region. Things have been particularly bad in the Fabricated Metals and Machinery and in Paper and Printing subsectors, which together account for more than 80 percent of all layoffs in Advanced Manufacturing. Yet these layoffs have abated in recent years. The Advanced Manufacturing sector has actually added a small number of jobs since 2010—although it still lags national trends of net job creation. Most of these recent gains were in in Food Processing and Production, with Chemicals and Plastics and Fabricated Metals also showing signs of recovery.

The aging of the Advanced Manufacturing workforce poses a major challenge to the Berkshire region. The Advanced Manufacturing workforce is the oldest of any region in the state. Over 60 percent of the Advanced Manufacturing workforce will reach retirement age within the next twenty years, and the region has relatively few people under the age of 25 to take their place. While outreach and training programs aimed younger workers would certainly help, employers and workforce officials should also look to recruiting non-traditional manufacturing workers—particularly women who are highly underrepresented even in comparison to other regions in the Commonwealth.

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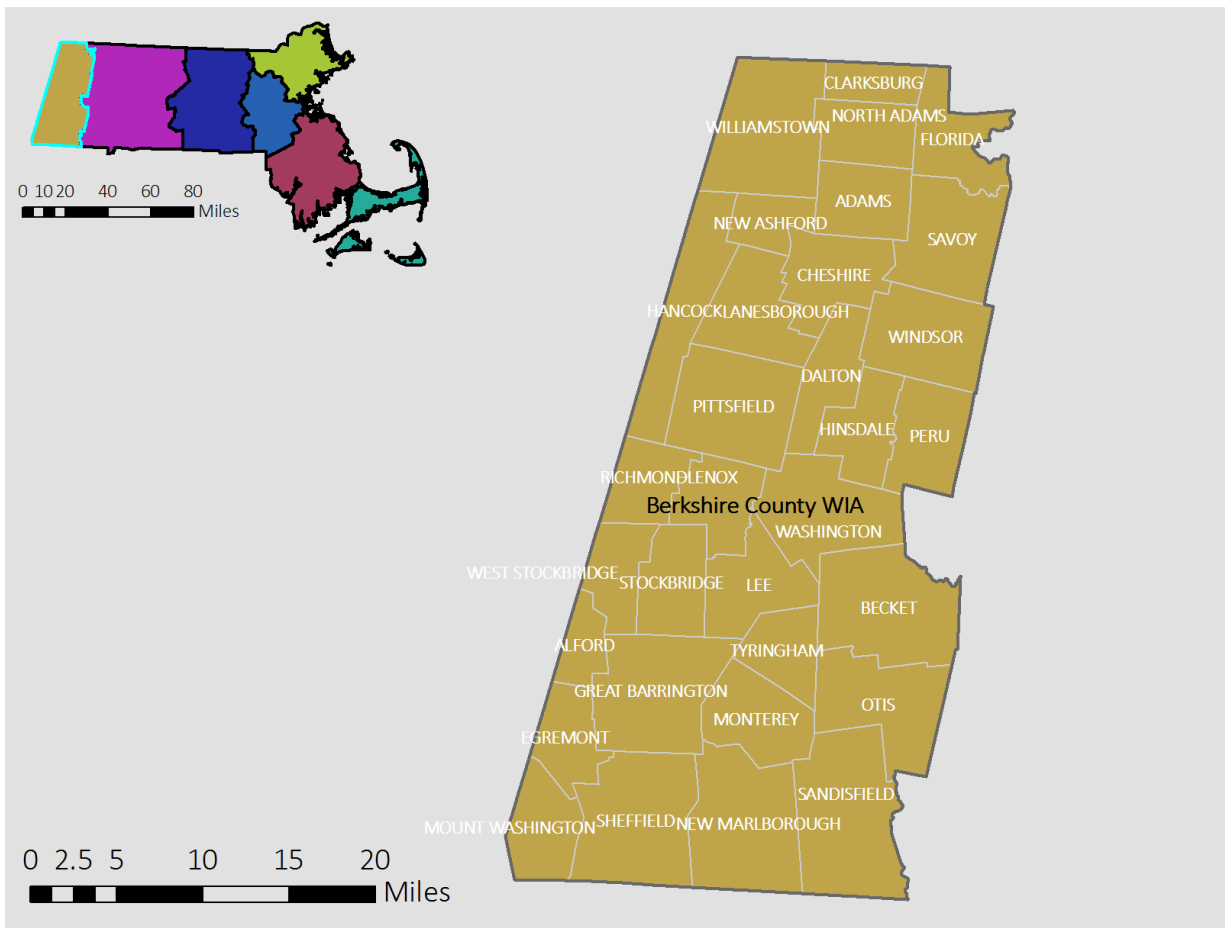
## Introduction

### Study Purpose and Scope

This report provides a detailed examination of the industrial ecology and occupational composition of Advanced Manufacturing in the Berkshire Region (Figure 1). Its purpose is to provide up-to-date and actionable information to help guide policy and program decisions directed towards securing a strong future for the region's Manufacturing sector. The industry definitions of the Advanced Manufacturing sector are provided in Appendix A. A more in-depth discussion on the rationale behind these definitions is provided in the state-level companion profile titled "A Profile of Advanced Manufacturing in the Commonwealth: Key Industry and Occupational Trends."

This report is one of seven regional profiles of the Advance Manufacturing sector (see Appendix B). This report focuses on industry and occupational trends within the Berkshire region, including comparisons to

**Figure 1**  
The Berkshire Region



state and national trends to help put the recent performance of the region's Advanced Manufacturing sector in a larger context. While this report is designed to stand alone, we highly encourage readers to also examine the state-level profile, which provides additional detail on definitions, methods and data sources; as well as providing comparisons across all of the seven designated regional labor markets. We also encourage interested readers to examine a 2013 UMASS Donahue Institute study on Advanced Manufacturing in Berkshire County, which also includes analysis of recent industry trends and more detail on the location of Advanced Manufacturing employers within the region, as well as results from case studies and employer interviews.<sup>1</sup>

This report follows a similar template and format as the state-level study. It opens with a review of recent industrial trends: employment, wages and salaries, and the impact of the recent recession and recovery in the Berkshire region. Next, we move on to a detailed examination of the most prominent and specialized (i.e. "core") occupations in the Advanced Manufacturing sector and its component subsectors. We also consider crossover occupations that are prevalent in multiple industries within Advanced Manufacturing, which provide likely targets for training programs that offer the greatest benefit to the most employers. We next examine the specific types of skills used and required by these core occupations. Skills transcend both occupations and industries, and thus regrouping occupations in terms of complimentary and similar skills provides another venue for identifying possible targets for training and other development programs.

This report closes with a detailed demographic profile of the people that work in Advanced Manufacturing in the Berkshire region. We pay particular attention to areas of critical concern for the future health of the industry, such as the aging of the workforce, the gender gap, commuting patterns, educational attainment, and the prevalence of foreign born workers. Our demographic profile uses similar data sources and many common metrics covered by the recent regional labor force profiles from the Federal Reserve Bank of Boston<sup>2</sup>. It differs in that our analysis focuses solely on the Advanced Manufacturing workforce, while the FRBB's covers the entirety of the labor market, with only limited coverage of workers in specific industries.

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<sup>1</sup> The UMASS Donahue Institute study of the Berkshire's Advanced Manufacturing sector is available at [http://www.donahue.umassp.edu/docs/Berkshire\\_Advanced\\_Manufacturing\\_Study/](http://www.donahue.umassp.edu/docs/Berkshire_Advanced_Manufacturing_Study/)

<sup>2</sup> The report and interactive data viewer for the Federal Reserve Bank of Boston labor market profiles can be viewed at <http://www.bostonfed.org/economic/neppc/labor-market-trends-in-massachusetts-regions/>

## Industry Trends in the Berkshire Region

Advanced Manufacturing is a relatively small, yet vital, component of the Berkshire regional economy. As of 2012, there were approximately 106 establishments and 4,000 employees in the Berkshire region's Advanced Manufacturing sector; roughly 6 percent of the region's total employment base, nearly matching national and state shares relative to the overall size of the region (Table 1, Figure 2).

The Berkshire region's Advanced Manufacturing sector suffered major losses in recent years, continuing long term trends of decline beginning in the 1970's. The region's Advanced Manufacturing sector lost nearly half of jobs and over a third of establishments that it had in 2001. The relative burden of these losses is the highest of any of the seven study regions, equivalent to a loss of nearly six percent of the entire regional employment base (Figure 3). While nearly all of the individual subsectors posted some net losses during this period, they were particularly concentrated in two subsectors: Paper Products and Printing and Fabricated Metals and Machinery.

On a positive note, it appears that the Advanced Manufacturing sector has stabilized in recent years with some signs of recovery and slight job growth in several subsectors—bucking almost forty years of decline. The job losses of the past twelve years were heavily concentrated in the first four years of the millennia, with a particularly sharp drop in the Fabricated Metals subsector between 2003 and 2004 (Figure 4). The

**Table 1**

Employment, Establishment, and Earnings Summary by Major Industry Sectors, 2012

Sector	Establishments			Employment			Real Wage and Salary Earnings*	
	Number	Change from 2001	Average Size	Number	Change from 2001	Location Quotient	per Worker	Change from 2001
Advanced Manufacturing	106	-63	35.4	3,755	-3,609	1.01	\$73,181	\$3,256
Other Manufacturing	59	-3	15.4	908	-138	0.51	\$43,549	\$10,456
Natural Resources and Mining	38	4	6.2	236	-27	0.26	\$29,610	-\$4,843
Construction	547	46	5.1	2,765	-387	1.04	\$48,888	\$2,530
Trade, Transportation and Utilities	891	-93	12.5	11,113	-167	0.91	\$30,826	-\$2,424
Information	86	-6	11.5	986	-435	0.76	\$44,582	-\$4,857
Financial Activities	279	3	8.7	2,414	-161	0.69	\$61,419	\$11,618
Professional and Business Services	606	-21	8.0	4,865	162	0.59	\$56,364	\$890
Education and Health Services	492	38	39.3	19,323	2,852	1.37	\$44,571	\$2,217
Leisure and Hospitality	607	29	14.6	8,882	215	1.36	\$19,581	-\$546
Other Services	901	245	3.1	2,822	-76	1.34	\$23,597	-\$1,863
Public Administration	148	19	16.9	2,498	148	0.75	\$44,296	-\$768
Total, all industries	4,760	198	12.7	60,568	-1,624	1.00	\$40,911	-\$749

\*Measured in 2013 dollars

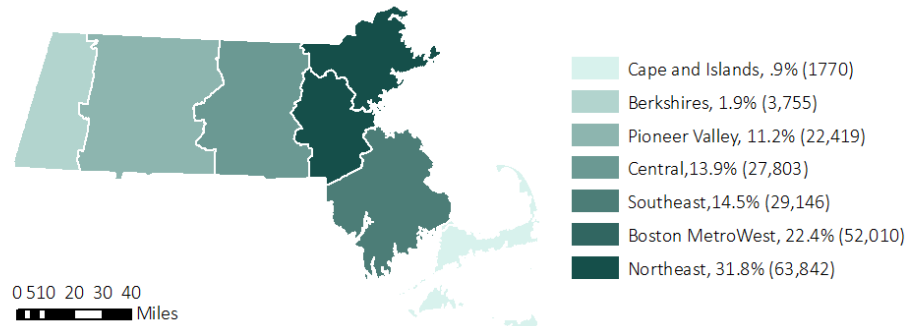
Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

region's Advanced Manufacturing sector continued a steady pace of year to year decline during the remainder of the 2000's, led by steady layoffs in the Chemicals and Plastics and Paper and Printing subsectors. Unlike most other areas, the Great Recession of 2008-09 only had relatively modest negative impacts on the region's Advanced Manufacturing sector. By 2010, the sector was poised for recovery, actually adding a small number of jobs during 2011 and 2012.

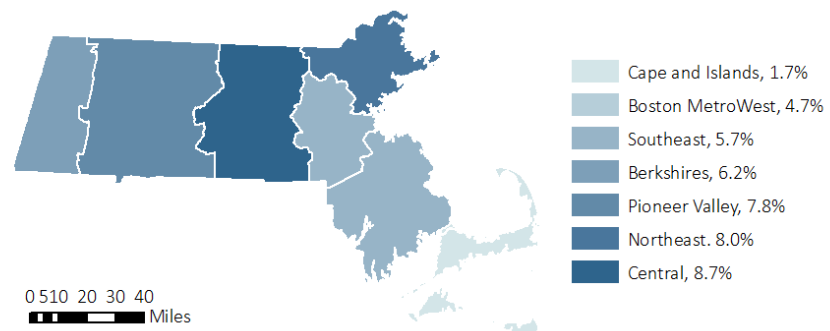
The lower portion of Figure 4 plots annual employment growth in the Berkshires against national trends. This type of comparison is useful for identifying whether employment trends are due primarily to broader market or technological conditions, or whether an indicator of a region-specific advantage or disadvantage. The region's Advanced Manufacturing sector essentially mirrored

**Figure 2**  
Regional Distribution of Advanced Manufacturing Employment

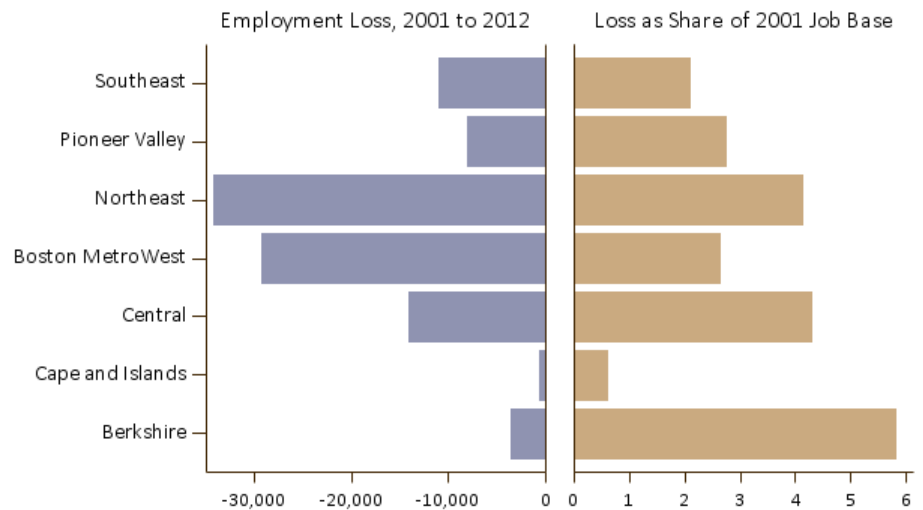
Share of State Advanced Manufacturing Employment, by Region



Advanced Manufacturing Share of Regional Employment



**Figure 3**  
Regional Distribution of Job Losses in Advanced Manufacturing



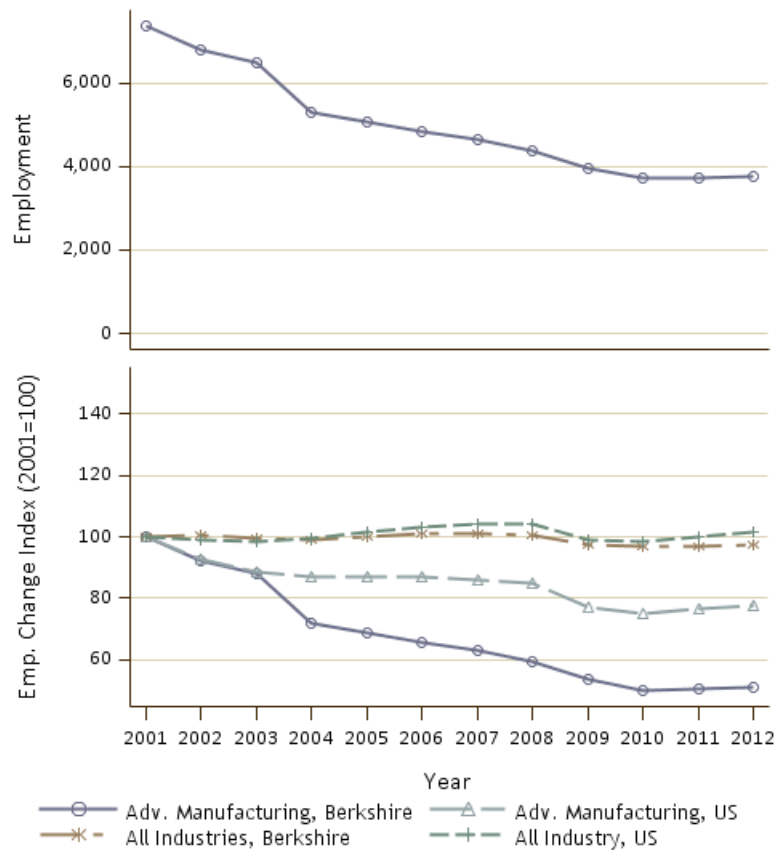
Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations



national trends of decline up until 2003, brought about by a negative shock in the Fabricated Metals sector. The Berkshires' Advanced Manufacturing sector continued to steadily decline throughout the remainder of the decade, while the rest of the nation experienced a temporary reprieve up to the 2008 recession. Both the region and nation show signs of post-recession recovery and possible rebound of Advanced Manufacturing, with the nation slightly outpacing the region in its rate of job creation.

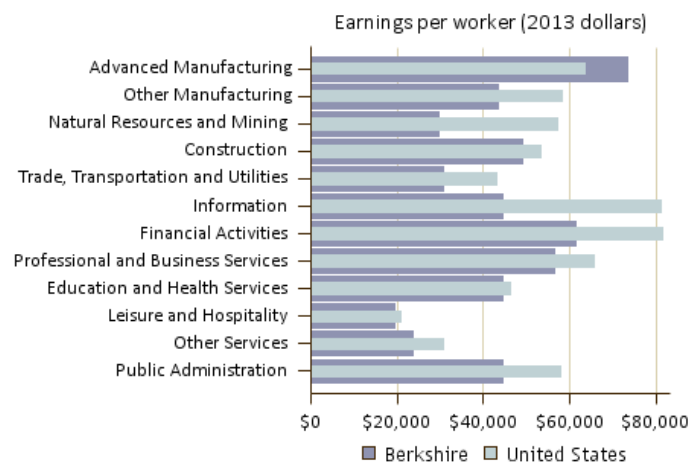
While only half the size it was at the start of the millennia, the Advanced Manufacturing sector continues to be an important source of income and wealth in the Berkshires that helps support jobs in other areas of the local economy. On average, workers in the region's Advanced Manufacturing sector earn nearly \$10,000 more a year than their national counterparts (Figure 5), and almost twice as much as the average regional salary for all workers (Table 1). In general, wages and salaries in the Berkshires tend to be among the lowest in the state. But in Advanced Manufacturing wages in the Berkshires actually surpass several other regions, namely the Pioneer Valley, Cape and Islands, and the Southeast. This is due, in part, to the region's heavy concentration of employment in Chemicals

**Figure 4**  
Annual employment change in Advanced Manufacturing, 2001 to 2012



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

**Figure 5**  
Average Earnings per Worker (2012),  
Berkshire Region compared to the Nation



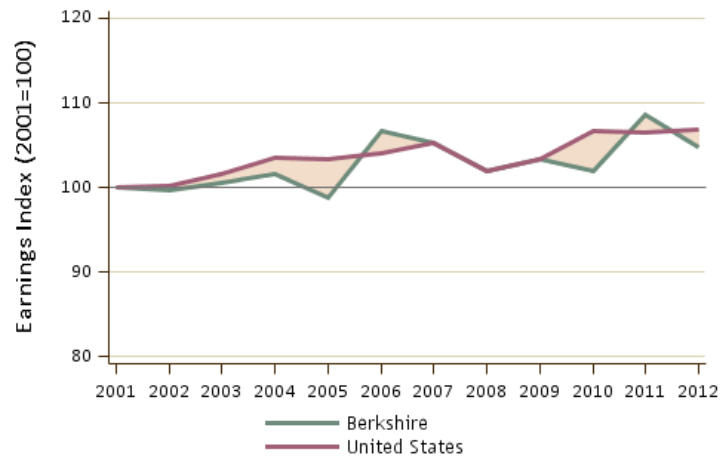
Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

and Plastics and Paper and Printing which pay relatively high wages. Wage growth in Massachusetts' Advanced Manufacturing sector have essentially kept pace with the nation, although somewhat lagging during the first half of the decade and tend to be more erratic due to its relatively small size (Figure 6).

Figure 7 helps put recent employment and wage trends into perspective, by plotting relative earnings per worker (vertical axis) against the rate of employment growth (y-axis), for each major industry sector. The size of each bubble is scaled according to its 2012 employ-

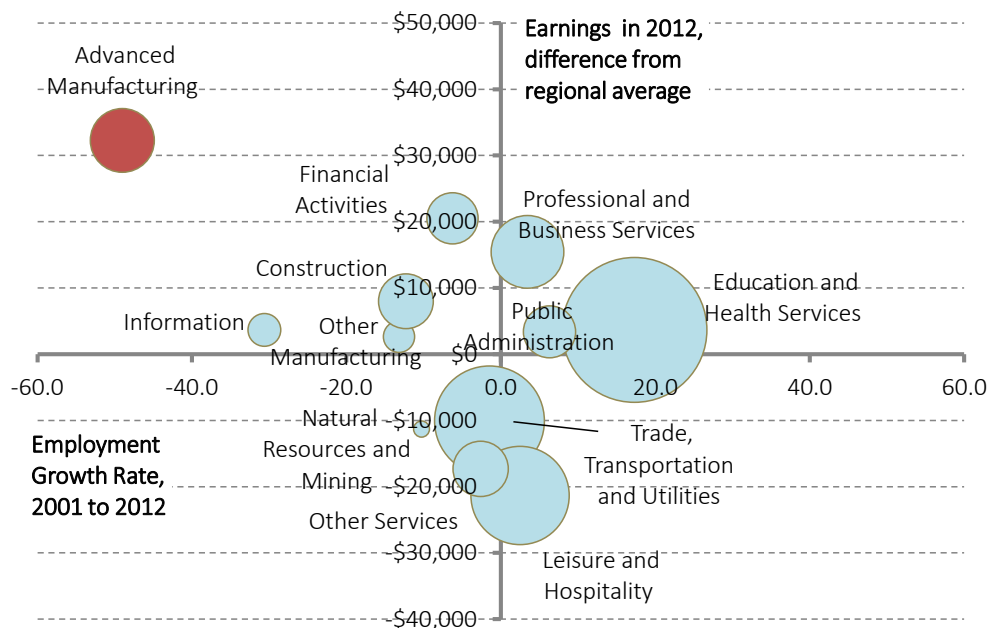
ment level. Advanced Manufacturing clearly suffered major job losses since 2001, far more than any other sector in terms of its relative size. Yet it is, by far, the highest-paying sector in region, and still constitutes a sizable part of the regional employment base. Few sectors saw net job growth over the past decade, and among those that did, only Professional and Business Services pays well above the regional average.

**Figure 6**  
Trends in Real Earnings per Worker in Advanced Manufacturing, Berkshire Region vs. the U.S., 2001 to 2012



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

**Figure 7**  
Major Industry Sectors, by Average Earnings, Size, and Growth



## Advanced Manufacturing Subsectors in the Berkshire Region

### Establishments, Employment and Regional Specializations

The Berkshire region’s Advanced Manufacturing economy is concentrated in Chemicals and Plastics and Paper and Printing, which together account for nearly two thirds of all sectoral employment in 2012 (Table 2). Paper and Printing is particularly specialized in the Berkshires, with a regional employment share that is over three times the national share—making it not only the most highly concentration subsector in the region but also the most highly regionalized subsector in the state (Figure 8). This is despite major job losses that have eroded the relative dominance of this subsector in the region relative to 2001. The Chemicals and Plastics subsector is a secondary regional specialization, with nearly two times the number of workers that we would expect given the size of the regional economy. There are likely to be some interconnections between the two subsectors, as Chemicals and Plastics often involves the refinement of materials produced by the paper industry.

The Fabricated Metals and Machinery subsector comes in third in terms of total employment, accounting for just 875 jobs in 2012. But while it employs fewer workers, the Fabricated Metals subsector has the largest number of individual employers of any subsector. This is because Fabricated Metals shops tend to be rather small, by comparison, with an average establishment size of 23 workers, compared to an average size of 64 workers for Chemicals and Plastics and 60 workers in Paper and Printing. Fabricated Metals was at one time a far more dominant subsector in the regional economy—that is before the major layoffs of the 2000’s nearly halved its employment base with the overall size of the regional economy remained nearly

**Table 2**

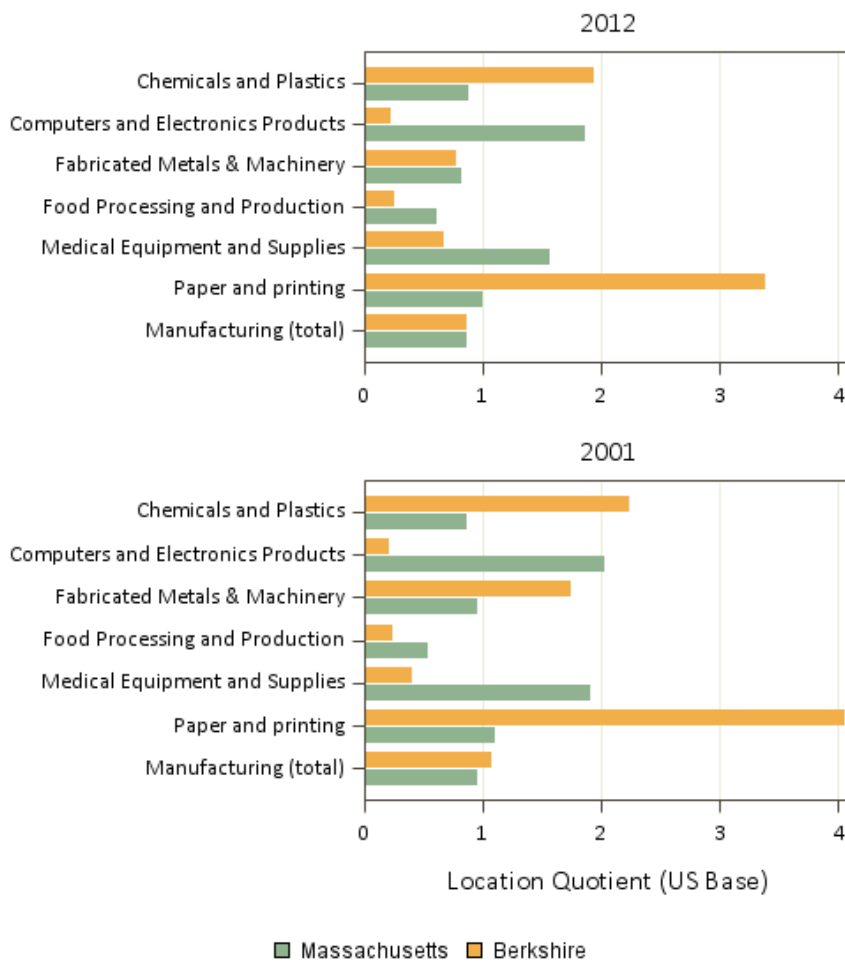
Employment, Establishment, and Earnings Summary by Advanced Manufacturing Subsectors, 2012

Sub-sector	Establishments			Employment			Real Wage and Salary Earnings*	
	Number	Change from 2001	Average Size	Number	Change from 2001	Location Quotient	per worker	Change from 2001
Chemicals and Plastics	18	-10	64.3	1,157	-600	1.934	\$89,142	\$7,141
Computers and Electronics Products	9	-17	15.8	142	-76	0.211	\$45,638	-\$26,955
Fabricated Metals & Machinery	38	-15	23.0	875	-1,657	0.759	\$63,774	-\$10,928
Food Processing and Production	16	-2	11.3	180	-6	0.239	\$25,431	-\$344
Medical Equipment and Supplies	3	-3	31.0	93	35	0.658	\$46,440	\$4,519
Paper and printing	22	-16	59.5	1,308	-1,305	3.378	\$76,818	\$16,102
Advanced Manufacturing (total)	106	-63	35.4	3,755	-3,609	1.013	\$73,181	\$3,256

\*Measured in 2013 Dollars

Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author’s Calculations

**Figure 8**  
Relative Concentration of Employment by Advanced Manufacturing Subsector, Berkshires vs. the Commonwealth



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

unchanged. In 2001, it had a location quotient of nearly two. Now it hovers just above .75, meaning that it is underrepresented for a region the size of the Berkshires. The smallest subsector in the region is Medical Equipment and Supplies, which has fewer than 100 workers and just a handful of businesses (Table 2). The region is also grossly underrepresented in both Food Processing and Production and in Computers and Electronics Products (Figure 8).

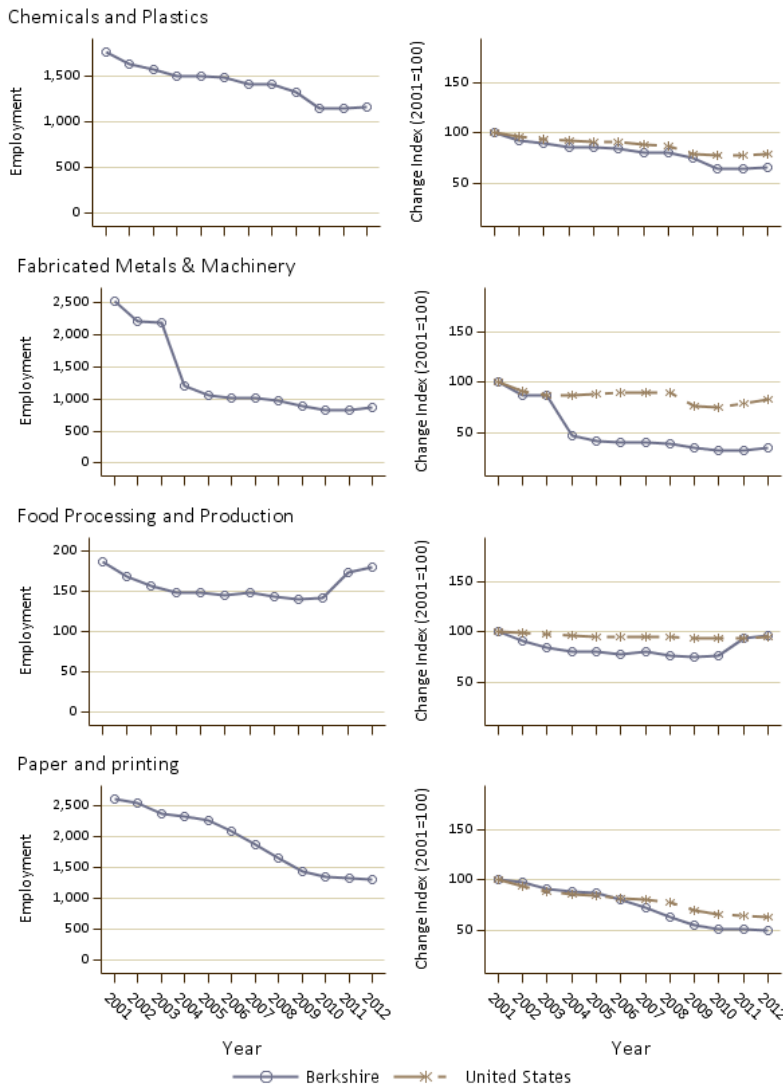
### Employment Trends

Year to year employment and wage trends in the Berkshires tend to be a bit erratic. This is especially true for the smallest subsectors—such as Medical Equipment and Computers and Electronics—where the

ad-hoc hiring or layoff decisions of even a single employer may lead to abrupt changes from one year to the next. With these caveats in mind, Figure 9 shows annual employment trends for the four largest subsectors.

All four subsectors show decline over most of the 2000s and signs of recovery since 2010 (Figure 9). For Chemicals and Plastics and Paper and Printing the decline was gradual, steady, and essentially mirrored national trends suggesting that broader national market conditions were largely to blame. While stable, both subsectors have lagged national trends of net job gains since 2010. Fabricated Metals and Machinery also trended with the nation over the first two years of the study period, but then experienced an abrupt one-

**Figure 9**  
Employment Change by Selected Subsectors Berkshire Region



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

both in general across all industries as well as within individual Advanced Manufacturing subsectors (Figure 10). There are two key exceptions where workers in the Berkshires earn more than their counterparts elsewhere in the Commonwealth. These include the region's two largest subsectors—Paper and Printing and Chemicals and Plastics. These two subsectors also experienced real wage growth since 2001, and, in the case of Paper and Printing, wage growth clearly outpaced both the nation and the state. Food Processing and Production is the only subsector that pays below the regional (all-industry) average.

There were also notable declines in real wages in the Computers and Electronics and Fabricated Metals and Machinery subsectors. Substantial real wage declines are rather unusual and are often the consequence

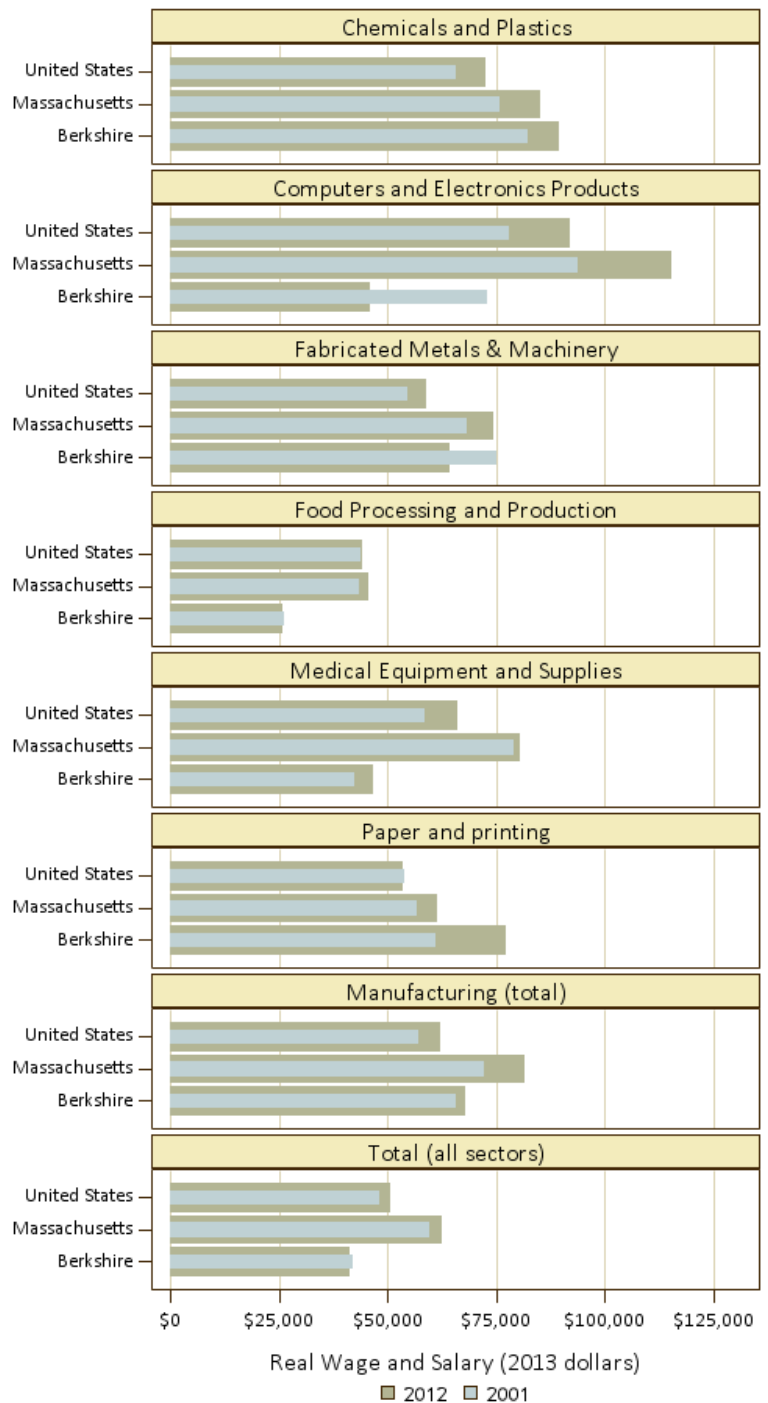
year decline in 2003. Fabricated Metals in the Berkshires stabilized in the years that followed, and actually performed slightly better than the national subsector during the Great Recession. But, like Chemical and Plastics and Paper and Printing, the Berkshire's Fabricated Metals subsector has not matched national job gains following the recession. Food Processing and Production is an exception where the regional sector has actually out-performed the nation in recent years. It also saw incremental job losses during the first half of the decade, but weathered the 2008 recession rather unscathed and added nearly 75 net new jobs in the Berkshires since 2010—a time when national employment trends remained flat.

### Earnings and Wage Trends

Wages in the Berkshire's Advanced Manufacturing sector tend to lag the state,

of a shift in workforce composition through hiring and layoffs. This is particularly true for small industries, like those found in the Berkshires, where the closure of even a single employer can have an undue influence on averages.

**Figure 10**  
Annual Earnings per Worker, 2001 to 2012



Source: Massachusetts Department of Labor, Quarterly Employment and Wages (ES-202), Author's calculations

## Occupational Profile of the Advanced Manufacturing Subsectors

This section profiles the knowledge, skills and abilities of the Advanced Manufacturing labor pool in the Berkshire region. It largely follows a similar structure and format as the companion state-level occupational profile—focusing on the specific occupations identified at the “core” of the Commonwealth’s Advanced Manufacturing sector. But there are some important differences. Several of the key data sources used to analyze occupations by industry are only available on a statewide basis. At the regional level data is limited to total (cross-industry) employment and wage figures by occupation. In other words, the figures discussed in this section include not only workers in Advanced Manufacturing, but workers doing similar jobs in other industries, as well. And while these are considered core occupations in Advanced Manufacturing, the number of workers actually working in Advanced Manufacturing may be far less. Yet, we feel that this analysis does provide an accurate portrayal of the *potential* Advanced Manufacturing workforce, otherwise referred to as the labor pool, because it covers occupations with generally similar skills and aptitudes as those found among workings in the industry.

We begin with a brief profile of the entire regional labor force, classified by major occupational groups that are most closely related to Advanced Manufacturing. We follow with a closer examination of the specific core occupations of the Advanced Manufacturing sector as a whole. The section closes with a brief discussion of employment and wage trends for occupations considered core to the six individual Advanced Manufacturing subsectors.

### Regional Occupational Structure

Table 3 presents total employment in the Berkshire region across major occupational categories—focusing on those previously identified as particularly prevalent in the Commonwealth’s Advanced Manufacturing sector. The largest share of the Berkshire region’s labor force are in office and administrative support occupations (15%) —in line with the state and most other regions. Yet our state level analysis of the Commonwealth shows that production occupations are the most specialized to the Advanced Manufacturing sector. The Berkshire region is somewhat less concentrated in production workers relative to the US, with a location quotient of .87 (Table 3). However, the region has a somewhat higher concentration of engineers (1.10) and food preparation and service related occupations, the latter likely reflect the region’s tourism industry. Workers across most all major occupational categories earn wages lower than the statewide average, although production workers are only slightly lower, while other key Advanced Manufacturing catego-

**Table 3**

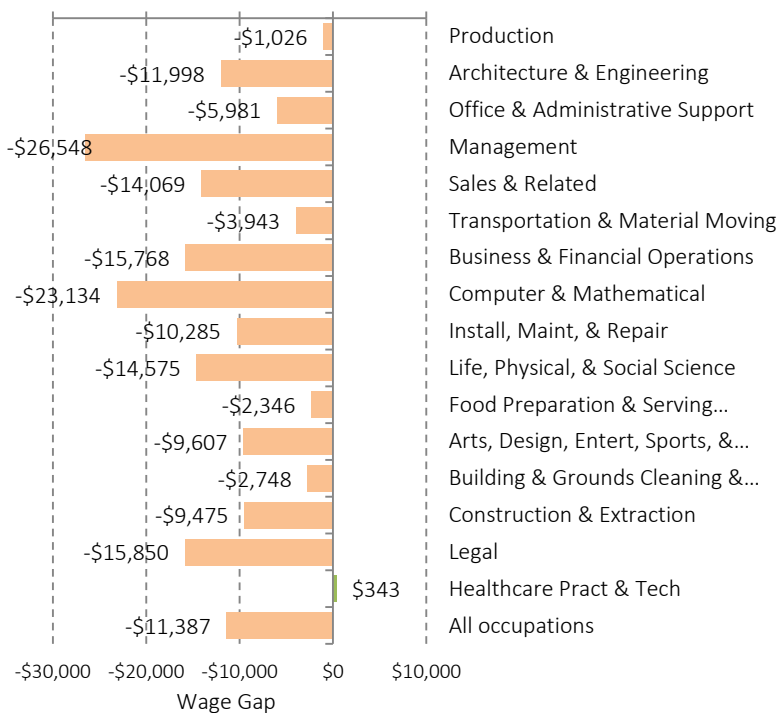
Major Occupational Groups Related to Advanced Manufacturing, Summary Employment and Wage Statistics, 2012

SOC	Occupational Category	Region wide Workers	Industry Share	Location Quotient	Annual wage
51-0000	Production Occupations	3,280	5.7%	0.87	\$37,091
17-0000	Architecture and Engineering Occupations	1,140	2.0%	1.10	\$72,368
43-0000	Office and Administrative Support Occupations	8,640	15.1%	0.92	\$33,984
11-0000	Management Occupations	2,970	5.2%	1.06	\$96,955
41-0000	Sales and Related Occupations	5,960	10.4%	0.98	\$31,229
53-0000	Transportation and Material Moving Occupations	2,070	3.6%	0.54	\$31,962
13-0000	Business and Financial Operations Occupations	1,780	3.1%	0.63	\$62,335
15-0000	Computer and Mathematical Occupations	990	1.7%	0.63	\$68,523
49-0000	Installation, Maintenance, and Repair Occupations	1,820	3.2%	0.82	\$40,710
19-0000	Life, Physical, and Social Science Occupations	440	0.8%	0.91	\$62,972
35-0000	Food Preparation and Serving Related Occupations	5,890	10.3%	1.16	\$23,368
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	570	1.0%	0.74	\$48,963
37-0000	Building and Grounds Cleaning and Maintenance Occupations	2,470	4.3%	1.32	\$29,531
47-0000	Construction and Extraction Occupations	2,470	4.3%	1.13	\$47,247
23-0000	Legal Occupations	210	0.4%	0.47	\$93,543
29-0000	Healthcare Practitioners and Technical Occupations	4,150	7.2%	1.23	\$81,931
00-0000	Total all occupations	57,260	100.0%	1.00	\$44,769

Source: MA Office Labor and Workforce Development (EOLWD) OES, author's calculations. Includes Major SOC categories with occupations in Advanced Manufacturing indicated by the state report. Wages are reported in 2013 dollars.

**Figure 11**

Difference in Major Occupational Category Earnings, Region v. State



Source: MA EOLWD, OES; US BLS, OES; author's calculations. In 2013 dollars.

ries such as architecture and engineering, computer and mathematical, and science oriented occupations earn a significant amount less than their statewide counterparts (Figure 11). Overall, workers in the region earn upwards of \$11,000 less than the statewide average.



## Advanced Manufacturing Core/Crossover Occupations

Table 4 reports the core/crossover occupations of the Advanced Manufacturing sector identified in our state-level analysis and the region wide employment totals. Occupations that are “core” in a particular sub-sector are designated by an “X”. Table 4 also includes regional employment totals for each occupation, as well as subsector industry employment levels (as reported in the previous section) to provide a sense of each subsector’s contribution to the region’s Advanced Manufacturing base. It is important to note that the

**Table 4**

Summary Employment and Core Advanced Manufacturing Crossover Occupations, 2012

SOC	Occupational Title	Region wide Workers	Chemicals and Plastics	Computers and Elect.	Fab. Metals and Mach.	Food Process. & Prod.	Medical Equip. and Supplies	Paper and Printing
11-9041	Architectural & Engineering	50	x	x	x		x	
51-4011	Computer-Controlled Machine Tool Operators, Metal & Plastic	40	x	x	x		x	
51-4031	Cutting, Punching, & Press Machine Setters, Operators, & Tenders, Metal & Plastic	70	x	x	x		x	x
17-3023	Electrical & Electronics Engineering Technicians	90		x	x		x	
51-2023	Electromechanical Equipment Assemblers	NA		x	x		x	
51-4021	Extruding & Drawing Machine Setters, Operators, & Tenders, Metal	NA	x	x	x			
51-1011	First-Line Supervisors of Production & Operating Workers	280	x	x	x	x	x	x
51-9198	Helpers--Production Workers	NA	x	x	x	x	x	x
17-3026	Industrial Engineering Technicians	130	x	x	x			x
17-2112	Industrial Engineers	130	x	x	x		x	x
49-9041	Industrial Machinery Mechanics	140	x	x	x	x	x	x
11-3051	Industrial Production Managers	90	x	x	x	x	x	x
51-9061	Inspectors, Testers, Sorters, Samplers, & Weighers	140	x	x	x	x	x	x
51-4041	Machinists	120	x	x	x		x	
17-2141	Mechanical Engineers	110	x	x	x		x	
51-4072	Molding, Coremaking, & Casting Machine Setters, Operators, & Tenders, Metal & Plastic	290	x	x	x			
51-4081	Multiple Machine Tool Setters, Operators, & Tenders, Metal &	30		x	x		x	
51-9111	Packaging & Filling Machine Operators & Tenders	70	x			x		x
51-2092	Team Assemblers	110		x	x	x	x	x
51-4111	Tool & Die Makers	70	x		x		x	x
Subsector Advanced Manufacturing industry employment (ES-202)		Share	32.1%	3.9%	24.2%	5.0%	2.6%	36.2%
		Number	1,157	142	875	180	93	1,308

Source: Massachusetts EOLWD, OES and ES-202 data series; author’s calculations

industry employment numbers include only those workers specific to the subsector, regardless of occupation. Whereas the occupational employment totals report all workers in the region, and not just those in Advanced Manufacturing.

Advanced Manufacturing in the Berkshire region is dominated by three subsectors: Paper and Printing, Chemicals and Plastics, and Fabricated Metals and Machinery. Together these three subsectors comprise 92% of the potential Advanced Manufacturing labor pool in the region. There is a high number of 'crossover' occupations shared between these subsectors, particularly between Chemicals and Plastics and Metal Machining. This suggests ample opportunities for cross-sector training and workforce development programs targeting employers to the mutual benefit of both subsectors. However, given the small size of the region, such scale benefits may be difficult to achieve.

### Chemicals and Plastics

Chemicals and Plastics is the second largest subsector in the region and constitutes a primary regional specialization. While the subsector shares a number of crossover occupations with other subsectors, Chemicals and Plastics differs by its high share of workers in scientific fields, such as chemists, biologists, and similar types of engineers that have somewhat specialized knowledge relative to other subsectors. Table 5

**Table 5**  
Summary Employment and Earnings Statistics, Key Occupations in Chemicals and Plastics, 2012

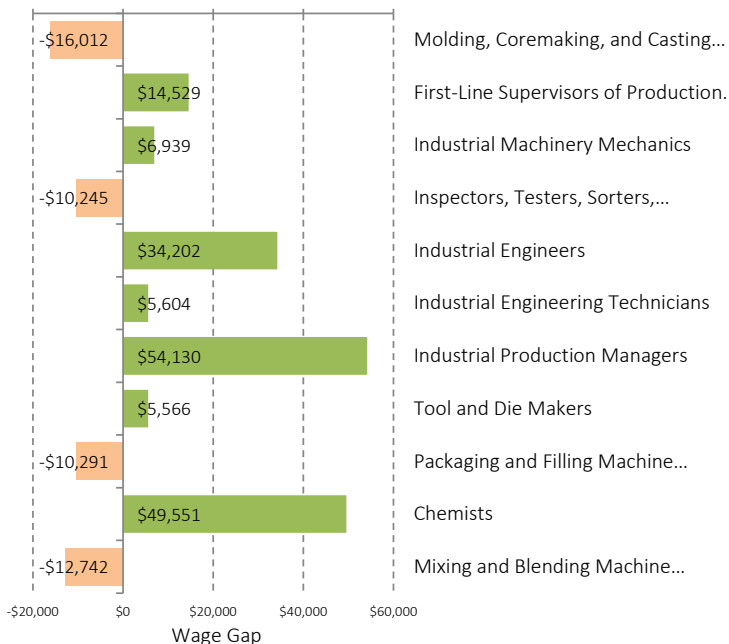
SOC	Occupational Title	Employment			Real Wage	
		Number	Change from 01	Location Quotient	Per worker	Change from 01
51-4072	Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic	290	140	5.30	\$28,757	-\$1,663
51-1011	First-Line Supervisors of Production and Operating Workers	280	-80	1.12	\$59,298	\$711
49-9041	Industrial Machinery Mechanics	140	90	1.06	\$51,708	\$7,634
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	140	-220	0.70	\$34,524	-\$5,677
17-2112	Industrial Engineers	130	50	1.34	\$78,971	\$1,072
17-3026	Industrial Engineering Technicians	130	80	4.39	\$50,373	-\$14,167
11-3051	Industrial Production Managers	90	0	1.28	\$98,899	\$12,430
51-4111	Tool and Die Makers	70	-40	2.08	\$50,335	-\$1,270
51-9111	Packaging and Filling Machine Operators and Tenders	70	10	0.43	\$34,478	\$4,035
19-2031	Chemists	40	-	1.07	\$94,320	\$28,982
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders	40	-40	0.78	\$32,027	-\$5,398

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

displays total occupational employment and wage trends in the Berkshire region for the core occupations in the Chemicals and Plastics subsector. The most abundant core occupations in the region are molding, coremaking, and casting machine setters; first-line supervisors of production and operating workers; inspectors, testers and sorters; and industrial machinery mechanics. The core labor pool is also highly concentrated in molding, coremaking, and casting machine setters; industrial engineering technicians; and tool and die makers among others that use knowledge that is rather specific to the subsector. While some of these workers may work in other industries, the high concentrations of these workers are reflective the region's strength in Chemicals and Plastics. Occupational employment trends in the core labor pool has been somewhat mixed since the early 2000's with some occupations adding workers and others in decline.

With the exception of core occupations that work with machines of various types, workers in the core labor pool earn wages above the regional average, particularly industrial engineers and chemists, which earn \$34,000 and upwards of \$50,000 more than the average for other occupations in the region (Figure 12). Workers that are machine oriented earn less than the average worker in the region. These differences may be reflective of various specializations, education, and skill requirements of these workers relative to the broader labor pool.

**Figure 12**  
Difference in occupational earnings for workers in Chemicals and Plastics v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

### Computers and Electronics

The types of workers in the Computers and Electronics subsector are characterized by large number of computer- and math-related occupations, as well as engineers. The core occupations in Computers and Electronics tend to be highly specialized to this subsector and include occupations such as electrical equipment production, electrical engineering, and semiconductors processing. Table 6 displays the total industry

**Table 6**

Summary Employment and Earnings Statistics, Key Occupations in Computers and Electronic Products, 2012

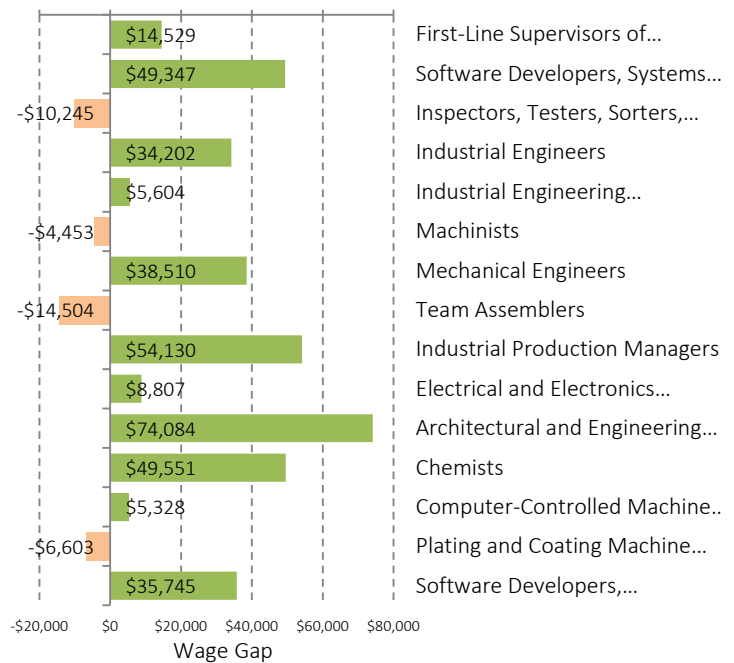
SOC	Occupational Title	Employment			Real Wage	
		Number	Change from 01	Location Quotient	Per worker	Change from 01
51-1011	First-Line Supervisors of Production and Operating Workers	280	-80	1.12	\$59,298	\$711
15-1133	Software Developers, Systems Software	260	-	1.51	\$94,116	-
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	140	-220	0.70	\$34,524	-\$5,677
17-2112	Industrial Engineers	130	50	1.34	\$78,971	\$1,072
17-3026	Industrial Engineering Technicians	130	80	4.39	\$50,373	-\$14,167
51-4041	Machinists	120	-70	0.70	\$40,316	\$610
17-2141	Mechanical Engineers	110	20	0.99	\$83,279	-\$129
51-2092	Team Assemblers	110	-100	0.25	\$30,265	\$4,836
11-3051	Industrial Production Managers	90	0	1.28	\$98,899	\$12,430
17-3023	Electrical and Electronics Engineering Technicians	90	40	1.42	\$53,576	-\$6,127
11-9041	Architectural and Engineering Managers	50	-80	0.61	\$118,853	\$14,649
19-2031	Chemists	40	-	1.07	\$94,320	\$28,982
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	40	-	0.66	\$50,097	-
51-4193	Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic	40	-	2.64	\$38,166	\$6,143
15-1132	Software Developers, Applications	30	-	0.12	\$80,514	-

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

occupational employment and wage trends in the Berkshire region for the occupations identified as core to the Computers and Electronics subsector. Like Medical Equipment and Supplies, the subsector is very small and underrepresented in the region, making up just 4% of Advanced Manufacturing employment in 2012 (Table 4). As a result, occupational data suggest the subsector's core labor pool in the region (Table 6) is significantly larger than subsector total industry employment. The labor pool is comprised of a number of occupations that are core to similar subsectors that have a much larger presence in the region, such as

**Figure 13**

Difference in occupational earnings for workers in Computers and Electronics v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

Chemicals and Plastics and Fabricated Metals and Machinery. However, there is a somewhat sizeable presence of software developers in the region, although these workers may be dispersed across a number of other industries outside of Advanced Manufacturing.

Most workers in the core labor pool earn significantly more than the regional average (Figure 13). This is particularly true for architects and engineers, industrial production managers, and software designers. It may be that firms in Computers and Electronics must pay higher wage premiums to attract talent from other industries or to keep their existing workers from moving elsewhere. However, it also reflects the very low average wage for all workers in the region, many of who work in retail and hospitality sectors.

### Fabricated Metals and Machinery

Relative to other subsectors, Fabricated Metals and Machinery has the highest concentration of production

**Table 7**

Summary Employment and Earnings Statistics, Key Occupations in Fabricated Metals and Machinery, 2012

SOC	Occupational Title	Employment			Real Wage	
		Number	Change from 01	Location Quotient	Per worker	Change from 01
51-1011	First-Line Supervisors of Production and Operating Workers	280	-80	1.12	\$59,298	\$711
49-9041	Industrial Machinery Mechanics	140	90	1.06	\$51,708	\$7,634
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	140	-220	0.70	\$34,524	-\$5,677
17-2112	Industrial Engineers	130	50	1.34	\$78,971	\$1,072
51-4041	Machinists	120	-70	0.70	\$40,316	\$610
17-2141	Mechanical Engineers	110	20	0.99	\$83,279	-\$129
51-2092	Team Assemblers	110	-100	0.25	\$30,265	\$4,836
11-3051	Industrial Production Managers	90	0	1.28	\$98,899	\$12,430
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	70	30	0.87	\$29,015	-\$2,505
51-4111	Tool and Die Makers	70	-40	2.08	\$50,335	-\$1,270
51-4121	Welders, Cutters, Solderers, and Brazers	70	40	0.48	\$38,130	-\$7,827
11-9041	Architectural and Engineering Managers	50	-80	0.61	\$118,853	\$14,649
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	40	-	0.66	\$50,097	-
51-4193	Plating and Coating Machine Setters, Operators, and Tenders, Metal and Plastic	40	-	2.64	\$38,166	\$6,143
51-2041	Structural Metal Fabricators and Fitters	30	-	0.87	\$33,691	-\$5,527
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	30	-	0.80	\$50,861	-

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

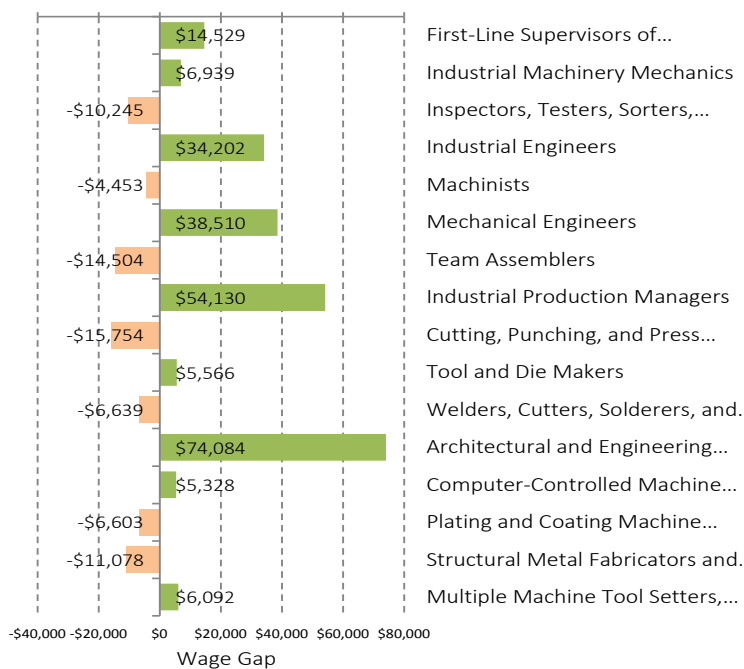
-oriented occupations. These include workers that use machining, tools, and other tangible processes to complete work. The subsector also employs a relatively large number of engineering-based occupations.

In the Berkshire region, the Fabricated Metals subsector represents about 24% of total Advanced Manufacturing industry employment and employs a broad range of workers that cut across numerous subsectors. Relatively high employment totals in its core occupations suggest a deep regional labor pool to draw from (Table 7). The region employs a significant number of engineers and occupations that work with machines, such as machinists—although they are somewhat underrepresented given the overall size of the regional economy. By contrast, industrial engineers; tool and die makers; and plating and coating machine setters are relatively concentrated in the region. In general, the core labor pool has followed overall industry trends of declining employment since 2001 in a number of core occupations, several of which are shared with other key regional subsectors. Retraining programs may play an important role for workers impacted by layoffs, while willing vacancies left by the aging workforce may create opportunities for the next generation of workers.

With the exception of engineering and managerial occupations, average wages in the subsector core labor pool are lower than the regional occupational average; not unlike what we found for other regions (Figure 14). In addition, average real wages have decreased in most of the occupations core to the subsector. Likely driven by the considerable jobs losses in this and related sectors that have put downward pressure on wages.

**Figure 14**

Difference in occupational earnings for workers in Fabricated Metals and Machinery v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. In 2013 dollars.

### Food Processing and Production

The Food Processing and Production subsector has a diverse occupational mix that is at times characteristic of other forms of manufacturing and at times more akin to food services. Many of the core occupations in the Food Processing and Production subsector involve industrial food preparing and processing and are somewhat specialized to the subsector. These include bakers; food batchmakers; meat, poultry and fish

**Table 8**

Summary Employment and Earnings Statistics, Key Occupations in Food Processing and Production, 2012

SOC	Occupational Title	Employment			Real Wage	
		Change Number	Location from 01	Quotient	Per worker	Change from 01
51-1011	First-Line Supervisors of Production and Operating Workers	280	-80	1.12	\$59,298	\$711
53-7064	Packers and Packers, Hand	180	-20	0.62	\$23,344	-\$2,371
49-9041	Industrial Machinery Mechanics	140	90	1.06	\$51,708	\$7,634
53-3031	Driver/Sales Workers	120	70	0.69	\$25,231	-\$8,733
51-2092	Team Assemblers	110	-100	0.25	\$30,265	\$4,836
51-3011	Bakers	110	-150	1.59	\$28,957	\$1,031
51-3022	Meat, Poultry, and Fish Cutters and Trimmers	80	-	1.15	\$24,706	-
51-9111	Packaging and Filling Machine Operators and Tenders	70	10	0.43	\$34,478	\$4,035

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

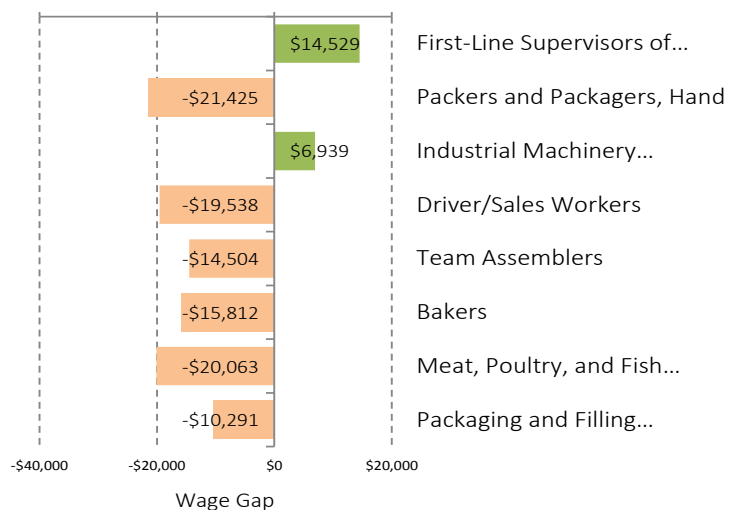
cutters; and food-related machinery operators. The subsector is somewhat under-represented in the Southeast, although it still comprises almost 17% of all Advanced Manufacturing employment in the region.

Like Computers and Electronics, the subsector makes up a very small share of total regional Advanced Manufacturing employment—just 5%. The core labor pool of the Food Processing and Production subsector is also small, and only consists of seven core occupations, which include various forms of packagers and workers that prepare foods for packaging and delivery (Table 8). However, several of its core occupations are shared with several other Advanced Manufacturing subsectors, namely first-line supervisors, industrial machinery mechanics, and team assemblers. The region is somewhat specialized in bakers, which may include workers that are more directly tied to the region's hospitality industry than food production, per se.

Wages in the subsector are well below the Berkshire regional occupational average, except for supervisors and industrial machinery mechanics, whose wages are generally commensurate with similar workers in other regions of the state. But while still below average, there has been real wages growth in most subsectors — aside from delivery drivers and food packagers where real wages have declined (Figure 9).

**Figure 15**

Difference in occupational earnings for workers in Food Processing and Production v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

## Medical Equipment and Supplies

Medical Equipment and Supplies make up a very small share of the region's Advanced Manufacturing employment (2.6%) and is the smallest of the six subsectors in the region. A majority its core occupations in are production- or engineering-based occupations. The subsector shares several core occupations with Fabricated Metals and Machinery, such as engineers, machinists, machine setters, and other types of machine operators (Table 9). Apart from machinists and computer-controlled machine tool operators, the machine and tooling occupations tend to be highly concentrated in the region. Employment across most core occupations in the subsector has declined since 2001, although several occupations were missing wage data for 2001 due to suppression.

With the exception of engineers and managers, average wages in the subsector's core occupations fall short of those for workers in other industries in the region (Figure 16). Although lower, real wages have risen since 2001 for most core occupations with particularly notably growth in wages for managerial occupations (Table 9).

**Table 9**

Summary Employment and Earnings Statistics, Key Occupations in Medical Equipment and Supplies, 2012

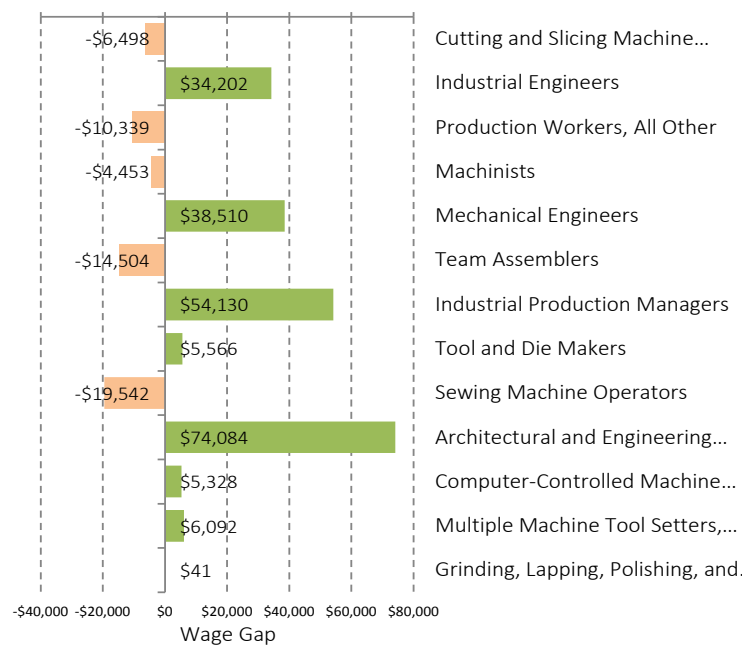
SOC	Occupational Title	Employment			Real Wage	
		Change Number	Location from 01	Quotient	Per worker	Change from 01
51-9032	Cutting and Slicing Machine Setters, Operators, and Tenders	140	-	5.63	\$38,271	-
17-2112	Industrial Engineers	130	50	1.34	\$78,971	\$1,072
51-9199	Production Workers, All Other	130	-	1.35	\$34,430	-\$129
51-4041	Machinists	120	-70	0.70	\$40,316	\$610
17-2141	Mechanical Engineers	110	20	0.99	\$83,279	-\$129
51-2092	Team Assemblers	110	-100	0.25	\$30,265	\$4,836
11-3051	Industrial Production Managers	90	0	1.28	\$98,899	\$12,430
51-4111	Tool and Die Makers	70	-40	2.08	\$50,335	-\$1,270
51-6031	Sewing Machine Operators	60	-	0.96	\$25,227	-
11-9041	Architectural and Engineering Managers	50	-80	0.61	\$118,853	\$14,649
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	40	-	0.66	\$50,097	-
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	30	-	0.80	\$50,861	-
51-4033	Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic	20	-	0.65	\$44,810	-\$4,634

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.



**Figure 16**

Difference in occupational earnings for workers in Medical Equipment and Supplies v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. Wages in 2013 dollars.

## Paper and Printing

The Paper and Printing subsector is the largest subsector in the region comprising over 1,300 workers in 2012. Similar to other Advanced Manufacturing subsectors, about half of the Paper and Printing workforce are in production-oriented occupations. Yet, the subsector is distinct from others by the presence of several core design and arts occupations in its set of core occupations.

The core labor pool of the subsector is made of various types of machine workers with skills that are rather specific to printing and press operation (Table 10). The largest occupations are paper goods machine setters, operators,

and tenders; and cutting slicing machine setters, operators and tenders. Like the subsector itself, these occupations are highly concentrated in the region, as are other occupations such as printing press operators

**Table 10**

Summary Employment and Earnings Statistics, Key Occupations in Paper and Printing, 2012

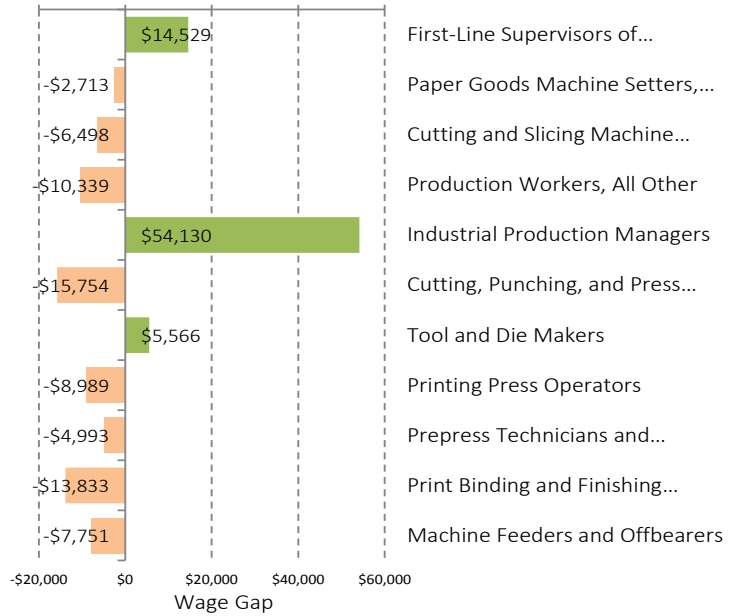
SOC	Occupational Title	Employment			Real Wage	
		Number	Change from 01	Location Quotient	Per worker	Change from 01
51-1011	First-Line Supervisors of Production and Operating Workers	280	-80	1.12	\$59,298	\$711
51-9196	Paper Goods Machine Setters, Operators, and Tenders	160	-200	3.80	\$42,056	-\$5,555
51-9032	Cutting and Slicing Machine Setters, Operators, and Tenders	140	-	5.63	\$38,271	-
51-9199	Production Workers, All Other	130	-	1.35	\$34,430	-\$129
11-3051	Industrial Production Managers	90	0	1.28	\$98,899	\$12,430
51-4031	Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	70	30	0.87	\$29,015	-\$2,505
51-4111	Tool and Die Makers	70	-40	2.08	\$50,335	-\$1,270
51-5112	Printing Press Operators	70	-	0.92	\$35,780	-
51-5111	Prepress Technicians and Workers	60	-	3.30	\$39,776	-
51-5113	Print Binding and Finishing Workers	40	-	1.72	\$30,936	-
53-7063	Machine Feeders and Offbearers	30	-	0.65	\$37,018	-

Source: Massachusetts EOLWD, OES; author's calculations. Wages in 2013 dollars.

and print binding and finishing workers that are highly specific to the subsector. As the industry has declined since 2001, so has the general labor pool for workers in the sectors core occupations.

In line with what we found for other regions, wages in the core occupations of the Paper and Plastics subsector generally fall short of regional averages. The exceptions in the Berkshire are for managerial occupations, first-line supervisors, and tool and die makers (Figure 17). The displacement of workers due to industry decline may call for programs that retrain workers in other types of machining or where skills may be adapted to the needs of other industries. This will be a challenge, particularly considering that many of the core occupations – occupations such as printing press operators and print binding and finishing workers—are typically not found in abundance within other industries.

**Figure 17**  
Difference in occupational earnings for workers in Paper and Printing v. regional average wage across all workers



Source: MA EOLWD, OES; author's calculations. In 2013 dollars.

## Occupational Skills and Knowledge Requirements

This section profiles the skill and knowledge stocks of workers in the Berkshire region across the six Advanced Manufacturing subsectors. As discussed in the state-level report, we link regional occupation employment data to the typical job requirements in 35 skill domains, as reported by the Bureau of Labor Statistics' Occupational Information Network (O\*Net). As discussed in the previous section, industry-specific occupational data is not reported at the regional level. Thus, our analysis is more indicative of the skills of the overall labor force or potential labor pool, and not exclusively to workers in Advanced Manufacturing in the Berkshire Region. For example, reported employment totals for industrial production managers include workers in Advanced Manufacturing as well as those working in other sectors: such as Transportation, Installation, and other areas.

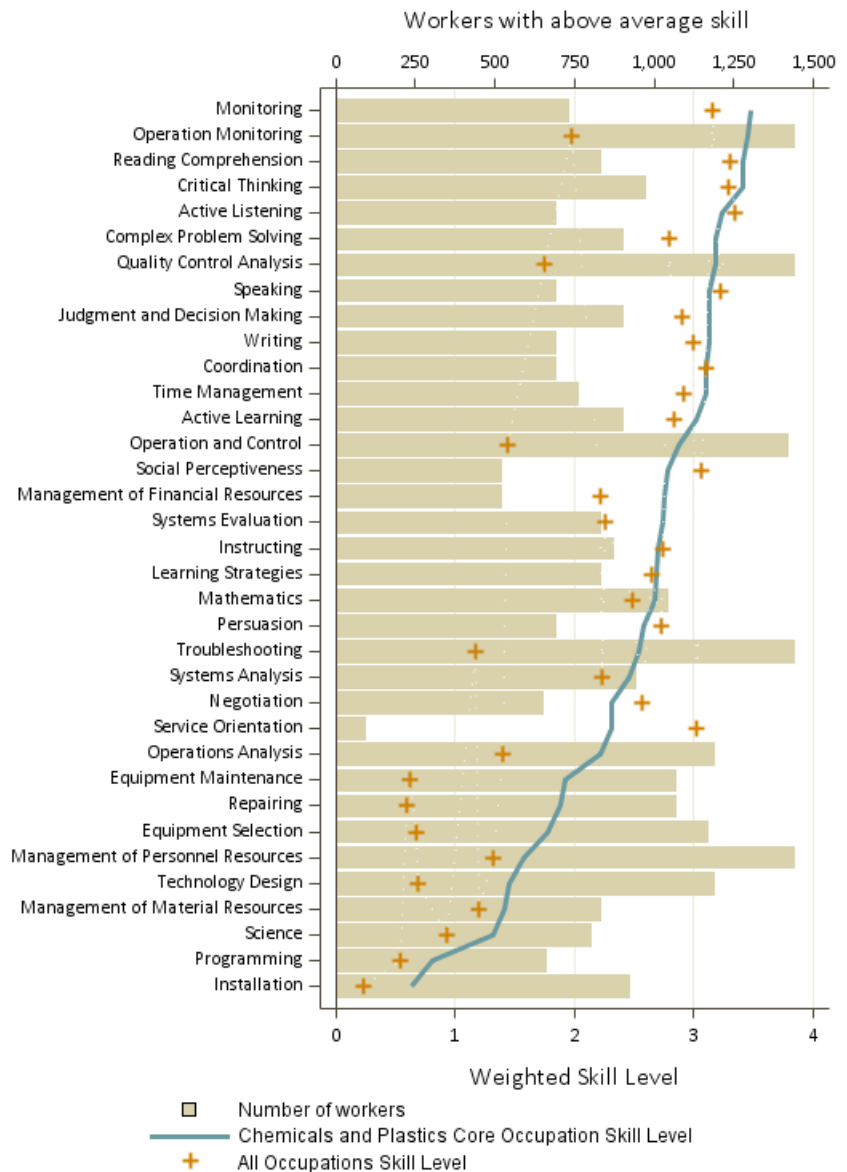
To do this, we follow a similar approach as the state-level report for which we calculate a weighted average skill level based upon the employment totals and relative skill level reported in the O\*Net for each subsector's core occupations, presented in the previous section. Average skill levels are then ranked from highest to lowest (top to bottom) and indicated by the blue line in each chart labeled "subsector core occupation skill level." Plus signs indicate the regional average skill score weighted across all occupations in all industries reported in the regional OES files. Finally, the horizontal bars indicate the number of workers in a particular subsector's core occupations which have an above average skill level, measured using the all occupation weighted average (plus signs) for each region. These measures help to identify strengths of potential labor pool for each subsector and Advanced Manufacturing across the Berkshire region. Knowledge requirements, characterized as post-secondary education, experience, on-the-job training, and in-plant training levels, are reported in years and as comparisons across subsector requirements. An 'all occupation' regional average is indicated by a vertical bar and provides a benchmark to compare subsector knowledge requirements to the broader regional labor pool. The remainder of this section presents the skill requirements for each subsector followed by the knowledge requirements of the regional labor pool.

### Chemicals and Plastics

Skill requirements in Chemicals and Plastics are somewhat more diverse compared to most other subsectors. The highest ranking skills for the core labor pool are often found in areas related to monitoring, operation monitoring, and quality control analysis (Figure 18). However, workers in Chemicals and Plastics also have high requirements of basic skill sets, such as reading, critical thinking, active learning, and math. The

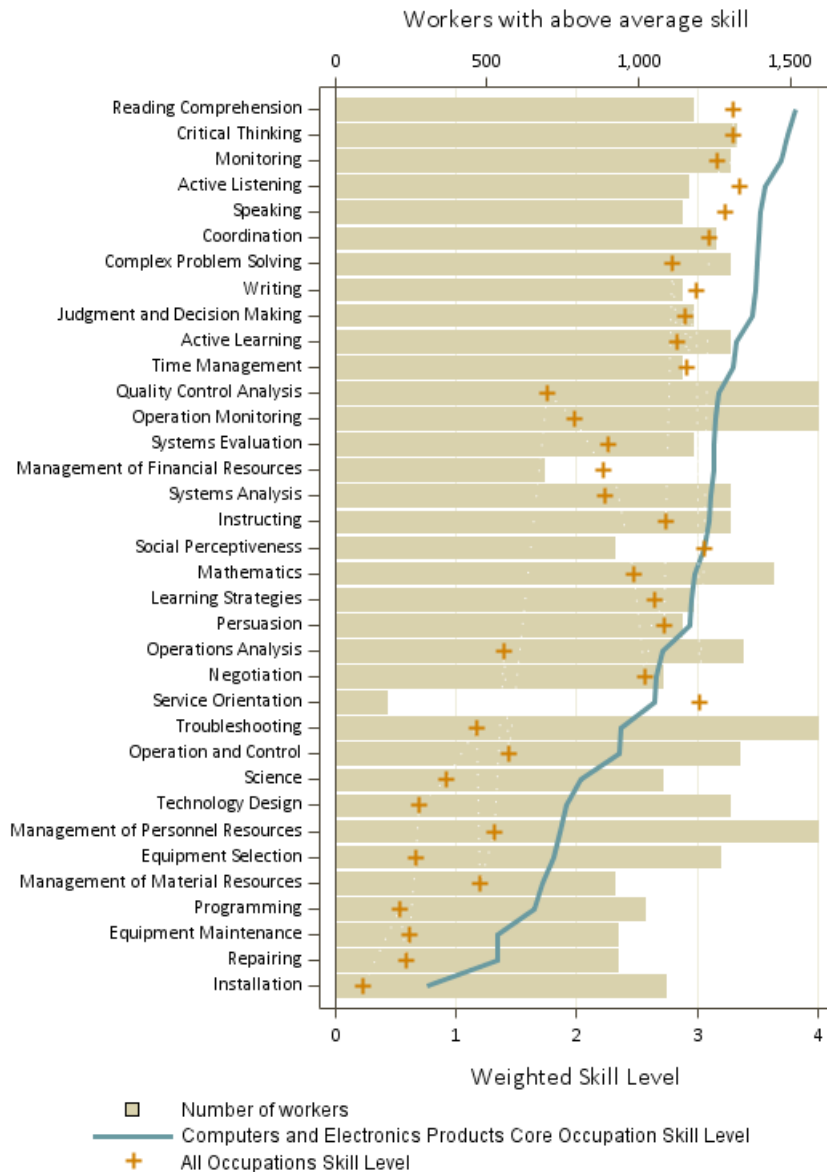
Berkshire regional labor pool in Chemicals and Plastics has average skill levels similar to the broader regional labor pool, though tends to fall below regional averages in more specialized socially based skills such as negotiation, social orientation, and social perceptiveness; skills which are less important to the subsector (Figure 18). The core labor pool exceeds the regional average in skills that are technically-oriented mechanical skills, such as troubleshooting, equipment maintenance and selection, and repairing. Likewise, we see large numbers of workers in the core labor pool requiring above average skills (reflected by the length of the horizontal bar in Figure 18) in areas such as operations monitoring, quality control analysis, operation and control, troubleshooting and monitoring of personnel resources. This means that the region is likely to have an abundant pool workers with skills in these areas to draw from.

**Figure 18**  
Skill Requirements in Chemicals and Plastics Occupations



Source: MA EOLWD, OES; US BLS ONET; author's calculations.

**Figure 19**  
Skill Requirements in Computers and Electronics Occupations



Source: MA EOLWD, OES; US BLS ONET; author's calculations.

in areas such as quality control, operations monitoring, troubleshooting, and management of personnel resources—all areas where the subsector skill requirements exceed the regional average. Nevertheless, as one of the smallest subsectors in the region, it is likely that most of the workers are currently employed outside of Computers and Electronics. Thus, the sector might best benefit from training programs that leverage cross subsector strengths and draw from other subsectors, such as Fabricated Metals and Machinery and Chemicals and Plastics which share many occupations with Computers and Electronics.

## Computers and Electronics

The core workforce of Computers and Electronics have the highest and most diverse skill requirements of the six subsectors. The skill requirements for the core subsector labor pool are higher than the regional labor force average for nearly all 35 of the skill domains (Figure 19). The only key exception where the subsector requires skills below the general workforce is in the area of social perceptiveness. Similar to Chemicals and Plastics, workers in Computers and Electronics have high skill requirements in skills that facilitate the acquisition and processing of new knowledge. The highest ranking skills are all directly related to basic learning and knowledge acquisition skills, such as reading, critical thinking, listening and speaking.

The core labor force for Computers and Electronics appears to be well represented by highly skilled workers

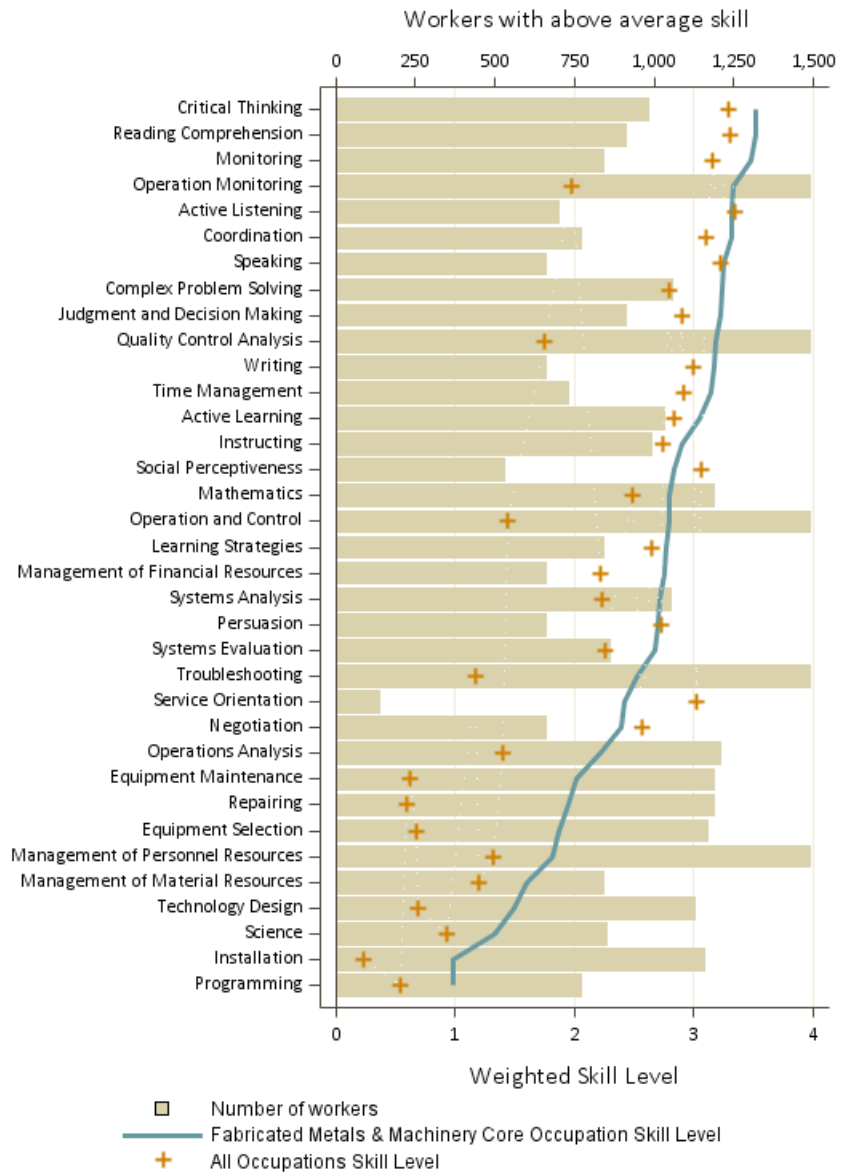
## Fabricated Metals and Machinery

The types of skills requiring high levels of knowledge in Fabricated Metals and Machinery are primarily technical and technological—operations monitoring, monitoring, quality control, and operations (Figure 20). In addition, a number of key decision making and information-

processing skills also appear among those requiring high levels, such as critical thinking, reading comprehension, problem solving, and judgment.

Similar to the other Advanced Manufacturing subsectors in the region, the core labor pool in Fabricated Metals and Machinery have average skill levels that typically exceed the general workforce—particularly in skills sets pertaining to the operations and machinery. The exceptions, where skill requirements fall below other sectors, are in basic social skills and interpersonal communications skills such as negotiation, service orientation, and social perceptiveness. Furthermore, Fabricated Metals shares much of the core labor force with other subsectors in the region. This is particularly Basic learning skills such as critical thinking, reading, listening, and speaking, as well as monitoring skills tend to require high skills levels that are shared among many subsectors.

**Figure 20**  
Skill Requirements in Fabricated Metals and Machinery Occupations

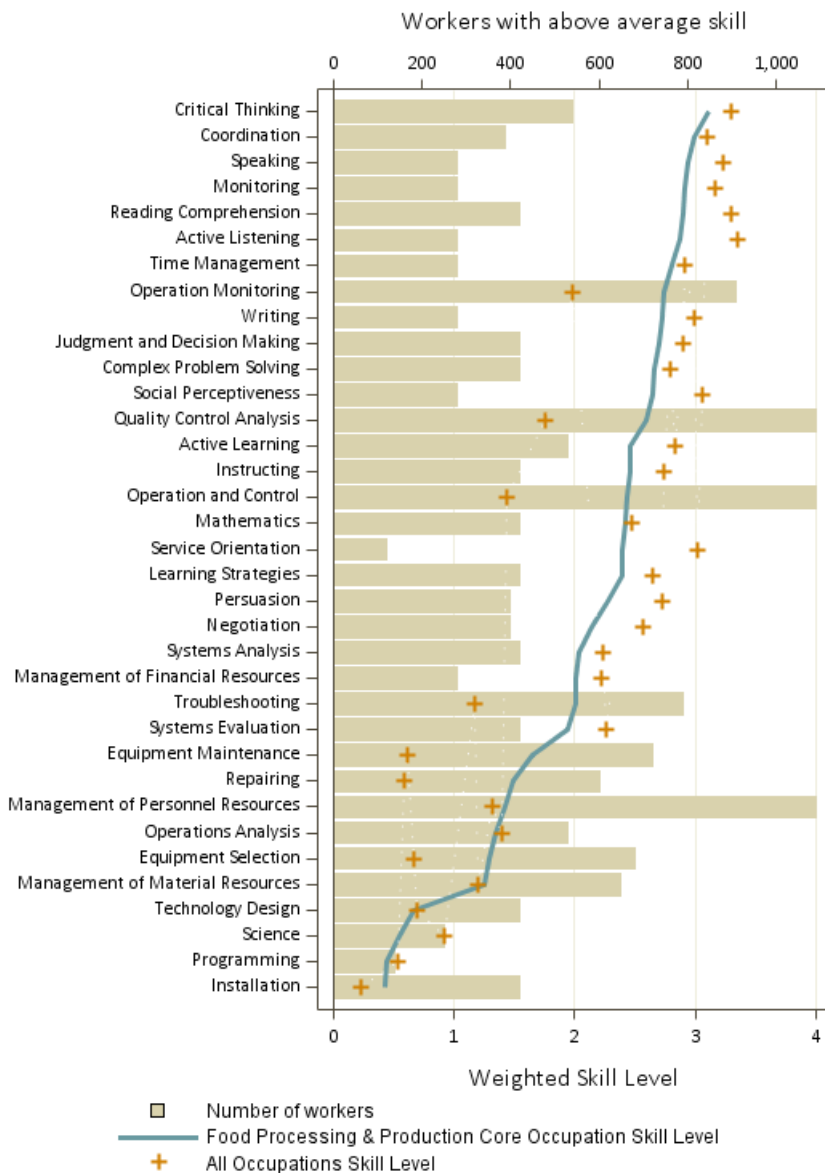


Source: MA EOLWD, OES; US BLS ONET; author's calculations.

## Food Processing and Production

Food Processing and Production has relatively few high-level skill requirements. In this way it is more characteristic of traditional forms of low-skilled, routine forms of production than we typically associate with Advanced Manufacturing. The core skills requiring fairly high levels are typically basic learning and instructional skills such as critical thinking, coordination, speaking, reading comprehension and active listening (Figure 21). However, we also see that the core labor force tends to be deficient in these key areas.

**Figure 21**  
Skill Requirements in Food Processing and Production Occupations



Technology and science skills, while still core to the subsector, require fairly only low levels of knowledge.

There are few workers in occupations requiring above average skill levels in with the exception of those related to equipment maintenance and repair; operations monitoring and control; and quality control. Fortunately, the regional labor pool seems to have abundant resources of highly skilled workers in most of these areas, as reflected by the length of the horizontal bars in Figure 21. Given the size of the subsector and the number of potential workers in the core labor pool, the subsector might benefit from training programs directed at those highly specialized skills, which are not found in abundance in other subsectors and are more aptly identified by specific occupational titles rather than in O\*Net skills data.

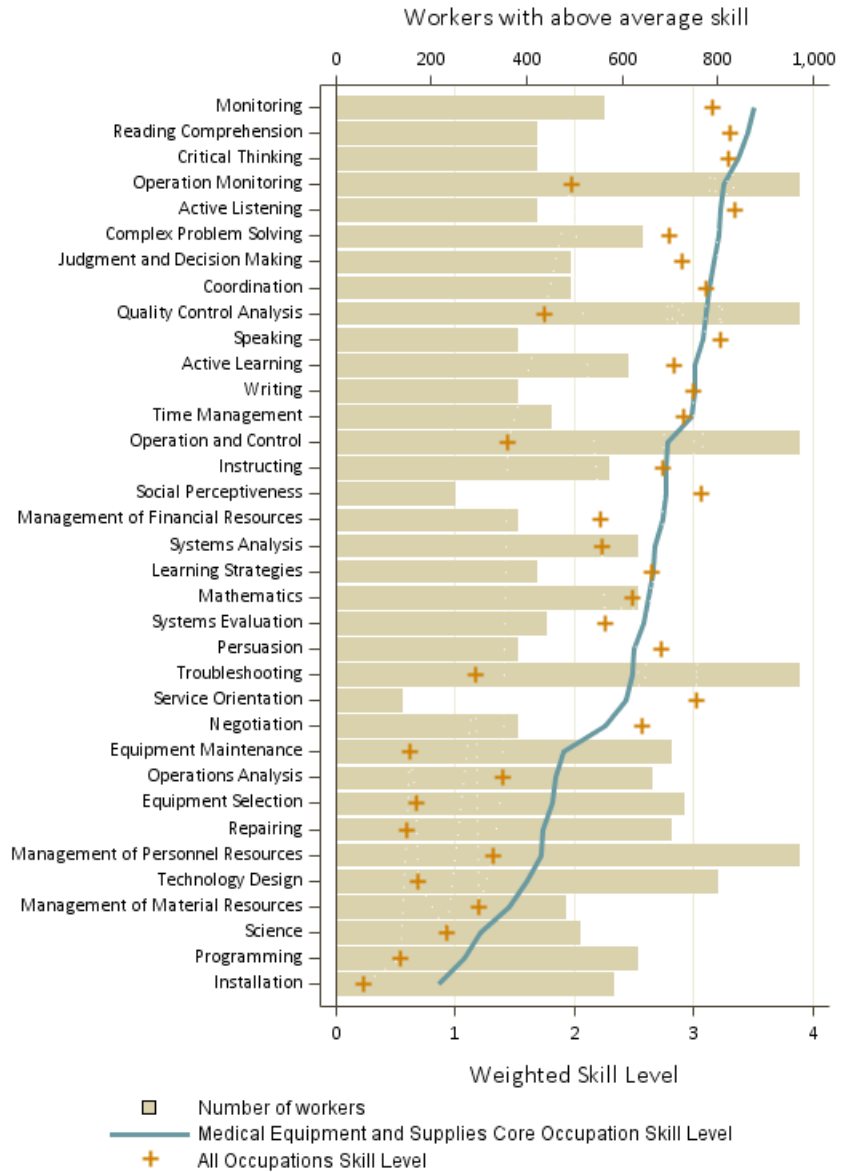
Source: MA EOLWD, OES; US BLS ONET; author's calculations.

## Medical Equipment and Supplies

Medical Equipment and Supplies is the smallest of the six subsectors in both the state and the region. Yet it has relatively high skill requirements across a number of technical, basic, and problem solving domains. No single or small set of skills seem to dominate the Medical Equipment workforce. Rather, there are many workers in occupations requiring above average skill levels and the range of skills represented are quite diverse.

Skills related to adaptive learning, and problem solving rank particularly high in this subsector (Figure 22). These include reading comprehension, critical thinking, active listening, complex problem solving and judgment. The skill requirements for Medical Equipment exceed the overall labor pool in areas pertaining to operations monitoring and control, quality control and troubleshooting—skills often shared with Fabri-

**Figure 22**  
Skill Requirements in Medical Equipment and Supplies Occupations



Source: MA EOLWD, OES; US BLS ONET; author's calculations.

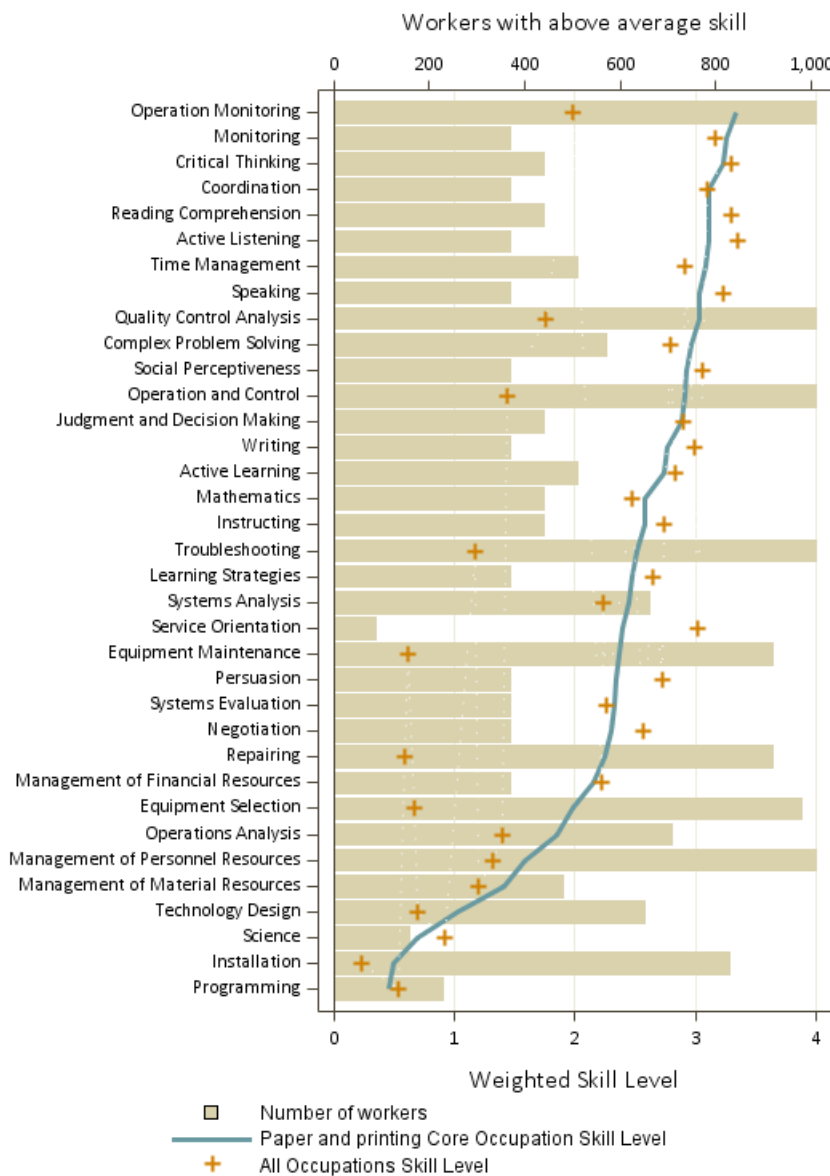
cated Metals and Machinery and Food Processing and Production and fairly abundant in the regional labor pool. Given the subsectors small size, the most effective training approach may be to target these shared skill areas to take advantage of economies of scale and scope in training programs.



## Paper and Printing

The skills profile for the Paper and Printing subsector is somewhat of a blend of Fabricated Metals and Machinery and Food Processing and Production, and shares a few similarities with Medical Equipment and Supplies. Many workers use production-oriented skills, but generally have lower skill requirements than other subsectors. In the Berkshires, the highest average skill levels are in operation monitoring, monitoring,

**Figure 23**  
Skill Requirements in Paper and Printing Occupations



critical thinking, coordination, and reading—reflective of the blended nature of the occupational skill requirements in the subsector (Figure 23). In general, average skill level requirements in the subsector closely correspond with the overall regional labor pool. The exceptions are the high level requirements in areas like quality control analysis, operation and control, troubleshooting, and various equipment oriented skills – skills important to the large number of machine operators and equipment personnel. The core labor pool also has a relatively large number of workers with above average levels in skills that are operational (monitoring and control), equipment management, quality control and troubleshooting. While still core, the Paper and Printing subsector requires only relatively low levels of knowledge in the areas related to design, science and programming.

Source: MA EOLWD, OES; US BLS ONET; author's calculations.

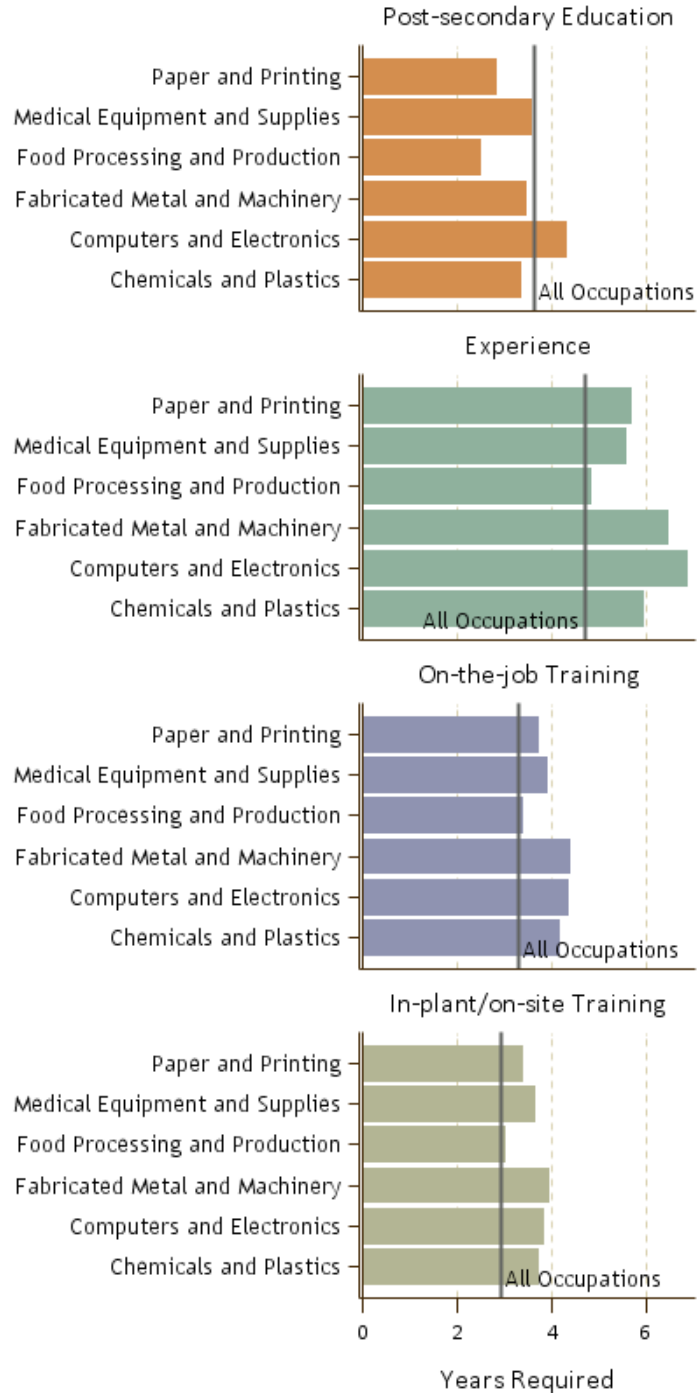
## Experience, Education and Training Requirements

Figure 24 presents the average education and training requirements for the six subsectors in the Berkshire region—measured as the average number of years typically required by the core occupations of each subsector.

The core labor pools in Computers and Electronics have the highest average education requirements, essentially requiring a Bachelor’s degree level education. The major subsectors in the Berkshire region, Paper and Printing; Chemicals and Plastics; and Fabricated Metals have education requirements lower than the regional average. However, along with the other subsectors, average levels of work experience exceed the regional average and have average requirements of greater than 4 years.

A similar story is found for on-the-job and in-plant training requirements. All six subsectors have above average requirements and follow a similar ranking pattern, but are roughly the same across subsectors. In general, we find occupational requirements in the regional Advanced Manufacturing subsectors to follow state averages where knowledge acquisition is rooted in more applied forms of instruction—i.e. learning-by-doing rather than strictly formal educational training. However, in Chemicals and Plastics and Computers and Electronics, a combination of formal education and hands-on work are needed to produce the highly skilled pool of workers needed by employers.

**Figure 24**  
Knowledge Requirements of Core Subsector Labor Pools



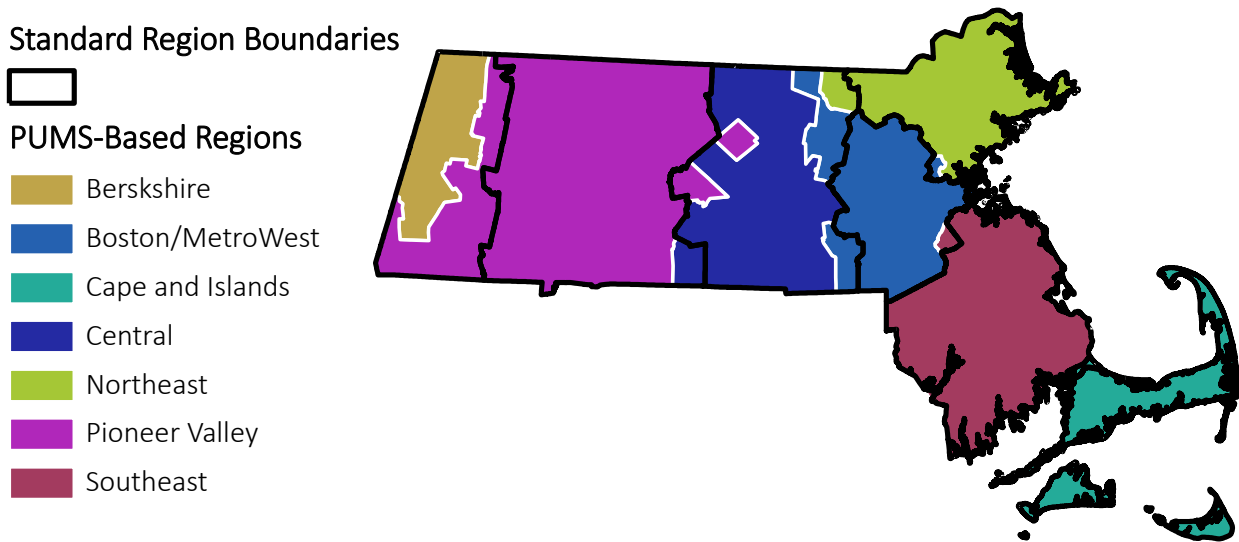
Source: Massachusetts EOLWD, OES; US BLS ONET; author’s calculations.

## Profile of the Advanced Manufacturing Workforce

This final section looks at the people that work in the Advanced Manufacturing sector of the Berkshire region in terms of race, gender, citizenship status, income, education, and commuting patterns. As in the state report, our demographic profile heavily relies on information from the American Community Survey Public Use Microsample (ACS PUMS) — a representative household survey conducted by the U.S. Census Bureau. It is important to keep in mind that the ACS PUMS is a sample, and not a full census count, and as such is prone to error. This is especially true in smaller regions and/or for analysis based on finely detailed subject categories where there is likely to be few survey respondents. While we provide some detailed estimates in Table 11 and the Figures than follow, we warn the reader against interpreting our results as highly precise estimates, but should instead be thought of as revealing general tendencies and trends.

As a final note: our demographic profiles are based on slightly different regional definitions than the rest of the study. This is because the ACS PUMS does not use standard geographic jurisdictions (e.g. towns, counties, and metropolitan areas) but rather its own jurisdictions called PUMAs (Public Use Micro-sample Areas). While we deliberately design each PUMA-based region to closely match our standard (WIA-based) regional boundaries, some differences were unavoidable (Figure 25). In the case of the Berkshires, the PUMS-based region is noticeably smaller, yet still includes all of the regions major employment centers and the bulk of its workforce.

**Figure 25**  
PUMS-Based Study Region Boundaries used in Demographic Analysis



**Table 11**

Summary, Demographic Profile of the Advanced Manufacturing Workforce, Berkshire Region

	Advanced Manufacturing	Chemicals and Plastics	Computers and Electronics Products	Fabricated Metals & Machinery	Food Processing & Production	Medical Equipment and Supplies	Paper and printing	All Industries
<b>Age</b>								
Median	48.0	48.0	51.0	45.0	37.0	46.0	49.0	45.0
Under 25 years old	2%	3%	1%	3%	20%	0%	1%	13%
25 to 39 years	25%	18%	32%	32%	37%	0%	26%	26%
40 to 54 years	50%	60%	30%	45%	17%	81%	53%	36%
55 years or older	22%	19%	37%	20%	26%	19%	19%	24%
<b>Race</b>								
White	93%	98%	87%	88%	100%	80%	94%	94%
African American	3%	0%	3%	4%	0%	0%	6%	2%
Asian	3%	2%	8%	3%	0%	20%	0%	1%
Other race	0%	0%	3%	0%	0%	0%	0%	1%
More than one race	1%	0%	0%	5%	0%	0%	0%	1%
Female	26%	34%	20%	13%	38%	4%	31%	52%
<b>Place of Birth</b>								
Massachusetts	77%	76%	57%	80%	100%	29%	88%	64%
Other New England	4%	2%	9%	4%	0%	0%	4%	7%
Other United States	12%	12%	18%	13%	0%	51%	7%	24%
Outside United States	7%	10%	17%	3%	0%	20%	1%	6%
<b>Median Income (2012 dollars)</b>								
Family Income	\$70,335	\$72,110	\$101,300	\$65,050	\$70,055	\$44,000	\$70,335	\$62,289
Personal Income	\$44,000	\$45,840	\$65,962	\$35,949	\$38,000	\$44,000	\$40,656	\$31,300
Wage and Salary Income*	\$40,656	\$45,738	\$60,767	\$34,300	\$38,000	\$44,000	\$40,000	\$27,653
<b>Educational Attainment</b>								
Less than High School	5%	3%	0%	8%	23%	2%	5%	5%
High School Diploma or GED	34%	40%	25%	41%	9%	0%	33%	29%
Associates Degree or Some College	33%	24%	23%	29%	45%	7%	49%	31%
Bachelors Degree or Higher	29%	32%	52%	22%	23%	91%	13%	35%
<b>Commuting</b>								
Ave. Travel Time to Work (mins)	22.6	21.7	29.9	22.2	20.1	41.1	18.6	19.2
<b>Region/State of Primary Residence</b>								
Berkshire	89%	91%	86%	84%	100%	70%	91%	83%
Boston MetroWest	1%	0%	3%	0%	0%	0%	0%	0%
Cape and Islands	0%	0%	0%	0%	0%	0%	0%	0%
Central	1%	0%	0%	3%	0%	0%	0%	0%
Northeast	0%	0%	0%	0%	0%	0%	0%	0%
Pioneer Valley	8%	4%	10%	11%	0%	30%	9%	9%
Southeast	0%	0%	0%	0%	0%	0%	0%	0%
Other State	2%	5%	1%	3%	0%	0%	0%	7%

\*Note: Wage and Salary Income reported in the ACS is different than the Total Wage and Salary reported from the Bureau of Labor Statistics and State Affiliates. The ACS is based on a much smaller sample of the workforce and does not include the dollar value of benefits as reported in BLS employer surveys.

## Age

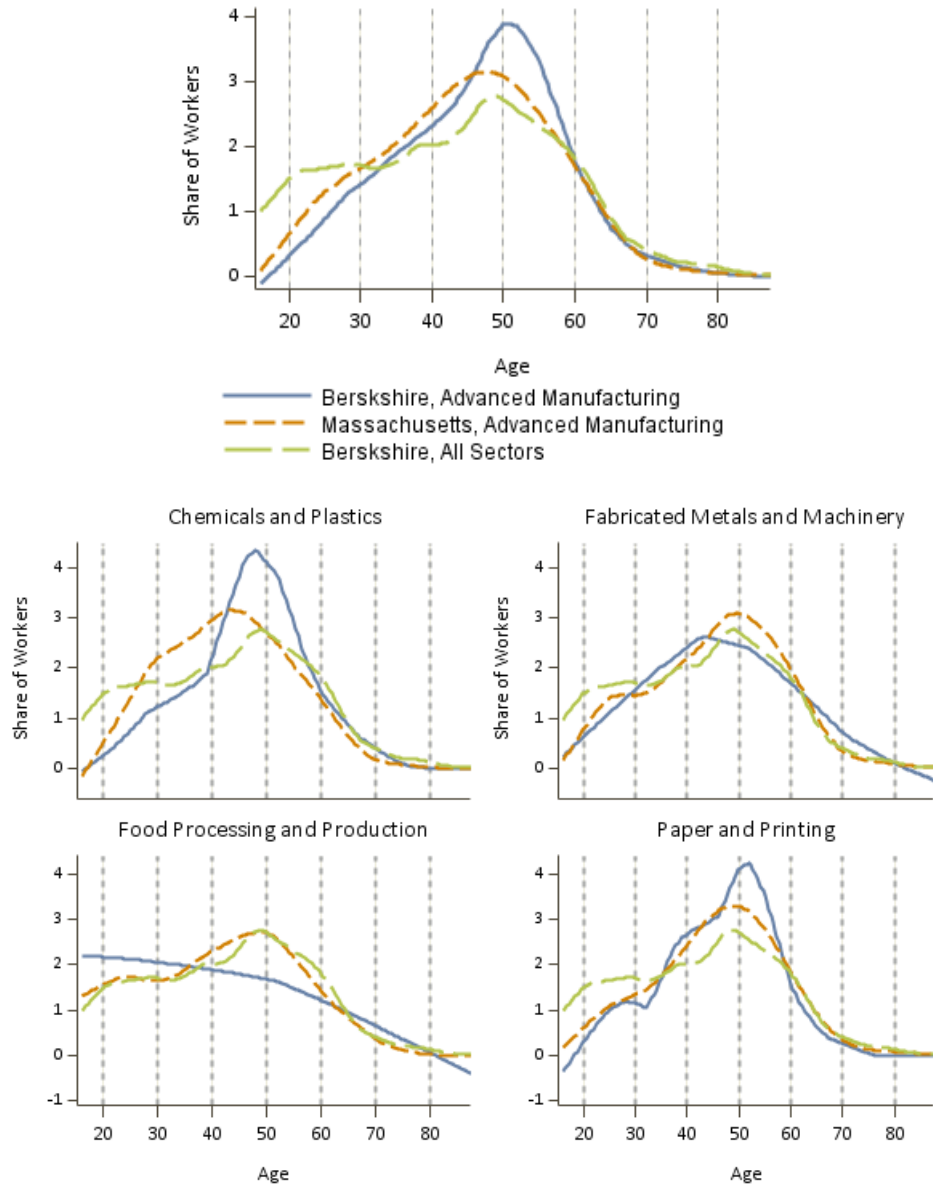
The anticipated manufacturing labor shortage is likely to start sooner and have a particularly acute impact in the Berkshire region in the coming years unless immediate action is taking to get more young people interested and trained in the skills needed by tomorrow's manufacturing sector.

The Advanced Manufacturing workforce of the Berkshires is the oldest of any region in the Commonwealth, with a median age of 48 compared to the state sector median of 45 (Table 11). Within the next twenty years, over 60 percent of the region's Advanced Manufacturing workforce will approach or enter the traditional retirement age of 65 years.

This is considerably higher than the state average of 52%

**Figure 26**

Age Distribution of the Advanced Manufacturing Workforce and Selected Subsectors, Berkshire region



Source: US Census Bureau, American Community Survey PUMS 2008-2012, Author's Calculations

for the same age group. The Berkshires also has few workers under the age of 25 to help offset the lost knowledge and skills of anticipated retirees (Figure 26).

Figure 26 also shows the workforce age distribution for the four largest subsectors in the Berkshires. The two largest subsectors, Chemicals and Plastics and Paper and Printing, will likely face the greatest difficulties associated with the aging workforce. By contrast, Food Processing is comprised of a younger than av-

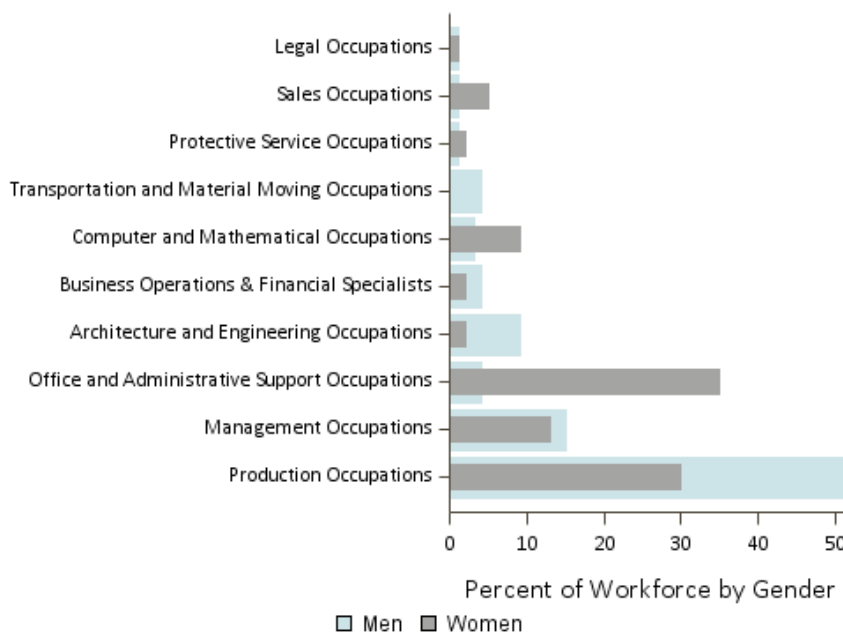
erage workforce, and impending retirements will likely cause little friction. The region’s Fabricated Metals subsector is another interesting case, because its workforce skews considerably younger than it does in other regions of the Commonwealth—where it is typically among the oldest of all subsectors.

### Race, Gender and Nativity

The overall workforce of Berkshire county is far less racially diverse than the balance of the Commonwealth, with approximately 94% of the population self-reported as “white alone.” The Advanced Manufacturing workforce largely follows the overall race profile of the region (Table 11). There, is however, a slightly higher share of African American in the Fabricated Metals subsector and Asian workers in Computers and Electronics and Medical Equipment. However, the sample sizes of minorities in specific subsector can be very small and may not be accurate. The Advanced Manufacturing sector also has a slightly higher share of foreign born workers, again primarily found in Computers and Electronics and Medical Equipment.

Advanced Manufacturing is also predominantly male, and the gender gap varies considerably by occupation and industry. Women make up only 26% of the Berkshire Advanced Manufacturing workforce—one of the lowest female participation rates in the state. While women are underrepresented in every subsector, the gender divide is largest in Medical Equipment and Supplies, Fabricated Metals and Computers and Electronics. The largest share of the women working in Advanced Manufacturing work in Office and Administrative Support Occupations where they are also heavily concentrated (Figure 27). By contrast, men are far more prominent in architecture and engineering and produc-

**Figure 27**  
Gender Differences by Major Occupation Groups in Advanced Manufacturing



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, Author’s Calculations

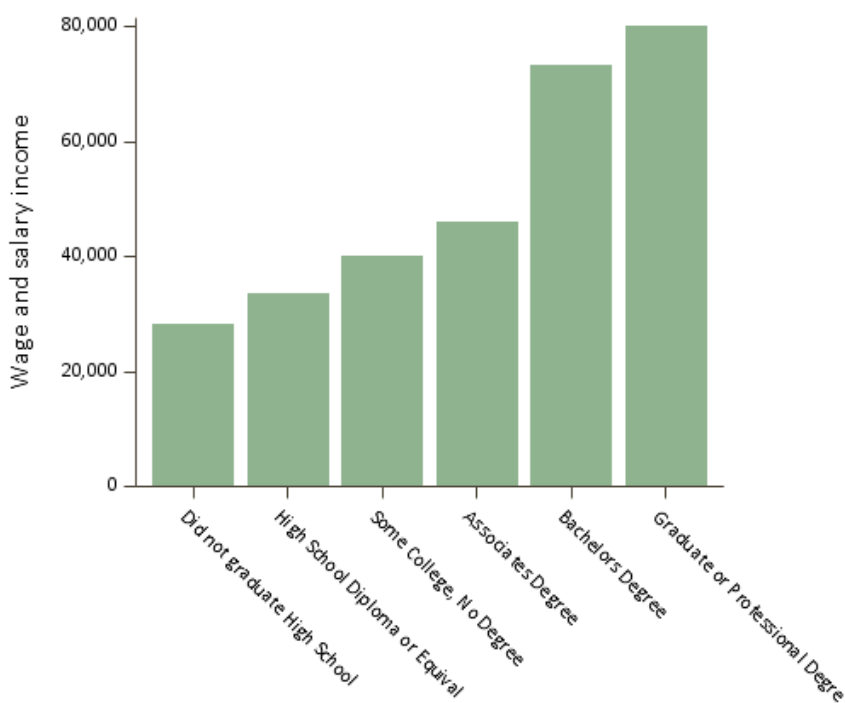
tion occupations. Unlike other regions, the share of the women in managerial positions is nearly equivalent to the share of men—although far fewer in number considering that only 26% of the Advanced Manufacturing workforce is female.

### Educational Attainment and Income

The Advanced Manufacturing workforce in the Berkshires is relatively less likely to have attended college than elsewhere in the Commonwealth. Roughly 62% of the people working in the Berkshires' Advanced Manufacturing sector have at least some college education (Table 11). This is below the educational attainment level of the regional workforce as well as the Commonwealth sectoral average (both close to 66%). While lower, on average, the Berkshire workforce in the Food Production, Medical Equipment, and Paper and Printing subsectors actually exceed their respective state averages.

Consistent with elsewhere in the Commonwealth, workers with higher educational attainment levels earn considerably more than those without (Figure 28). There is a particularly large jump in wages for Bachelors degree holders, as this often denotes the distinction between shop floor workers and managerial/professional staff.

**Figure 28**  
Median Wage and Salary Earnings by Education, Advanced Manufacturing



### Residency and Commuting Patterns

The Berkshire region has one of the highest rates of within-region residency of any region in the state, presumably due to its rela-

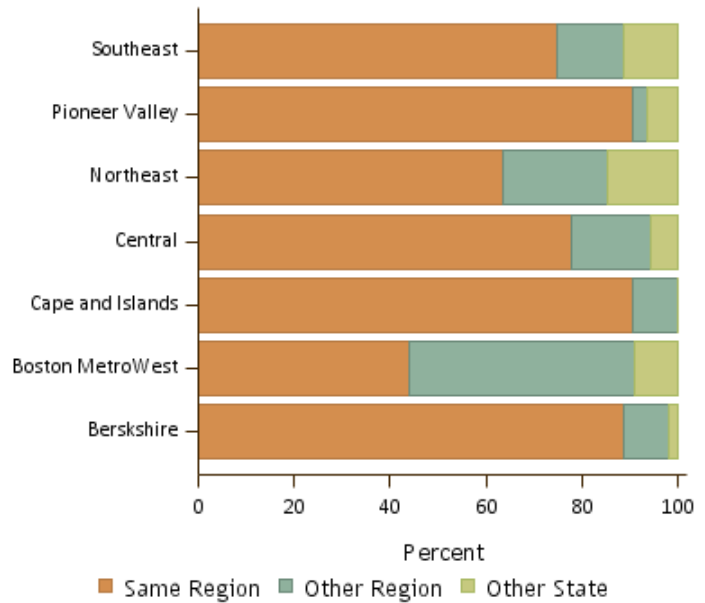
*Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, Author's Calculations*

tive isolation and rural character (Table 11, Figure 29). Nearly 90 percent of those working in the region,

also live there. The average one-way commute time of 23 minutes is also among the lowest in the Commonly. Very few lie outside Massachusetts—despite the region’s shared border with three other states. Those that do lie outside the region, tend to come in from the Pioneer Valley.

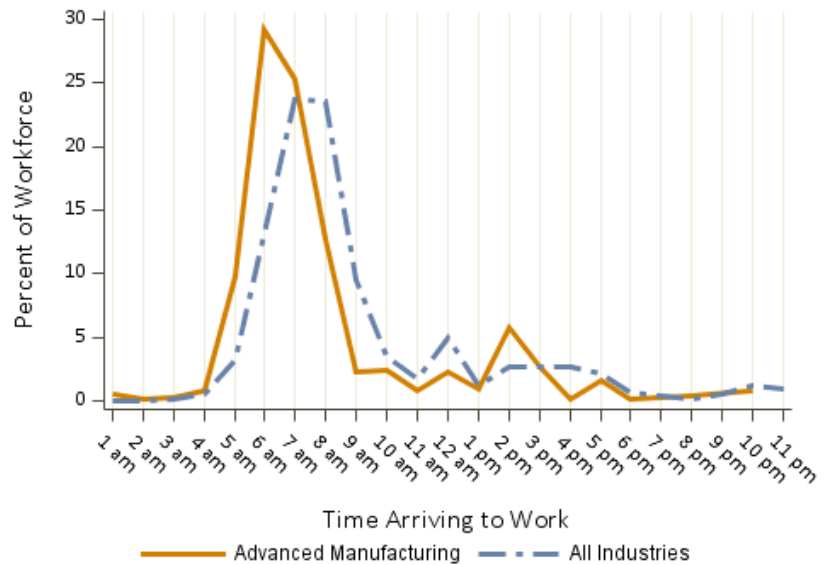
The typical worker in Advanced Manufacturing enjoys a relative standard work day, albeit with a substantially earlier arrival time compared to the typical worker in the region (Figure 30).

**Figure 29**  
Place of Residence by Region



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, author’s calculations

**Figure 30**  
Time Arriving to Work



Source: US Census Bureau, American Community Survey Public Use Micro Sample 2008-2012, author’s calculations



## Appendices

### Appendix A

#### Advanced Manufacturing Subsector Definitions

##### Chemical & Plastics (incl. Pharmaceuticals)

NAICS	Description
3251	Basic chemical
3252	Resin, synthetic rubber, and artificial synthetic fibers
3253	Pesticide, fertilizer, and other agricultural chemical
3254	Pharmaceutical and medicine
3255	Paint, coating, and adhesive
3256	Soap, cleaning compound, and toilet preparation
3259	Other chemical product and preparation
3261	Plastics product

##### Fabricated Metal Products & Machinery

NAICS	Description
3321	Forging and stamping
3322	Cutlery and handtool
3323	Architectural and structural metals
3324	Boiler, tank, and shipping container
3325	Hardware
3326	Spring and wire product
3327	Machine shops; turned product; and screw, nut, and bolt
3328	Coating, engraving, heat treating, and allied activities
3329	Other fabricated metal product
3331	Agriculture, construction, and mining machinery
3332	Industrial machinery
3333	Commercial and service industry machinery
3334	Ventilation, heating, air-conditioning, and commercial ref
3335	Metalworking machinery
3336	Engine, turbine, and power transmission equipment
3339	Other general purpose machinery

##### Paper and Printing

NAICS	Description
3221	Pulp, paper, and paperboard mills
3222	Converted paper product
3231	Printing and related support activities

##### Computer and Electronic Products

NAICS	Description
3341	Computer and peripheral equipment
3342	Communications equipment
3343	Audio and video equipment
3344	Semiconductor and other electronic component
3345	Navigational, measuring, electromedical, and control instruments
3346	Manufacturing and reproducing magnetic and optical media
3351	Electric lighting equipment

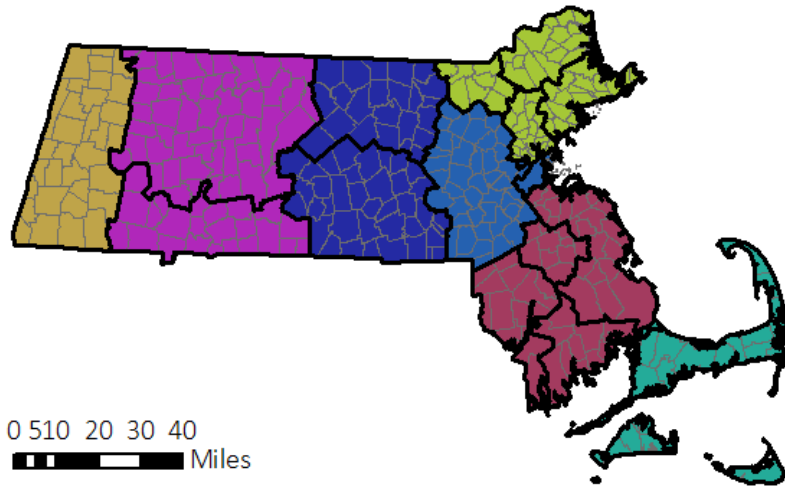
##### Food Processing and Production

NAICS	Description
3112	Grain and oilseed milling
3113	Sugar and confectionery product
3114	Fruit and vegetable preserving and specialty foods
3115	Dairy product
3116	Animal slaughtering and processing
3117	Seafood product preparation and packaging
3118	Bakeries and tortilla
3119	Other food


##### Medical Equipment and Supplies

NAICS	Description
3391	Medical equipment and supplies








Appendix B  
Regional Boundary Definitions



Legend

 Workforce Investment Areas

Study Regions

-  Berkshire
-  Cape & Islands
-  Central
-  Boston MetroWest
-  Northeast
-  Pioneer Valley
-  Southeast