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**NORTHEAST
OHIO
HIGH-TECH
ECONOMY
REPORT**

**Center for
Economic
Development**



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EXECUTIVE SUMMARY

INTRODUCTION

This study is an update of three previous reports commissioned by NorTech examining the high-tech sector of Northeast Ohio (NEO). This study shows trends in NEO's high-tech sector and compares their dynamics with the high-tech sector in the Remainder of Ohio, the state of Ohio, the Midwest, and the United States. This study presents high-tech sectors data for the period from 2000 to 2008 with special highlights on the changes from 2004 to 2008 and the latest years' changes of 2006 and 2007 to 2008.

The report shows overall trends of the high-tech sector in terms of changes in employment, average annual wages, gross regional product (value added of goods and services produced in a region) and productivity (gross regional product per employee). High-tech trends are examined in eight technology groups and individual industries focusing on employment and average wages data. Northeast Ohio's and the Remainder of Ohio's fastest growing industries and technology groups are analyzed and compared. In addition to industry analysis, the report also analyzes research and development (R&D) for industries and universities using the most recent data available. A new section in this year's report analyzes the high-tech sector described not only by industry, but also by occupation. The study looked at employment in high-tech occupations and compare technology-oriented occupations to non-technology-oriented occupations within the high-tech sector of the regional economy.

MAIN FINDINGS

✓ In 2008, NEO high-tech sector employment reached 174,754; it was growing despite a continued decline of total employment. NEO high-tech employment was growing faster than in the Remainder of Ohio and the Midwest, however, its share of high-tech

employment in total employment was not growing fast enough to close the gap between Northeast Ohio and the Remainder of Ohio, the Midwest, and the United States.

- ✓ In 2007 to 2008, the main growth in NEO's high-tech sector occurred in highly technology-intensive industries – a group that characterizes the most sophisticated jobs within the high-tech sector. Both Northeast Ohio and the Remainder of Ohio gained jobs in this group, faster than the Midwest, but not as fast as the very technology- intensive group in the United States.
- ✓ In 2008, the annual average wage in the NEO high-tech sector was \$71,864, which was 93% higher than the average wage for non-high-tech industries (\$37,246). However, the high tech wage was \$2,016 lower than in 2007. The wage decline occurred in both the high-tech and non-high-tech sectors in all regions included in our comparison from 2007 to 2008, which is consistent with the decline in the overall economic recession. Northeast Ohio continues to have a large gap in annual average wages paid in the high-tech sector compared to in the Remainder of Ohio (Northeast Ohio paid 12.1% lower wages), the Midwest (15.6%), and the United States (19.7%).
- ✓ Three technology groups showed growth from 2007 to 2008: Management, Sales, and Facilities Support (primarily comprised of companies' headquarters); Energy and Power and Propulsion; and Information and Communication. The Management, Sales, and Facilities Support group remains not only the largest group accounting for more than 30% of all jobs in high-tech industries, but also the one with the most growth in 2007 to 2008 (1,838 employees, 3.5%). Other large technology groups are Information and Communication (16.6%, grew 2.7%) and Science & Engineering (16.3%, grew 1.8%). The three largest groups, combined, account

for more than 63% of all high-tech employment in Northeast Ohio in 2008.

- ✓ Of all employment in 2008 NEO's high-tech sector, only 23.7% of occupations were considered to be technology-oriented. More than three quarters of all high-tech sector jobs (133,389 or 76.3%) were in non-technology-oriented occupations helping to sustain the production of high-tech industries.
- ✓ NEO's colleges and universities reported \$492,783 million in research expenditures in FY 2008. As with the industry R&D expenditures, NEO's academic R&D expenditures were growing, but they accounted for only 24.5% of the total in Ohio in 2007 and 27% in 2008. Although in 2007 to 2008 NEO academic R&D and industry R&D expenditures grew at the highest rate of all benchmark areas, the region significantly lags in per employee expenditures. Academic per employee expenditures in 2008 in Northeast Ohio were only 60% of those in the Remainder of Ohio, 70% of the Midwest, and 64% of U.S. institutions.

DETAILED FINDINGS ON HIGH-TECH SECTOR PERFORMANCE

Between 2007 and 2008, NEO high-tech employment grew by 1.8% (3,025 jobs).¹ Although NEO high-tech **employment** grew faster than in the Remainder of Ohio and the Midwest, it did not catch up with the U.S. high-tech employment growth, which increased by 2.4% from 2007 to 2008. While the difference between the U.S. and NEO high-tech sectors' employment growth was 1.2% in the period from 2006 to 2007, in 2007 to 2008 this difference decreased to 0.6%.

¹ This year's report is based on a slightly changed definition of the high-tech sector following the changes in NAICS system. Accounting for these changes, last year's growth, between 2006 and 2007, is estimated at 0.52%, which is lower than previously estimated with the definition of high-tech (1.4% in last year's report). This downscaling of last-year's growth number shows that this year's growth is a conservative estimate of the changes in the NEO high-tech sector.

Northeast Ohio is still lagging behind the nation, but it is closing the gap in the rate of employment growth in the high-tech sector.

Despite the fast growth of the NEO high-tech sector, the share of high-tech industries in total employment is the lowest of all benchmark regions. Almost one third (31%) of NEO's high-tech sector was in the group of highly technology-intensive industries (Level I) in 2008. The employment in Level I industries grew 10.1% and its share within total high-tech employment increased by 2% compared to 2004. This is the fastest growing technology level and added the most employment in high-tech jobs to the regional economy.

In 2008, the **annual average wage** for high-tech jobs in Northeast Ohio was \$71,864.² This illustrates a decline in the average wage in NEO's high-tech sector of \$2,016 from 2007 and \$271 from 2006. The wage decline in both the high-tech and non-high-tech sectors in all regions included in our comparison from 2007 to 2008 is consistent with the overall economic recession. Within the high-tech sector, the largest decrease was observed in the Remainder of Ohio (-3.0%) where average wages fell from \$84,255 to \$81,741. It was followed by Northeast Ohio with a decline in average annual wage from \$73,880 in 2007 to \$71,864 in 2008. U.S. high-tech sector wages declined by -1.4% and the Midwest held its level at above \$85,000, losing only \$234 (-0.3%). In 2008, NEO's average wages were 12.1% (\$9,877) lower than in the Remainder of Ohio, 15.6% (\$13,253) lower than in the Midwest, and 19.7% (\$17,651) lower than in the United States.

In 2008, NEO's high-tech economy produced \$27.5 billion **Gross Regional Product (GRP)**, which represented 17.8% growth since 2000. Northeast Ohio grew in this indicator every year from 2000 to 2007, although it experienced a small decline in 2008. Showing steady growth, the regional high-tech sector started at \$23.3 billion in 2000, passed a mark of \$25.2 billion in 2004, and held at \$27.5

² According to updated definitions of the high-tech sector, some industries now included in high-tech have lower paying jobs than the average of the high-tech sector wages identified in the previous NorTech reports (2008 & 2007).

billion in 2007 and 2008. NEO's non-high-tech sector was also growing from 2000 to 2008, but at a mere 0.2%, which is meager when compared to 4.6% in the Midwest and 15.6% in the United States.

In the period from 2004 to 2008, Northeast Ohio didn't perform in GRP growth as well as other regions, showing only single digit growth (8.9%), while the Remainder of Ohio grew almost twice as fast (15.7%), surpassing again both the Midwest (10.5%) and the United States (14.9%). For the last 2 years, NEO's growth rate was similar to that of benchmark regions, showing an increase at 5.2%. However, in 2007 to 2008, Northeast Ohio was the only region with a decline in GRP (-0.2%), while the Remainder of Ohio's high-tech sector increased its GRP by 3.6%, the Midwest by 2.1%, and the United States by 1.9%.

Measured as the GRP per employee, NEO's high-tech sector **productivity** showed a modest performance as well. In 2007 to 2008, productivity declined in both sectors, high-tech (-1.0%) and non-high-tech (-0.8%). During the same

year, the Remainder of Ohio grew in high-tech productivity by 3.4% while its non-high-tech declined (-1.3%), the Midwest high-tech productivity grew by 1.9%, and the U.S. high-tech productivity grew by 1.0%. For both the Midwest and the United States, the non-high-tech sectors declined at -0.8% and -0.7%, respectively.

Analyzing the high-tech sector in Northeast Ohio by **eight technology groups** (Table I) reveals that Management, Sales, and Facilities Support (primarily comprised of companies' headquarters), remains not only the largest group accounting for more than 30% of all jobs in high-tech industries, but also the one with the most growth in the period from 2007 to 2008 (1,838 employees, 3.5%). Other large technology groups are Information and Communication (16.6%, grew 2.7%) and Science & Engineering (16.3%, grew 1.8%). The three largest groups, combined, account for more than 63% of all high-tech employment in Northeast Ohio in 2008. Moreover, all three groups were growing in the period from 2007 to 2008 and added 3,137 jobs to NEO high-tech.

TABLE I. EMPLOYMENT IN BENCHMARK REGIONS BY TECHNOLOGY GROUPS, 2004-2008

Technology Group	Emp 2008	Percentage Change: 2004-2008				Percentage Change: 2007-2008			
	NEO	NEO	Rem OH	MW	US	NEO	Rem OH	MW	US
Advanced Manufacturing	17,331	2.20	4.50	0.91	1.68	-2.45	0.26	-0.89	0.02
Advanced Materials	15,849	-5.97	-0.84	0.04	-6.55	-0.29	2.12	-0.22	-0.55
Electronics	16,300	-1.12	-10.08	-1.80	-2.21	-0.52	-2.78	-0.20	-0.89
Energy and Power & Propulsion	13,130	7.64	11.22	3.71	8.53	3.32	3.39	2.15	3.35
Information & Communication	29,028	6.66	4.33	5.56	7.72	2.80	1.68	2.19	3.23
Mgmt, Sales & Facilities Support	53,151	0.13	2.23	3.36	9.81	3.58	2.42	1.62	2.72
Pharmaceuticals	1,449	N/A	N/A	-3.88	1.55	2.16	3.12	0.73	-0.80
Science & Engineering	28,517	12.62	11.30	8.38	20.59	1.82	1.73	1.28	3.79
Total High-Tech Employment	174,754	3.28	4.33	3.66	8.77	1.76	1.74	1.20	2.43
Total Employment, all Industries	1,983,341	-0.96	0.98	1.39	5.81	-0.81	-0.26	-0.16	0.59

Average wages in all NEO technology groups are lagging behind average wages in the groups at the national level, the Midwest, and the Remainder of Ohio, respectively. The technology group that is competitive in all Midwest states is Science and Engineering. This is the second of only two NEO technology groups that showed growth of annual average wages in the period from 2007 to 2008, and the one with the smallest gap in annual average wages between it and the Remainder of Ohio (\$3,973) and other benchmark regions (\$17,537 between it and the Midwest and

\$17,082 between it and the U.S.). The wages in this group were growing over the last year and showed a high growth rate over the longer period of time, from 2004 to 2008.

Out of all employment in 2008 NEO's high-tech sector, only 23.7% of **occupations** were considered as technology-oriented (Table II). More than three quarters of all the high-tech sector jobs (133,389 or 76.3%) were in non-technology-oriented occupations, helping to sustain the production of high-tech industries.

TABLE II. EMPLOYMENT IN HIGH-TECH SECTOR BY HIGH TECHNOLOGY OCCUPATIONS, 2008

High-Tech Industries Employment by Occupations	Employment	Percentage
Total High-Tech Industries Employment	174,754	100.0%
High-Tech Occupations	41,365	23.7%
Non-High-Tech Occupations	133,389	76.3%

The largest occupational group that employs workers in technology-oriented occupations is Computer and Mathematical Science Occupations; it employs 19,544 technology-oriented jobs or 47.2% of all technology-oriented occupations in NEO's high-tech sector. It is followed by Architecture and Engineering Occupations with 15,007 technology-oriented occupations, which accounts for another 36.3% of all technology-oriented occupations in NEO's high-tech sector.

In NEO's high-tech sector, the largest non-technology-oriented occupational group was Office and Administrative Support Occupations, which employed 32,437 workers in 2008. It was followed by Production Occupations – 27,852, Business and Financial Operations Occupations – 17,030, Installation, Maintenance, and Repair Occupations – 11,156, and Sales and Related Occupations – 10,118 workers.

Industry R&D expenditures in Northeast Ohio leads in the rate of growth over the longer period of time and over the last 3-year and 1-year periods. In Northeast Ohio it grew by more than 16% since 2000, while all other benchmark regions except the United States experienced

declines in industry R&D. NEO's industry R&D increased more than 50% between 2004 and 2007 and grew 6.3% over the last year, 2006 to 2007. It outpaced the Remainder of Ohio (2.3% in 2006-2007), the Midwest (-0.4%), and even the national level (5.7%). However, when industry R&D funding is calculated per employee, Northeast Ohio still significantly lags all benchmark areas. In 2007, industry R&D funding per employee in Northeast Ohio was \$959 compared to \$1,665 in the Remainder of Ohio, \$2,121 in the Midwest, and \$2,020 in the United States.

NEO's colleges and universities reported \$492,783 million in research expenditures in FY 2008. Similarly to the industry R&D expenditures, NEO's **academic R&D expenditures** accounted for only 24.5% of the total in Ohio in 2007 and 27% in 2008. NEO's academic R&D also grew at the highest rate of all benchmark areas, by 7.4% in 2007 to 2008, 7.3% from 2006 to 2008, and 43.3% since 2004. Moreover, a large amount of research activity in Northeast Ohio takes place outside academic institutions, such as the Cleveland Clinic Lerner Research Institute, and NASA Glenn Research Center. Although Northeast Ohio has experienced solid growth in academic R&D

overall, due to the density of its population and employment Northeast Ohio again lags the state, the Midwest, and the nation in its level of funding when R&D expenditures are calculated per employee. In 2008, per employee expenditures in Northeast Ohio were \$248, up from \$230 in 2007, but about only 60% of that in the Remainder of Ohio, 70% of the Midwest, and 64% of the United States.

Northeast Ohio's high-tech sector is improving, but it still has a long way to go to close the gap in its high-tech share of our regional economy, the sophistication of its high-tech jobs, and the academic and industry R&D expenditures in Northeast Ohio and the Remainder of Ohio, the Midwest, and the nation. These three crucial indicators illustrate that the regional economy is restructuring towards a bigger presence of technology-intensive and knowledge-intensive companies and industries.

INTRODUCTION

This report analyzes the high-tech sector in Northeast Ohio (NEO). It was prepared for NorTech by the Center for Economic Development at Cleveland State University's Levin College of Urban Affairs. This study is an update of three previous reports that examined the high-tech sector in Northeast Ohio.

The study shows trends in NEO's high-tech sector and compares their dynamics with the high-tech sector in the Remainder of Ohio, Ohio, the Midwest, and the United States. This study presents high-tech sectors data for the period from 2000 to 2008 with special highlights on the changes from 2004 to 2008 and the latest years' changes of 2006 and 2007 to 2008. The report shows overall trends of the high-tech sector in terms of changes in employment, average annual wages, gross regional product (value added) and productivity (gross regional product per employee). In addition to industry analysis, the report also analyzes research and development (R&D) for both industry and university using data from 2000 to 2007 (the most recent data available). It also includes analysis of employment by high-tech occupations.

The Northeast Ohio region analyzed in this study corresponds to the NorTech Service Area that includes 21 counties (Appendix A). The Remainder of Ohio is defined as Ohio less Northeast Ohio. The Midwest region is defined as an aggregation of six states including: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin.

This report consists of five major parts. The first part includes an executive summary, this introduction, and a brief methodology section. The second part analyzes overall high-tech trends in Northeast Ohio in comparison to the Remainder of Ohio, Ohio, the Midwest and the United States. It also includes an analysis by subregion within Northeast Ohio (6 metropolitan areas and 8 non-metro counties combined) and a snapshot of industry groups divided by technological intensity. The third part of the report presents the analysis of eight technology groups within the 44-industries in the high-tech sector: Advanced Manufacturing; Advanced Materials; Pharmaceuticals; Electronics; Energy and Power & Propulsion; Information and Communication Technology; Management, Sales, & Facilities Support Services (primarily comprised of headquarters of companies); and Science & Engineering. Each of the 44 high-tech industries was assigned to one of the eight technology groups by NorTech. The performance of these groups in NEO is compared to the same groups of industries in the Remainder of Ohio, the Midwest and the United States.

The fourth part of the report analyzes occupations in high-tech industries, differentiating between technology-oriented and other occupations. It looks at the four major occupational groups within high-tech sectors and compares technology-oriented and non-technology-oriented occupations within each of them. The data for NEO occupations are derived using the 2006 U.S. occupation matrix (the latest data available). The last section of the report describes industry and academic research and development (R&D) expenditures and compares Northeast Ohio to Ohio, the Remainder of Ohio, the Midwest, and the United States. The industry R&D are examined from 2000 to 2007 (the last year available), and academic R&D expenditures are examined from 2000 to 2008 overall and by academic institutions and between 2006 and 2007 by the funding sources. The report concludes with major findings and policy recommendations.

RELATIONSHIP TO THE DASHBOARD OF ECONOMIC INDICATORS

This report complements the Dashboard of Economic Indicators project that assesses the state of the economy of the Northeast Ohio's metropolitan statistical areas in comparison to similar size metropolitan areas across the United States. The ongoing effort, which tracks economic and social variables that are linked to economic growth, is supported by the Fund for Our Economic Future (also a funding source for NorTech). For the Dashboard, economic growth is measured in terms of employment, gross regional product, productivity, and per capita income.

This report uses the same four measures of economic growth and includes an in-depth analysis of employment and wages. It also analyzes industry and academic R&D funding used in the Dashboard Indicators report. It differs from the Dashboard Indicators project, however, in terms of geographic focus and the analytical details. While the Dashboard Indicators project measures economic performance for metropolitan areas, including four in Northeast Ohio, this report defines Northeast Ohio as a 21-county area that includes both metropolitan and non-metropolitan counties. Since Northeast Ohio is not a statistical region that can be compared to other regions in the country, this study compares Northeast Ohio to the national average, the average of Midwest states, the state of Ohio, and the rest of Ohio (all Ohio less the Northeast Ohio). Moreover, this study focuses only on the high-tech sector, while the Dashboard Indicators project addresses all sectors of the economy. Since this study has a more narrow focus, it is possible to include an in-depth analysis of the individual industries that comprise the high-tech sector.

METHODOLOGY

This study examines the high-tech sector in Northeast Ohio. There are four sections of analysis that form a comprehensive picture of the high-tech sector: (1) an analysis of high-tech trends with a regional breakdown within Northeast Ohio and comparison to larger geographic benchmarks with a snapshot of levels of technological intensity, (2) analysis of high-tech industries as eight technology groups, (3) a description of NEO high-tech occupations, and (4) an analysis of research and development activity. These analyses draw upon different data sets and emphasize different dynamics of the high-tech sector.

Northeast Ohio is defined as a 21-county area corresponding to NorTech’s service area (Figure 1). Northeast Ohio includes six metropolitan areas (Cleveland-Elyria-Mentor, Akron, Canton-Massillon, Mansfield, Sandusky, and Youngstown-Warren-Boardman) that encompass 13 metro counties and eight non-metro counties. The Cleveland metro area includes Cuyahoga, Geauga, Lake, Lorain, and Medina Counties; the Akron metro area includes Portage and Summit Counties; the Canton metro area includes Carroll and Stark Counties; the Mansfield metro area includes Richland County; the Sandusky metro area includes Erie County; and the Youngstown metro area includes Mahoning and Trumbull Counties.³ The eight non-metro counties include Ashland, Ashtabula, Columbiana, Crawford, Holmes, Huron, Tuscarawas, and Wayne. A list of all NEO subregions and their counties is also included in Appendix A.

FIGURE 1. NORTECH SERVICE AREA



³ This report excludes Mercer County, Pennsylvania, which is a part of the Youngstown MSA according to OMB definition of metropolitan areas.

ANALYSIS OF HIGH-TECH INDUSTRIES

This study draws from a definition of high-tech industries established by Daniel Hecker,⁴ who identified industries as high-tech with the qualification that, “An industry is considered high-tech if employment in technology-oriented occupations accounted for a proportion of that industry’s total employment that was at least twice the 4.9% average for all industries.”⁵ We adjusted that definition and reduced the number of industries that belongs to high-tech because of the changes in the North American Industry Classification System (NAICS) (Appendix B Table B1). Following these changes, in this study we used 44 four-digit NAICS industries to identify the NEO high-tech sector (in comparison to the previous studies that used a 46-industry high-tech definition).

This section of the study includes two analytical sections: (1) analysis of the high-tech sector overall and (2) analysis of high-tech industries combined into eight technology groups. The changes in the high-tech sector as a whole are supplemented with the distribution of the high-tech sector across NEO geographic regions. Another snapshot is given to an analysis of three groups of high-tech industries distinguished by the level of technological intensity. The second section includes an analysis of eight high-tech groups clustered by market relationships and a detailed analysis of some industries within the groups. The analysis of the overall trends in the high-tech sector includes a comparison of the NEO high-tech sector to that of the benchmark areas: the Remainder of Ohio, the state of Ohio, the Midwest, and the United States. The dynamics of high-tech industries is compared to totals of all industries in employment, annual average wages, gross regional product, and productivity. The dynamics of the overall trend in the high-tech sector is complemented by its distribution across metropolitan areas and rural counties (as one group) within Northeast Ohio.

The analysis of the technology-intensive groups is based on Hecker’s definition of three levels of high-technology industries. Level I includes the 13 most high-tech intensive industries, where employment in high-tech occupations accounts for at least 5 times the national average. These industries are considered highly technology-intensive. Level II includes 12 high-tech industries, where employment in high-tech occupations accounts for 3.0 to 4.9 times the national average. These industries are considered as moderately technology-intensive. Level III includes the 19 high-tech industries where employment in high-tech occupations accounts for 2.0 to 2.9 times the national average. These industries will be referred to as low technology-intensive. This analysis also focuses on employment and average wages in Northeast Ohio, the Remainder of Ohio, the Midwest, and the United States.

The analysis of the 44 high-tech industries divided into eight technology groups is based on an industry assignment to a regional cluster identified by NorTech. This eight technology groups are: Advanced Manufacturing; Advanced Materials; Pharmaceuticals; Electronics; Energy and Power & Propulsion; Information and Communication Technology; Management, Sales, and Facility Support Services (primarily comprised of headquarters of companies); and Science and Engineering. This analysis focuses on trends in employment and average wages in Northeast Ohio, the Remainder of Ohio, the Midwest, and the United States.

Industry trends are examined for the 2004 to 2008 time period, with a special focus on changes in the last-year (2007-2008). The overall trends are assessed in comparison to 2000 as well. After recessionary declines between 2000 and 2004, total employment in Northeast Ohio began to increase in 2005 and kept growing through 2006. Data for 2007 and 2008 show that total NEO employment declined but there was continuous

⁴ Daniel E. Hecker is a former economist at the U.S. Bureau of Labor Statistics. He discerned the high-tech industries definition using three measures of high tech employment – utilization of technology-oriented workers, expenditures for R&D, and utilization of technology-oriented workers and R&D expenditures combined.

⁵ Daniel E. Hecker “High-technology employment: a NAICS-based update.” *Monthly Labor Review*, pp. 57-72, July 2005.

growth in high-tech employment. Following these trends, we established three time periods to use in our analysis; we used the 2004 to 2008 period to track gains in Northeast Ohio during the expansionary years and the 2006 to 2008 period and 2007 to 2008 period to monitor high-tech dynamics during the beginning of the period of employment decline. In some analyses, the dynamics at the state level are omitted due to their similarity with either Northeast Ohio or the Remainder of Ohio. The Midwest region is defined as an aggregation of six states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Employment trends are also analyzed for the subregions that comprise Northeast Ohio—the six metropolitan areas and the non-metro counties.

The industry analyses rely on data from two sources: the Quarterly Census of Employment and Wages (ES202) and Moody's Economy.com. Employment and wage data are extracted from the ES202 database while the gross product and productivity data are extracted from Moody's Economy.com.⁶ There are important data adjustments for these analyses that need to be emphasized. The data for the high-tech sector in this report is different from the data shown in the previous years of this study. Two factors explain this difference: changes in the definition of NAICS and revisions in data from earlier years. Hecker defined high-tech industries using 2002 NAICS; however, the classification system of industries was updated in 2007 and the update affected Hecker's definition. The previous reports were based on the 2002 NAICS definition of industries; this current report is based on 2007 NAICS. Major NAICS changes occurred in four high-tech NAICS sectors, three sectors were discontinued (5161, 5173, and 5181) and one sector was added (5191). Employment in NAICS 5173 (Telecommunication resellers) was distributed to non-high-tech NAICS 5179 (Other telecommunications); all of the employment from NAICS 5161 (Internet publishing and broadcasting) was transferred to NAICS 5191 (Other information services); and a portion of NAICS 5181 (Internet service providers and web search portals) also went to NAICS 5191. We added NAICS 5191 sector to the high-tech definition due to these transfers. In addition to the former high-tech NAICS (all 5161 and a part of 5181) that were transferred to NAICS 5191, this sector by itself has substantial employment. Within NAICS 5191, we excluded subsector NAICS 51912 (Libraries and archives) from the total employment of NAICS 5191 due to the non-technology nature of the majority of jobs in this subsector.⁷

HIGH-TECH OCCUPATIONS

This report analyzes the high-tech sector not only in terms of industries, but also by occupations. According to Daniel Hecker, 71 technology-oriented occupations, such as scientific, engineering, and technical occupations, are used to define high-tech industries. Workers in these high-tech occupations "need an in-depth knowledge of the theories and principles of science, engineering, and mathematics underlying technology, a knowledge generally acquired through specialized post-high school education in some field of technology leading up to an award ranging from a vocational certificate or an associate's degree to a doctorate. Individuals employed in these occupations are collectively referred to as technology-oriented workers."⁸ Employment within the 71 high-tech occupations for Northeast Ohio was derived from applying the Bureau of Labor Statistics National Employment Matrix's distribution to NEO 2008 total employment. Using a cross section analysis between high-tech industries and high-tech occupations shows that there are also non-high-tech occupations' workers that are employed within high-tech industries. The occupational employment is analyzed for the whole region and looks at the high-tech sector from three perspectives: (1) the share of high-tech and non-high-tech occupations within NEO's high-tech sector, (2) the employment of

⁶ Employment data include all workers in high-tech industries — regardless of whether they are employed in high-tech occupations or not.

⁷ Besides, subsector NAICS 51912 contains mainly publicly funded libraries, which makes data on this sector for Northeast Ohio less comparable to the Midwest and the United States data that includes only statistics for private establishments. All NAICS definitions mentioned in this section can be found in Appendix B to this study.

⁸ Daniel E. Hecker "High-technology employment: a NAICS-based update." *Monthly Labor Review*, p. 58, July 2005.

high-tech and non-high-tech occupations within occupational categories, and (3) the high-tech and non-high-tech detailed occupations that employ the largest number of workers from the high-tech sector.

RESEARCH & DEVELOPMENT ANALYSIS

The study examines research and development activity in the region using data on industry R&D funding and R&D expenditures of academic institutions. In addition, some information is provided on the R&D activity of two large research institutions in Northeast Ohio, the NASA Glenn Research Center and the Cleveland Clinic. Data on industry and academic R&D were obtained from the National Science Foundation (NSF) Division of Science Resources Statistics.

The industry R&D in Northeast Ohio and the Remainder of Ohio is estimated by distributing statewide funding according to each county's share of employment in one industry—Scientific Research and Development Services (NAICS 5417). This industry includes private sector companies with a primary function of research and development; therefore, employment levels are used to develop a proxy of industry R&D funding at the regional level. Employment counts for NAICS 5417 are derived from Moody's Economy.com data.

Academic R&D expenditures are provided for individual institutions in Northeast Ohio that reported data to NSF. The latest data for industry R&D is for 2007 and for academic R&D is 2008. R&D data for other research institutions (the Cleveland Clinic and NASA Glenn Research Center) were provided by the respective institutions.

HIGH-TECH INDUSTRIES: OVERALL TRENDS AND GEOGRAPHIC DISTRIBUTION

EMPLOYMENT TRENDS

This section provides the analysis of high-tech industries showing the overall trend during the period from 2000 to 2008 with a focus on the 2004 to 2008 time period and the dynamics over the last 2 years (Figure 2, Table 1, and Table 2).

FIGURE 2. TOTAL EMPLOYMENT AND HIGH-TECH EMPLOYMENT SINCE 2004
Index, 2004=100

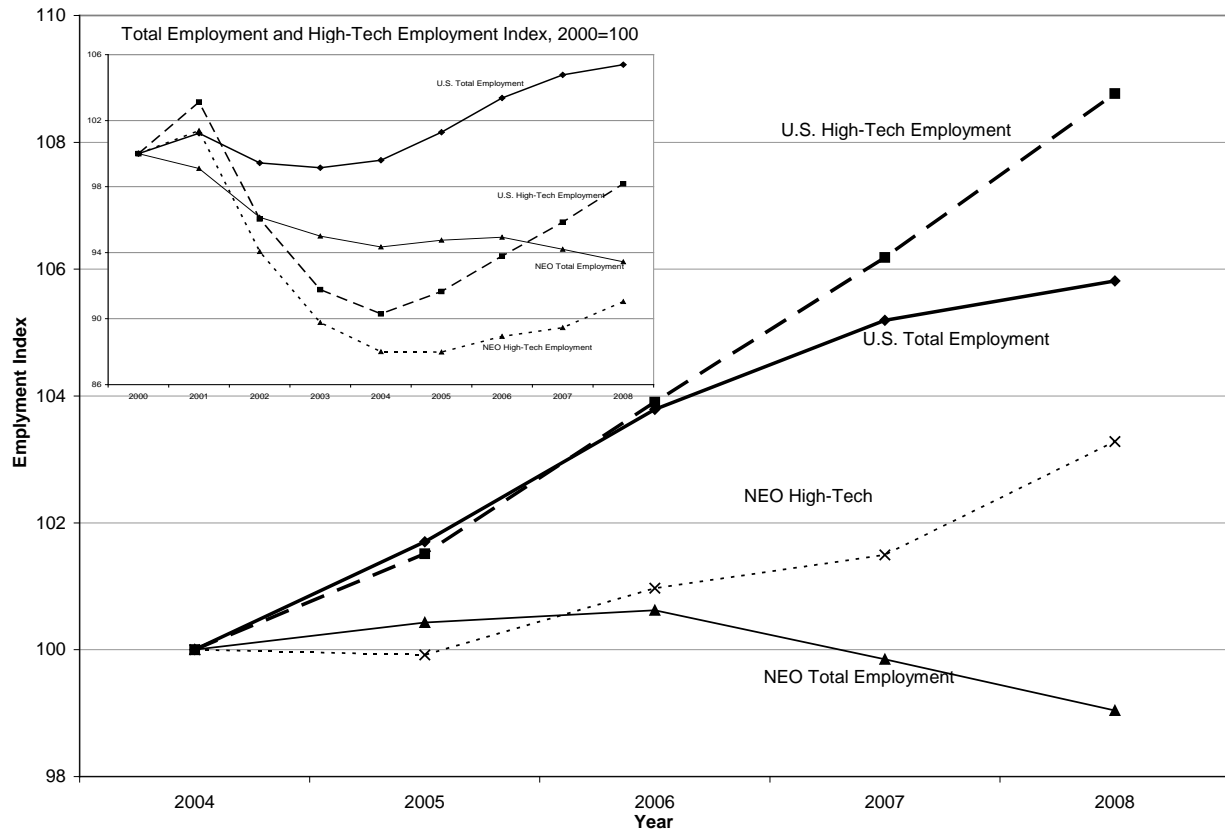


TABLE 1. TOTAL EMPLOYMENT AND HIGH-TECH EMPLOYMENT IN NEO AND THE U.S., 2000-2008

	2000	2001	2002	2003	2004	2005	2006	2007	2008
U.S. All Industries	127,237,676	128,812,186	126,525,919	126,150,891	126,730,069	128,889,163	131,534,435	133,311,681	134,097,038
U.S. High-Tech Industries	13,380,574	13,800,063	12,836,069	12,254,912	12,057,007	12,239,453	12,527,484	12,802,735	13,114,147
NEO All Industries	2,122,532	2,103,391	2,040,671	2,016,423	2,002,530	2,011,153	2,015,010	1,999,512	1,983,341
NEO High-Tech Industries	193,148	195,776	181,027	172,455	169,202	169,061	170,846	171,729	174,754

TABLE 2. TOTAL AND HIGH-TECH EMPLOYMENT IN NEO AND BENCHMARK REGIONS, PERCENTAGE CHANGE

Geography	2008	2000-2008	2004-2008	2006-2008	2007-2008
Northeast Ohio					
NEO high-tech	174,754	-9.5%	3.3%	2.3%	1.8%
NEO non-high-tech	1,808,587	-6.3%	-1.3%	-1.9%	-1.1%
NEO all industries	1,983,341	-6.6%	-1.0%	-1.6%	-0.8%
Remainder of Ohio					
Remainder of OH high-tech	305,348	-8.0%	4.3%	3.1%	1.7%
Remainder of OH non-high-tech	2,898,273	-2.1%	0.6%	-0.7%	-0.5%
Remainder of OH all industries	3,203,621	-2.7%	1.0%	-0.3%	-0.3%
State of Ohio					
Ohio high-tech	480,102	-8.6%	3.9%	2.8%	1.7%
Ohio non-high-tech	4,706,860	-3.7%	-0.1%	-1.1%	-0.7%
Ohio all industries	5,186,962	-4.2%	0.2%	-0.8%	-0.5%
Midwest States					
Midwest high-tech	2,141,036	-8.7%	3.7%	1.6%	1.2%
Midwest non-high-tech	21,091,436	-1.8%	1.2%	-0.3%	-0.3%
Midwest all industries	23,232,471	-2.4%	1.4%	-0.2%	-0.2%
United States					
U.S. high-tech	13,114,147	-2.0%	8.8%	4.7%	2.4%
U.S. non-high-tech	120,982,892	6.3%	5.5%	1.7%	0.4%
U.S. all industries	134,097,038	5.4%	5.8%	1.9%	0.6%

During the last year, 2007 to 2008, total NEO employment continued to decline following a downward trend since 2006. In 2006, it reversed its 2004 to 2006 growth trend, which illustrated a short break from the longer and larger decline during the 2000 to 2004 time period. The latest decline was less than 1% (-0.8%), exactly the same percentage by which the total employment declined between 2006 and 2007. This time, it reflected the loss of slightly more than 16,000 jobs (16,171).

However, as the last year, this decline is the only negative trend among all four measures presented in Figure 2.⁹ In sharp contrast to trends in total employment, NEO high-tech employment grew by 1.8% (3,025 jobs) between 2007 and 2008¹⁰ (Tables 1 and 2). Although NEO high-tech employment grew faster than in the Remainder of Ohio and the Midwest, it did not catch up with the U.S. high-tech employment growth, which increased by 2.4% from 2007 to 2008. While the percentage point difference between the U.S. and NEO high-tech sectors' employment growth was 1.2% in the period from 2006 to 2007, in 2007 to 2008 this difference decreased to 0.6%.

Comparing NEO and U.S. high-tech sectors over greater periods of time, it is noteworthy that, since 2004, NEO high-tech grew 3.3% (0.83% annually) while the U.S. high-tech sector increased its employment by 8.8% (2.2% annually). Similar dynamics between 2006 and 2008 show that high-tech employment grew at 1.2% annually in Northeast Ohio and 2.4% in the United States. Northeast Ohio is still lagging behind the nation, but it is closing the gap in the rate of employment growth in the high-tech sector.

Moreover, NEO high-tech growth reflects a great effort on the part of the regional economy, which shows signs of restructuring and the potential to become once again a prosperous economic system. Last year, NEO

⁹ In Figure 2 the employment index for every year is calculated as the change from 2004, where 2004 is the base year and is equated to 100. In the reference figure included in Figure 2, the employment index is calculated as the change from 2000, where 2000 is the base year and is equal to 100.

¹⁰ This year's report is based on a slightly changed definition of the high-tech sector following the changes in NAICS system. Accounting for these changes, the last year growth, between 2006 and 2007, is estimated at 0.52%, which is lower than previously estimated with the definition of high-tech (1.4% in last year's report). This downscaling of last-year's growth number shows that this year's growth is a conservative estimate of the changes in NEO high-tech sector.

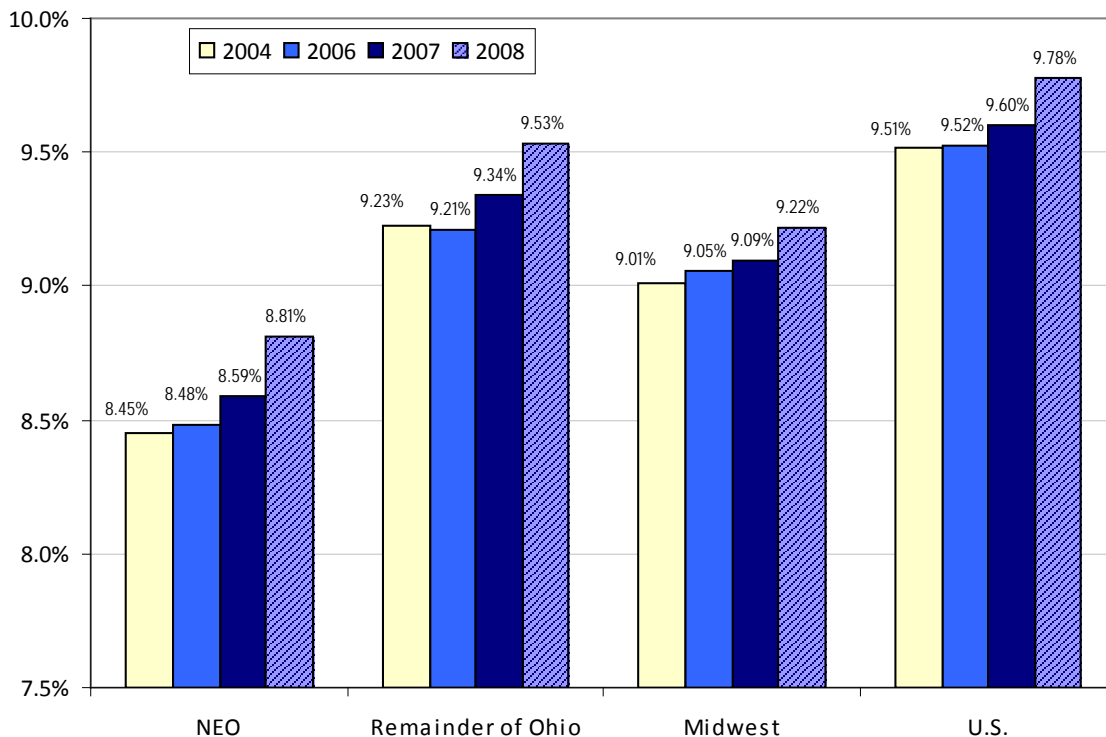
added high-tech jobs 3.4 times faster than in the previous year (2006-2007). NEO's high-tech sector is growing despite the severe decline of the non-high-tech sector, which lost 19,197 jobs or 1.1% from 2007 to 2008. In contrast, the U.S. high-tech sector grew by 2.4% while the non-high-tech industries were growing at the rate of 0.4%.

The Remainder of Ohio (Ohio less Northeast Ohio) shows almost the same performance of the high-tech sector for 2007 to 2008 (1.7%), but it grew faster, 3.1%, over the 2-year period (2006-2008) in comparison to NEO's 2.3%. The Remainder of Ohio also lost jobs in the non-high-tech sector, but the losses were more than half that of NEO. Overall, Ohio's high-tech sector grew faster (1.7%) than the Midwest (1.2%) for the last year and over the last 4 years (2.8% compared to 1.6%, respectively), even though Ohio's non-high-tech sector was losing jobs at a rate (-1.1%) higher than the Midwest (-0.3%).

Not only the employment of NEO high-tech sector was growing, but the share of NEO high-tech employment in total regional employment was growing as well (Figure 3). The rate of increase of the share had accelerated over the last year (2007-2008), growing 0.22% compared to the previous (2006-2007) year's acceleration at 0.11%. Overall, the NEO high-tech share increased 0.33% from 2006 to 2008. However, the increase in the high-tech share is the result of high-tech industries' growth and the decline in total employment.

Despite the fast growth of the NEO high-tech sector share and a level of 8.81% reached in 2008, the region is still much below the Remainder of Ohio high-tech industries' share (9.53%), which is close to that of the entire United States (9.78%). NEO's high-tech share is still not only below the Remainder of Ohio, but is the lowest of all benchmark regions, specifically of Ohio (9.26%) and the Midwest (9.22%). In fact, the Remainder of Ohio high-tech's share of all industries is the second highest in this group following the U.S. share.

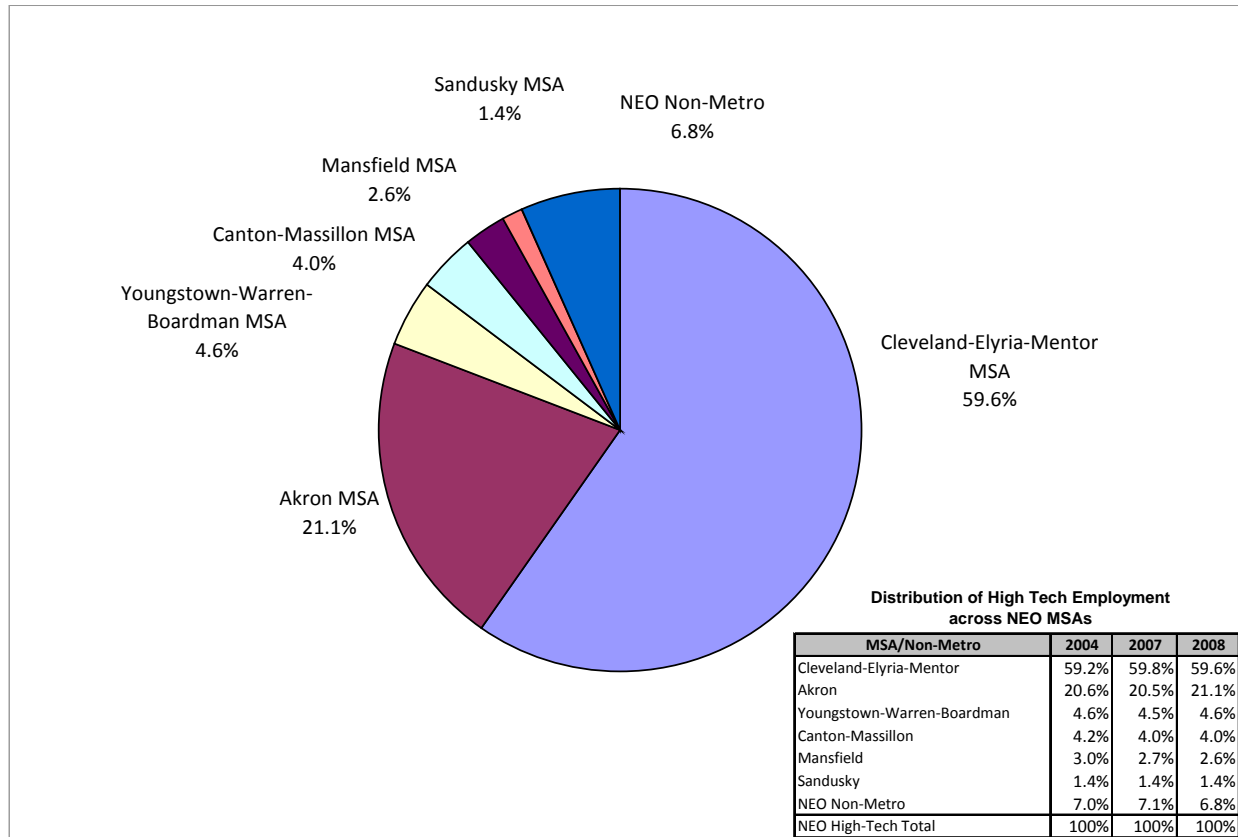
FIGURE 3. HIGH-TECH EMPLOYMENT SHARE: NEO, REMAINDER OF OHIO, MIDWEST, AND U.S., 2004 TO 2008



EMPLOYMENT IN NEO'S SUBREGIONS

In 2008, the distribution of high-tech employment across NEO's six metropolitan areas and rural counties illustrates that the four larger metropolitan areas—Cleveland-Elyria-Mentor, Akron, Youngstown, and Canton-Massillon—together accounted for 89.3% of all NEO high-tech employment, a 0.5% increase from the previous year. The Cleveland-Elyria-Mentor MSA captured the largest share of NEO high-tech employment, holding at almost 60% for the past 2 years (Figure 4.)

FIGURE 4. TOTAL NEO HIGH-TECH EMPLOYMENT BY MSA, 2008



The only significant increase of the high-tech sector within Northeast Ohio occurred in the Akron MSA. From 2007 to 2008, the share of the Akron MSA in NEO high-tech employment increased by 1.4% (from 20.5% to 21.1%), reflecting 1,710 jobs added to this sector. For the same time period, the Cleveland MSA added only 1,482 jobs in the high-tech sector, despite the fact that Cleveland's high-tech sector is almost 3 times bigger. The share of the Cleveland MSA remains almost unchanged between 2004 and 2008.

In Northeast Ohio, the share of high-tech employment within the total employment in each region was the highest in the Akron MSA (11.4%) (Table 3). From 2006 to 2008, Akron increased the high-tech share within its total employment, adding 2,040 jobs. During the same time, Cleveland added 1,962 jobs, which increased its share from 9.9% to 10.3%. Another area with a growing share of high-tech employment is the Sandusky MSA (from 6.8% in 2007 to 7.4% in 2008), but it reflects the addition of only 150 new high-tech jobs and a very small base of the high-tech sector (2,511 in 2008).

TABLE 3. HIGH-TECH EMPLOYMENT SHARE: NEO METROPOLITAN AREAS, 2004-2008

MSA/Non-Metro	2004			2006			2007			2008		
	High-Tech	Total	% of Total	High-Tech	Total	% of Total	High-Tech	Total	% of Total	High-Tech	Total	% of Total
Akron	34,787	310,425	11.2%	34,789	319,084	10.9%	35,119	320,068	11.0%	36,829	322,326	11.4%
Canton-Massillon	7,139	166,291	4.3%	6,918	165,702	4.2%	6,894	165,384	4.2%	6,910	165,118	4.2%
Cleveland-Elyria-Mentor	100,119	1,026,453	9.8%	102,258	1,032,117	9.9%	102,738	1,026,928	10.0%	104,220	1,016,231	10.3%
Mansfield	5,055	57,364	8.8%	4,708	56,934	8.3%	4,656	55,972	8.3%	4,500	55,044	8.2%
Sandusky	2,376	35,532	6.7%	2,353	35,257	6.7%	2,361	34,918	6.8%	2,511	33,964	7.4%
Youngstown-Warren-Boardman	7,863	186,171	4.2%	7,843	185,898	4.2%	7,794	180,745	4.3%	7,985	176,784	4.5%
NEO non-metro	11,862	220,295	5.4%	11,977	220,018	5.4%	12,166	215,497	5.6%	11,798	213,874	5.5%
NEO Total	169,202	2,002,530	8.4%	170,846	2,015,010	8.5%	171,729	1,999,512	8.6%	174,754	1,983,341	8.8%

Overall, Northeast Ohio added 5,552 high-tech jobs while it lost more than 24,741 in other economic sectors between 2004 and 2008. Cleveland, Akron, Youngstown, and Sandusky added high-tech jobs between 2004 and 2008, while Canton, Mansfield, and rural counties lost jobs. More than half (57.5% or 3,192) of the high-tech jobs added to NEO's high-tech sector for the last year were added in Cleveland and Akron, the two largest MSAs. Even though NEO's high-tech sector was growing over the last 4 years, it did not reach the 2000 level of 193,148 jobs. If NEO continues to accelerate annually with the rate of increase it showed in the period from 2007 to 2008, it will surpass the 2000 high-tech employment level in 2 years.

EMPLOYMENT IN NEO BY TECHNOLOGY LEVELS

The three levels of high-technology industries are defined by the level of employment in technology-oriented occupations compared to the national average. Level I group includes the 13 highly technology-intensive industries, where employment in high-tech occupations accounts for at least 5 times the national average. Level II includes 12 moderately technology-intensive industries, where employment in high-tech occupations accounts for 3.0 to 4.9 times the national average. Level III includes the 19 low technology-intensive industries, where employment in high-tech occupations accounts for 2.0 to 2.9 times the national average. The share of technology-oriented employment in each technology level characterizes the level of technological sophistication of the economy.

Almost one third (31%) of NEO's high-tech sector was in the group of highly technology-intensive industries (Level I) in 2008 (Table 4). The employment in this group grew 2.1% (between 2007 and 2008), but the share of this group remained unchanged. The employment in Level I industries grew 10.1% and its share within total high-tech employment increased by 2% compared to 2004. This is the fastest growing technology level group, which added the most employment in high-tech occupations to the regional economy.

The group of Level II high-tech industries captured 21.7% of the high-tech employment (37,888 employees) and remains almost unchanged from 2004 to 2008. Level III industries group captures 47.3% of all high-tech employment and remains unchanged in terms of the number of employees since 2006. Compared to 2004, the employment in this group decreased by 316 employees; however, this trend of losses (-0.8% from 2004 to 2006) has changed to a trend of growth (1.9% from 2007 to 2008).

TABLE 4. NEO EMPLOYMENT BY TECHNOLOGY LEVELS, 2004-2008

Technology Level	Employment Totals				Employment Change, %		
	2004	2006	2007	2008	2004-2006	2004-2008	2007-2008
Level I High-Tech Industries	49,139	51,456	53,022	54,119	4.7%	10.1%	2.1%
Level II High-Tech Industries	37,001	36,994	37,491	37,888	0.0%	2.4%	1.1%
Level III High-Tech Industries	83,062	82,396	81,216	82,746	-0.8%	-0.4%	1.9%
Total High-Tech	169,202	170,846	171,729	174,754	1.0%	3.3%	1.8%
Total Employment in all industries	2,002,530	2,015,010	1,999,512	1,983,341	0.6%	-1.0%	-0.8%

These dynamics in Northeast Ohio are compared with changes in the Remainder of Ohio, the Midwest, and the United States (Table 5). In 2007-2008, Level I high-tech industries in the Remainder of Ohio grew by 2.1%, the same rate as Northeast Ohio, faster than the Midwest (0.9%), but not as fast as this group was growing in the United States (2.4%). The Level II group was growing in the Remainder of Ohio by 2.6%, the most of all three groups, and faster than in Northeast Ohio (1.1%) and the Midwest (1.5%), but, again, not as fast as in the United States. (3.1%).

TABLE 5. EMPLOYMENT CHANGE BY TECHNOLOGY LEVELS IN BENCHMARK AREAS, 2004-2008

Technology Level	2004-2006				2004-2008				2007-2008			
	NEO	Rem OH	MW	U.S.	NEO	Rem OH	MW	U.S.	NEO	Rem OH	MW	U.S.
Level I High-Tech Industries	4.7%	2.6%	2.8%	5.3%	10.1%	7.4%	5.3%	10.7%	2.1%	2.1%	0.9%	2.4%
Level II High-Tech Industries	0.0%	1.2%	4.2%	4.2%	2.4%	5.1%	6.1%	10.4%	1.1%	2.6%	1.5%	3.1%
Level III High-Tech Industries	-0.8%	-0.1%	0.0%	1.6%	-0.4%	1.2%	0.8%	4.8%	1.9%	0.9%	1.3%	2.1%
Total High-Tech Employment	1.0%	1.1%	2.0%	3.9%	3.3%	4.3%	3.7%	8.8%	1.8%	1.7%	1.2%	2.4%
Total Employment in all industries	0.6%	1.3%	1.6%	3.8%	-1.0%	1.0%	1.4%	5.8%	-0.8%	-0.3%	-0.2%	0.6%

For the longer period of time, from 2004 to 2008, both Northeast Ohio and the Remainder of Ohio increased their Level I group by 10.1% and 7.4%, respectively, which were higher rates of growth than any other periods and groups except this group in the United States (10.7%). The higher employment growth rate of Level I high-tech industries indicates an increase of high-tech intensity of the regional economy. Higher technological intensity tends to yield higher productivity and outputs of the regional economy. However additional research is required to define how much higher the regional growth is due to the increase of employment in these industries compared to the regional growth triggered by the increase of employment in other levels of technology-intensive industries.

AVERAGE WAGE TRENDS

In 2008, the average wage for high-tech jobs in Northeast Ohio was \$71,864.¹¹ This illustrates a decline in the average wage in NEO's high-tech sector of \$2,016 from 2007 and of \$271 from 2006 (Table 6 and Figure 5). The wage decline in both the high-tech and non-high-tech sectors in all regions included in our comparison from 2007 to 2008 is consistent with overall economic recession. Within the high-tech sector, the largest decrease was observed in the Remainder of Ohio (-3.0%), where the average wages fell from \$84,255 to \$81,741. It was followed by Northeast Ohio with a decline of the average annual wage from \$73,880 in 2007. U.S. high-tech sector wages declined by -1.4% and the Midwest held its level at above \$85,000, losing only \$234 (-0.3%).

¹¹ According to updated definitions of the high-tech sector, some industries now included in high-tech have lower paying jobs than the average of the high-tech sector wages identified in the previous NorTech reports (2008 & 2007).

TABLE 6. AVERAGE ANNUAL WAGES IN NEO AND BENCHMARK REGIONS, 2000-2008

Geography	2008	2000-2008	2004-2008	2006-2008	2007-2008
Northeast Ohio					
NEO high-tech	71,864	13.6%	9.8%	-0.4%	-2.7%
NEO non-high-tech	37,246	-0.4%	-0.1%	-1.5%	-4.3%
NEO all industries	40,296	1.4%	1.6%	-1.0%	-3.9%
Remainder of Ohio					
Remainder of Ohio high-tech	81,741	11.9%	6.1%	-0.4%	-3.0%
Remainder of Ohio non-high-tech	38,073	2.0%	2.2%	0.1%	-2.3%
Remainder of Ohio all industries	42,267	3.2%	3.2%	0.4%	-2.2%
State of Ohio					
Ohio high-tech	78,208	12.2%	7.2%	-0.4%	-2.9%
Ohio non-high-tech	37,771	1.2%	1.4%	-0.5%	-3.1%
Ohio all industries	41,514	2.6%	2.6%	-0.1%	-2.9%
Midwest States					
Midwest high-tech	85,117	9.7%	7.0%	2.4%	-0.3%
Midwest non-high-tech	40,415	2.5%	1.8%	-0.6%	-2.0%
Midwest all industries	44,534	3.1%	2.9%	0.1%	-1.6%
United States					
U.S. high-tech	89,515	4.1%	6.4%	0.1%	-1.4%
U.S. non-high-tech	42,454	6.3%	4.0%	0.4%	-1.7%
U.S. all industries	47,056	5.0%	4.7%	0.6%	-1.4%

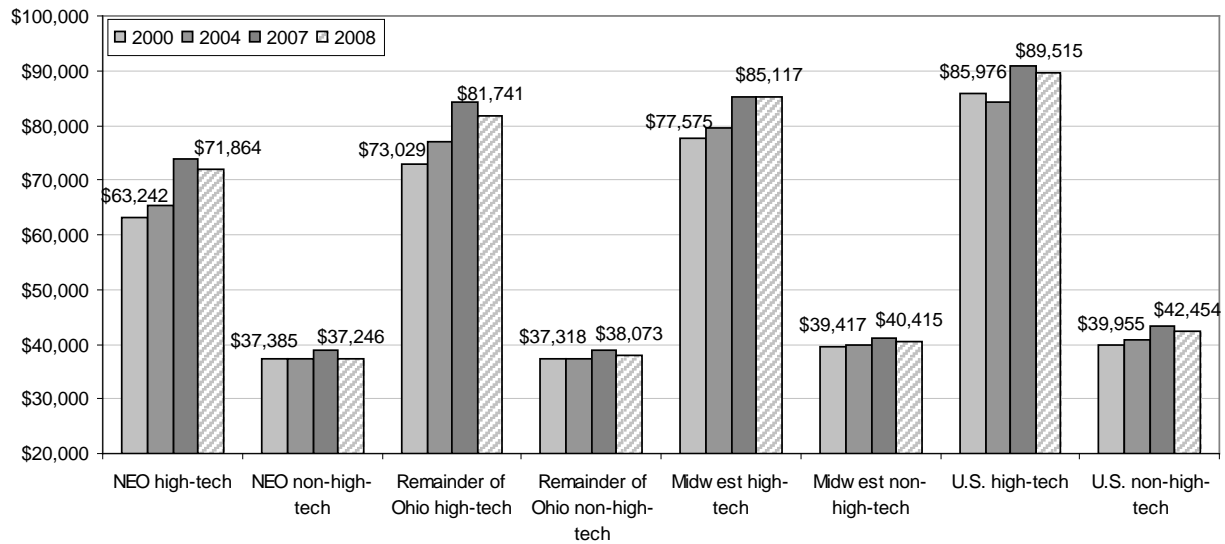
In 2008, the average wage in NEO high-tech industries was 93% higher than the average wage for non-high-tech industries (\$71,864 compared to \$37,246); such a difference was typical for all areas. The average wage in NEO high-tech industries continues to be lower than in all benchmark areas, including the Remainder of Ohio (\$81,741), the Midwest (\$85,117), and the United States (\$89,515). The NEO wage in non-high-tech industries is also consistently lower than in all benchmark areas. As in previous years, the gap between the NEO average wages in high-tech industries and the benchmark areas is much larger. In 2008, NEO average wages were 12.1% (\$9,877) lower than in the Remainder of Ohio, 15.6% (\$13,253) lower than in the Midwest, and 19.7% (\$17,651) lower than in the United States. NEO average wages are slowly closing the gap since 2000 when they lagged behind the U.S. average by 26.4%; in 2004, this gap dropped to 22.2% and in 2006 it was 19.3%. In 2007, the gap between Northeast Ohio and the United States in high-tech average annual wages was 18.6% and in 2008 it was back on the rise and higher than in 2006.

From 2007 to 2008, NEO non-high-tech average wages were declining at the highest rate when compared to other benchmark regions (-4.3%), indicating an average loss of \$1,673. However, the level of non-high-tech wages was critically different only from the U.S. average (\$37,246 compared to \$42,454, respectively).

The combination of a lower share of high-tech employment in the regional economy and the average wages in this sector placed Northeast Ohio at the lowest level of total regional average wages when compared to the benchmarks. In 2008, all industries' average wage was \$40,296 in Northeast Ohio, compared to \$42,267 in the Remainder of Ohio, \$44,534 in the Midwest, and \$47,056 in the United States.

Overall, Northeast Ohio still holds its leading position in high-tech average wage growth from 2000 to 2008 at 13.6% compared to 11.9% in the Remainder of Ohio, 9.7% in the Midwest and 4.1% in the United States. Northeast Ohio also saw the most growth of all regions in this indicator between 2004 and 2008, 9.8% compared to 6.1% in the Remainder of Ohio, 7.0% in the Midwest, and 6.4% in the United States.

FIGURE 5. AVERAGE WAGES IN HIGH-TECH AND NON-HIGH-TECH: NEO, THE REMAINDER OF OHIO, THE MIDWEST AND THE U.S., 2000 – 2008



GROSS REGIONAL PRODUCT AND PRODUCTIVITY TRENDS

In 2008, NEO's high-tech economy produced an added value of \$27.5 billion worth of products and services, which represented 17.8% growth since 2000. Northeast Ohio grew in this indicator every year from 2000 to 2007, although it experienced a small decline in 2008 (Table 7). Showing steady growth, the regional high-tech sector started at \$23.3 billion in 2000, passed a mark of \$25.2 billion in 2004, and held at \$27.5 billion in 2007 and 2008. NEO's non-high-tech sector was also growing from 2000 to 2008, but at a mere 0.2%, meager when compared to 4.6% in the Midwest and 15.6% in the United States.

The total gross regional product (GRP) in Northeast Ohio just reached \$180.2 billion in 2008, rolling back from \$183.8 billion – the highest level during the period NEO high-tech sector reached in 2006. Northeast Ohio's GRP grew from \$175.8 billion in 2000 to \$183.1 billion in 2004; held above \$183 billion for 3 years between 2004 and 2007; and then declined by \$3.5 billion in 2008.

Gross regional product reflects the overall size of the regional economy. Regions that are significantly different in size can be compared using the percentage change of the gross regional product over time. From 2000 to 2008, the high-tech sector in the Remainder of Ohio grew by 19.4%, the highest increase of all benchmark regions. In comparison, the Midwest grew 16.8% and the United States grew 18.6%.

In the period from 2004 to 2008, Northeast Ohio didn't perform as well as other regions, showing only single digit growth (8.9%), while the Remainder of Ohio grew almost twice as fast (15.7%), surpassing again both the Midwest (10.5%) and the United States (14.9%). For the last 2 years, NEO's growth rate was similar to that of benchmark regions, showing a modest increase at 5.2%. However, in 2007 to 2008, Northeast Ohio was the only region with a decline in GRP (-0.2%), while the Remainder of Ohio's high-tech sector increased its GRP by 3.6%, the Midwest by 2.1%, and the United States by 1.9%.

TABLE 7. GROSS REGIONAL PRODUCT FOR NEO AND BENCHMARK REGIONS, 2000-2008
(IN THOUSANDS OF 2008 DOLLARS)

Geography	2008	2000-2008	2004-2008	2006-2008	2007-2008
Northeast Ohio					
NEO high-tech	\$27,460,003	17.8%	8.9%	5.2%	-0.2%
NEO non-high-tech	\$152,768,371	0.2%	-3.2%	-3.1%	-2.2%
NEO all industries	\$180,228,374	2.5%	-1.6%	-1.9%	-1.9%
Remainder of Ohio					
Remainder of Ohio high-tech	\$53,130,255	19.4%	15.7%	7.5%	3.6%
Remainder of Ohio non-high-tech	\$238,373,439	2.0%	-3.7%	-2.7%	-2.5%
Remainder of Ohio all industries	\$291,503,694	4.8%	-0.7%	-0.9%	-1.4%
State of Ohio					
Ohio high-tech	\$80,590,258	18.9%	13.3%	6.7%	2.3%
Ohio non-high-tech	\$391,141,810	1.3%	-3.5%	-2.8%	-2.4%
Ohio all industries	\$471,732,068	3.9%	-1.0%	-1.3%	-1.6%
Midwest States					
Midwest high-tech	\$401,486,476	16.8%	10.5%	6.9%	2.1%
Midwest non-high-tech	\$1,846,050,562	4.6%	-0.9%	-1.8%	-1.9%
Midwest all industries	\$2,247,537,038	6.6%	1.0%	-0.4%	-1.2%
United States					
U.S. high-tech	\$2,755,919,959	18.6%	14.9%	6.8%	1.9%
U.S. non-high-tech	\$11,405,246,670	15.6%	5.3%	0.0%	-1.1%
U.S. all industries	\$14,161,166,628	16.2%	7.0%	1.3%	-0.6%

With the slowdown of high-tech GRP, Northeast Ohio has lower probability of catching up with other benchmark regions for a share of high-tech GRP in the regional economy. Significantly lagging behind the Remainder of Ohio, which increased its share of total GRP from 17.3% in 2007 to 18.2% in 2008, Northeast Ohio grew by only 0.2% (from 15.0% in 2007 to 15.2% in 2008) (Figure 6). Not only was the share of high-tech GRP in the Remainder of Ohio higher than that in the Midwest (17.9% in 2008), the share was growing faster (0.9% in the Remainder of Ohio) than in the Midwest (0.6%) and the United States (0.5%). Even if Northeast Ohio could keep its growth rate at its best level (between 2000 and 2008), it will not be able to reach the levels in the Midwest and the United States in this decade (if the benchmark regions continue to grow at their average growth rate).

Measured as the gross regional product per employee, the productivity showed a modest performance in NEO's high-tech sector as well. In 2007 to 2008, productivity declined in both, high-tech (-1.0%) and non-high-tech (-0.8%) sectors (Table 8). During the same year, productivity in the Remainder of Ohio in high-tech industries grew by 3.4% while productivity in non-high-tech industries declined (-1.3%); the Midwest high-tech productivity grew by 1.9%, and the U.S. high-tech grew by 1.0%. For both the Midwest and the United States the non-high-tech sectors declined at -0.8% and -0.7%, respectively.

The highest annual average growth in NEO high-tech productivity occurred between 2006 and 2007 (4.8%). It declined from 2007 to 2008 (-1.0%), and averages 4.0% over the 2-year period, from 2006 to 2008. For the longer period of time, from 2000 to 2008, Northeast Ohio had its high-tech productivity growth at 23.3%, compared to the Remainder of Ohio at 25.2%, the Midwest at 29.3% (highest among all benchmark areas), and the United States at 24.6%. The benchmark areas' high-tech sectors showed a similar dynamic between 2000 and 2008. All regions grew between 2000 and 2005. In 2006, the Midwest high-tech productivity declined by a percentage point and then joined the United States and the Remainder of Ohio in their continued growth through 2008.

FIGURE 6. SHARE OF HIGH-TECH GRP IN TOTAL GRP IN NEO AND BENCHMARK REGIONS, 2000-2008

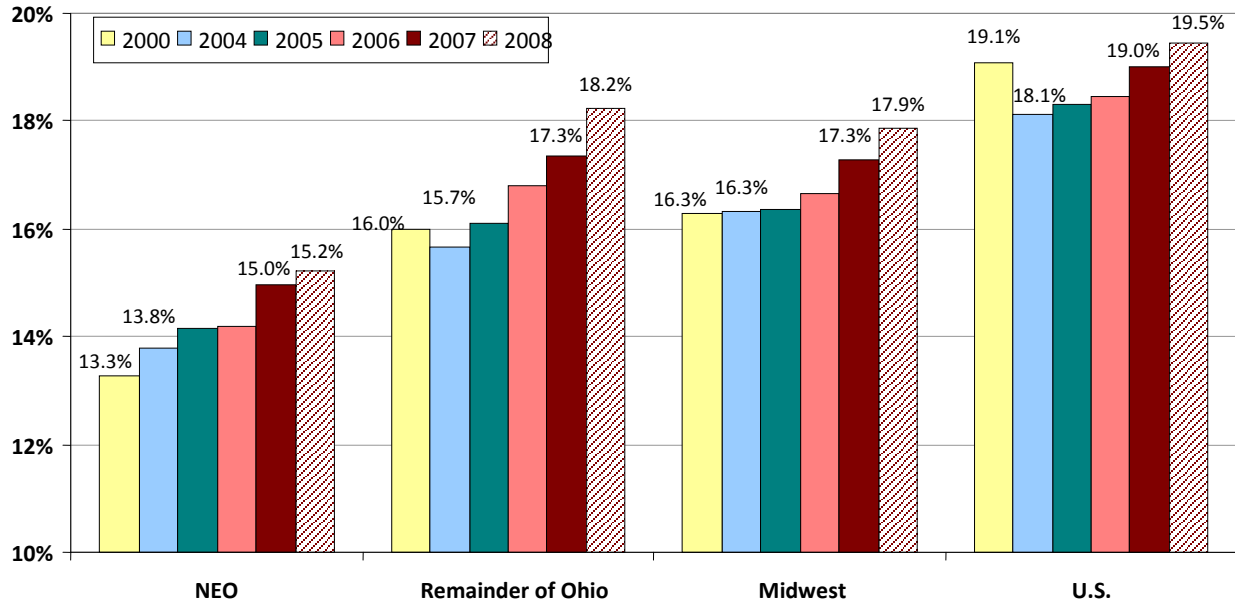


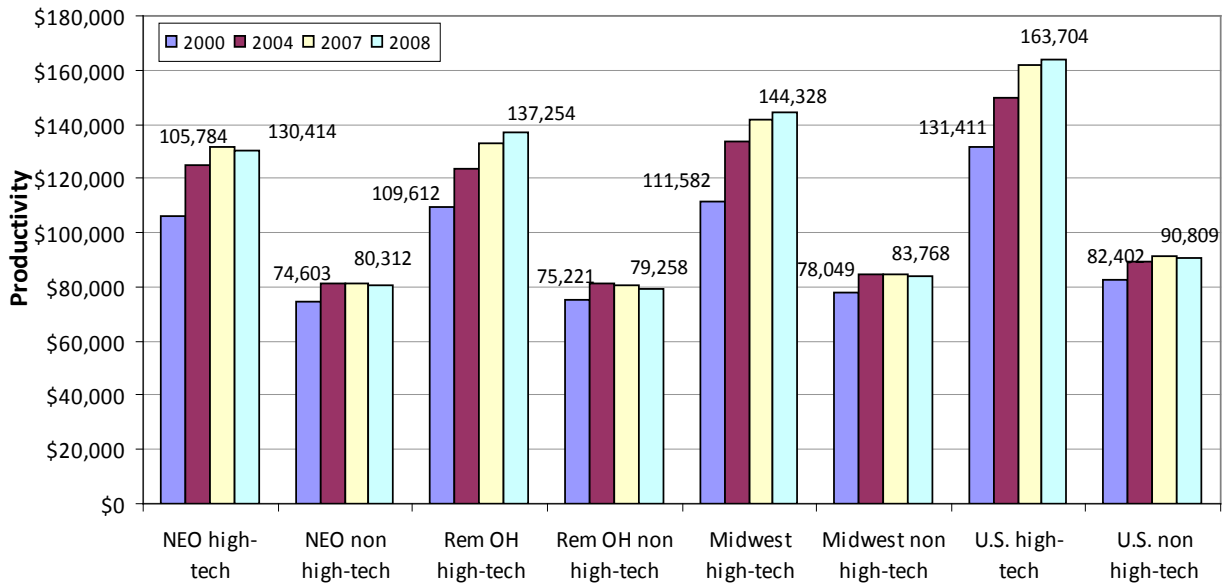
TABLE 8. PRODUCTIVITY IN NEO AND BENCHMARK REGIONS, 2000-2008

Geography	2008	2000-2008	2004-2008	2006-2008	2007-2008
Northeast Ohio					
NEO high-tech	130,414	23.3%	4.2%	4.0%	-1.0%
NEO non-high-tech	80,312	7.7%	-1.1%	-1.2%	-0.8%
NEO all industries	85,306	9.9%	0.0%	-0.3%	-0.7%
Remainder of Ohio					
Remainder of Ohio high-tech	137,254	25.2%	10.9%	5.5%	3.4%
Remainder of Ohio non-high-tech	79,258	5.4%	-2.8%	-1.3%	-1.3%
Remainder of Ohio all industries	85,872	8.4%	-0.3%	0.0%	-0.4%
State of Ohio					
Ohio high-tech	134,844	24.6%	8.5%	5.0%	1.9%
Ohio non-high-tech	79,667	6.3%	-2.1%	-1.3%	-1.1%
Ohio all industries	85,654	9.0%	-0.2%	-0.1%	-0.5%
Midwest States					
Midwest high-tech	144,328	29.3%	7.8%	6.2%	1.9%
Midwest non-high-tech	83,768	7.3%	-0.7%	-0.8%	-0.8%
Midwest all industries	90,555	10.3%	0.9%	0.5%	-0.2%
United States					
U.S. high-tech	163,704	24.6%	9.2%	4.4%	1.0%
U.S. non-high-tech	90,809	10.2%	1.3%	-0.5%	-0.7%
U.S. all industries	99,424	12.1%	2.9%	0.5%	-0.2%

With the productivity of the high-tech sector in Northeast Ohio at a lower level than in benchmark regions, the gap between the high-tech and non-high-tech sectors is smaller than in other regions (Figure 7). In 2008, this difference in Northeast Ohio was \$50,102, in the Midwest it was \$60,560, and in the United States it was \$72,895. These gaps between the high-tech and non-high-tech sectors vary significantly mainly because of

the difference in the level of productivity in the high-tech sectors. The range of difference between productivity in benchmark regions in the non-high-tech sector is half as small (from \$80,312 in Northeast Ohio to \$90,809 in the United States) as that in the high-tech sector (\$80,312 in NEO, \$83,768 in the Midwest, and 90,809 in the United States).

FIGURE 7. PRODUCTIVITY OF HIGH-TECH AND NON-HIGH-TECH IN NEO AND BENCHMARK REGIONS, 2000-2008



All the differences between benchmark regions are due to the significantly different performance of some industries within the high-tech sectors.

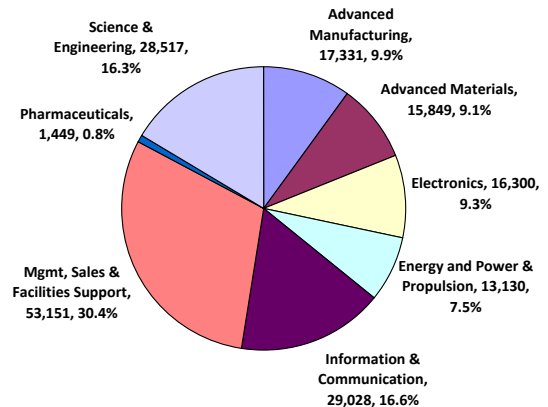
HIGH-TECH INDUSTRIES BY TECHNOLOGY GROUP

This section analyzes high-tech industries in terms of employment and average wages in eight technology groups that are prominent in Northeast Ohio. Tables B-2 and B3 in Appendix B provide performance in employment and annual average wages by individual industries in each technology group. Northeast Ohio is compared to the Remainder of Ohio, the Midwest and the United States.

EMPLOYMENT

Analyzing the high-tech sector in Northeast Ohio by eight technology groups (Table 9 and Figure 8) reveals that Management, Sales, and Facilities Support (primarily comprised of companies' headquarters), remains not only the largest group accounting for more than 30% of all jobs in high-tech industries, but also the one with the most growth in 2007-2008 (1,838 employees, 3.5%). Other large technology groups are Information and Communication (16.6%, grew 2.7%) and Science & Engineering (16.3%, grew 1.8%). The three largest groups, combined, account for more than 63% of all high-tech employment in Northeast Ohio in 2008. Moreover, all three groups were growing in the period from 2007 to 2008 and added 3,137 jobs to NEO high-tech. The next three large groups, Advanced Manufacturing, Electronics and Advanced Materials, combined, account for 28.3% of high-tech employment. These three groups lost employment in 2007 to 2008. The two smallest technology groups, Pharmaceuticals and Energy and Power & Propulsion added 453 employees, with the later group growing at the second-highest rate among all groups in 2007-2008 (3.2%).

TABLE 9. NEO EMPLOYMENT CHANGE BY TECHNOLOGY GROUP, 2008					FIGURE 8. DISTRIBUTION OF NEO HIGH-TECH EMPLOYMENT BY TECHNOLOGY GROUPS, 2008	
Technology Group	NEO 2008	Employment Change			Technology Group	Employment, 2008
		2004-2006	2006-2007	2007-2008		
Advanced Manufacturing	17,331	681	127	-435	Science & Engineering, 28,517, 16.3%	
Advanced Materials	15,849	-503	-457	-45	Advanced Manufacturing, 17,331, 9.9%	
Electronics	16,300	-191	91	-85	Advanced Materials, 15,849, 9.1%	
Energy and Power & Propulsion	13,130	61	448	422	Electronics, 16,300, 9.3%	
Information & Communication	29,028	551	473	789	Energy and Power & Propulsion, 13,130, 7.5%	
Mgmt, Sales & Facilities Support	53,151	-1,122	-647	1,838	Information & Communication, 29,028, 16.6%	
Pharmaceuticals	1,449	N/A	38	31	Mgmt, Sales & Facilities Support, 53,151, 30.4%	
Science & Engineering	28,517	1,877	810	510	Pharmaceuticals, 1,449, 0.8%	
Total High-Tech Employment	174,754	1,645	882	3,025		
Total Employment, all Industries	1,983,341	12,480	-15,497	-16,172		



Compared to the benchmark regions, in 2007-2008, Northeast Ohio performed very well in the growth of technology groups (Table 10). The Management, Sales and Facilities Support group showed the highest growth of all comparable areas (3.6% compared to the United States at 2.7%, Remainder of Ohio at 2.4% and the Midwest at 1.6%). Science and Engineering and Information and Communication are two more groups that outperformed the Midwest and the Remainder of Ohio but did not perform as well as the same groups of industries on the national level.

TABLE 10. EMPLOYMENT IN BENCHMARK REGIONS BY TECHNOLOGY GROUPS, 2004-2008

Technology Group	Emp 2008	Employment Change 2004-2008, %				Employment Change 2007-2008, %			
	NEO	NEO	Rem OH	MW	US	NEO	Rem OH	MW	US
Advanced Manufacturing	17,331	2.20	4.50	0.91	1.68	-2.45	0.26	-0.89	0.02
Advanced Materials	15,849	-5.97	-0.84	0.04	-6.55	-0.29	2.12	-0.22	-0.55
Electronics	16,300	-1.12	-10.08	-1.80	-2.21	-0.52	-2.78	-0.20	-0.89
Energy and Power & Propulsion	13,130	7.64	11.22	3.71	8.53	3.32	3.39	2.15	3.35
Information & Communication	29,028	6.66	4.33	5.56	7.72	2.80	1.68	2.19	3.23
Mgmt, Sales & Facilities Support	53,151	0.13	2.23	3.36	9.81	3.58	2.42	1.62	2.72
Pharmaceuticals	1,449	N/A	N/A	-3.88	1.55	2.16	3.12	0.73	-0.80
Science & Engineering	28,517	12.62	11.30	8.38	20.59	1.82	1.73	1.28	3.79
Total High-Tech Employment	174,754	3.28	4.33	3.66	8.77	1.76	1.74	1.20	2.43
Total Employment, all Industries	1,983,341	-0.96	0.98	1.39	5.81	-0.81	-0.26	-0.16	0.59

The growing technology groups not only were performing better than some benchmark areas, but some of the declining groups were losing jobs at a smaller rate than the Midwest and, in some cases, even slower than the United States. Among the three declining groups, two were losing their employment only slightly (Electronics -0.5% and Advanced Materials -0.3%) and performed better than the United States (-0.9% and -0.6%, respectively). These two groups were also losing jobs in the Midwest, but at a slightly lower level. Electronics lost -2.8% (523 jobs) in the Remainder of Ohio, while Advanced Materials added 2.1% (349 jobs) in the same region.

To compare this performance with the longer period of time, from 2004 to 2008, it is worth noting that Advanced Manufacturing still shows positive growth (2.2%), evidently offsetting last year's decline with growth in the previous years. The Advanced Manufacturing technology group was growing from 2004 to 2007, adding 809 employees during this time, and showing only a slight decline from 2007 to 2008 (-435 jobs). Although these dynamics do not seem alarming, compared to other regions Northeast Ohio is losing employment in this area. Both during the last year and over the longer period of time, the Remainder of Ohio region outperformed Northeast Ohio in Advanced Manufacturing by adding 0.3% of employment in 2007 to 2008 and 4.5% in 2004 to 2008.

This rate of growth in the Remainder of Ohio region was the third highest after the growth of the Science and Engineering (11.3%) and Energy and Power & Propulsion (11.2%) technology groups. Both technology groups are significantly larger than in Northeast Ohio. The Science and Engineering group in the Remainder of Ohio is twice as large as in Northeast Ohio and represents 18.4% in the Remainder of Ohio high-tech sector. The Energy and Power & Propulsion group is 2.6 times larger than in Northeast Ohio and represents 11.2% of that region's high-tech employment (compared to NEO's 3.2% share).

Performance of other NEO technology groups during 2004 to 2008 is also promising. Even though, the Science and Engineering group is smaller than in the Remainder of Ohio, it grew at a faster rate (12.6%) than in the rest of Ohio (11.3%) and the Midwest (8.4%). However, employment in this group in all three regions grew at a much slower rate than that in the United States (20.6%). Employment in Information and Communication grew faster (6.7%) than that in the Remainder of Ohio (4.3%) and the Midwest (5.6%), getting closer to the national level of employment growth (7.7%). Also the Energy and Power & Propulsion

group was growing (7.6%) faster than the same group in the Midwest (3.7%) and close to the national average (8.5%).

Differences in performance by individual high-tech industries are behind the dynamics of the technology groups in Northeast Ohio (Appendix B Table B2). Despite the overall modest growth of NEO high-tech employment over the longer period of time (3.3% in 2004-2008 compared to 4.3% in the Remainder of Ohio, 3.7% in the Midwest and 8.8% in the United States), the last-year change of high-tech employment in Northeast Ohio slightly outperformed the Remainder of Ohio region (1.76% compared to 1.74%) and the Midwest (1.2%). However, these industries grew slower than the national level of 2.4%.

Three technology groups show consistent growth over the last 2 years in the performance of their individual industries. Science and Engineering added employment in all of its three industries during 2006 to 2007 and 2007 to 2008. Almost all larger industries were growing for 2 years also in the Information and Telecommunication technology group. The Wireless Telecommunication Carriers; the Other Telecommunications; the Data Processing, Hosting, and Related Services; the Other Information Services; and the Computer System Design and Related Services were all growing between 2006 and 2008. The only larger industry that showed a slight decline for 2 years in a row is the Wired Telecommunication Carriers. The third group, Energy and Power & Propulsion, added employees in three out of its five larger industries.

ANNUAL AVERAGE WAGES

The annual average wages in Northeast Ohio and benchmark regions reflect the level of sophistication of the jobs employed in each industry and each technology group, as well as their productivity. However, not all the differences in annual average wages between Ohio, the Midwest, and the United States can be attributed to the differences in companies' performance and productivity. At least a portion of that difference is due to the different costs of living in the benchmark areas.¹² Wage trends were analyzed in each of the technology groups in all benchmark regions, concentrating on last-year changes, 2007 to 2008, and the trends from 2004 to 2008.

The Energy and Power and Propulsion technology group was paying the highest annual average wages to its workers in 2008 (Table 11 and Figure 9). This is the second smallest sector among NEO technology groups (13,130 employees in 2008 or 7.5% of NEO total high-tech employment), which is growing in both employment and wages from 2004. This is one of only two technology groups (together with Science and Engineering) that increased average wages compared to 2007 (Table 12 and Table B3 in Appendix B).

Although this technology group shows positive changes, it looks less competitive compared to this group in benchmark regions. In the Remainder of Ohio, the Energy and Power and Propulsion group paid average wages 19% higher than that in Northeast Ohio in 2008. Besides paying much higher wages, this technology group employs a workforce that is 3.6 times larger in the Remainder of Ohio than in Northeast Ohio and constitutes almost 10% of its total high-tech employment. The Remainder of Ohio average wages in this technology group (\$93,092 in 2008) are very close to the Midwest's wages (\$95,105) and lags only \$5,689 of that at the national level. Even though Northeast Ohio is lagging all benchmark areas in the level of wages in the Energy and Power and Propulsion technology group, the last year rate of growth of average wages outpaced all regions, including the national level (1.9% in NEO compared to 1.6% in the U.S.). Northeast Ohio also grew faster during a longer period of time, from 2004 to 2008.

¹² In 2008, the difference in cost of living between Northeast Ohio and the Remainder of Ohio is minimal; cost of living in the Cincinnati MSA is 2.4% higher than in Cleveland, and in Columbus cost of living is 3.8% higher than in Cleveland (and Cleveland is only 0.3% higher than Akron). However, the cost of living is significantly higher in the Midwest cities; in Milwaukee – by 10%, Minneapolis – 14%, Chicago – 19% higher than in Cleveland. The difference between Cleveland and the average of U.S. metropolitan areas is 8.5%. Source: Moody's Economy.com.

TABLE 11. AVERAGE ANNUAL WAGES IN BENCHMARKED REGIONS BY TECHNOLOGY GROUPS, 2007-2008

Technology Group	NEO		Remainder of Ohio Average Wages		Midwest Average Wages		USA Average Wages	
	2007	2008	2007	2008	2007	2008	2007	2008
Energy & Power & Propulsion	76,896	78,392	93,696	93,092	95,105	95,502	99,640	101,191
Advanced Materials	80,821	76,277	71,300	68,901	75,702	74,211	78,919	78,488
Management, Sales & Facilities Support Services	77,843	75,436	111,835	101,834	108,587	106,783	106,796	103,006
Pharmaceuticals	82,537	69,858	70,350	73,370	124,410	124,832	125,176	118,912
Information & Communications Technology	65,431	64,558	81,386	77,965	80,388	77,091	90,065	88,842
Science & Engineering	62,931	63,119	65,904	67,092	77,252	80,656	79,737	80,201
Electronics	57,146	57,141	60,078	75,356	63,500	65,375	85,125	82,839
Advanced Manufacturing	53,352	52,834	57,857	56,096	58,831	57,720	60,848	59,880
High-Tech Average Wage	73,880	71,864	84,255	81,741	85,351	85,117	90,747	89,515
All Industries Average Wage	41,921	40,296	43,237	42,267	45,253	44,534	47,744	47,056

* Sorted by 2008 NEO average wages column

FIGURE 9. ANNUAL AVERAGE WAGES IN NEO HIGH-TECH INDUSTRY GROUPS, 2007-2008

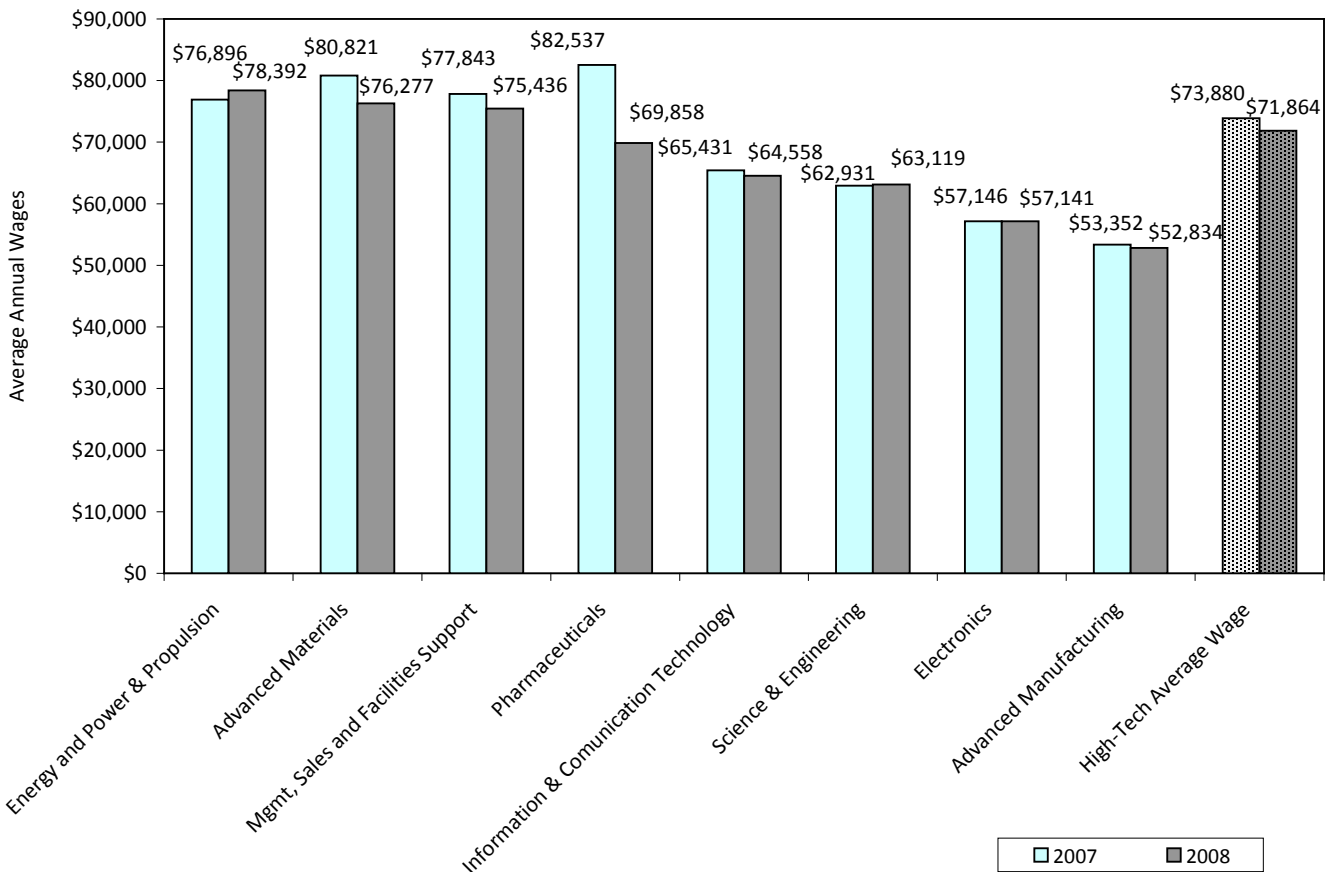


TABLE 12. CHANGES OF AVERAGE ANNUAL WAGES IN BENCHMARK REGIONS BY TECHNOLOGY GROUPS, 2004-2008

Technology Group	Av Wages 2008	Av Wages Change 2004-2006, %				Av Wages Change 2007-2008, %			
	NEO	NEO	RemOH	MW	U.S.	NEO	RemOH	MW	U.S.
Energy and Power & Propulsion	78,392	15.5%	15.4%	12.5%	9.6%	1.9%	-0.6%	0.4%	1.6%
Science & Engineering	63,119	4.7%	2.0%	2.8%	5.1%	0.3%	1.8%	4.4%	0.6%
Advanced Materials	76,277	6.3%	4.6%	8.6%	4.4%	-5.6%	-3.4%	-2.0%	-0.5%
Information & Communication	64,558	0.1%	0.9%	2.9%	4.7%	-1.3%	-4.2%	-4.1%	-1.4%
Advanced Manufacturing	52,834	6.4%	7.9%	1.9%	2.3%	-1.0%	-3.0%	-1.9%	-1.6%
Electronics	57,141	6.5%	8.8%	3.6%	8.9%	0.0%	25.4%	3.0%	-2.7%
Mgmt, Sales and Facilities Support	75,436	12.4%	8.9%	3.4%	7.2%	-3.1%	-8.9%	-1.7%	-3.5%
Pharmaceuticals	69,858	N/A	N/A	12.9%	7.2%	-15.4%	4.3%	0.3%	-5.0%
High-Tech Average Wage	71,864	10.2%	6.5%	4.5%	6.3%	-2.7%	-3.0%	-0.3%	-1.4%
All Industries Average Wage	40,296	2.7%	2.9%	2.8%	4.1%	-3.9%	-2.2%	-1.6%	-1.4%

Three industries drove this technology group's indicators up in Northeast Ohio: Electric Power Generation, Transmission, and Distribution (NAICS 2211) (high-tech industry that is third highest in growth in NEO, Table 13), Petroleum and Coal Products Manufacturing (NAICS 3241), and Aerospace Products and Parts Manufacturing (NAICS 3364). The Electric Power Generation, Transmission and Distribution industry was also growing in the Remainder of Ohio, but at a slower rate (9.5%) than in Northeast Ohio (11.2%) (Table 14). Aerospace Products and Parts Manufacturing was growing in the Remainder of Ohio at 9.5%, while it was growing in Northeast Ohio at only 1.7%. Petroleum and Coal Product Manufacturing was not among the fastest growing high-tech industries in the Remainder of Ohio.

Average wages in all NEO technology groups are lagging average wages in the respective groups at the national level, the Midwest, and the Remainder of Ohio. The only exception to this trend is Advanced Materials – the next fastest wage growing among NEO technology groups. In 2007 to 2008, this group's wages declined more than in the benchmark regions (-5.6% in Northeast Ohio compared to -3.4% in the Remainder of Ohio, -2% in the Midwest, and -0.5% in the United States), but the level of average wages in Northeast Ohio remained higher than in the Midwest and the Remainder of Ohio, lagging the United States by only \$2,211. This group started almost from the same average wages as the Midwest and the Remainder of Ohio in 2004, but was able to grow its wages more than these regions, especially during 2006 to 2007.

Although the Management, Sales, and Facilities Support Services group has the third highest level of wages in Northeast Ohio, it significantly lags all other benchmark areas in annual average wages. This group has the largest difference in average wages with the same groups in all three benchmark regions in 2008; it lags the Remainder of Ohio by \$26,398, the Midwest by \$31,347, and the United States by \$27,570. The Management, Sales, and Facilities Support Services group grew faster in all other regions in 2004 to 2006, but was not able to retain its advantage in 2007 to 2008. Within this group, the Remainder of Ohio might include industries and successful companies that may have higher productivity and potentially higher annual average wages than those in Northeast Ohio. An example of a successful company headquartered in the Remainder of Ohio is American Financial Group (AFG), a holding company headquartered in Cincinnati. According to the company's website¹³ and its annual report,¹⁴ increased revenues and net earnings provided shareholders with 17% of core net operating earnings and 7% of net earnings in 2008. In 2009, these figures grew to 16% and 17%, respectively. Excellent financial performance secured earnings per share in 2008 at the level of \$1.67 that grew to \$4.45 in 2009.

¹³ <http://www.afginc.com/phoenix.zhtml?c=89330&p=companyOverview>, Accessed on March 20, 2010.

¹⁴ http://media.corporate-ir.net/media_files/irol/89/89330/AFG_Annual_2009-web.pdf, Accessed on March 20, 2010.

TABLE 13. NEO FASTEST GROWING TECHNOLOGY GROUPS AND INDUSTRIES, 2004-2008

Tech Group	Industry NAICS	Industry/Group Description	NEO Employment 2008	NEO Employment Change				NEO Employment Change Shares
				2004-2006	2006-2007	2006-2008	2007-2008	2007-2008
<i>Fastest growing technology groups</i>								
7		Management, Sales and Facilities Support Services	53,151	-1,122	-647	1,192	1,838	42.8%
6		Information and Communication Technology	29,028	551	473	1,262	789	18.4%
8		Science & Engineering	28,517	1,877	810	1,319	510	11.9%
5		Energy and Power & Propulsion	13,130	61	448	871	422	9.8%
<i>Fastest growing industries</i>								
7	5511	Management of companies and enterprises	41,240	-1,165	-695	1,126	1,821	42.4%
6	5415	Computer systems design and related services	14,405	2,127	618	1,364	746	17.4%
5	2211	Electric power generation, transmission, & distribution	5,837	-303	215	553	338	7.9%
8	5416	Management, scientific, and technical consulting services	9,014	887	270	588	318	7.4%
7	5612	Facilities support services	1,897	270	-23	143	166	3.9%
8	5413	Architectural, engineering, and related services	15,793	174	471	607	136	3.2%
6	5172	Wireless telecommunications carriers (except satellite)	1,441	18	23	122	99	2.3%
6	5191	Other information services	623	5	51	125	74	1.7%
6	5182	Data processing, hosting, and related services	2,145	-127	93	159	66	1.5%
2	3255	Paint, coating, and adhesive manufacturing	4,677	9	-195	-131	65	1.5%
6	5179	Other telecommunications	1,455	-934	87	150	64	1.5%
4	3353	Electrical equipment manufacturing	5,171	225	89	149	60	1.4%
5	3241	Petroleum and coal products manufacturing	1,300	23	10	66	56	1.3%
8	5417	Scientific research-and-development services	3,709	816	69	124	56	1.3%
5	3364	Aerospace product and parts manufacturing	3,834	252	96	147	51	1.2%
2	3252	Resin, synthetic rubber, & artificial synthetic fibers & filaments manufacturing	3,329	-67	29	78	49	1.1%
Total Employment of Growing High-Tech Industries in 2007-2008							4,292	100.0%
Total High-Tech Employment			174,754	1,645	882	3,908	3,025	

Note: Table 13 provides information on the fastest growing technology groups and industries in Northeast Ohio and show what percentage of the employment growth in the period from 2007 to 2008 is due to each selected industry and a technology group. The table is sorted by the change of employment in 2007-2008.

TABLE 14. REMAINDER OF OHIO FASTEST GROWING TECHNOLOGY GROUPS AND INDUSTRIES, 2004-2008

Tech Group	Industry NAICS	Industry/Group Description	Remainder of OH Employment 2008	Remainder of OH Employment Change				Remainder of OH Employment Change Shares
				2004-2006	2006-2007	2006-2008	2007-2008	2007-2008
<i>Fastest growing technology groups</i>								
7		Management, Sales and Facilities Support Services	84,463	-58	-92	1,902	1,993	28.0%
6		Information and Communication Technology	68,889	-158	1,876	3,017	1,141	16.0%
5		Energy and Power & Propulsion	34,083	2,081	239	1,357	1,118	15.7%
8		Science & Engineering	56,329	2,605	2,157	3,114	958	13.4%
2		Advanced Materials	16,819	-449	-43	306	349	4.9%
3		Pharmaceuticals	3,587	N/A	-261	-153	109	1.5%
<i>Fastest growing industries</i>								
7	5511	Management of companies and enterprises	67,273	-313	-108	1,529	1,637	23.0%
6	5415	Computer systems design and related services	36,960	1,156	2,045	3,662	1,617	22.7%
5	3364	Aerospace product and parts manufacturing	12,801	1,687	448	947	499	7.0%
5	2211	Electric power generation, transmission, and distribution	12,310	248	-32	463	495	6.9%
1	3369	Other transportation equipment manufacturing	2,652	279	117	585	467	6.6%
2	3251	Basic chemical manufacturing	6,320	-140	-353	60	414	5.8%
8	5416	Management, scientific, and technical consulting services	15,202	1,453	1,064	1,437	373	5.2%
8	5417	Scientific research-and-development services	11,947	648	-119	198	317	4.5%
7	4234	Professional & commercial equipment & supplies, merchant wholesalers	15,872	232	-61	255	316	4.4%
8	5413	Architectural, engineering, and related services	29,179	504	1,212	1,479	267	3.8%
3	3254	Pharmaceutical and medicine manufacturing	3,587	N/A	-261	-153	109	1.5%
2	3253	Pesticide, fertilizer, and other agricultural chemical manufacturing	1,914	-235	231	333	102	1.4%
4	3344	Semiconductor and other electronic component manufacturing	4,082	-365	-119	-19	100	1.4%
Total Employment of Growing High-Tech Industries in 2007-2008				7,127				100.0%
Total High-Tech Employment			305,348	3,346	4,082	9,314	5,231	

Note: Table 14 provides information on the fastest growing technology groups and industries in the Remainder of Ohio and show what percentage of the employment growth in the period from 2007 to 2008 is due to each selected industry and a technology group. The table is sorted by the change of employment in 2007-2008.

A remarkable growth in annual average wages is demonstrated by Electronics in the Remainder of Ohio (25.4% in 2007-2008). Such a significant increase also might be driven by successful companies, for example, First Solar.¹⁵ This company's headquarters is located in Tempe, Arizona, and one of its three manufacturing facilities is located in Perrysburg, Ohio. According to the company's profile, it "is the largest manufacturer of thin film solar modules, having expanded manufacturing capacity to an annualized run rate of 53.4MW per line in the 4th quarter of 2009. By enabling clean, renewable electricity at lower costs, First Solar is providing a sustainable alternative to conventional energy sources." It launched an IPO on November 17, 2006; common stock is traded on the NASDAQ Stock Market.¹⁶

Another technology group, Pharmaceuticals, has a significant difference in the average wages between Northeast Ohio, national, and Midwest levels. The only difference from the previous groups is that the Remainder of Ohio joins Northeast Ohio in this trend. Both Northeast Ohio and the Remainder of Ohio lag the Midwest by \$54,974 and \$51,462, respectively, and the U.S. level by \$49,054 and \$45,542 in 2008. The underlying fact is that Ohio isn't just a competitor to Illinois and Wisconsin in Pharmaceuticals, which results in NEO's and Remainder of Ohio's much lower average wages for this technology sectors overall.

The technology group that is competitive in all Midwest states is Science and Engineering. This is the second of only two NEO technology groups that showed growth of annual average wages in the period from 2007 to 2008, and the one with the smallest gap in annual average wages between it and the Remainder of Ohio (\$3,973) and other benchmark regions (\$17,537 between it and the Midwest and \$17,082 between it and the U.S.). The wages in this group were growing over the last year and showed a high growth rate over the longer period of time, from 2004 to 2008.

Despite the decline of all other technology groups' average wages, there were individual industries that performed better than others in all technology groups. The industries of special interest are those that grew in Northeast Ohio while declining in the Remainder of Ohio or in other benchmark areas. The next section looks at the individual industries that were growing in Northeast Ohio and drove the growth of respective technology groups. The employment of these industries is compared to the growing industries in the Remainder of Ohio and employment growth is shown for the geographies in Northeast Ohio and the Remainder of Ohio.

FASTEST HIGH-TECH GROWTH

The most noticeable differences in high-tech sector performance were observed between NEO's employment and wages and the same technology groups, industries, and high-tech sectors in the Remainder of Ohio. These two regions have the same state public policy environment and many common legacies. The biggest difference in the structure of the regional economies within Ohio is NEO's larger manufacturing sector, which is composed of industries producing market products at the mature and declining phases of the product cycle. The automotive industries with their supply chain alone account for the bulk of employment and GRP losses over the last and previous recessions. Due to the long and complicated economic restructuring of these industries, Northeast Ohio is probably still experiencing some declines.

Although the decline affected the NEO economy hard, its high-tech sector is growing and the growth is driven by a number of industries with new or rejuvenated products in the market (Appendix Tables B2 and B3). In Northeast Ohio, 16 industries grew by 50 or more workers and five technology groups were adding employees in 2007 to 2008. In the Remainder of Ohio, 17 industries added more than 50 new employees and seven technology groups were growing.

¹⁵ Listed in Hoover with NAICS 4433.

¹⁶ Company's website, <http://www.firstsolar.com/en/index.php>.

As already mentioned in two previous sections, four NEO technology groups were leading employment growth in NEO high-tech; Management, Sales and Facilities Support (added 1,838 jobs in 2007-2008), Information and Communication Technology (789), Science and Engineering (510), and Energy and Power and Propulsion (422). Not only these technology groups were growing during the last year, but they also had a positive net job growth for the last 2 years and, with the exception of Management, Sales and Facilities Support Services, for the longer period of time from 2004 to 2008. These technology groups together added 83% of all employment growth (4,292) in NEO high-tech. Each of these four technology groups was driven by specific industries within the group.

The Management, Sales and Facilities Support technology group (which accounts for more than 30% of all NEO high-tech employment in 2008) was driven by the strong growth of the industry Management of Companies and Enterprises (NAICS 5511). This industry is comprised of companies' headquarters and alone added 1,821 employees in 2007 to 2008 accounting for 42% of the growth of all NEO high-tech sectors. Not only was this industry adding jobs, it also pays one of the highest annual average wages in the sector (\$94,917 in 2008). Just mentioning a few, NEO accounts for the location of such headquarters as Ohio Farmers Insurance Company, Third Federal Savings and Loan, Honeywell, Key Bank, First Merit Corporation, Cortland Savings Banking, First Energy Corporation, and Farmers National Bank.¹⁷ Besides the headquarters, this technology group includes the Facilities Support Services industry (NAICS 5612) that was hiring in 2007 to 2008 and accounted for another 4% of NEO high-tech growth.

The Information and Communication Technology group added another 18.4% of NEO high-tech growth by hiring 789 new employees last year. This is the second largest technology group in Northeast Ohio and its growth was due to five growing industries. The Computer Systems Design and Related Services (NAICS 5415) was the second-fastest growing industry in Northeast Ohio and the fastest growth industry in this group. It added 746 employees and accounted for 17.4% of all NEO high-tech sector growth in 2007 to 2008. Dominated by medium-sized businesses, this industry is concentrated in the Cleveland MSA and includes such companies as Datavantage Corporation, Techni Graphic Systems, Satyam Computer Services, Agilysys Inc., TMW Systems, Intellinex, Mirifex Systems, Rovisys Company in Akron, and Turning Technologies in Youngstown.

Besides the Computer Systems Design industry, other data-related IT and wireless communication industries were growing in this group. The Wireless Communication Carriers (NAICS 5172) hired 99 employees and together with Other Telecommunication (NAICS 5179), which added another 64 employees, accounted for about 4% of the total growth in NEO high-tech. The Data Processing, Hosting, and Related Services industry (NAICS 5182) and Other Information Services (NAICS 5191) together added 140 employees.

The Science and Engineering technology group is comprised of three industries, and all three were growing not only last year but were annually adding employment since 2004. As a group, they increased their employment by 510 workers from 2007 to 2008 (17% of all NEO high-tech growth). The Management, Scientific, and Technical Consulting Services (NAICS 5416) was the fastest growing industry in this group. It added 318 employees in 2007 to 2008 (10.5% of NEO high-tech growth), and showed a sturdy increase of employment since 2004. This industry is dominated by medium-sized businesses like Acxiom Information Security Services, Accenture, Wyatt Company, McKinsey and Company, and Gaggemini US.

Two more industries in this technology group, the Architectural, Engineering, and Related Services (NAICS 5413) and Scientific Research-and-Development Services (NAICS 5417) added 136 and 56 employees,

¹⁷ All companies' information in this section was derived from Lexis-Nexis, Hoover's, and Reference USA databases and the companies' websites.

respectively. Both industries annually have been adding new employees since 2004. The Architectural and Engineering Services industry was not only hiring new employees, it increased its annual average wages by 1.3% in 2007 to 2008. This industry was growing despite the recession and decline in construction-related industries which they serve extensively (e.g., Washington Group International, Middough Consulting, Louis Perry and Associates, Thorson Baker and Associates, C T Consultants), and strengthen the other wing of the sector represented by companies similar to bio-research oriented Ricerca Biosciences, environment-oriented Test America, NASA- and medical-related oriented ZIN Technologies, or more versatile Analex Corporation.

The Energy and Power and Propulsion technology group added another 10% of NEO high-tech employment, driven mainly by the Electric Power Generation, Transmission, and Distribution industry (NAICS 2211). Between 2006 and 2008, this industry added 553 employees, and it increased annual average wages by 5.4% last year. Two more industries, Petroleum and Coal Products Manufacturing (NAICS 3241) and Aerospace Product and Parts Manufacturing (NAICS 3364) were hiring in this group and belong to 16 NEO high-tech industries that added 50 or more employees in 2007 to 2008. Even though this technology group is the second-smallest in Northeast Ohio, it has the second-highest average wages, which have been growing since 2004.

Comparing NEO high-tech growth to the growth of the high-tech sector in the Remainder of Ohio, it is worth noting that the first four of all six fast-growing technology groups in Northeast Ohio and in the Remainder of Ohio are the same: the Management, Sales and Facilities Support (added in the Remainder of Ohio 1,993 jobs in 2007-2008), Information and Communication Technology (1,141), Energy and Power and Propulsion (1,118), and Science and Engineering (958). Two other technology groups that were growing in the Remainder of Ohio are Advanced Materials and Pharmaceuticals, which showed only modest growth, 349 and 109 new employees, respectively. These six groups together accounted for almost 80% of all the Remainder of Ohio high-tech employment growth in 2007 to 2008.

The Management, Sales and Facilities Support technology group added only slightly more jobs (155) in the Remainder of Ohio than in Northeast Ohio, despite the fact that this technology group is 1.5 times larger than in Northeast Ohio. The considerable difference between these technology groups in Northeast Ohio and the Remainder of Ohio is their annual average wages. In Northeast Ohio the average wage in this technology group was \$75,436 in 2008, while in the Remainder of Ohio it was 35% higher (\$101,834). As in Northeast Ohio, the main growth in this technology group was driven by the industry Management of Companies and Enterprises, which alone added 1,637 jobs that accounted for 23% of all Remainder of Ohio high-tech sector growth. This industry paid on average \$109,435 in 2008 and drove the group's average wages.

The second fastest growing technology group in the Remainder of Ohio, the Information and Communication Technology, like Northeast Ohio, is driven by the Computer Systems Design and Related Services industry (NAICS 5415) that hired 1,617 employees between 2007 and 2008 (which was proportional to the industry size). As with the previously mentioned industry, Computer Systems paid Remainder of Ohio employees salaries, on average, 23% higher than those in Northeast Ohio. Unlike Northeast Ohio, no other industries from this sector were growing significantly.

The Science and Engineering and Energy and Power and Propulsion technology groups were growing at the same rate in Northeast Ohio and the Remainder of Ohio; they added more employees in the Remainder of Ohio, a number proportional to the larger employment bases in these technology groups. The Science and Engineering group in NEO had 28,517 employees and grew by 510 new workers in the period from 2007 to 2008; in the Remainder of Ohio, this technology group employed 56,329, about twice more than in Northeast Ohio, and it added about twice more employees, 958, in 2007 to 2008. The Energy and Power and Propulsion technology group employed 13,130 in 2008 in Northeast Ohio and added 422 new workers in 2007 to 2008; in the Remainder of Ohio, it has an employment base (34,083) that is 2.6 times bigger and added,

respectively, exactly 2.6 times more new employees (1,118). Therefore, the rate of growth of these two technology groups was similar in Northeast Ohio and the Remainder of Ohio.

The overall growth in the Science and Engineering technology group in the Remainder of Ohio (958 employees) was composed of growth in the same individual industries as in Northeast Ohio. However, the growth in Energy and Power and Propulsion technology group, unlike its growth in Northeast Ohio, was evenly split between two industries. In the Remainder of Ohio, besides the Electric Power Generation industry (NAICS 2211) that added 495 workers, the Aerospace Products and Parts Manufacturing industry (NAICS 3364) hired 499 new employees. This industry added only 51 employees in Northeast Ohio in 2007-2008. The average annual wages in the Aerospace Products and Parts Manufacturing industry in Northeast Ohio was significantly lower than that in the Remainder of Ohio, \$65,082 compared to \$94,842, respectively, and in 2007-2008 the NEO average wages in this industry declined by 6.6%. These wage differences between Northeast Ohio and the Remainder of Ohio were consistent for all other growing industries in this technology group. As a result, the Energy and Power and Propulsion technology group paid their employees, on average, 19% higher wages in the Remainder of Ohio than in Northeast Ohio.

The Advanced Materials technology group added 349 new jobs in the Remainder of Ohio in 2007 to 2008, while in Northeast Ohio this technology group lost 45 employees. In the Remainder of Ohio, the growth in this technology group was driven by the Basic Chemical Manufacturing industry (NAICS3251) which added 414 employees (5.8% of all high-tech employment growth in the Remainder of Ohio) and Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing (NAICS 3253), which grew by 101. This is the only technology group that paid their employees, on average, higher annual average wages in Northeast Ohio (\$76,277) than in the Remainder of Ohio (\$68,901) in 2008.

The Pharmaceutical technology group is 2.5 times larger in the Remainder of Ohio than in Northeast Ohio, and in the Remainder of Ohio it grew faster in its employment compared to its growth in Northeast Ohio. The Pharmaceutical group paid 5% higher wages in the Remainder of Ohio than in Northeast Ohio.

To clarify where the most growth occurred in the Remainder of Ohio, we looked at its 2008 distribution of employment base in the high-tech sector in comparison to that of Northeast Ohio (Table 15)¹⁸ and at the distribution of growth across major metropolitan areas in Northeast Ohio and the Remainder of Ohio. While 59% of the NEO high-tech employment base is concentrated in the Cleveland MSA, the bulk of the Remainder of Ohio high-tech sector is more evenly split between two large MSAs, Cincinnati (32%) and Columbus (31%). Another difference is in the shares of the other metropolitan areas and rural areas of Northeast Ohio and the smaller MSAs and rural areas in the Remainder of Ohio. The category *Other Remainder of Ohio* contains six smaller metropolitan areas, Huntington-Ashland WV-KY-OH, Lima OH, Parkersburg-Marietta WV-OH, Springfield OH, Weirton-Steubenville WV-OH, and Wheeling WV-OH, and non-metropolitan counties that together account for 17% of the total high-tech employment in the Remainder of Ohio. This category in Northeast Ohio contains two smaller MSAs, Mansfield and Sandusky, and together with rural counties accounts for 11.3 % of the total high-tech employment in NEO.

¹⁸ Only the parts of Ohio MSAs that cross the state border were considered.

TABLE 15. DISTRIBUTION OF 2008 HIGH-TECH EMPLOYMENT ACROSS MAJOR METROPOLITAN STATISTIC AREAS: NEO AND THE REMAINDER OF OHIO

MSA	Employment 2008	Share of Total Employment	MSA	Employment 2008	Share of Total Employment
Cleveland-Elyria-Mentor, OH MSA	103,256	59.1%	Cincinnati-Middletown, OH-KY-IN MSA	96,801	31.7%
Akron, OH MSA	36,829	21.1%	Columbus, OH MSA	94,195	30.8%
Youngstown-Warren-Boardman, OH-PA MSA	7,985	4.5%	Dayton, OH MSA	42,595	14.0%
Canton-Massillon, OH MSA	6,909	4.0%	Toledo, OH MSA	19,727	6.5%
Other NEO	19,775	11.3%	Other Remainder of OH	52,031	17.0%
Total NEO high-tech	174,754	100%	Total Remainder of OH high-tech	305,348	100%

The comparison of the employment growth in Northeast Ohio and the Remainder of Ohio is shown by the shares of 2007 to 2008 employment growth (Figures 10 and Figure 11). The shares of employment growth in Northeast Ohio were calculated based on the total employment increase (3,386) and did not include employment decline in other Northeast Ohio (-361). The bulk of growth in Northeast Ohio is due to employment increases in the Akron MSA and some growth in the Cleveland MSA. The regions of growth within the Remainder of Ohio are quite surprising. The Other Remainder of Ohio, which includes six smaller MSAs and the rural counties, grew faster than its high-tech employment base in 2008, while Cincinnati and Columbus showed growth proportional to their employment shares. The Dayton MSA was below its proportion of total high-tech employment (13.9%), which means it grew below the average for the Remainder of Ohio.

FIGURE 10. SHARES OF 2007-2008 NEO EMPLOYMENT GROWTH IN TOTAL HIGH-TECH EMPLOYMENT

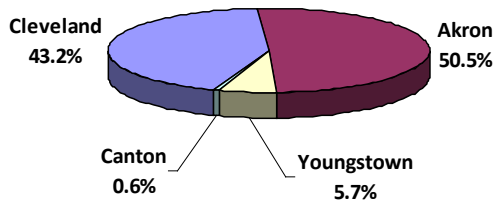
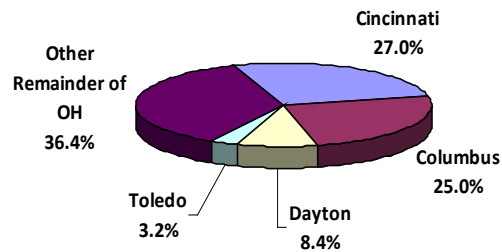


FIGURE 11. SHARES OF 2007-2008 THE REMAINDER OF OHIO EMPLOYMENT GROWTH IN TOTAL HIGH-TECH EMPLOYMENT



HIGH-TECH OCCUPATIONS

According to the methodology of defining a high-tech sector, only industries that employ a certain percentage of employment¹⁹ in technology-oriented occupations are considered high-tech. However, not all workers in those industries are employed in high-tech occupations; a significant number of employees, even in high-technology industries, are employed in non-technology-oriented occupations.

Out of all employment in 2008 NEO's high-tech sector, only 23.7% of occupations were considered as technology-oriented (Table 16). More than three quarters of all high-tech sector's jobs (133,389 or 76.3%) were in non-technology-oriented occupations helping to sustain the production of high-tech industries.

TABLE 16. EMPLOYMENT IN HIGH-TECH SECTOR BY HIGH TECHNOLOGY OCCUPATIONS, 2008

High-Tech Industries Employment by Occupations	Employment	Percentage
Total High-Tech Industries Employment	174,754	100.0%
High-Tech Occupations	41,365	23.7%
Non-High-Tech Occupations	133,389	76.3%

All technology-oriented occupations are classified within four major occupational groups. None of these groups includes only technology-oriented jobs. In major occupational group 11, Management Occupations, only 3 out of 34 six-digit occupational detailed groups are considered as technology-oriented. In the major occupational group 15, Computer and Mathematical Occupations, 14 out of 16 occupations are considered technology-oriented; in the major group 17, Architecture and Engineering Occupations, 28 out of 35 are technology-oriented, and in the major group 19, Life, Physical, and Social Science Occupations, only 26 out of 43 occupations are technology-oriented. With this mix of technology-oriented and non-technology-oriented occupations, within the four mixed occupational sectors alone, only 68% of all employment (or 41,365 out of 60,864 jobs) are technology-oriented jobs (Table 17).

The largest sector that employs workers in technology-oriented occupations is Computer and Mathematical Science Occupations; it employs 19,544 technology-oriented jobs or 47.2% of all technology-oriented occupations in NEO's high-tech sector. It is followed by Architecture and Engineering Occupations with 15,007 technology-oriented occupations, which accounts for another 36.3% of all technology-oriented occupations in NEO's high-tech sector. If calculated as the percentage of 2008 total NEO high-tech employment, these two technology-oriented occupational sectors employ only 11.2% and 8.6% of all employment. Together with 3,472 high-tech employees in Life, Physical, and Social Science Occupations and 3,342 technology-oriented jobs in Management Occupations, the technology-oriented jobs in NEO's high-tech sector totals 41,365 or 23.7% of all NEO high-tech employment in 2008.

In the 2008 NEO high-tech sector, most of the technology-oriented occupations were filled by employees of such professions as Computer Specialists (19,086), Engineers (9,733), and Drafters, Engineering, and Mapping Technicians (5,234) (Appendix B, Table B4). Other technology-oriented occupations in Northeast Ohio included those who worked as Operations Specialties Managers (1,697), Other Management Occupations (1,645), Physical Scientists (1,510), and Life, Physical, and Social Science Technicians (1,326). Life Scientists accounted for 635 workers and Mathematical Science Occupations for 458 workers that also belong to technology-oriented occupations.

¹⁹ The percentage of technology-oriented occupations by industry varies from 4.7% to 60.2%. Source: Daniel E. Hecker "High-technology employment: a NAICS-based update." *Monthly Labor Review*, pp. 57-72, July 2005

TABLE 17. EMPLOYMENT IN HIGH-TECH INDUSTRIES BY DETAILED OCCUPATIONS

Occupation Code		Occupation Title	High-Tech or Non - High-Tech Occupation	Employment
Mixed Occupational Sectors	11-0000	Management occupations	High-tech Non-high-tech	3,342 13,731
	15-0000	Computer and mathematical science occupations	High-tech Non-high-tech	19,544 849
	17-0000	Architecture and engineering occupations	High-tech Non-high-tech	15,007 3,161
	19-0000	Life, physical, and social science occupations	High-tech Non-high-tech	3,472 1,759
Non-High-Tech Occupational Sectors	43-0000	Office and administrative support occupations	Non-high-tech	32,437
	51-0000	Production occupations	Non-high-tech	27,852
	13-0000	Business and financial operations occupations	Non-high-tech	17,030
	49-0000	Installation, maintenance, and repair occupations	Non-high-tech	11,156
	41-0000	Sales and related occupations	Non-high-tech	10,118
	53-0000	Transportation and material moving occupations	Non-high-tech	4,981
	27-0000	Arts, design, entertainment, sports, and media occupations	Non-high-tech	2,101
	47-0000	Construction and extraction occupations	Non-high-tech	1,787
	33-0000	Protective service occupations	Non-high-tech	1,577
	37-0000	Building and grounds cleaning and maintenance occupations	Non-high-tech	1,076
	29-0000	Healthcare practitioners and technical occupations	Non-high-tech	1,054
	23-0000	Legal occupations	Non-high-tech	716
	21-0000	Community and social services occupations	Non-high-tech	548
	35-0000	Food preparation and serving related occupations	Non-high-tech	420
	25-0000	Education, training, and library occupations	Non-high-tech	366
	39-0000	Personal care and service occupations	Non-high-tech	327
31-0000	Healthcare support occupations	Non-high-tech	244	
45-0000	Farming, fishing, and forestry occupations	Non-high-tech	98	
Total High-Tech Industries Employment				174,754

The bulk of NEO's high-tech sector employs workers in non-technology-oriented occupations. All Mixed Occupational Sectors that include technology-oriented jobs also include non-technology-oriented occupations necessary for sustaining the operations of high-tech industries. For example, one third of Life, Physical, and Social Science Occupations are not technology-oriented and include workers of such occupations as Social Scientists and Related Workers.

The largest non-technology-oriented occupational group was Office and Administrative Support Occupations that employed 32,437 workers in 2008. It was followed by Production Occupations – 27,852, Business and Financial Operations Occupations – 17,030, Installation, Maintenance, and Repair Occupations – 11,156, and Sales and Related Occupations – 10,118 workers (Table 17).

The largest detailed occupational employment group in NEO's high-tech sector was Business Operation Specialists, which employed 11,534 workers in 2008. It was followed by Assemblers and Fabricators – 8,342, Information and Record Clerks – 8,215, Other Production Occupations – 7,946, and Metal Workers and Plastic Workers – 6,697 (Appendix B Table B4).

All non-high-tech workers of NEO's high-tech sector were employed across 91 detailed non-technology-oriented occupations. Together they accounted for 133,389 jobs or 76.3% of NEO's high-tech sector. All these employees were essential to NEO's high-tech sector, which cannot sustain its operations without these non-technology-oriented workers. These workers, in turn, benefit from the large size and the growth in NEO's high-tech sector.

RESEARCH & DEVELOPMENT

Research and development (R&D) activity in Northeast Ohio is assessed in terms of approximated industry R&D expenditures, and academic R&D expenditures. The industry R&D is approximated from 2000 to 2007, and the academic R&D expenditures are analyzed from 2000 to 2008 as total R&D expenditures by NEO academic institutions and to 2007 by sources of funding. This section also provides some information on the R&D activity of two of the region's major non-academic research institutions: The Cleveland Clinic and NASA Glenn Research Center.

INDUSTRY RESEARCH & DEVELOPMENT

Estimates of regional industry R&D expenditures are based on the distribution of state R&D industry expenditures by regional employment in Scientific Research and Development Services industry sector (NAICS 5417).²⁰ Total industry R&D in Northeast Ohio was \$1,918 Million in 2007. Industry R&D in Northeast Ohio grew the fastest over the longer period of time and over the last 3-year and 1-year periods (Table 18). In Northeast Ohio it grew by more than 16% since 2000, while all other benchmark regions except the United States experienced industry R&D decline. NEO's industry R&D increased more than 50% between 2004 and 2007, and grew 6.3% over the last year, 2006-2007. It outpaced the Remainder of Ohio (2.3% in 2006-2007), the Midwest (-0.4%), and even the national level (5.7%). Despite the high rates of growth, Northeast Ohio accumulates only 26.4% of all industry R&D expenditures in Ohio.

Among the regions within Northeast Ohio, about 55% of all R&D spenders were concentrated in the Cleveland MSA. This amount grew 5.9% over the last year, 2006 to 2007, and by 27% since 2004. Another 27% of all NEO industry R&D was concentrated in the Akron MSA, and that amount grew over the last year (2.1%) and more than tripled since 2004. Non-metro counties and Mansfield experienced the highest growth over the last year (12% and 32.5%, respectively) and accounted for another 17% of total NEO industry R&D expenditures. Two metropolitan areas continued to experience a decline: industry R&D decreased in Canton by 1.2% in 2006-2007 and by 48.4% since 2004; Youngtown lost 4.3% of their industry R&D in 2006 to 2007 and 37.1% since 2004. Both of these metropolitan areas experienced the decline in industry R&D since 2000.

²⁰ According to U.S. Census Bureau, "This industry group comprises establishments engaged in conducting original investigation undertaken on a systematic basis to gain new knowledge (research) and/or the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes (experimental development). The industries within this industry group are defined on the basis of the domain of research; that is, on the scientific expertise of the establishment." Two industry groups within this sector comprise establishments primarily engaged in conducting research and experimental development in the physical, engineering, or life sciences, such as agriculture, electronics, environmental, biology, botany, biotechnology, computers, chemistry, food, fisheries, forests, geology, health, mathematics, medicine, oceanography, pharmacy, physics, veterinary, and other allied subjects. The other subsector includes establishments primarily engaged in conducting research and analyses in cognitive development, sociology, psychology, language, behavior, economic, and other social science and humanities research.

TABLE 18. ESTIMATED INDUSTRY R&D FUNDING BY SUBREGION, 2000-2007

(in Millions of 2007 Dollars)

MSA/other region	2000	2004	2005	2006	2007	2000-2007	2004-2007	2006-2007
Akron	201.3	120.9	207.6	506.1	516.6	156.6%	327.3%	2.1%
Canton Massillon	173.4	42.0	26.3	21.9	21.6	-87.5%	-48.4%	-1.2%
Cleveland-Elyria-Mentor	857.1	826.3	883.0	990.4	1,048.9	22.4%	26.9%	5.9%
Mansfield	89.0	68.2	58.8	65.3	86.5	-2.8%	27.0%	32.5%
Sandusky	18.7	11.2	8.1	8.3	8.6	-54.3%	-23.3%	3.2%
Youngstown-Warren	26.1	10.7	7.3	7.1	6.8	-74.1%	-37.1%	-4.3%
Non-Metro Counties	285.5	184.5	199.5	204.8	229.4	-19.6%	24.3%	12.0%
Northeast Ohio	1,651.3	1,255.6	1,390.5	1,804.0	1,918.3	16.2%	52.8%	6.3%
Remainder of Ohio	6,345.8	4,701.3	4,776.9	5,226.7	5,346.7	-15.7%	13.7%	2.3%
Ohio Total	8,062.1	5,982.8	6,202.1	7,036.7	7,265.0	-9.9%	21.4%	3.2%
Midwest	52,862	44,787	48,401	49,569	49,349	-6.6%	10.2%	-0.4%
U.S.	266,696	228,602	240,055	254,672	269,266	1.0%	17.8%	5.7%

However, when industry R&D funding is calculated per employee, Northeast Ohio still significantly lags all benchmark areas (Table 19). In 2007, industry R&D funding per employee in Northeast Ohio was \$959 compared to \$1,665 in the Remainder of Ohio, \$2,121 in the Midwest, and \$2,020 in the United States. Over the longer term, industry R&D funding in Northeast Ohio grew faster than the rest of the state, the Midwest, and the United States; however, it only slightly narrowed the gap between Northeast Ohio and benchmark areas by the number of industry R&D per employee.

TABLE 19. ESTIMATED INDUSTRY R&D FUNDING PER EMPLOYEE, 2000-2007

(2007 Dollars)

	2000	2004	2005	2006	2007	2000-2007	2004-2007	2006-2007
Northeast Ohio	778	627	691	895	959	23.3%	53.0%	7.2%
Remainder of Ohio	1,928	1,482	1,500	1,626	1,665	-13.7%	12.3%	2.3%
Ohio Total	1,489	1,156	1,194	1,346	1,394	-6.4%	20.6%	3.6%
Midwest	2,220	1,955	2,098	2,130	2,121	-4.5%	8.5%	-0.4%
U.S.	2,096	1,804	1,862	1,936	2,020	-3.6%	12.0%	4.3%

ACADEMIC RESEARCH & DEVELOPMENT

NEO's colleges and universities reported \$492,783 million in research expenditures in FY 2008.²¹ Similarly to the industry R&D expenditures, NEO's academic R&D expenditures accounted for only 24.5% of the total in Ohio in 2007 and 27% in 2008 (Table 20). NEO academic R&D also grew at the highest rate of all benchmark areas, by 7.4% in 2007 to 2008, 7.3% from 2006 to 2008, and 43.3% since 2004. In comparison, Ohio declined last year by 2.5%, the Midwest grew by 2.4% and the U.S. average grew by 1.1%. A large amount of research activity in Northeast Ohio takes place outside academic institutions, such as the Cleveland Clinic's Lerner Research Institute, and NASA Glenn Research Center.

TABLE 20. R&D EXPENDITURES AT NORTHEAST OHIO COLLEGES AND UNIVERSITIES, FY 2000-2008
(in Thousands of 2008 Dollars)

Institution	2000	2004	2006	2007	2008	2000-2008	2004-2008	2006-2008	2007-2008
United States	42,637,853	47,225,112	51,006,025	51,338,370	51,908,726	21.7%	9.9%	1.8%	1.1%
Midwest	6,484,656	7,862,695	7,881,273	7,971,504	8,163,708	25.9%	3.8%	3.6%	2.4%
Ohio	1,271,223	1,533,078	1,742,668	1,873,301	1,827,042	43.7%	19.2%	4.8%	-2.5%
NEO Institutions	329,726	343,948	459,263	459,022	492,783	49.5%	43.3%	7.3%	7.4%
U. Akron all campuses	26,729	31,784	30,226	28,179	27,182	1.7%	-14.5%	-10.1%	-3.5%
Case Western Reserve U.	264,701	268,026	392,452	386,652	416,077	57.2%	55.2%	6.0%	7.6%
Cleveland State U.	14,004	19,528	15,406	16,560	14,131	0.9%	-27.6%	-8.3%	-14.7%
John Carroll U.	1,470	553	504	309	405	-72.4%	-26.7%	-19.6%	30.9%
Kent State U. all campuses	14,831	14,698	11,772	19,730	23,293	57.1%	58.5%	97.9%	18.1%
NEO U. C. of Medicine	5,500	6,477	5,626	5,175	9,165	66.6%	41.5%	62.9%	77.1%
Oberlin C.	947	441	861	803	726	-23.3%	64.6%	-15.7%	-9.5%
C. Wooster	813	325	1,027	980	611	-24.8%	87.9%	-40.5%	-37.7%
Youngstown State U.	729	2,117	1,390	634	1,193	63.6%	-43.6%	-14.2%	88.0%

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development. Expenditures at Universities and Colleges, FY 2000-2008

Over the period of time between 2000 and 2008, four major NEO universities significantly increased their R&D funding. Case Western Reserve University and Kent State University grew by more than 57% since 2000, Northeastern Ohio Universities College of Medicine and Youngstown State University by 67% and 64%, and Akron University and Cleveland State University by modest 1.7% and 0.9%, respectively.

Case Western Reserve University is the dominant educational research institution in the region; it accounted for more than 84% of 2008 NEO's academic R&D expenditures. Out of \$33.8 million of NEO's 2007 to 2008 growth, Case Western Reserve added \$29.4 or 87% in academic R&D expenditures. In this institution alone, academic R&D expenditures grew by 7.6% last year and by 55.2% since 2004. Three more universities that accounted for more than \$1 million R&D expenditures growth in the last year included Kent State by 18.1%, Northeastern Ohio Universities College of Medicine by 77.1%, and Youngstown State University by 88.0%. University of Akron and Cleveland State University decreased their R&D expenditures, continuing a decline from 2004.

²¹ The Ohio Agricultural Research and Development Center (OARDC), located in Wooster, Ohio (Wayne County) is part of The Ohio State University and therefore its research activities are not captured in data on Northeast Ohio institutions. OARDC is Ohio's only higher education-related investment in the agro-biosciences. OARDC uses state support to maintain and build infrastructure that provides a solid base from which OARDC faculty leverage external funding from competitive grants, contracts, and federal awards. This funding totaled \$41.7 million in FY 2009. (Source: OARDC website, http://oardc.osu.edu/OARDC_jobsbrochure.pdf).

TABLE 21. R&D EXPENDITURES GROWTH AT NEO COLLEGES AND UNIVERSITIES BY FUNDING SOURCE, FY 2006-2007

Institution	Total (%)	Federal Government (%)	State and Local Government (%)	Industry (%)	Institutional Funds (%)	All other sources (%)
U.S.	0.7	-1.4	1.4	7.1	3.6	6.2
Midwest	1.2	-1.2	2.5	14.4	1.1	10.8
Ohio	7.5	2.7	15.4	23.5	8.7	22.3
Northeast Ohio Institutions	-0.1	-2.8	25.7	-1.4	24.7	-18.6
U. Akron all campuses	-6.8	-4.2	-9.3	-4.6	-13.9	2.2
Case Western Reserve U.	-1.5	-3.0	27.7	-10.2	25.7	-23.8
Cleveland State U.	7.5	-3.5	30.1	65.8	0.7	8.9
John Carroll U.	-38.6	-36.7		-77.8		
Kent State U. all campuses	67.6	16.8	22.4	85.9	370.4	
NEO Univ. C. of Medicine	-8.0	-1.5	-28.0	-58.0	-6.6	-36.3
Oberlin C.	-6.8	13.9		-14.5	-84.0	
C. Wooster	-4.5	-57.8				-7.8
Youngstown State U.	-54.4	-57.5	-61.2	-18.3	-4.9	

Although the major source of funding NEO universities is the federal government (76%, Appendix B Table B5), this source is declining (-2.8% in 2006-2007) compared to growing funds from the state and local governments (25.7%) and institutional funds (24.7%) (Table 21). This trend is consistent across the United States until the end of the current decade, as a decrease of industry funding of universities is common during economic declines. Only Cleveland State University and Kent State University were able to significantly increase their industry funding in 2007 compared to 2006; the rest of the institutions experienced a decline of the funding from this source.

Although Northeast Ohio has experienced solid growth in academic R&D overall, due to the density of its population and employment Northeast Ohio again lags the state, the Midwest, and the nation in its level of funding when R&D expenditures are calculated per employee (Table 22). In 2008, per employee expenditures in Northeast Ohio were \$248, up from \$230 in 2007, but about only 60% of that in the Remainder of Ohio, 70% of the Midwest, and 64% of the U.S. institutions. The Remainder of Ohio decreased the per-employee level of academic R&D expenditures from \$440 in 2007 to \$416 in 2008, but it still leads all benchmark areas in this indicator. Northeast Ohio may have an advantage over many other areas in terms of research conducted at institutions not captured in this data (see below); however, the lack of comparable data prevents further analysis.

TABLE 22. ACADEMIC R&D EXPENDITURES PER EMPLOYEE, 2000-2008

(in 2008 Dollars)

Institution	2000	2004	2005	2006	2007	2008	2000-2008	2004-2008	2006-2008	2007-2008
Northeast Ohio Institutions	155	172	208	228	230	248	59.9%	44.7%	9.0%	8.2%
Remainder of Ohio	286	375	393	399	440	416	45.6%	11.1%	4.3%	-5.4%
Ohio	235	296	321	333	359	352	50.0%	18.9%	5.7%	-2.0%
Midwest	272	343	334	339	343	351	29.1%	2.4%	3.8%	2.6%
U.S.	335	373	391	388	385	387	15.5%	3.9%	-0.2%	0.5%

INSTITUTIONAL RESEARCH

Industry funding and academic research expenditures capture only a portion of the research activity being conducted in Northeast Ohio. Directly comparable data on R&D expenditures are not available for the Cleveland Clinic and NASA Glenn Research Center; however, both institutions conduct a considerable amount of research.

The Cleveland Clinic's Lerner Research Institute is formally affiliated with Case Western Reserve University and constitutes a significant scientific base for regional biomedical research. Its total annual research expenditures were about \$258 million in 2008 (including \$75 million in new National Institute of Health (NIH) funding). More than 1,200 people (including about 194 principal investigators, 350 junior faculty and postdoctoral fellows, and 160 graduate students) in 11 departments work in research programs focusing on cardiovascular, cancer, neurologic, musculoskeletal, allergic and immunologic, eye, metabolic, and infectious disease. The Institute includes more than 700,000 square feet of space. The Institute also is an integral part of the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University and created the Molecular Medicine PhD Program – training the next generation of physician-scientists.²²

NASA's Glenn Research Center, in partnership with U.S. industry, universities, and other government institutions, develops critical systems technologies and capabilities that address national priorities. Their world-class research, technology, and capability development efforts are keys to advancing exploration of the solar system and beyond while maintaining global leadership in aeronautics.

Glenn is distinguished by its unique blend of aeronautics and spaceflight experience. Their work is focused on technological advancements in spaceflight systems development, aeropropulsion, space propulsion, power systems, nuclear systems, communications and human research. NASA Glenn has won many awards and honors for its state-of-the-art technology development and cutting-edge research. They include 105 R&D 100 Awards since 1966, four NASA Software of the Year Awards, two Collier Trophies and an Emmy Award. They have reported more than 2,000 invention disclosures since 1991 and won an average of nine awards per year from the NASA Inventions and Contributions Board. Thirteen patents were awarded in 2009.²³

In FY 2008, Glenn Research Center reported annual research expenditures of \$691.3 million.²⁴ It is important to note that NASA contracts with local universities to conduct research and includes these contract dollars in its reported research expenditures. Therefore, some of the same dollars are captured in NASA and university research expenditures.

²² According to Lerner Research Institute website, http://my.clevelandclinic.org/media_relations/cleveland_clinic_researchers_receive_grant_to_study_treatments_for_spinal_cord_injuries.aspx

²³ Source: NASA Glenn Research Center website, <http://technology.grc.nasa.gov/>.

²⁴ Source: NASA Glenn Research Center, Office of the Chief Financial Officer, April 2010.

CONCLUDING REMARKS & POLICY IMPLICATIONS

This report provides an ongoing monitoring tool describing changes in the high-tech sector in Northeast Ohio. Tracking a specific set of measures on an annual basis provides policy makers with a method for assessing progress and directing resources.

High-tech employment in Northeast Ohio was growing despite the continued decline of non-high-tech industries. This trend of growth in high-tech and decline in non-high-tech industries is common for all Midwest regions, but Northeast Ohio's rate of decline in the non-high-tech industries is greater than in benchmark regions. The growth in NEO's high-tech sector is similar to the average in the Midwest, but smaller than that of the Remainder of Ohio.

Despite the fact that Northeast Ohio is located within the same legislative space as the Remainder of Ohio, the dynamics in the high-tech sectors in both regions are different. The differences between Northeast Ohio and the Remainder of Ohio are especially intriguing because the industries with the most growth within the sector are similar in both regions. The major differences are in the absolute scale of the sectors, but not in their share within the high-tech regional economy.

In comparing NEO high-tech growth to the growth of the high-tech sector in the Remainder of Ohio, it is worth noting that four of the six fast-growing technology groups in Northeast Ohio and in the Remainder of Ohio are the same: Management, Sales and Facilities Support, Information and Communication Technology, Energy and Power and Propulsion, and Science and Engineering. Two other technology groups that were growing in the Remainder of Ohio are Advanced Materials and Pharmaceuticals, which showed only modest growth. The four growing groups showing growth in Northeast Ohio added 83% of total jobs added to the high-tech sector. The six groups in the Remainder of Ohio together accounted for almost 80% of all the high-tech employment growth in that region in 2007 to 2008.

Even though the shares of these groups within respective regional economies were similar or only slightly larger in the Remainder of Ohio, the annual average wages that were earned by workers in these sectors in the Remainder of Ohio were significantly higher than those in Northeast Ohio. For example, in Northeast Ohio the average wage in the Management, Sales and Facilities Support technology group was \$75,436 in 2008, while in the Remainder of Ohio it was 35% higher than in Northeast Ohio (\$101,834). As in Northeast Ohio, the main growth in this technology group was driven by the Management of Companies industry and Enterprises, which alone added 1,637 jobs that accounted for 23% of all Remainder of Ohio high-tech sector growth. This industry paid, on average, \$109,435 in 2008 and was responsible for the group's average wages. In comparison, this industry paid, on average, only \$94,917 in Northeast Ohio in 2008. The second fastest growing technology group in the Remainder of Ohio, the Information and Communication Technology, like Northeast Ohio, is driven by the Computer Systems Design and Related Services industry (NAICS 5415) that hired a number of employees between 2007 and 2008, which was proportional to the industry size. However, as with the previously mentioned industry, Computer Systems paid Remainder of Ohio employees salaries that were, on average, 23% higher than those in Northeast Ohio.

Overall, in 2008, NEO average high-tech wages were 12.1% (\$9,877) lower than in the Remainder of Ohio, 15.6% (\$13,253) lower than in the Midwest, and 19.7% (\$17,651) lower than in the United States. NEO average wages are slowly closing the gap of 2000 when they lagged behind the U.S. average by 26.4%; in 2004, this gap dropped to 22.2% and in 2006 it was 19.3%. In 2007, the gap between Northeast Ohio and the United States in high-tech average annual wages was 18.6% and in 2008 was back on the rise and higher than

in 2006. Northeast Ohio still holds its leading position in high-tech average wage growth from 2000 to 2008 at 13.6% compared to 11.9% in the Remainder of Ohio, 9.7% in the Midwest and 4.1% in the United States; however, the present rate of growth is still too low to close the gap with benchmark regions over the short run.

The big gap in average wages to some extent reflects differences in the cost of living in different regions. However, in the case of disparities between Northeast Ohio and the Remainder of Ohio, it reflects a higher level of jobs and productivity. Measured as the Gross Regional Product (GRP) per employee, the productivity showed a modest performance in NEO's high-tech sector. In 2007 to 2008, productivity in both sectors, high-tech (-1.0%) and non-high-tech (-0.8%), declined. During the same year, the Remainder of Ohio grew in high-tech productivity by 3.4% while its non-high-tech declined (-1.3%), the Midwest high-tech productivity grew by 1.9%, and the U.S. high-tech grew by 1.0%.

As a result, Northeast Ohio didn't perform in GRP growth as well as other regions, showing only single digit growth in 2004 to 2008 (8.9%), while the Remainder of Ohio grew almost twice as fast (15.7%), surpassing again both the Midwest (10.5%) and the United States (14.9%). For the last 2 years, NEO's growth rate was similar to that of benchmark regions, showing a modest increase at 5.2%. However, in 2007 to 2008, Northeast Ohio was the only region with a decline in GRP (-0.2%), while the Remainder of Ohio's high-tech sector increased its GRP by 3.6%, the Midwest by 2.1%, and the United States by 1.9%.

The synopses identified in this summary describe the dynamics of NEO's high-tech sector up to year 2008, and the national economy was still on a decline during 2009. The regional economy was declining more severely than the national average in previous years, and expectations for the improvements within the worst recession since pre-war years are not high. The region is growing at the rate of R&D expenditures, indicative that it is building a new knowledge economy, but the rate of growth is inadequate to close the gap in per capita academic R&D and industry R&D between Northeast Ohio and benchmark areas.

Despite the fact that this report explores the high-tech sector of the regional economy, the message is relevant to all types of occupations. Out of all employment in 2008 NEO's high-tech sector, only 23.7% of occupations are considered as technology-oriented. More than three quarters of all high-tech sector jobs (133,389 or 76.3%) are occupied by people who have probably never considered themselves as high-tech workers. They are employed in non-technology-oriented occupations helping to sustain the production of high-tech industries.

Northeast Ohio as a region, does have successful companies and prosperous industries; and NEO high-tech sector is growing despite a continued severe decline in other areas of the regional economy. However, the rest of the Midwest and the nation that was already ahead of our region at the beginning of this decade are accelerating their growth. Northeast Ohio needs to continue to grow in high-tech sector and the different technology groups.

APPENDIX A: NORTECH SERVICE AREA

Metropolitan Areas

Akron MSA

Portage County

Summit County

Canton-Massillon MSA

Carroll County

Stark County

Cleveland-Elyria-Mentor MSA

Cuyahoga County

Geauga County

Lake County

Lorain County

Medina County

Mansfield MSA

Richland County

Sandusky MSA

Erie County

Youngstown-Warren-Boardman MSA

Mahoning County

Trumbull County

Mercer County, PA*

Non-Metro Counties

Ashland County

Ashtabula County

Columbiana County

Crawford County

Holmes County

Huron County

Tuscarawas County

Wayne County

* Mercer County is not included in the analyses, with the exception of the section on employment in high-tech occupations.

APPENDIX B: DETAILED TABLES AND FIGURES FOR THE HIGH-TECH SECTOR

TABLE B1. CHANGES OF NAICS IN HIGH-TECH INDUSTRY DEFINITION

Code	2002	2007
5161	<u>Internet Publishing and Broadcasting</u> - This industry comprises establishments engaged in publishing and/or broadcasting content on the Internet exclusively. These establishments do not provide traditional (non-Internet) versions of the content that they publish or broadcast. Establishments in this industry provide textual, audio, and/or video content of general or specific interest on the Internet.	Discontinued
5173	<u>Telecommunications Resellers</u> - This industry comprises establishments primarily engaged in purchasing access and network capacity from owners and operators of the networks and reselling wired and wireless telecommunications services to businesses and households. Establishments in this industry resell telecommunications; they do not operate and maintain telecommunications switching and transmission facilities.	Discontinued
5181	<u>Internet Service Providers and Web Search Portals</u> - This industry comprises establishments known as Internet service providers or known as Web search portals. Establishments in this industry provide clients access to the Internet or operate Web sites that use a search engine to provide Internet search services. Establishments in this industry generally provide related services, such as Web hosting, Web page design, and related advice and assistance. Web search portals often provide additional Internet services, such as e-mail, connections to other Web sites, auctions, news, and other limited content, and serve as a home base for Internet users.	Discontinued
5191	<u>Other Information Services</u> - Businesses engaged in supplying information, storing information, providing access to information, and searching and retrieving information.	<u>Other Information Services</u> - Businesses engaged in supplying information, storing and providing access to information, searching and retrieving information, operating Web sites that use search engines to allow for searching information on the Internet, or publishing and/or broadcasting content exclusively on the Internet.
5179	<u>Other Telecommunications</u> - Businesses engaged in (1) providing specialized telecommunication applications, such as satellite tracking, communications telemetry, and radar stations operations; or (2) providing satellite terminal stations and associated facilities operationally connected with one or more terrestrial communications systems and capable of transmitting telecommunications to or receiving telecommunications from satellite systems.	<u>Other Telecommunications</u> - Businesses engaged in (1) purchasing access and network capacity from owners and operators of telecommunications networks and reselling wired and wireless telecommunications services (except satellite) to businesses and households; (2) providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation; (3) providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems; or (4) providing Internet access services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections. Businesses in this industry do not operate as telecommunications carriers. Mobile virtual network operators (MVNO) are included in this industry.
51912	<u>Libraries and Archives</u> - This industry comprises establishments primarily engaged in providing library or archive services. These establishments are engaged in maintaining collections of documents (e.g., books, journals, newspapers, and music) and facilitating the use of such documents (recorded information regardless of its physical form and characteristics) as are required to meet the informational, research, educational, or recreational needs of their user. These establishments may also acquire, research, store, preserve, and generally make accessible to the public historical documents, photographs, maps, audio material, audiovisual material, and other archival material of historical interest. All or portions of these collections may be accessible electronically.	<u>Libraries and Archives</u> - This industry comprises establishments primarily engaged in providing library or archive services. These establishments are engaged in maintaining collections of documents (e.g., books, journals, newspapers, and music) and facilitating the use of such documents (recorded information regardless of its physical form and characteristics) as are required to meet the informational, research, educational, or recreational needs of their user. These establishments may also acquire, research, store, preserve, and generally make accessible to the public historical documents, photographs, maps, audio material, audiovisual material, and other archival material of historical interest. All or portions of these collections may be accessible electronically.

TABLE B2. EMPLOYMENT CHANGE BY TECHNOLOGY GROUP: NEO, THE MIDWEST AND THE U.S. 2004-2008, %

NAICS	Industry Description	Emp 2008	2004-2006 Employment Change				2004-2008 Employment Change				2007-2008 Employment Change			
		NEO	NEO	Rem	MW	U.S.	NEO	Rem	MW	U.S.	NEO	Rem	MW	U.S.
Total Advanced Manufacturing		17,331	4.0%	2.1%	2.6%	1.2%	2.2%	4.5%	0.9%	1.7%	-2.4%	0.3%	-0.9%	0.0%
3332	Industrial machinery manufacturing	3,792	13.5%	5.4%	10.2%	1.5%	9.7%	5.3%	7.1%	1.6%	-2.4%	-1.4%	-2.7%	-1.9%
3333	Commercial and service industry machinery manufacturing	1,704	-16.2%	-29.5%	-6.6%	-5.2%	-19.7%	-34.1%	-10.7%	-6.9%	-3.9%	1.8%	-1.9%	-0.1%
3339	Other general-purpose machinery manufacturing	11,722	5.0%	6.8%	2.6%	3.0%	4.6%	7.9%	2.7%	4.3%	-2.3%	-2.6%	0.1%	0.3%
3369	Other transportation equipment manufacturing	113	-4.1%	15.6%	0.3%	6.4%	-34.6%	48.3%	-4.9%	9.6%	-0.9%	21.4%	-1.1%	4.7%
Total Advanced Materials		15,849	-3.0%	-2.6%	-1.5%	-4.5%	-6.0%	-0.8%	0.0%	-6.5%	-0.3%	2.1%	-0.2%	-0.6%
3251	Basic chemical manufacturing	4,518	-5.5%	-2.2%	-3.9%	-6.8%	-6.6%	-1.2%	0.1%	-3.3%	0.2%	7.0%	4.5%	2.9%
3252	Resin, synthetic rubber, & artificial synthetic fibers & filaments mnf	3,329	-2.0%	0.7%	13.4%	-3.4%	0.3%	2.9%	16.6%	-3.4%	1.5%	-1.0%	-1.9%	-0.9%
3253	Pesticide, fertilizer, and other agricultural chemical manufacturing	250	-18.2%	-12.9%	-18.9%	-8.2%	-63.6%	5.4%	-8.3%	-13.3%	-19.5%	5.6%	-1.4%	-0.1%
3255	Paint, coating, and adhesive manufacturing	4,677	0.2%	-9.2%	-5.8%	-2.8%	-2.5%	-10.2%	-7.9%	-8.8%	1.4%	-0.1%	-1.4%	-2.0%
3259	Other chemical product and preparation manufacturing	3,075	-1.7%	5.6%	0.2%	-2.0%	-4.4%	1.7%	-1.5%	-10.3%	-3.4%	-4.2%	-2.2%	-4.5%
Total Pharmaceuticals		1,449	N/A	N/A	-2.8%	0.7%	N/A	N/A	-3.9%	1.6%	2.2%	3.1%	0.7%	-0.8%
3254	Pharmaceutical and medicine manufacturing	1,449	N/A	N/A	-2.8%	0.7%	N/A	N/A	-3.9%	1.6%	2.2%	3.1%	0.7%	-0.8%
Total Electronics		16,300	-1.2%	-6.2%	-0.7%	-0.1%	-1.1%	-10.1%	-1.8%	-2.2%	-0.5%	-2.8%	-0.2%	-0.9%
3341	Computer and peripheral equipment manufacturing	479	-6.1%	2.0%	-0.5%	-7.0%	3.8%	-6.7%	-12.5%	-13.8%	7.9%	-13.2%	-6.7%	-2.1%
3342	Communications equipment manufacturing	1,069	-4.5%	-13.1%	-6.4%	-1.6%	-22.8%	-21.1%	-11.6%	-9.3%	-2.8%	-3.9%	-3.6%	-1.2%
3344	Semiconductor and other electronic component manufacturing	2,845	13.4%	-8.2%	2.6%	1.2%	10.8%	-8.6%	3.3%	-1.7%	-2.8%	2.5%	1.2%	-2.6%
3345	Navigational, measuring, electromedical, & control instruments mnf	5,699	-8.4%	-5.3%	-0.3%	1.5%	-4.7%	-7.2%	2.1%	2.4%	-0.7%	-0.4%	0.5%	0.6%
3353	Electrical equipment manufacturing	5,171	4.7%	-7.5%	-2.9%	-0.1%	7.8%	-10.4%	-2.6%	2.8%	1.2%	-4.1%	1.4%	1.5%
8112	Electronic & precision equipment repair & maintenance	1,038	-13.0%	3.6%	1.4%	3.7%	-19.8%	-5.7%	-5.4%	2.6%	-2.5%	-7.2%	0.6%	-0.9%
Total Energy and Power & Propulsion		13,130	0.5%	6.8%	1.6%	2.6%	7.6%	11.2%	3.7%	8.5%	3.3%	3.4%	2.2%	3.4%
2111	Oil and gas extraction	459	-4.1%	-9.8%	-6.1%	7.9%	15.4%	-1.1%	3.3%	28.3%	-1.6%	3.7%	2.2%	9.1%
2211	Electric power generation, transmission, and distribution	5,837	-5.4%	2.1%	-0.9%	-3.3%	4.5%	6.1%	0.8%	-1.7%	6.2%	4.2%	2.3%	1.6%
3241	Petroleum and coal products manufacturing	1,300	1.9%	1.1%	0.7%	-0.1%	7.4%	5.2%	0.1%	3.9%	4.5%	3.0%	0.0%	1.5%
3336	Engine, turbine, & power transmission equipment manufacturing	1,435	7.9%	7.4%	4.1%	8.8%	6.7%	-2.9%	3.7%	12.8%	-1.8%	-1.8%	2.1%	3.4%
3364	Aerospace product and parts manufacturing	3,834	7.3%	16.6%	7.4%	7.6%	11.6%	25.9%	16.1%	15.6%	1.3%	4.1%	4.2%	4.0%
4862	Pipeline transportation of natural gas	163	0.4%	7.9%	1.6%	-0.8%	-0.2%	11.4%	-3.8%	-4.3%	0.8%	1.9%	-5.1%	-2.3%
Total Information and Communication Technology		29,028	2.0%	-0.2%	1.4%	1.7%	6.7%	4.3%	5.6%	7.7%	2.8%	1.7%	2.2%	3.2%
5112	Software publishers	614	-5.6%	7.2%	4.1%	2.1%	-9.5%	2.7%	10.5%	9.7%	-1.2%	-1.0%	4.7%	3.6%
5171	Wired telecommunications carriers	8,139	-5.2%	-5.4%	-8.4%	-7.9%	-12.0%	-7.9%	-9.3%	-9.5%	-3.2%	0.6%	2.4%	1.9%
5172	Wireless telecommunications carriers (except satellite)	1,441	1.4%	8.5%	4.6%	4.5%	10.7%	10.5%	13.2%	6.8%	7.4%	-12.4%	0.7%	-2.0%
5179	Other telecommunications	1,455	-41.7%	-4.6%	-6.5%	-13.1%	-35.0%	2.0%	-23.5%	-29.1%	4.6%	-0.1%	-7.2%	-6.9%
5182	Data processing, hosting, and related services	2,145	-6.0%	-7.7%	-3.5%	-1.3%	1.5%	-16.7%	-6.9%	-0.6%	3.2%	-4.9%	-5.8%	-2.3%
5191	Other information services	623	0.9%	-5.8%	8.3%	6.1%	26.3%	-5.3%	24.0%	47.8%	13.5%	0.3%	8.1%	13.4%
5415	Computer systems design and related services	14,405	19.5%	3.6%	8.9%	11.4%	32.0%	15.0%	20.8%	27.4%	5.5%	4.6%	4.7%	7.0%
Total Management, Sales and Facilities Support Services		53,151	-2.1%	-0.1%	1.9%	4.1%	0.1%	2.2%	3.4%	9.8%	3.6%	2.4%	1.6%	2.7%
4234	Professional & commercial equipment & supplies, merchant	9,041	-3.8%	1.5%	1.8%	1.0%	-5.2%	3.2%	1.7%	2.9%	-1.7%	2.0%	0.7%	0.3%
5511	Management of companies and enterprises	41,240	-2.8%	-0.5%	1.5%	5.1%	-0.1%	1.8%	3.4%	12.0%	4.6%	2.5%	1.9%	3.6%
5612	Facilities support services	1,897	18.2%	-4.6%	25.0%	8.8%	27.9%	14.1%	32.2%	20.0%	9.6%	8.3%	3.7%	2.6%
Total Science & Engineering		28,517	7.4%	5.1%	5.8%	11.7%	12.6%	11.3%	8.4%	20.6%	1.8%	1.7%	1.3%	3.8%
5413	Architectural, engineering, and related services	15,793	1.2%	1.9%	3.3%	9.3%	5.2%	7.3%	5.5%	16.4%	0.9%	0.9%	0.2%	2.2%
5416	Management, scientific, and technical consulting services	9,014	11.8%	11.8%	13.1%	18.4%	19.6%	23.5%	21.7%	35.5%	3.7%	2.5%	4.8%	7.5%
5417	Scientific research-and-development services	3,709	29.5%	5.8%	2.0%	8.6%	34.0%	7.6%	-2.9%	11.0%	1.5%	2.7%	-1.7%	2.1%
Total High-Tech		174,754	1.0%	1.1%	2.0%	3.9%	3.3%	4.3%	3.7%	8.8%	1.8%	1.7%	1.2%	2.4%
Total Employment, all industries		1,983,341	0.6%	1.3%	1.6%	3.8%	-1.0%	1.0%	1.4%	5.8%	-0.8%	-0.3%	-0.2%	0.6%

Note: Industries with fewer than 50 employees in Northeast Ohio are not shown.

TABLE B3. AVERAGE ANNUAL WAGES CHANGE BY TECHNOLOGY GROUP: NEO, THE MIDWEST AND THE U.S., 2004-2008, %

NAICS	Industry Description	Ann Av Wages 2008	2 0 0 4 - 2 0 0 6				2 0 0 4 - 2 0 0 8				2 0 0 7 - 2 0 0 8			
		NEO	NEO	RemOH	MW	U.S.	NEO	RemOH	MW	U.S.	NEO	RemOH	MW	U.S.
Total Advanced Manufacturing		\$52,834	6.4%	7.9%	1.9%	2.3%	2.1%	4.3%	-0.3%	0.4%	-1.0%	-3.0%	-1.9%	-1.6%
3332	Industrial machinery manufacturing	\$52,975	4.4%	6.9%	4.6%	5.6%	1.8%	5.4%	2.3%	3.3%	-0.2%	-0.5%	-0.9%	-1.0%
3333	Commercial and service industry machinery manufacturing	\$39,847	-7.9%	3.1%	4.9%	1.8%	-6.4%	0.6%	2.5%	0.3%	1.1%	-8.9%	-4.6%	-1.4%
3339	Other general-purpose machinery manufacturing	\$54,869	8.1%	8.4%	3.7%	3.3%	2.3%	5.0%	2.0%	1.5%	-1.4%	-1.8%	-1.6%	-1.8%
3369	Other transportation equipment manufacturing	\$32,911	-9.7%	7.3%	-15.0%	-10.6%	-8.5%	-5.5%	-19.3%	-13.0%	-6.1%	-11.7%	-2.1%	-2.0%
Total Advanced Materials		\$76,277	6.3%	4.6%	8.6%	4.4%	12.1%	0.0%	7.1%	5.5%	-5.6%	-3.4%	-2.0%	-0.5%
3251	Basic chemical manufacturing	\$96,318	11.4%	3.6%	10.5%	7.9%	18.2%	-5.7%	4.5%	6.1%	-10.1%	-8.9%	-6.5%	-3.4%
3252	Resin, synthetic rubber, & artificial synthetic fibers and filaments mnf	\$61,100	-4.5%	10.1%	26.2%	5.9%	-5.2%	6.0%	25.5%	7.3%	-8.0%	-0.1%	1.7%	0.7%
3253	Pesticide, fertilizer, and other agricultural chemical manufacturing	\$58,674	-5.9%	14.2%	0.9%	-2.3%	7.6%	-0.2%	2.0%	10.2%	19.3%	-1.7%	7.4%	10.1%
3255	Paint, coating, and adhesive manufacturing	\$69,408	9.0%	2.3%	2.8%	2.2%	9.9%	3.0%	0.7%	-0.2%	2.7%	-1.8%	-3.6%	-3.4%
3259	Other chemical product and preparation manufacturing	\$75,136	6.8%	-0.4%	-0.2%	1.1%	21.4%	7.6%	0.1%	1.1%	-6.7%	2.4%	-2.5%	-0.6%
Total Pharmaceuticals		\$69,858	N/A	N/A	12.9%	7.2%	N/A	N/A	23.0%	8.1%	-15.4%	4.3%	0.3%	-5.0%
3254	Pharmaceutical and medicine manufacturing	\$69,858	N/A	N/A	12.9%	7.2%	N/A	N/A	23.0%	8.1%	-15.4%	4.3%	0.3%	-5.0%
Total Electronics		\$57,141	6.5%	8.8%	3.6%	8.9%	9.6%	36.0%	4.8%	0.9%	0.0%	25.4%	3.0%	-2.7%
3341	Computer and peripheral equipment manufacturing	\$70,658	-7.3%	6.0%	-6.7%	19.4%	-2.0%	6.5%	-8.7%	0.1%	-4.4%	2.0%	-5.6%	-9.4%
3342	Communications equipment manufacturing	\$60,608	2.4%	11.0%	10.2%	3.0%	18.0%	1.5%	14.4%	-2.4%	5.8%	-11.9%	9.0%	-2.1%
3344	Semiconductor and other electronic component manufacturing	\$41,166	-1.6%	16.1%	3.3%	9.2%	-2.0%	172.3%	13.4%	-1.0%	1.1%	133.2%	12.9%	-0.9%
3345	Navigational, measuring, electromedical, & control instruments mnf	\$55,155	5.8%	9.4%	4.8%	7.9%	13.1%	9.3%	5.6%	7.0%	2.4%	-1.3%	3.6%	-1.3%
3353	Electrical equipment manufacturing	\$68,248	14.3%	5.9%	8.5%	6.5%	11.5%	1.7%	6.7%	7.0%	-3.0%	1.5%	-0.8%	2.8%
8112	Electronic and precision equipment repair and maintenance	\$46,688	-4.8%	2.6%	-3.1%	-0.1%	-2.0%	4.5%	-6.8%	-1.1%	-5.6%	-0.9%	-3.1%	-2.1%
Total Energy and Power & Propulsion		\$78,392	15.5%	15.4%	12.5%	9.6%	17.1%	13.3%	13.0%	10.7%	1.9%	-0.6%	0.4%	1.6%
2111	Oil and gas extraction	\$53,477	5.8%	17.7%	15.8%	21.4%	13.2%	3.4%	8.0%	22.0%	-2.5%	-16.3%	-11.3%	11.7%
2211	Electric power generation, transmission, and distribution	\$95,461	24.4%	27.5%	12.6%	5.4%	26.1%	31.1%	14.5%	6.6%	5.4%	2.6%	-0.6%	-0.8%
3241	Petroleum and coal products manufacturing	\$70,605	12.0%	21.5%	14.8%	10.2%	25.8%	8.7%	13.3%	12.8%	4.5%	-11.1%	0.9%	0.1%
3336	Engine, turbine, & power transmission equipment manufacturing	\$58,212	5.5%	10.7%	16.1%	9.7%	7.8%	3.0%	16.4%	9.1%	-1.1%	0.2%	4.2%	2.2%
3364	Aerospace product and parts manufacturing	\$65,082	8.8%	3.9%	8.6%	10.2%	2.9%	0.0%	5.8%	7.6%	-6.6%	0.4%	-0.5%	-2.0%
4862	Pipeline transportation of natural gas	\$73,136	0.0%	3.9%	2.3%	3.4%	15.4%	11.9%	9.8%	8.5%	8.8%	5.9%	8.1%	1.7%
Total Information and Communication Technology		\$64,558	0.1%	0.9%	2.9%	4.7%	-0.9%	3.7%	2.8%	4.2%	-1.3%	-4.2%	-4.1%	-1.4%
5112	Software publishers	\$73,090	-3.9%	5.4%	8.8%	7.3%	-5.1%	-6.4%	-0.8%	7.6%	-5.0%	-32.1%	-7.0%	1.8%
5171	Wired telecommunications carriers	\$61,397	-9.7%	-10.8%	-4.3%	1.1%	-10.9%	-8.7%	-7.6%	-4.1%	-2.5%	-2.4%	-4.5%	-4.3%
5172	Wireless telecommunications carriers (except satellite)	\$66,890	8.0%	9.7%	10.0%	13.2%	1.5%	-12.4%	0.4%	3.4%	-3.3%	7.4%	1.4%	3.3%
5179	Other telecommunications	\$54,207	33.7%	-5.8%	2.2%	4.7%	21.2%	-0.1%	-0.6%	2.1%	-10.0%	-0.2%	-2.1%	-1.0%
5182	Data processing, hosting, and related services	\$48,577	0.3%	9.0%	5.5%	6.1%	5.8%	16.0%	12.3%	8.1%	-2.7%	6.4%	-11.5%	-3.2%
5191	Other information services	\$58,817	2.4%	7.9%	5.6%	4.9%	3.7%	8.8%	11.3%	46.4%	-1.4%	-1.4%	1.7%	2.4%
5415	Computer systems design and related services	\$69,080	0.5%	3.0%	3.3%	4.0%	0.3%	8.2%	4.1%	2.6%	0.6%	-3.3%	-3.6%	-2.3%
Total Management, sales and facilities support services		\$75,436	12.4%	8.9%	3.4%	7.2%	11.3%	4.3%	8.0%	8.9%	-3.1%	-8.9%	-1.7%	-3.5%
4234	Professional & commercial equipment and supplies, merchant whsl	\$71,660	13.7%	3.7%	3.3%	0.5%	7.5%	3.8%	0.0%	0.6%	-4.5%	-1.7%	-2.8%	-0.9%
5511	Management of companies and enterprises	\$94,917	22.1%	9.8%	3.3%	9.2%	19.8%	4.5%	9.4%	10.9%	-6.3%	-10.1%	-1.6%	-4.6%
5612	Facilities support services	\$39,983	7.5%	14.7%	-8.1%	2.1%	24.2%	22.5%	-4.4%	5.5%	-0.3%	6.7%	-2.2%	1.7%
Total Science & Engineering		\$63,119	4.7%	2.0%	2.8%	5.1%	5.7%	2.9%	6.5%	8.0%	0.3%	1.8%	4.4%	0.6%
5413	Architectural, engineering, and related services	\$58,239	2.6%	2.8%	4.1%	6.1%	5.4%	3.6%	9.0%	8.0%	1.3%	0.3%	6.3%	0.9%
5416	Management, scientific, and technical consulting services	\$64,271	1.8%	3.4%	4.4%	2.4%	0.1%	6.0%	15.7%	7.8%	-0.8%	3.0%	4.5%	1.3%
5417	Scientific research-and-development services	\$81,102	12.0%	-1.4%	-0.3%	6.8%	12.9%	-1.4%	-5.3%	9.2%	-1.1%	3.1%	1.0%	-0.8%
High-Tech Annual Average Wage		\$71,864	10.2%	6.5%	4.5%	6.3%	9.8%	6.1%	7.0%	6.4%	-2.7%	-3.0%	-0.3%	-1.4%
All Industries Annual Average Wage		\$40,296	2.7%	2.9%	2.8%	4.1%	1.6%	3.2%	2.9%	4.7%	-3.9%	-2.2%	-1.6%	-1.4%

Note: Industries with fewer than 50 employees in Northeast Ohio are not shown.

TABLE B4. EMPLOYMENT IN NEO HIGH-TECH INDUSTRIES BY DETAILED OCCUPATIONS

	Occupation Code	Occupation Title	High-Tech or Non-High-Tech Occupation	Employment
Mixed Occupational Sectors	11-1000	Top Executives	non-high-tech	4,931
	11-2000	Advertising, Marketing, Promotions, Public Relations, & Sales Managers	non-high-tech	2,456
	11-3000	Operations Specialties Managers	non-high-tech high-tech	4,391 1,697
	11-9000	Other Management Occupations	non-high-tech high-tech	1,953 1,645
	15-1000	Computer Specialists	non-high-tech high-tech	797 19,086
	15-2000	Mathematical Science Occupations	non-high-tech high-tech	52 458
	17-1000	Architects, Surveyors, and Cartographers	non-high-tech	1,680
	17-2000	Engineers	non-high-tech high-tech	1,036 9,773
	17-3000	Drafters, Engineering, and Mapping Technicians	non-high-tech high-tech	446 5,234
	19-1000	Life Scientists	non-high-tech high-tech	67 635
	19-2000	Physical Scientists	non-high-tech high-tech	81 1,510
	19-3000	Social Scientists and Related Workers	non-high-tech	1,413
	19-4000	Life, Physical, and Social Science Technicians	non-high-tech high-tech	198 1,326
	Non-high-tech Occupational Sectors	13-1000	Business Operations Specialists	non-high-tech
51-2000		Assemblers and Fabricators	non-high-tech	8,342
43-4000		Information and Record Clerks	non-high-tech	8,215
51-9000		Other Production Occupations	non-high-tech	7,946
51-4000		Metal Workers and Plastic Workers	non-high-tech	6,697
49-9000		Other Installation, Maintenance, and Repair Occupations	non-high-tech	6,096
43-3000		Financial Clerks	non-high-tech	5,804
43-9000		Other Office and Administrative Support Workers	non-high-tech	5,695
43-6000		Secretaries and Administrative Assistants	non-high-tech	5,672
13-2000		Financial Specialists	non-high-tech	5,496
41-4000		Sales Representatives, Wholesale and Manufacturing	non-high-tech	4,716
43-5000		Material Recording, Scheduling, Dispatching, and Distributing Workers	non-high-tech	4,551
49-2000		Electrical and Electronic Equipment Mechanics, Installers, and Repairers	non-high-tech	3,596
53-7000		Material Moving Workers	non-high-tech	3,267
51-1000		Supervisors, Production Workers	non-high-tech	2,307
41-3000		Sales Representatives, Services	non-high-tech	2,187
43-1000		Supervisors, Office and Administrative Support Workers	non-high-tech	2,179
51-8000		Plant and System Operators	non-high-tech	2,165
41-9000		Other Sales and Related Workers	non-high-tech	1,469
53-3000		Motor Vehicle Operators	non-high-tech	1,259
47-2000		Construction Trades Workers	non-high-tech	1,061
27-3000		Media and Communication Workers	non-high-tech	1,000
27-1000		Art and Design Workers	non-high-tech	982
49-1000		Supervisors of Installation, Maintenance, and Repair Workers	non-high-tech	943
41-2000		Retail Sales Workers	non-high-tech	893
41-1000		Supervisors, Sales Workers	non-high-tech	853
37-2000		Building Cleaning and Pest Control Workers	non-high-tech	762
33-3000		Law Enforcement Workers	non-high-tech	679
33-9000		Other Protective Service Workers	non-high-tech	619

	Occupation Code	Occupation Title	High-Tech or Non-high-tech Occupation	Employment
Non-high-tech Occupational Sectors	21-1000	Counselors, Social Workers & Other Community & Social Service Specialists	non-high-tech	537
	49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	non-high-tech	521
	29-1000	Health Diagnosing and Treating Practitioners	non-high-tech	498
	23-1000	Lawyers, Judges, and Related Workers	non-high-tech	472
	47-4000	Other Construction and Related Workers	non-high-tech	444
	29-2000	Health Technologists and Technicians	non-high-tech	341
	53-1000	Supervisors, Transportation and Material Moving Workers	non-high-tech	339
	43-2000	Communications Equipment Operators	non-high-tech	322
	37-3000	Grounds Maintenance Workers	non-high-tech	250
	23-2000	Legal Support Workers	non-high-tech	244
	51-6000	Textile, Apparel, and Furnishings Workers	non-high-tech	217
	29-9000	Other Healthcare Practitioners and Technical Occupations	non-high-tech	215
	39-9000	Other Personal Care and Service Workers	non-high-tech	210
	35-3000	Food and Beverage Serving Workers	non-high-tech	180
	47-1000	Supervisors, Construction and Extraction Workers	non-high-tech	160
	33-2000	Fire Fighting and Prevention Workers	non-high-tech	141
	33-1000	First-Line Supervisors/Managers, Protective Service Workers	non-high-tech	138
	31-9000	Other Healthcare Support Occupations	non-high-tech	135
	25-4000	Librarians, Curators, and Archivists	non-high-tech	132
	51-5000	Printing Workers	non-high-tech	103
	31-1000	Nursing, Psychiatric, and Home Health Aides	non-high-tech	96
	47-5000	Extraction Workers	non-high-tech	94
	35-1000	Supervisors, Food Preparation and Serving Workers	non-high-tech	93
	25-9000	Other Education, Training, and Library Occupations	non-high-tech	89
	45-2000	Agricultural Workers	non-high-tech	87
	35-2000	Cooks and Food Preparation Workers	non-high-tech	84
	27-4000	Media and Communication Equipment Workers	non-high-tech	78
	25-3000	Other Teachers and Instructors	non-high-tech	74
	35-9000	Other Food Preparation and Serving Related Workers	non-high-tech	64
	37-1000	Supervisors, Building and Grounds Cleaning and Maintenance Workers	non-high-tech	63
	39-3000	Entertainment Attendants and Related Workers	non-high-tech	62
	51-7000	Woodworkers	non-high-tech	61
	53-6000	Other Transportation Workers	non-high-tech	55
	53-2000	Air Transportation Workers	non-high-tech	46
	27-2000	Entertainers and Performers, Sports and Related Workers	non-high-tech	41
	25-2000	Primary, Secondary, and Special Education School Teachers	non-high-tech	36
	25-1000	Postsecondary Teachers	non-high-tech	35
	39-1000	Supervisors, Personal Care and Service Workers	non-high-tech	33
	47-3000	Helpers, Construction Trades	non-high-tech	28
	51-3000	Food Processing Workers	non-high-tech	15
31-2000	Occupational and Physical Therapist Assistants and Aides	non-high-tech	13	
39-6000	Transportation, Tourism, and Lodging Attendants	non-high-tech	12	
21-2000	Religious Workers	non-high-tech	12	
45-1000	Supervisors, Farming, Fishing, and Forestry Workers	non-high-tech	9	
53-4000	Rail Transportation Workers	non-high-tech	8	
39-2000	Animal Care and Service Workers	non-high-tech	7	
53-5000	Water Transportation Workers	non-high-tech	7	
39-5000	Personal Appearance Workers	non-high-tech	3	
45-4000	Forest, Conservation, and Logging Workers	non-high-tech	3	
45-3000	Fishing and Hunting Workers	non-high-tech	0	
Total High-Tech Industries Employment				174,754

TABLE B5. R&D EXPENDITURES AT NEO COLLEGES AND UNIVERSITIES BY FUNDING SOURCE, 2007

(in Thousands of 2007 Dollars)

Institution	Total R&D Expenditures	Federal Government		State and Local Government	Industry	Institution Funds	All Other Sources
		Total	Share				
United States	49,430,767	30,440,745	61.6%	3,145,376	2,672,333	9,655,290	3,517,023
Midwest	7,689,532	4,437,192	57.7%	468,588	445,932	1,780,564	557,256
Ohio	1,807,038	1,061,089	58.7%	178,154	172,659	295,365	99,771
NEO Institutions	442,071	335,242	75.8%	27,118	10,957	46,629	22,125
U. Akron all campuses	27,138	11,210	41.3%	672	3,239	8,298	3,719
Case Western Reserve U.	372,374	304,742	81.8%	21,104	5,772	24,517	16,239
Cleveland State U.	15,948	5,097	32.0%	4,269	392	4,739	1,451
John Carroll U.	298	293	98.3%	0	5	0	0
Kent State U. all campuses	19,001	9,801	51.6%	921	1,332	6,947	0
Northeastern OH Us C of Medicine	4,984	2,777	55.7%	98	49	1,777	283
Oberlin C.	773	639	82.7%	0	112	22	0
C. Wooster	944	219	23.2%	0	0	292	433
Youngstown State U.	611	464	75.9%	54	56	37	0

Source: National Science Foundation/Division of Science Resource Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2007.
http://www.nsf.gov/statistics/nsf09303/content.cfm?pub_id=3871&id=2