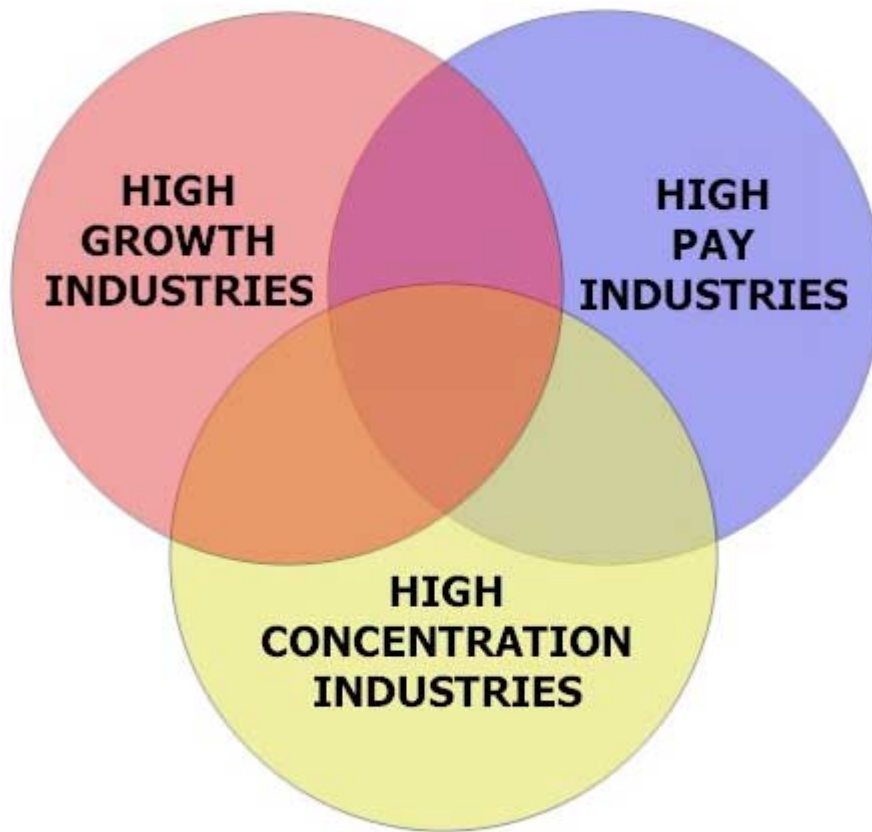


WISCONSIN

High-Tech Opportunities



Prepared for
Wisconsin Technology Council, Inc.

Authored by
NorthStar Economics, Inc.

November 2001

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Dennis K. Winters, Vice President and Director of Research, NorthStar Economics, Inc., is the principal investigator and lead author of this study, with substantial contributions made by NorthStar Economics, Inc., principals, Dr. David J. Ward, President, and Alan J. Hart, Vice President, Director of Operations. Karyn Kriz, Research Assistant, was invaluable in gathering data and contributed to the writing and organization of the report.

The author accepts full responsibility for the accuracy of the data and results of this analysis.

Preface

This study focuses on high-tech industries as a driver for Wisconsin's economy. One of the primary objectives for advancing Wisconsin's economy is that of raising the per capital income level of the state's citizenry, now at 95% of the national average. The positive correlation between education and income is common knowledge. It is also widely understood that high-tech industries employ a larger share of highly educated workers than do most industries. This is, in fact, a *de facto* corollary to the definition of high-tech industries that is used through much of the existing body of work on the subject.

The intention of this report is to compare Wisconsin's high-tech industry economy with that of the nation as a whole. The goal of the study is to identify some of the promising high-tech industries in the state that would warrant further attention based on the opportunity vectors intersection of employment growth, pay levels, and high-tech occupational concentrations. This study is limited in its scope in that it only considers high-tech industries as the basis for state and national comparisons. Little attention is paid to comparing high-tech industries with non-high-tech industries. Obviously, other opportunities reside in the state and our recommendations are not to be considered all-inclusive or exclusive of other potential opportunities.

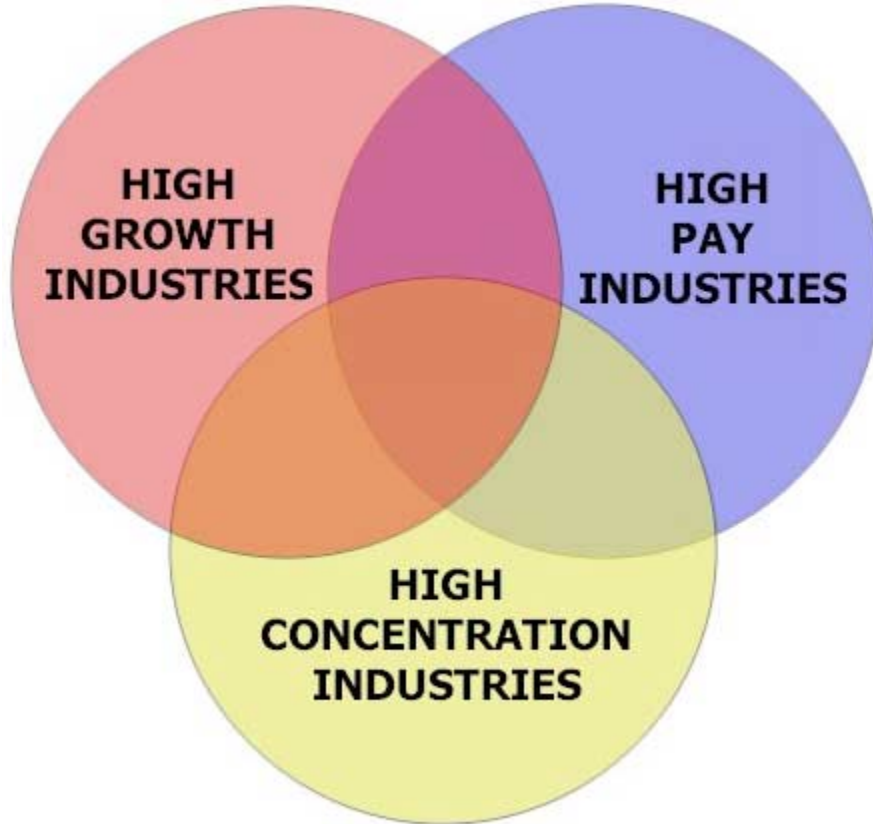
This study provides an essential benchmark and database of Wisconsin's current high-tech economy. Further analysis should be undertaken to determine what Wisconsin's economic structure should be ten, twenty, thirty years hence. Then the state's economic development strategy can be constructed and economic development initiatives can be implemented to achieve that structure. That analysis should include how high-tech industries mesh with all the other resources the state of Wisconsin has at its disposal, including natural, human, capital and creative resources.

Dennis K. Winters
Vice President, Director of Research
NorthStar Economics, Inc.

HIGHLIGHTS

This analysis identifies promising industries for high-technology economic development in Wisconsin. Industries that met the evaluation criteria of high employment growth, high pay levels and high concentrations of high-technology workers generated a super-intersection that holds great promise for Wisconsin economic development initiatives.

Super-Intersection of High-Tech Industry Promise



This Super-Intersection of high-growth, high-paying, and high-talent industries in Wisconsin yields a set of five high-tech industries, listed in the table below. These five industries present Wisconsin with the greatest opportunities for growth and economic development.

Fast Growing, High Paying, High Occupation Concentrations in Wisconsin

<u>Industry</u>	<u>Employment Growth Rank</u>	<u>Wage Rank</u>	<u>Occupation Concentration Rank</u>
Computer & Data Processing Services	2 nd	5 th	1 st
Industrial Organic Chemicals	3 rd	19 th	8 th
Industrial Inorganic Chemicals	7 th	10 th	21 st
Management & Public Relations Services	12 th	11 th	11 th
General Industrial Machinery	13 th	18 th	19 th

Source: The Bureau of Labor Statistics, The Department of Workforce Development

Wisconsin has the opportunity to grow a number of other promising high-tech industries that exist in the state. The high-tech industries in the state that also show promise based upon two-way opportunity vector intersections are listed in the following table.

Wisconsin High-Tech Industry Opportunities

<u>Industry</u>	<u>High Employment Growth</u> (≥ 20%)	<u>High Paying</u> (≥ 133%)	<u>High High-Tech Occupational Concentration</u> (≥ 9.0%)
Drugs	X	X	
Motor Vehicles & Equipment	X	X	
Electronic Components & Accessories	X		X
Communications Equipment	X		X
Household Audio & Video Equipment	X		X
Medical Equipment, Instruments & Supplies		X	X
Search & Navigation Equipment		X	X
Miscellaneous Chemical Products		X	X
Engines & Turbines		X	X
Engineering & Architectural Services		X	X
Special Industrial Machinery		X	X
Measuring & Controlling Devices		X	X
Paint & Allied Products		X	X
Electrical Industrial Apparatus		X	X
Plastics Materials & Synthetics		X	X
High employment growth is greater than 20% increase in employment over the 1991 to 1999 period. High-paying is average annual industry income is at least 133% of average annual Wisconsin worker income, \$29,607. High high-tech occupational concentration is the share of high-tech workers is at least 9% of all the industry's workers.			

Other Comparative Advantages

Still other Wisconsin industries show some unique traits that set them apart from their counterparts at the national level. This set of industries possesses some comparative advantages relative to national averages. The next table lists these industries and how they compared to the national situation.

Wisconsin Comparative Advantage High-Tech Industries

<u>Industry</u>	<u>Comparative Advantage</u>
Industrial Organic Chemicals	High growth in Wisconsin/Negative growth in U.S.
Agricultural Chemicals	High growth in Wisconsin/Negative growth in U.S.
General Industrial Machinery	High growth in Wisconsin/Negative growth in U.S.
Soaps, Cleaners, & Toilet Goods	Annual wages higher in Wisconsin than U.S.
Medical Equipment, Instruments & Supplies	Annual wages higher in Wisconsin than U.S.
Electric Distribution Equipment	Higher occupational concentration in Wisconsin than U.S.
Electrical Industrial Apparatus	Higher occupational concentration in Wisconsin than U.S.

Source: Bureau of Labor Statistics, Department of Workforce Development

The industries listed in the tables above deserve more attention as candidates for focused economic development initiatives. Wisconsin should foster the development of these industries through:

- Developing the cluster infrastructure surrounding these industries
- Encouraging capital investment in these industries
- Networking the financial resources supporting these industries
- Creating educational programs for entrepreneurs and workers in these industries
- Networking the supplier and customer base for these industries
- Assisting in the technology transfer to these industries and of these industries

Many of these initiatives are part of the strategic plan developed by the Wisconsin Technology Council.

Obviously, the high-tech industry list presented in this analysis is not an exhaustive list of opportunities for economic development initiatives. There are many emerging businesses that could become the foundations for entire new industry clusters in the state. Wisconsin would best be served by building the supportive infrastructure that will foster the creation and expansion of all businesses and industries that generate high-paying jobs in the state.

EXECUTIVE SUMMARY

The Wisconsin Technology Council (Council) is charged with promoting and supporting the creation, development and retention of science-based and technology-based businesses in Wisconsin. In order to carry out that task, the Council needs to gather information about the state of Wisconsin's high-tech or New Economy. The Council also requires a benchmarking of Wisconsin's New Economy to measure progress of the Council's initiatives.

NorthStar Economics, Inc. (NorthStar) reviewed the New Economy literature for the Council to find and compare high-technology industry definitions and measurement methodologies. The Bureau of Labor Statistics definition of high-tech industry was selected due to thoroughness of definition, availability of data for continued monitoring and the ability to compare Wisconsin data with other states. Federal and state data sources offer readily available, consistent, historical data sets for quantitative economic analysis.

By integrating employment, wages and occupational data, Wisconsin's high-tech industries that hold the most potential for future growth are identified. This study identifies a number of high-tech industries that meet two criteria for advancing Wisconsin's economy: 1) the industries are growing rapidly and, 2) those industries' workers are paid well.

Also integrated is an important third vector of high-tech occupational concentrations. This vector serves as a means through which to capture those industries that could add a relatively large number of well-paying jobs, thereby lifting Wisconsin's overall per capita income level.

Pay and Brain Drain

Wisconsin's opportunity vector intersection for high paying, high-tech occupations holds promise in the respect that the state employs a below national average number of high-tech workers and pays them less than the comparable national average salary. This is further evidence of Wisconsin's "Brain Drain" problem and one indication of its cause – less pay. It is also indicative of Wisconsin's concentration in manufacturing industries (second highest employment share in the nation and low on the spectrum of industry spending on research and development) instead of industries that spend heavily on research and development (Wisconsin companies invest \$1 billion dollars less annually on research and development than the national average).

The opportunities lie in increasing earning levels of high-tech workers and in increasing research and development investment in Wisconsin industries. Research and development infrastructure must be built and competitive wages must be paid if the state wants to attract more high-tech, highly-paid workers.

Promising High-Tech Industries

Wisconsin has the opportunity to enhance a number of promising high-tech industries in the state. The high-tech industries in the state that show the most promise based upon the opportunity vector intersections analysis conducted in this paper are listed in the following table. The industries listed in the table are portrayed by their intersection of two or three opportunity vectors.

There is a hierarchy in the table listing below. The industries listed first are located at the super-intersection of all three opportunity vectors: high employment growth, high-paying industries and high high-tech occupational concentrations. Industries subsequently listed in the table represent those industries that registered intersections of two of the opportunity vectors, their intersecting vectors are designated.

Wisconsin High-Tech Industry Opportunities

<u>Industry</u>	<u>High Employment Growth</u> (≥ 20%)	<u>High Paying</u> (≥ 133%)	<u>High High-Tech Occupational Concentration</u> (≥ 9.0%)
Computer & Data Processing Services	X	X	X
Industrial Organic Chemicals	X	X	X
Industrial Inorganic Chemicals	X	X	X
Management & Public Relations Services	X	X	X
General Industrial Machinery	X	X	X
Drugs	X	X	
Motor Vehicles & Equipment	X	X	
Electronic Components & Accessories	X		X
Communications Equipment	X		X
Household Audio & Video Equipment	X		X
Medical Equipment, Instruments & Supplies		X	X
Search & Navigation Equipment		X	X
Miscellaneous Chemical Products		X	X
Engines & Turbines		X	X
Engineering & Architectural Services		X	X
Special Industrial Machinery		X	X
Measuring & Controlling Devices		X	X
Paint & Allied Products		X	X
Electrical Industrial Apparatus		X	X
Plastics Materials & Synthetics		X	X
High employment growth is greater than 20% increase in employment over the 1991 to 1999 period. High-paying is average annual industry income is at least 133% of average annual Wisconsin worker income, \$29,607. High high-tech occupational concentration is the share of high-tech workers is at least 9% of all the industry's workers.			

Wisconsin's High-Tech Industry Structure

There are significant numbers of workers employed in Wisconsin's high-technology industries and in high-technology occupations. Of the thirty-one industries that are classified as "high-tech", Wisconsin employed workers in thirty of them in 1998, excepting Guided Missiles. Wisconsin employed 198,061 workers in high-tech industries in 1998. The state employed 98,800 workers in high-tech occupations in 1998.

Many employees in the thirty-one high-tech industries are not employed in high-technology occupations. Of the 198,061 workers employed in Wisconsin high-tech industries, 40,389, or 20.4%, were employed in high-tech occupations. By comparison, the U.S. employed 10,151,340 workers in high-tech industries, 2,740,800 of whom held high-tech occupation positions, a 27.0% share.

High-Tech Industry Employment

The Motor Vehicle and Equipment industry employed the most Wisconsin workers of the high-tech industries in the state, almost 23,000 in 1998. The Computer & Data Processing Industry is the second largest high-tech industry employer in Wisconsin, with 20,731 workers in 1998. The Computer & Data Processing Industry tops both the U.S. and Wisconsin list for both the number of workers employed and the concentration of employees in high-tech occupations, with high-tech occupation concentrations at about 50%. Motor Vehicles & Equipment is also in the top five for employment in both the state and the nation. However, very few Wisconsin workers in the motor vehicle industry are employed in high-tech occupations, only 6.6%.

Wisconsin possesses some strengths when compared against national high-tech industries. Electrical Industrial Apparatus, General Industrial Machinery, and Special Industrial Machinery rank in the top five Wisconsin high-tech industries in employment terms, but are nowhere near the top of the national list.

High-Tech Industry Employment Growth

The Computer & Data Processing Industry is at or near the top of the list for employment growth for Wisconsin (second, with 114% growth from 1991-1999) and the U.S. (first, at 135% growth). Employment growth in the Drugs and the Electronic Components & Accessories industries also rank in the top ten in both Wisconsin and the U.S. Wisconsin shows high employment growth in three other industries that don't appear in list of top five high employment growth industries for the U.S. They are Aircraft & Parts, Industrial Inorganic Chemicals and Electronic Components & Accessories, although the Aircraft & Parts and Industrial Inorganic Chemicals industries employment is small, each has less than a thousand workers in the state.

High-Tech Industry Pay

All but four of the high-tech industries pay Wisconsin workers significantly more than the state's 1999 average annual wage of \$29,607. The top two industries, Soaps, Cleaners & Toilet Goods and Medical Equipment, Instruments & Supplies pay more than double the annual average Wisconsin wage. The top twelve high-tech industries pay wages more than 150% of Wisconsin average annual wage. The Computers & Data Processing Services industry again registers in the top five of this category list.

Wisconsin and the United States share four of the top ten highest-paying high-tech industries. The remaining highest paying industries at the national level were among the lowest paying high-tech industries in Wisconsin. Conversely, the highest paying industries in Wisconsin, Soaps, Cleaners, & Toilet Goods and Medical Equipment, Instruments & Supplies, ranked near the bottom at the national level.

High-paying Occupations

The five highest paying, high-tech occupations in Wisconsin and the U.S. are shared. Three of the five are computer industry related. The caveat is that Wisconsin pays its high-tech workers significantly less than the U.S. average. Wisconsin high-tech workers are paid \$44,965 on average per year versus \$50,218 for the average U.S. high-tech worker, a 12% difference.

High-tech Occupational Concentrations

There are twenty-three industries in Wisconsin and twenty-seven industries in the U.S. that have high-tech occupation concentrations of at least 9.0%, three times the national industry average. Wisconsin and the U.S. share the same five high-tech industries that have the highest percentages of occupation concentration. The remaining industries that have high high-tech occupation concentrations are quite different when comparing Wisconsin to the U.S.

Intersection of High-Growth and High-Paying Industries

Eight high-tech industries are among both the highest employment growth (greater than 20% for the decade) and highest paying (greater than 133% of average annual Wisconsin wage) industries the in Wisconsin: Computer & Data Processing Services, Industrial Inorganic Chemicals, Petroleum Refining, Motor Vehicles and Equipment, Drugs, Industrial Organic Chemicals, Management & Public Relations Services, and General Industrial Machinery. These industries hold significant potential for high-tech industry development.

Fast Growing, High Paying Industries in Wisconsin

<u>Industry</u>	<u>Employment Growth Rank</u>	<u>Pay Rank</u>
Computer & Data Processing Services	2 nd	5 th
Industrial Organic Chemicals	3 rd	18 th
Drugs	4 th	14 th
Industrial Inorganic Chemicals	7 th	9 th
Petroleum Refining	9 th	6 th
Motor Vehicles & Equipment	10 th	4 th
Management & Public Relations Services	12 th	10 th
General Industrial Machinery	13 th	17 th

Source: Bureau of Labor Statistics, Department of Workforce Development

Intersection of High-Growth Industries and Occupational Concentration

There are eight high-tech industries in Wisconsin that demonstrate employment growth of at least 20% and have high-tech occupation concentrations of at least 9.0%. Four fast growing high-tech industries in Wisconsin are not listed in the chart below, because they had high-tech occupation concentrations under 9.0%, eliminating them from this intersection.

Fast Growing, High Occupation Concentration Industries in Wisconsin

<u>Industry</u>	<u>Employment Growth Rank</u>	<u>Occupation Concentration Rank</u>
Computer & Data Processing Services	2 nd	1 st
Industrial Organic Chemicals	3 rd	8 th
Electronic Components & Accessories	5 th	18 th
Communications Equipment	6 th	7 th
Industrial Inorganic Chemicals	7 th	21 st
Household Audio & Video Equipment	11 th	23 rd
Management & Public Relations Services	12 th	11 th
General Industrial Machinery	13 th	19 th
Source: Department of Workforce Development, Bureau of Labor Statistics		

Intersection of High-Paying Industries and Occupational Concentration

There are fifteen high-tech industries in Wisconsin that pay wages above 133% of the average annual Wisconsin wage and have high-tech occupation concentrations of at least 9.0%. This intersection allowed for the comparison of twenty highest paying, high-tech industries with twenty-three industries possessing the highest occupational concentrations.

High Paying, High Occupation Concentrations in Wisconsin

<u>Industry</u>	<u>Wage Rank</u>	<u>Occupation Concentration Rank</u>
Medical Equipment, Instruments & Supplies	2 nd	13 th
Search & Navigation Equipment	3 rd	4 th
Computer & Data Processing Services	5 th	1 st
Miscellaneous Chemical Products	7 th	9 th
Engines & Turbines	8 th	22 nd
Engineering & Architectural Services	9 th	2 nd
Industrial Inorganic Chemicals	10 th	21 st
Management & Public Relations Services	11 th	11 th
Special Industrial Machinery	12 th	14 th
Measuring & Controlling Devices	13 th	6 th
Paint & Allied Products	16 th	16 th
Electrical Industrial Apparatus	17 th	12 th
General Industrial Machinery	18 th	19 th
Industrial Organic Chemicals	19 th	8 th
Plastics Materials & Synthetics	20 th	15 th
Source: Bureau of Labor Statistics, Department of Workforce Development		

Super Opportunity Vector Intersection

The Super-Intersection of fast-growing, high-paying, and high occupational concentration high-tech industries in Wisconsin yields a set of five industries: Computer & Data Processing Services, Industrial Organic Chemicals, Industrial Inorganic Chemicals, Management & Public

Relations Services, and General Industrial Machinery. These five industries present Wisconsin with the greatest opportunities for growth and economic development.

Fast Growing, High Paying, High Occupation Concentrations in Wisconsin

<u>Industry</u>	<u>Employment Growth Rank</u>	<u>Wage Rank</u>	<u>Occupation Concentration Rank</u>
Computer & Data Processing Services	2 nd	5 th	1 st
Industrial Organic Chemicals	3 rd	19 th	8 th
Industrial Inorganic Chemicals	7 th	10 th	21 st
Management & Public Relations Services	12 th	11 th	11 th
General Industrial Machinery	13 th	18 th	19 th

Source: Bureau of Labor Statistics, Department of Workforce Development

Other Comparative Advantages

Other Wisconsin industries show some unique traits that set them apart from their counterparts at the national level. This set of industries possesses some comparative advantages relative to national averages. The next table lists these industries and how they compared to the national situation.

Wisconsin Comparative Advantage Industries

<u>Industry</u>	<u>Comparative Advantage</u>
Industrial Organic Chemicals	High growth in Wisconsin/Negative growth in U.S.
Agricultural Chemicals	High growth in Wisconsin/Negative growth in U.S.
General Industrial Machinery	High growth in Wisconsin/Low growth in U.S.
Soaps, Cleaners, & Toilet Goods	Annual wages higher in Wisconsin than U.S.
Medical Equipment, Instruments & Supplies	Annual wages higher in Wisconsin than U.S.
Electric Distribution Equipment	Higher occupational concentration in Wisconsin than U.S.
Electrical Industrial Apparatus	Higher occupational concentration in Wisconsin than U.S.

Source: Bureau of Labor Statistics, Department of Workforce Development

The industries listed in the tables above deserve more attention as candidates for focused economic development initiatives. Wisconsin should foster the development of these industries through:

- Developing the cluster infrastructure surrounding these industries
- Encouraging capital investment in these industries
- Networking the financial resources supporting these industries
- Creating educational programs for entrepreneurs and workers in these industries
- Networking the supplier and customer base for these industries
- Assisting in the technology transfer to these industries and of these industries

Obviously, the high-tech industry list presented in this analysis is not an exclusive list, by any means, for the attention of economic development initiatives. Wisconsin would best be served by building the supportive infrastructure that will foster the creation and expansion of all businesses and industries that generate high-paying jobs in the state.

INTRODUCTION

The Wisconsin Technology Council (Council) is charged with promoting and supporting the creation, development and retention of science-based and technology-based businesses in Wisconsin. In order to carry out that task, the Council needs to gather information about the state of Wisconsin's high-tech or New Economy. The Council also requires a benchmarking of Wisconsin's New Economy to measure progress of the Council's initiatives.

The Council asked NorthStar Economics, Inc. (NorthStar) to analyze the existing New Economy literature to extract current relevant definitions, establish benchmarks and create measures related to topics of the New Economy and high-tech economic development in Wisconsin. Included in the analysis is some preliminary work on the availability of existing data and the need to gather new data.

NorthStar reviewed the New Economy literature to find and compare New Economy definitions and measurement methodologies. NorthStar also collected and compared employment, wage, and occupation data to compare Wisconsin's New Economy profile with that of the nation. NorthStar also identified some opportunity vector intersections to help the Council decide which high-tech avenues to pursue.

This report begins with a listing of several high-technology industry definitions. The source of each is identified and the definition presented. Some of the definitions are more quantitatively precise than others. Some of the definitional criteria overlap.

The high-tech industry definition selected for benchmarking and comparative analyses was based upon the Bureau of Labor Statistics' work. The quantitative approach to set benchmarks and monitor subsequent measurement criteria was based upon data that was 1) readily available, 2) had a history and, 3) was consistent and comparable across geographic regions.

The report continues with a presentation of high-tech industry employment, earnings and occupational data. Several comparative statistics for Wisconsin and the U.S. are presented. Opportunity vectors are defined by ranking the high-tech industries' employment growth, wages and salaries, and high-tech occupational concentrations. Then intersections for those industries that are common to two opportunity vectors are identified. Finally, the super-intersection of all three opportunity vectors is presented. It is hoped that this information will generate a high-tech industry listing on which the Council may focus its mission efforts.

NEW ECONOMY DEFINITIONS

Milken Institute (Milken) – “Our definition of high tech industries includes industries that spend an above-average amount of revenue on research and development (R&D) and that employ an above industry-average number of technology using occupations – such as scientists, engineers, mathematicians and programmers.” Milken's definition uses government data on industry output, share of R&D to output and industry occupational shares of technology using employees. Milken's industry selection is based upon 3-digit Standard Industrial Classification (SIC) coding, allowing for economic comparisons across industries and geographic regions. The Milken list contains fourteen industries.

American Electronic Association (AEA) – “industries that make or create technology” (phone conversation with Chris Novak of AEA). AEA’s list is a reasonable but somewhat arbitrary selection of industries. Mr. Novak also mentioned their desire to include AEA membership in their selection process. AEA’s written definition of high-tech industries talks mostly of what is not included in their listing and gives no other criteria for industry selection. AEA’s high-tech industry list goes to the 4-digit SIC level. Their list includes forty-five 4-digit SIC industries that happens to be largely a digit expansion (4-digit SIC from 3-digit SIC) of the Milken list.

Bureau of Labor Statistics (BLS) – high-tech industries are defined as those industries in which employment in both R&D and in all technology-oriented occupations accounted for a proportion of employment that was at least twice the average for all industries. The BLS list consists of thirty-one, 3-digit SIC code industries, twenty-seven in manufacturing and four in the services industry group.

Humphrey Institute of Public Affairs (HIPA) – the HIPA definition raises the threshold of high-tech occupational concentration to three times the national average and does not include an R&D component. HIPA defines a list of thirty, 3-digit SIC high-tech industries that include manufacturing and services industries.

Progressive Policy Institute (PPI) – takes a broader view of the New Economy measures than do the others and focuses more on geographic region than it does specific industries. PPI measures seventeen indicators within five broader groupings: Knowledge Jobs, Globalization, Economic Dynamism, Digital Economy, and Innovation Capacity. The PPI numbers look at a larger array of new economy influences, not just jobs or firms or R&D spending. PPI data includes business “churn”, measures of internet access in schools, how many people are internet accessible, education levels of the workforce, and the number of jobs related to global trade as well as the number of high growth firms and the amount of IPOs in a region. The indicators usually put the measures in share or percentages of employment, gross state product or usage by share of population. PPI uses the AEA list for High-tech jobs definition.

Organization for Economic Cooperation and Development (OECD) – In designating four high-tech industries, OECD took into account both direct and indirect R&D intensities for 10 countries: the United States, Japan, Germany, France, the United Kingdom, Canada, Italy, The Netherlands, Denmark, and Australia. Direct intensities were calculated by the ratio of R&D expenditure to output (production) in 22 industrial sectors. Each sector was given a weight according to its share in the total output of the 10 countries using purchasing power parities as exchange rates. Indirect intensity calculations were made using technical coefficients of industries on the basis of input-output matrices. OECD then assumed that for a given type of input and for all groups of products, the proportions of R&D expenditure embodied in value added levels remained constant. The input-output coefficients were then multiplied by the direct R&D intensities.

National Science Foundation (NSF) – NSF uses the OECD definition.

University of Michigan Transportation Research Institute (TRI) – TRI begins with the AEA industry numbers and then expands the set to include high-tech workers in the automotive industry, in which Michigan has a high concentration of workers. TRI plays with a number of sets to illustrate their point that if the automotive industry is considered a high-tech industry

(which the BLS does), and all employees are then considered in labor counts (as the AEA method does), then Michigan ranks very high as a high-tech state. TRI did try to compromise in listing all Michigan AEA jobs plus automotive industry occupations that are considered high-tech occupations (scientists, engineers, etc.). The result is not an unfair basis for comparison. In fact, the second part of the approach may be applied across all industries to define a set of high-tech industry measures based upon a high-tech occupation concentration per industry.

Life science industries are largely covered in this report. Of the eight, four-digit SIC code life science industries listed in the recent Ernst and Young study, “Bridging the Gap: Ernst & Young’s 13th Biotechnology Industry Annual Report”, five fall under the three-digit SIC industry code for the chemicals or drugs industry designations, 283 and 286, in this report. They are: Medicinal Chemicals and Botanical Products, 2833; Pharmaceutical Preparations, 2834; In Vitro & In Vivo Diagnostic Substances, 2835; Biological Products, 2836; and Industrial Organic Chemicals, 2869. Three industries: Crop Planting, Cultivating, & Protecting, 0721; Animal Services, Except Veterinary, 0751; and Medical Laboratories, 8071; did not meet the definition of high-tech industries used in this study.

Existing and Available Data

The existence and availability of data for determining new economy opportunity vectors comes from federal and state sources. The federal data is usually consistent across states and serves as the best data set for cross-state comparison studies. Federal sources for employment and occupational data as well as the wages data comes from the U.S. Department of Commerce Bureau of Labor Statistics. Research and Development spending data generally comes from the National Science Foundation as does patent data.

State labor data for Wisconsin comes from the Wisconsin Department of Workforce Development. It is not always consistent with similar data series from the federal agencies due to manipulations made by the federal agencies to make all states’ data consistent and comparable.

The geographical detail can vary depending upon the data series. Generally speaking, the finer the geographic granularity, the more dated is the data and the more susceptible to reporting nuances. For example, occupational data by state by industry is currently 1998 data and subject to data repression due to confidentiality restraints. Such restrictions make it difficult to compare high-tech employment concentrations by industries across states, for instance, due to non-disclosed data in many data array cells.

Nevertheless, the federal and state data sources offer readily available, consistent, historical data sets for quantitative economic analysis. These are the data sources for the analysis undertaken in this report.

Data Sources

Bureau of Labor Statistics
Bureau of Economic Analysis
County Business Patterns

Department of Workforce Development
Bureau of the Census
National Science Foundation

Further Data Collection

Other data that needs to be gathered for further analysis of Wisconsin's commitment to the New Economy are:

- New high-tech business formations by SIC or NAICS codes – hopefully as a historical series. DWD collects the data for unemployment insurance purposes. The data resides in flat files by 2-, 3-, and 4-digit SIC codes going back until 1976. The data needs to be distilled and formatted to be made useful.
- Research & development spending for all states – the federal government is considering expanding the existing data set that currently records R&D spending by industry for only the top ten states. Inferred R&D data for other states can be compared with actual totals to show gaps. Wisconsin, for instance, is about \$1 billion below the national average using this method.
- Federal publication of state level data for occupations by industry – would allow cross-state comparisons of high-tech occupational concentration by industry without having to go to each state's designated agency. Data at this level of industry and geographic granularity is subject to confidentiality suppression criteria. It is unlikely federal agencies will offer this data set in the foreseeable future.
- Percentage of college graduates in the population – the correlation between education and income is well documented and important to Wisconsin if one economic development goal is to raise the state's per capita income. Income level by educational attainment data are collected by the Bureau of the Census.
- Venture capital and early stage investment data – these data are gathered by a handful of private firms. The data sets are usually consistent, but it is difficult to assess the richness and coverage of the information.
- Tax credit and government incentive program data – this data set would require an ongoing private initiative to assess federal and state programs, how the incentives are structured, what real and measurable effect is realized and how the programs change over time.

WISCONSIN'S HIGH-TECH INDUSTRY PROFILE

The size and constituency of Wisconsin's high-tech industries are discussed below. The BLS definition of high-tech industries is used in this analysis. The analysis begins with employment growth in Wisconsin's high-tech industries and compares it with the U.S. Wages and salaries in Wisconsin's high-tech industries are also analyzed and compared with U.S. averages. A similar analysis is carried out for high-tech occupations in Wisconsin and the U.S. Industry opportunity vectors for the state are shown and vector intersections are identified.

By integrating employment, wages and occupations, Wisconsin's high-tech industries that hold the most potential for future growth were identified. Focus on these opportunity vector intersections will help define the mission of the Council and offer insight into the strategic

economic development plan for the state that must deal with, among other things, raising the per capita income for Wisconsin citizens.

High-Tech Industries Ranked by Employment

Wisconsin

There are substantial numbers of Wisconsin workers employed in high-technology industries. Of the thirty-one industries that are classified as high-tech, Wisconsin employs workers in thirty of them, excepting Guided Missiles. In total, 198,061 Wisconsin workers were employed in high-tech industries in 1998.

The Motor Vehicle and Equipment industry employed the most Wisconsin high-tech industry workers in 1998, almost 23,000. The Computer & Data Processing Industry is the second largest high-tech industry employer in Wisconsin, with 20,731 workers in the state in 1998. See Table A – 1 in the appendix for a complete listing.

Wisconsin’s Top Five High-Tech Industry Employers

<u>Industry</u>	<u>Total Employees</u>
Motor Vehicles & Equipment	22,985
Computer & Data Processing Services	20,731
Electrical & Industrial Apparatus	16,844
General Industrial Machinery	15,505
Special Industrial Machinery	14,800
Source: Department of Workforce Development	

U.S.

There were 10,151,340 workers employed in high-technology industries in the United States in 1998. The list of the top five, high-tech industry employers for the U.S. shows two overlapping industries with Wisconsin. The Computer & Data Processing industry is near the top of the U.S. and Wisconsin list for the number of workers employed. Motor Vehicles & Equipment is also in the top five for both the state and the nation.

Top Five U.S. High-Tech Industry Employers

<u>Industry</u>	<u>Total Employees</u>
Computer & Data Processing Services	1,662,750
Management & Public Relations Services	1,061,240
Motor Vehicles & Equipment	1,021,290
Engineering & Architectural Services	929,970
Electronic Components & Accessories	643,950
Source: Bureau of Labor Statistics	

Wisconsin-U.S. Comparison

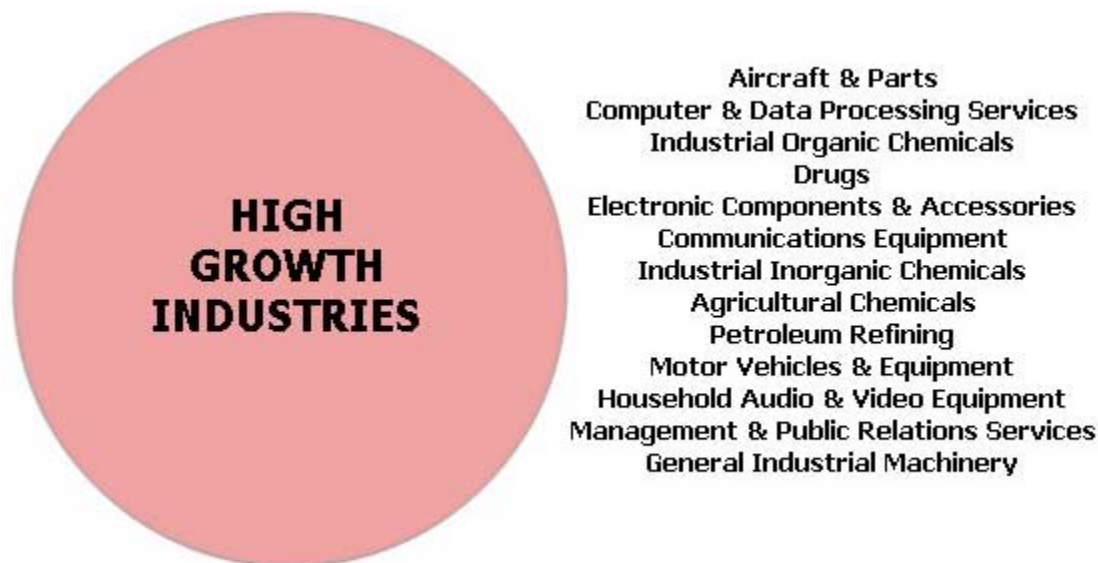
Wisconsin possesses some unique strengths when compared against national high-tech industries. While the Computer & Data Processing Services and Motor Vehicles & Equipment industries rank near the top of both the state and national high-tech industry employment lists, the next ranking Wisconsin industries, Electrical & Industrial Apparatus, General Industrial Machinery, and Special Industrial Machinery rank nowhere near the top of the national list.

The top five high-tech industries in Wisconsin, as listed above, rank 3rd, 1st, 19th, 13th, and 15th, respectively, in the United States. By the same token, the top five high-tech industries in the United States rank 2nd, 11th, 1st, 6th, and 9th, respectively, in Wisconsin, indicating important differences in the state and national high-tech economy structure. See Tables A – 1 and A – 2 in the appendix for complete rankings of all high-tech industries in Wisconsin and the United States.

High-Tech Industries Ranked by Employment Growth

Wisconsin

Wisconsin experienced employment growth in twenty-four of the thirty-one high-tech industries through the 1990s, and employment loss in six high-tech industries. There is no Wisconsin employment in the Guided Missiles industry. Thirteen Wisconsin industries experienced growth greater than 20% for the period 1991-99.



Three Wisconsin high-tech industries demonstrated employment growth in excess of 100% since 1991: Aircraft and Parts, Computer & Data Processing Services, and Industrial Organic Chemicals. Computer & Data Processing Services' high employment growth is due to the overall trend toward computer and internet usage in a broad range of industries, both high-tech and otherwise. The high employment growth rates for the Aircraft & Parts and Industrial Organic Chemicals industries are skewed by relatively small initial employment levels of Wisconsin workers.

The Drugs industry nearly approached that same level, with 97% growth over the period. Electronic Components & Accessories, and Communications Equipment, grew by less than 100%, but in excess of 50%. The top seventeen industries all exhibited employment growth in excess of 10% for the decade. Some state industries remained relatively static in employment growth. Miscellaneous Chemical Products and Medical Equipment, Instruments & Supplies had employment growth of less than 1%. Other Wisconsin industries had negative employment growth over the period.

Twenty percent employment growth over the period was used in this analysis as a cutoff for the high employment growth criteria, encompassing thirteen Wisconsin high-tech industries. See Table A – 3 in the appendix for a complete ranking of employment growth in high-tech industries.

High-Tech Industries in Wisconsin with Employment Growth of at least 20%
(1991-1999)

<u>Industry</u>	<u>Employment Growth</u>
Aircraft & Parts	136.3%
Computer & Data Processing Services	114.4%
Industrial Organic Chemicals	112.4%
Drugs	97.4%
Electronic Components & Accessories	88.4%
Communications Equipment	53.5%
Industrial Inorganic Chemicals	44.6%
Agricultural Chemicals	41.9%
Petroleum Refining	38.7%
Motor Vehicles & Equipment	35.1%
Household Audio & Video Equipment	23.6%
Management & Public Relations Services	21.4%
General Industrial Machinery	20.6%

Source: Department of Workforce Development

U.S.

There are significant differences at the national level with respect to industry employment growth. Not surprisingly, Computer & Data Processing Services show very high employment growth for the country as a whole. However, no other industries showed as dramatic growth at the national level. Management & Public Relations Services was the only other industry at the national level with employment growth in excess of 50% for the decade.

Only thirteen U.S. industries showed employment increases in the 1990s. In most cases, their growth was much more modest, ranging from less than 3% to 29%, with the exception of the top two industries noted above. Eighteen high-tech industries actually lost employment in the nation during the 1990s, decreasing anywhere from 1% to 48%.

High-Tech Industries in the U.S. with Employment Growth of at least 20%
(1991-1999)

<u>Industry</u>	<u>Employment Growth</u>
Computer & Data Processing Services	135.3%
Management & Public Relations Services	67.1%
Motor Vehicles & Equipment	29.1%
Engineering & Architectural Services	27.5%
Drugs	20.6%
Source: Bureau of Labor Statistics	

Wisconsin-U.S. Comparison

Comparing the employment growth rates in Wisconsin to the national growth rates, only four industries grew by 20% or better for both geographies: Computer & Data Processing Services, Drugs, Management & Public Relations Services, and Motor Vehicles & Equipment. The other eight fast growing Wisconsin industries may offer a comparative advantage for the state that is worth investigating further.

For example, the Industrial Organic Chemicals, Industrial Inorganic Chemicals, Agricultural Chemicals, General Industrial Machinery, and Petroleum Refining industries all have high employment growth rates in Wisconsin, while demonstrating extremely low to negative employment growth rates in the U.S. These industries could represent a comparative advantage for Wisconsin. See Tables A – 3 and A – 4 in the appendix for a complete ranking of employment growth in high-tech industries.

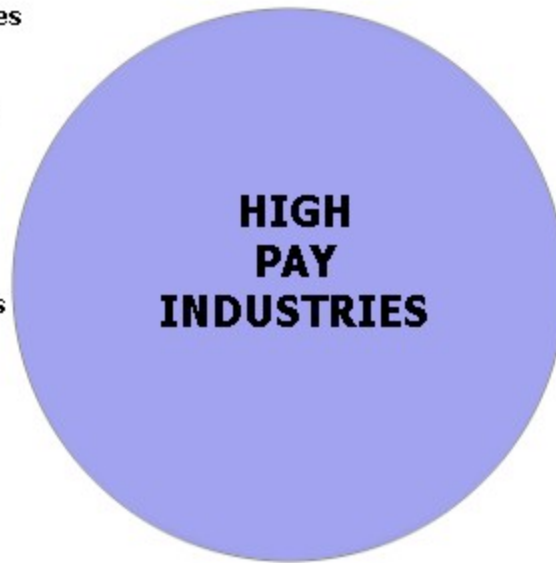
High-Tech Industries Ranked by Pay

Wisconsin

Wisconsin workers earned wages in all of the thirty-one high-technology industries in 1999. An analysis of the income data reveals that high-technology industries are among the highest paying industries in the state. Twenty industries pay greater than 133% of the annual average Wisconsin earnings. All but four of the high-tech industries, Household Audio & Video Equipment, Photographic Equipment & Supplies, Electronic Components & Accessories, and Guided Missiles pay Wisconsin workers significantly more than the state’s 1999 average annual wage of \$29,607.

The two highest paying industries, Soaps, Cleaners & Toilet Goods and Medical Equipment, Instruments & Supplies pay more than double the annual average Wisconsin wage. This can be partly attributed to the fact that corporate headquarters in these industries are located in the state. The top twelve high-tech industries pay wages more than 150% of Wisconsin average annual wage. For complete wages ranking of Wisconsin high-tech industries, see appendix Table A – 5.

Soaps, Cleaners & Toilet Goods
Medical Equipment, Instruments & Supplies
Search & Navigation Equipment
Motor Vehicles & Equipment
Computer & Data Processing Services
Petroleum Refining
Miscellaneous Chemical Products
Engines & Turbines
Engineering & Architectural Services
Industrial Inorganic Chemicals
Management & Public Relations Services
Special Industrial Machinery
Measuring & Controlling Devices
Construction & Related Machinery
Drugs
Paint & Allied Products
Electrical Industrial Apparatus
General Industrial Machinery
Industrial Organic Chemicals
Plastics, Materials & Synthetics



The cutoff for pay level consideration in this analysis is 133% of average Wisconsin pay levels. The cutoff point was chosen because it represents a substantial income increase, almost a \$1,000 more per month over the average Wisconsin annual wage, and it includes a tight grouping of industry pay levels, ten industries with average pay levels between \$40,000 to \$45,000 per year.

Wisconsin High-Tech Industries Paying at least 133% of Wisconsin Average Annual Wage
(1999)

Industry	Average Annual Wage
Soaps, Cleaners & Toilet Goods	\$66,582
Medical Equipment, Instruments & Supplies	\$60,377
Search & Navigation Equipment	\$57,993
Motor Vehicles & Equipment	\$51,996
Computer & Data Processing Services	\$51,985
Petroleum Refining	\$47,937
Miscellaneous Chemical Products	\$47,598
Engines & Turbines	\$47,555
Engineering & Architectural Services	\$46,845
Industrial Inorganic Chemicals	\$45,505
Management & Public Relations Services	\$44,499
Special Industrial Machinery	\$44,454
Measuring & Controlling Devices	\$44,412
Construction & Related Machinery	\$44,119
Drugs	\$43,541
Paint & Allied Products	\$42,993
Electrical Industrial Apparatus	\$41,996
General Industrial Machinery	\$41,668
Industrial Organic Chemicals	\$41,518
Plastics, Materials, & Synthetics	\$41,292
Source: Bureau of Labor Statistics	

U.S.

An analysis of the national data shows similar trends. All of the thirty-one high-tech industries in the United States paid average annual wages that significantly exceed average annual national wages of \$33,244 in 1999. However, the disparity is more pronounced at the national level. Twenty-two of the highest-paying high-tech industries in the United States pay more than 150% of average U.S. wages and four pay as high as double the U.S. annual average wage. For a complete ranking of wages by high-tech industries in the U.S., see Table A – 6 in the appendix.

U.S. High-Tech Industries Paying at least 133% of U.S. Average Annual Wage
(1999)

<u>Industry</u>	<u>Average Annual Wage</u>
Computer & Office Equipment	\$82,853
Drugs	\$74,802
Computer & Data Processing Services	\$73,371
Petroleum Refining	\$72,370
Industrial Organic Chemicals	\$65,691
Guided Missiles	\$64,603
Communications Equipment	\$63,928
Search & Navigation Equipment	\$63,120
Industrial Inorganic Chemicals	\$60,471
Photographic Equipment & Supplies	\$57,467
Plastics, Materials, & Synthetics	\$56,591
Agricultural Chemicals	\$55,593
Aircraft & Parts	\$55,179
Management & Public Relations Services	\$55,071
Electronic Components & Accessories	\$54,268
Measuring & Controlling Devices	\$54,087
Soaps, Cleaners, & Toilet Goods	\$53,834
Engines & Turbines	\$53,824
Motor Vehicles & Equipment	\$53,222
Miscellaneous Chemical Products	\$52,874
Engineering & Architectural Services	\$52,382
Research, Development, & Testing Services	\$49,980
Medical Equipment, Instruments, & Supplies	\$49,567
Special Industrial Machinery	\$49,273
Household Audio & Video Equipment	\$47,031
Paint & Allied Products	\$45,705
Source: Bureau of Labor Statistics	

Wisconsin-U.S. Comparison

Comparing Wisconsin high-tech industry wages to national data reveals that Wisconsin shares an interest in high-paying jobs in certain high-technology industries. It also exhibits some unique Wisconsin high-technology strengths in additional industries.

Looking at the data for all thirty-one high-tech industries, seventeen industries are among the industries that pay average annual wages of at least 133% above the average annual Wisconsin and U.S. wage, respectively.

The remaining highest paying industries at the national level were among the lowest paying high-tech industries in Wisconsin. Conversely, the highest paying industries in Wisconsin, Soaps, Cleaners, & Toilet Goods and Medical Equipment, Instruments & Supplies, ranked near the bottom at the national level.

For most of the high-tech industries, the U.S. pays annual wages higher than Wisconsin. The Soaps, Cleaners, and Toilet Goods, and Medical Equipment, Instruments and Supplies industries pay wages significantly higher in Wisconsin in comparison to the U.S., offering Wisconsin a comparative advantage. The Soaps, Cleaners, and Toilet Goods industry pays wages of \$66,582 in Wisconsin and \$53,834 in the U.S. The Medical Equipment, Instruments & Supplies industry pays wages of \$60,377 in Wisconsin and \$49,567 in the U.S. The high pay levels in these Wisconsin industries may well be a function of the presence of corporate headquarters in the state.

High-Paying, High-Tech Industries in both the U.S. and Wisconsin
(1999)

<u>Industry</u>	<u>Average WI Wage</u>	<u>Average U.S. Wage</u>	<u>WI Rank</u>	<u>U.S. Rank</u>
Soaps, Cleaners, & Toilet Goods	\$66,582	\$53,834	1 st	17 th
Medical Equipment, Instruments & Supplies	\$60,377	\$49,567	2 nd	23 rd
Search & Navigation Equipment	\$57,993	\$63,120	3 rd	8 th
Motor Vehicles & Equipment	\$51,996	\$53,222	4 th	19 th
Computer & Data Processing Services	\$51,985	\$73,371	5 th	3 rd
Petroleum Refining	\$47,937	\$72,370	6 th	4 th
Miscellaneous Chemical Products	\$47,598	\$52,874	7 th	20 th
Engines & Turbines	\$47,555	\$53,824	8 th	18 th
Engineering & Architectural Services	\$46,845	\$52,382	9 th	21 st
Industrial Inorganic Chemicals	\$45,505	\$60,471	10 th	9 th
Management & Public Relations Services	\$44,499	\$55,071	11 th	14 th
Special Industrial Machinery	\$44,454	\$49,273	12 th	24 th
Measuring & Controlling Devices	\$44,412	\$54,087	14 th	16 th
Drugs	\$43,541	\$74,802	15 th	2 nd
Paint & Allied Products	\$42,993	\$45,705	18 th	26 th
Industrial Organic Chemicals	\$41,518	\$65,691	19 th	5 th
Plastics Materials & Synthetics	\$41,292	\$56,591	20 th	11 th

Source: Bureau of Labor Statistics, Wisconsin Department of Workforce Development

WISCONSIN'S HIGH-TECH OCCUPATIONAL PROFILE

This section of the study compares Wisconsin high-tech occupations to those of the U.S. High-tech occupational employment levels, concentrations and earnings for the same 31 high-tech industries were examined, except Guided Missiles, for which no data for Wisconsin was reported.

The Bureau of Labor Statistics (BLS) definition of high-tech occupations was used for this profile. This definition involves forty-eight occupations generally listed under the titles of scientists, engineers, mathematicians, computer programmers, and assorted technicians. Our definition deviates slightly from the Humphrey Institute of Public Affairs (HIPA) set of high-tech occupations, the only other study reviewed that gave a list of high-tech occupations.

The BLS definition uses differs from the definition used by HIPA in that it takes account of technicians and a majority of the five occupational titles from the computer and math scientist group that HIPA chose not to include. The HIPA definition does include five occupations (Other Engineers, Foresters and Conservation Scientists, All Other Natural Scientists and Related Workers, All Other Systems Researchers, and All Other Computer Scientists) that are not included in this study.

This analysis uses the BLS definition of forty-eight occupations when examining 1998 Occupational Employment Statistics (OES) data. OES data for 1998 was used to compare occupational concentrations by industry by state, because this level of occupational data detail is not available from the BLS and the 1999 state level data from the Wisconsin Department of Workforce Development (DWD) was not yet available. While the 1998 data may not be the latest occupation data available by state or by industry, it did give the finer geographical detail sought without jeopardizing the information or overall comparison characteristics contained within the dataset.

DWD was also unable to present all of the desired occupational employment data by industry for Wisconsin due to reasons of confidentiality. As a result, conclusions are unable to be drawn about industries for which there are no data. These industries include: Plastics Materials and Synthetics; Soaps, Cleaners, and Toilet Goods; Industrial Organic Chemicals; and Search & Navigation Equipment.

High-Tech Occupation Employment for Wisconsin and the U.S.

There are 87,800 people employed in high-tech occupations in Wisconsin in 1998. High-tech occupational employment for the nation as a whole, totals 5,387,010. Based upon 1998 figures, the Wisconsin high-tech occupation to total employment concentration factor is 3.08 versus 3.83 for the U.S. That is to say that 3.1% of all Wisconsin workers are employed in high-tech occupations.

Wisconsin and U.S. High-Tech Occupation Employment
(1998)

	<u>High-Tech Occupation Employment</u>	<u>Total Employment</u>	<u>High-Tech Occupation Employment Factor</u>
Wisconsin	87,800	2,852,556	3.08
U.S.	5,387,010	140,514,000	3.83
Source: Wisconsin Department of Workforce Development, U.S. Bureau of Labor Statistics			

Other employment metrics for the state and the nation are in the following table.

Wisconsin and U.S. High-Tech Metrics
(1998)

<u>Metric</u>	<u>Wisconsin</u>	<u>U.S.</u>
Population	5,222,124	270,248,003
Total Employment	2,852,556	140,514,000
HT Industry Employment	198,061	10,151,340
HT Occupation Employment	87,800	5,387,010
HT Occupation Employment in HT Industries	40,389	2,740,800
Source: Census, BLS, DWD		

There are a number of high-tech concentration factors that can be calculated from the above numbers:

- Total Employment/Population
- High-Tech Industry Employment/Population
- High-Tech Industry Employment/Total Employment
- Total High-Tech Occupation Employment/Population
- Total High-Tech Occupation Employment/Total Employment
- High-Tech Occupation Employment in High-Tech Industries/High-Tech Industry Employment

These factor values generate the following table:

Wisconsin and U.S. High-Tech Factors
(1998)

<u>Factor</u> (quotient x 100)	<u>Wisconsin</u>	<u>U.S.</u>
Total Employment/Population	54.6	52.0
HT Industry Employment/Population	3.8	3.8
HT Industry Employment/Total Employment	6.9	7.2
Total HT Occupation Employment/Population	1.7	2.0
Total HT Occupation Employment/Total Employment	3.1	3.8
HT Occupation Employment/HT Industry Employment*	20.4	27.0
* is High-Tech Occupation Employment in High-Tech Industries/High-Tech Industry Employment		

What can be surmised from these figures? Basically, that Wisconsin employs relatively fewer high-tech workers than does the nation on average. Already known is that the workforce participation rate for Wisconsin residents is among the highest in the nation. This is portrayed in the Total Employment to Population ratios, 54.6 for Wisconsin versus 52.0 for the U.S. The high-tech industry employment to population factor is essentially identical for the state and the nation due to higher workforce participation rates, but the high-tech industry employment to total employment ratio drops slightly for Wisconsin versus the U.S.

The large discrepancies occur in the high-tech occupation per employment characteristics. High-tech occupation employment per total employment for Wisconsin is significantly lower than for the U.S., a concentration of 3.1 versus 3.8. More disconcerting is the substantial difference in high-tech occupational positions in Wisconsin's high-tech industries versus the U.S. Wisconsin has a high-tech occupational concentration share of only 20.4, compared to 27.0 for the U.S.

These figures mean Wisconsin businesses employ relatively few high-tech workers in the state's industries and profoundly fewer in the state's high-tech industries.

High-Tech Occupations Ranked by Pay

Annual 1999 occupational wage data for Wisconsin and the United States was collected, sorted, and ranked in descending order. After close examination of the wage listings of Wisconsin and the United States, some important conclusions can be drawn.

The five highest-paying occupations in Wisconsin were also the five highest-paying occupations in the U.S., although not necessarily in like order. These occupations are Physicists, Engineering Managers, Computer & Information Systems Managers, Computer Hardware Engineers, and Computer & Information Scientists. The U.S. average annual wages for Engineering Managers and Computer & Information Systems Managers are significantly higher than those for Wisconsin. The salaries for the other three listed occupations are relatively close in value.

Wisconsin Five Highest-Paying High-Tech Occupations

(1999)

<u>Occupation</u>	<u>Employment</u>	<u>Annual Wage</u>
Physicists	60	\$78,120
Engineering Managers	4,900	\$70,120
Computer & Information Systems Managers	5,280	\$64,390
Computer Hardware Engineers	***	\$63,480
Computer & Information Scientists	***	\$63,350
Source: Bureau of Labor Statistics		
***Data unavailable due to reasons of confidentiality		

U.S. Five Highest-Paying High-Tech Occupations

(1999)

<u>Occupation</u>	<u>Employment</u>	<u>Annual Wage</u>
Engineering Managers	248,210	\$81,560
Physicists	10,290	\$76,140
Computer & Information Systems Managers	280,820	\$74,430
Computer & Information Scientists	26,280	\$67,180
Computer Hardware Engineers	60,420	\$66,960
Source: Bureau of Labor Statistics		

Likewise, the five lowest-paying, high-tech occupations in the Wisconsin were the same as the lowest five in the U.S. Wisconsin wages for these five occupations trailed the U.S. average annual wages as well.

Pay scales across all high-tech occupations are skewed against Wisconsin employees. Of the forty-eight high-tech positions, only two Wisconsin high-tech occupations' average salaries register more than 5% above the corresponding U.S. position average salary, Electro-Mechanical Technician and Environmental Engineering Technician. Fully, thirty-seven U.S. high-tech positions' average pay is more than 5% above corresponding Wisconsin salaries, with twenty-

three positions paying over 10% more, and five paying over 20% more. The remaining nine occupations fall within a 5% range of each other.

Wisconsin Five Lowest-Paying High-Tech Occupations
(1999)

<u>Occupation</u>	<u>Employment</u>	<u>Annual Wage</u>
Environmental Science & Protection Technicians	350	\$30,080
Agricultural & Food Science Technicians	1,180	\$28,080
Biological Technicians	750	\$27,220
Forest & Conservation Technicians	350	\$26,750
Surveying & Mapping Technicians	1,650	\$26,630
Source: Bureau of Labor Statistics		

U.S. Five Lowest-Paying High-Tech Occupations
(1999)

<u>Occupation</u>	<u>Employment</u>	<u>Annual Wage</u>
Environmental Science & Protection Technicians	26,240	\$34,270
Biological Technicians	39,580	\$32,060
Forest and Conservation Technicians	17,140	\$29,340
Agricultural & Food Science Technicians	15,050	\$29,310
Surveying and Mapping Technicians	47,330	\$29,260
Source: Bureau of Labor Statistics		

Even when an occupation's relative wage rank was higher on the Wisconsin occupational list than on the U.S. list, the U.S. annual average wage was still higher for the U.S. than for Wisconsin employees. For example, Epidemiologists ranked twenty-first in Wisconsin and received an annual salary of \$48,410 in 1999, while in the U.S. they ranked thirty-second yet received a higher annual salary of \$49,020.

High-Tech Occupation Concentrations by Industry

Wisconsin

Wisconsin has several industries that merit consideration for further economic development based upon their high-tech occupational concentrations. By looking at detailed industry and occupational data for the state, these industries are identified below.

A finer breakout of high-tech occupational employment in Wisconsin's high-tech industries yields a more detailed comparative occupational data set for the state. This level of detail allows us to pinpoint those Wisconsin industries that have a higher concentration of high-tech occupations than the national average and yields another set of opportunity vectors.

In this analysis, it was necessary to use 1998 data because 1999 occupational employment data is not yet available by state. Some high-tech occupational data by industry for Wisconsin was unobtainable due to confidentiality restrictions. In these cases, it was assumed Wisconsin industries had equal concentrations of high-tech occupations as those for the nation. This

assumption may overstate Wisconsin high-tech occupational concentration in some state high-tech industries as explained in the high-tech occupational factors section above.

High-tech occupation concentrations by industry were found using the high-tech employment and total employment numbers for each industry in Wisconsin and in the U.S. Any industry that demonstrated a level of high-tech occupational concentration greater than 9.0% (about three times the state average) was considered to have a high occupational concentration. There were twenty-three high-tech industries in Wisconsin with high-occupation concentrations above 9.0% in 1998. See table below for a complete listing of the twenty-three industries.

Computer & Data Processing Services	Medical Equipment, Instruments & Supplies
Engineering & Architectural Services	Special Industrial Machinery
Research, Development & Testing Services	Plastics, Materials & Synthetics
Search & Navigation Equipment	Paint & Allied Products
Computer & Office Equipment	Photographic Equipment & Supplies
Measuring & Controlling Devices	Electronic Components & Accessories
Communications Equipment	General Industrial Machinery
Industrial Organic Chemicals	Ordnance & Accessories
Miscellaneous Chemical Products	Industrial Inorganic Chemicals
Electric Distribution Equipment	Engines & Turbines
Management & Public Relations Services	Household Audio & Video Equipment
Electrical Industrial Apparatus	



There are substantial numbers of Wisconsin workers employed in high-tech industries. Of the thirty-one industries that are classified as high-tech, Wisconsin employs workers in thirty of them, excepting Guided Missiles. However, many employees within these industries are not employed in high-tech occupations. In total, 198,061 Wisconsin workers were employed in high-tech industries in 1998. Of these, 40,389, or 20.4%, were employed in high-tech occupations.

An overview of the high-tech industries employing the most Wisconsin workers reveals dramatic differences in the concentration employed in high-tech jobs. The Computer & Data Processing

Industry is the second largest high-technology employer in Wisconsin. It is also the state's high-tech industry that employs the greatest concentration of high-tech workers within its industry. In 1998, the Computer & Data Processing Industry employed 20,731 workers in Wisconsin, 11,229 of them in high-tech occupations, a 54.2% occupational concentration share.

Among Wisconsin's high-tech industries, only the Motor Vehicle and Equipment industry employed more Wisconsin workers. However, relatively few workers in the motor vehicle industry are employed in high-tech occupations, only 6.6%.

High-Tech Industries in Wisconsin with High High-Occupation Concentrations
(1998)

Industry	High-Tech Employment	Total Employment	Occupation Concentration
Computer & Data Processing Services	11,299	20,731	54.2%
Engineering & Architectural Services	6,240	13,682	45.6%
Research, Development, & Testing Services	2,374	5,488	43.3%
Search & Navigation Equipment	751	1,749	42.9%
Computer & Office Equipment	1,448	5,301	27.3%
Measuring & Controlling Devices	1,290	6,080	21.2%
Communications Equipment	222	1,064	20.8%
Industrial Organic Chemicals	308	1,525	20.2%
Miscellaneous Chemical Products	324	1,822	17.8%
Electric Distribution Equipment	995	5,910	16.8%
Management & Public Relations Services	1,338	8,580	15.6%
Electrical Industrial Apparatus	2,559	16,844	15.2%
Medical Equipment, Instruments, & Supplies	1,316	8,746	15.0%
Special Industrial Machinery	2,200	14,800	14.9%
Plastics, Materials, & Synthetics	123	897	13.7%
Paint & Allied Products	253	1,865	13.6%
Photographic Equipment & Supplies	24	189	12.6%
Electronic Components & Accessories	1,125	9,198	12.2%
General Industrial Machinery	1,724	15,505	11.1%
Ordnance & Accessories	85	842	10.1%
Industrial Inorganic Chemicals	60	622	9.6%
Engines & Turbines	1,223	12,873	9.5%
Household Audio & Video Equipment	92	1,000	9.2%

Source: Department of Workforce Development, Bureau of Labor Statistics

There were only six high-tech industries in Wisconsin that had high-tech occupation concentrations of less than 9.0% in 1998. These six industries had occupation concentrations ranging from 3.0% to 8.7%. The Petroleum Refining industry had an occupational concentration of 3.1%, the lowest of the high-tech industries in Wisconsin. The Construction & Related Machinery industry came close to making the 9.0% cutoff with an occupational concentration of 8.7%.

U.S.

The same high-tech industries were also listed by high-tech occupational concentration at the national level. Twenty-seven of the high-tech industries in the U.S. revealed occupational concentrations of at least 9.0%. Only two industries had concentrations of less than 9.0%, but both of these industries had occupational concentrations of at least 7.7%.

In the United States, there were 10,151,340 workers employed in high-technology industries in 1998. Of these workers, 2,740,800 were employed in high-tech occupations, yielding a high-tech occupation concentration of 27.0%. The list of the top five high-tech industry employers for the U.S. shows two overlapping industries with Wisconsin. The Computer & Data Processing Industry tops both the U.S. and Wisconsin list for both the number of workers employed and the concentration of employees in high-tech occupations. Motor Vehicles & Equipment is also in the top five for both the state and the nation.

High-Tech Industries in the U.S. with High-Occupation Concentrations
(1998)

<u>Industry</u>	<u>High-Tech Employment</u>	<u>Total Employment</u>	<u>Occupation Concentration</u>
Computer & Data Processing Services	855,620	1,662,750	51.5%
Engineering & Architectural Services	416,180	929,970	44.8%
Search & Navigation Services	71,280	161,240	44.2%
Computer & Office Equipment	146,910	379,730	38.7%
Research, Development, Testing Services	234,310	620,550	37.8%
Communications Equipment	77,330	276,870	27.9%
Aircraft & Parts	119,750	525,980	22.8%
Electronic Components & Accessories	143,820	643,950	22.3%
Measuring & Controlling Devices	66,890	299,680	22.3%
Drugs	62,220	279,540	22.3%
Industrial Organic Chemicals	29,440	135,090	21.8%
Industrial Inorganic Chemicals	21,170	114,820	18.4%
Plastics, Materials, & Synthetics	27,170	154,590	17.6%
Photographic Equipment & Supplies	13,100	78,080	16.8%
Management & Public Relations Services	159,000	1,061,240	15.0%
Special Industrial Machinery	25,090	173,410	14.5%
Miscellaneous Chemical Products	13,200	93,920	14.1%
Paint & Allied Products	6,850	51,840	13.2%
Petroleum Refining	12,260	93,590	13.1%
Medical Equipment, Instruments, & Supplies	36,760	281,510	13.1%
Engines & Turbines	10,640	82,360	12.9%
Household Audio & Video Equipment	10,420	82,000	12.7%
Ordnance & Accessories	5,120	40,880	12.5%
Electric Distribution Equipment	9,390	80,860	11.6%
Electrical Industrial Apparatus	16,660	152,240	10.9%
General Industrial Machinery	25,540	265,220	9.6%
Soaps, Cleaners, Toilet Goods	14,720	156,600	9.4%

Source: Bureau of Labor Statistics

Wisconsin-U.S. Comparison

There are twenty-three high-tech industries that have occupation concentrations of at least 9.0% in both the U.S. and Wisconsin. The twenty-three industries are all of the industries in Wisconsin that have high-tech occupational concentrations of at least 9.0%. All but four of the twenty-seven U.S. industries with occupational concentrations greater than 9.0% are also in Wisconsin's set of high-occupational concentrations.

Most of the high-tech industries have somewhat similar high-tech occupational concentration levels in the U.S. and Wisconsin. However, two of the high-tech industries offer Wisconsin a comparative advantage: Research, Development, Testing Services and Electric Distribution Equipment. Each showed a high-tech occupational concentration of at least five percentage points higher than the U.S. figures. The Research, Development & Testing Services industry ranked third in Wisconsin and fifth in the U.S. in terms of high-tech occupational concentration. The Electric Distribution Equipment industry is ranked tenth in Wisconsin and twenty-fourth in the U.S.

High-Tech Industries in the U.S. and Wisconsin with High-Occupations Concentrations
(1998)

<u>Industry</u>	<u>WI Occ. Conc. Share</u>	<u>WI Occ. Conc. Rank</u>	<u>U.S. Occ. Conc. Share</u>	<u>U.S. Occ. Conc. Rank</u>
Computer & Data Processing Services	54.2%	1 st	51.5%	1 st
Engineering & Architectural Services	45.6%	2 nd	44.8%	2 nd
Research, Development, Testing Services	43.3%	3 rd	37.8%	5 th
Search & Navigation Equipment	42.9%	4 th	44.2%	3 rd
Computer & Office Equipment	27.3%	5 th	38.7%	4 th
Measuring & Controlling Devices	21.2%	6 th	22.3%	9 th
Communications Equipment	20.8%	7 th	27.9%	6 th
Industrial Organic Chemicals	20.2%	8 th	21.8%	11 th
Miscellaneous Chemical Products	17.8%	9 th	14.1%	17 th
Electric Distribution Equipment	16.8%	10 th	11.6%	24 th
Management & Public Relations Services	15.6%	11 th	15.0%	15 th
Electrical Industrial Apparatus	15.2%	12 th	10.9%	25 th
Medical Equipment, Instruments, & Supplies	15.0%	13 th	13.1%	20 th
Special Industrial Machinery	14.9%	14 th	14.5%	16 th
Plastics, Materials, & Synthetics	13.7%	15 th	17.6%	13 th
Paint & Allied Products	13.6%	16 th	13.2%	18 th
Photographic Equipment & Supplies	12.6%	17 th	16.8%	14 th
Electronic Components & Accessories	12.2%	18 th	22.3%	8 th
General Industrial Machinery	11.1%	19 th	9.6%	26 th
Ordnance & Accessories	10.1%	20 th	12.5%	23 rd
Industrial Inorganic Chemicals	9.6%	21 st	18.4%	12 th
Engines & Turbines	9.5%	22 nd	12.9%	21 st
Household Audio & Video Equipment	9.2%	23 rd	12.7%	22 nd

Source: Bureau of Labor Statistics, Department of Workforce Development

OPPORTUNITY VECTOR INTERSECTIONS

High employment growth industries, high-paying industries and high-tech occupational concentrations are not necessarily members of the same empirical set. The following paragraphs describe the opportunity vector intersections of high-tech industries with respect to:

- 1) employment growth and wages & salaries,
- 2) employment growth and occupational concentrations,
- 3) wages & salaries and occupational concentration, and finally,
- 4) the super-intersection of all three opportunity vectors.

Three Wisconsin opportunity vector intersection industries are distilled below and compared with the national set. When considering the lists of opportunity vector intersection industry candidates, limiting parameters were placed on each opportunity vector set of industries. Employment growth parameters were set such that the high-tech industry had to experience at least 20% absolute employment growth over the 1991-1999 period (from the last recession until the latest data).

Wage and salary levels were limited to those high-tech industries that paid at least a third more than the average workers pay, \$29,607 for Wisconsin and \$33,244 for the U.S. This level was chosen for two reasons: 1) the cut-off point yields nearly another \$1,000 per month or \$12,000 per year in earned income above the Wisconsin average, deemed a noteworthy and substantial difference, and 2) a large number of Wisconsin industries' average pay scales were tightly grouped in the \$40,000 to \$45,000 per year range, roughly a third higher than the average annual Wisconsin worker pay.

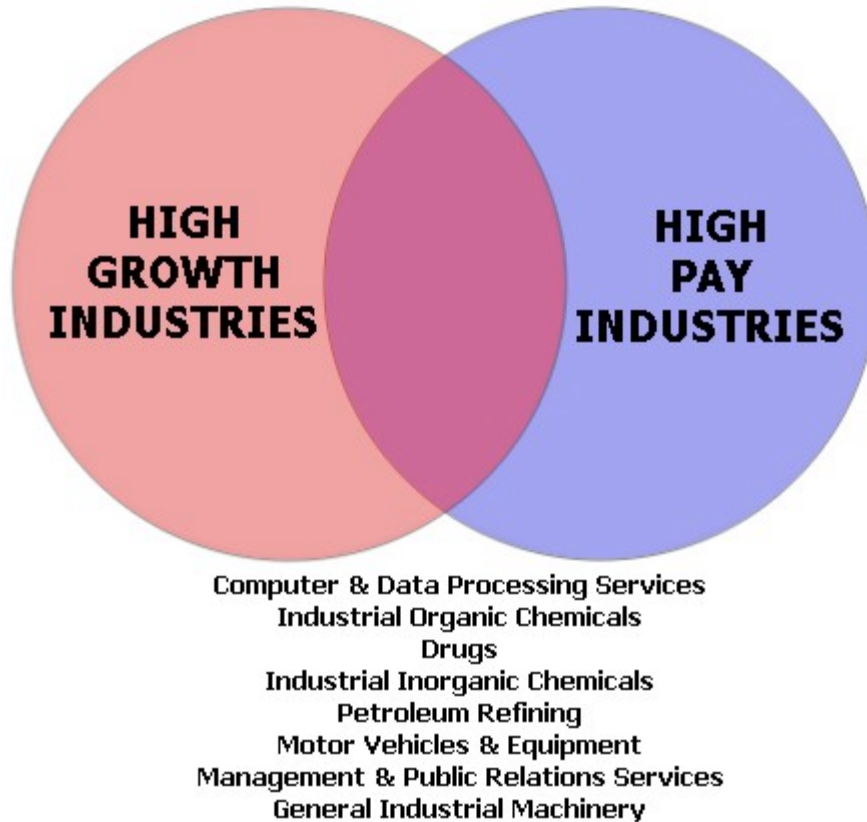
Occupational concentration limits were placed at the 9% level. In other words, 9% or more of any particular industry's employees are employed in high-tech occupations. This cut-off point designates about three times the Wisconsin average and was a noticeable gap in the spectrum of occupational concentrations across all high-tech industries.

Intersection of High-Growth Industries with High-Pay Industries

Wisconsin

Computer & Data Processing Services, Industrial Inorganic Chemicals, Drugs, Industrial Organic Chemicals, Petroleum Refining, Motor Vehicles & Equipment, Management & Public Relations Services, and General Industrial Machinery all lie at the intersection of high employment growth rates and high-paying industries for Wisconsin.

Wisconsin's fastest growing high-tech industries, for the most part, are not the highest-paying industries in the state. Several industries pay very well, but they also demonstrate employment growth rates that are relatively static or, in some cases, negative. For example, Medical Equipment, Instruments & Supplies, Miscellaneous Chemical Products, Search & Navigation Equipment, and Engines & Turbines are all in the top ten with respect to pay, but in the bottom ten with respect to employment growth.



The Medical Equipment, Instruments & Supplies industry registered second highest in pay levels, but twenty-fourth in employment growth, at less than one percent for all of the 1990s. Miscellaneous Chemical Products ranked seventh highest for pay levels, but twenty-third highest growth, also at less than one percent for the decade. Search & Navigation Equipment was the third highest paying Wisconsin industry, but actually showed an employment loss of nearly 50% of its workforce during the period. Engines & Turbines, with the eighth highest pay rank, had an employment loss of 7.4% for the 1990s. See Tables A – 3 and A – 5 in the appendix for complete rankings.

Conversely, some Wisconsin industries demonstrate significant employment growth during the 1990s, but do not pay well relative to the other state high-tech industries. Agricultural Chemicals has the eighth highest employment growth, but the twenty-seventh highest pay rank. Household Audio & Video Equipment has the eleventh highest employment growth, but is twenty-ninth highest (or third lowest) for wages and salaries. Aircraft & Parts, Communications Equipment, Electronic Components & Accessories, and Petroleum Refining are also among the ten industries with the highest level of employment growth, but among the ten lowest paying high-tech industries in Wisconsin.

Nevertheless, Wisconsin is home to a few industries with rapid employment growth that are high paying as well. These are the industries that may hold significant potential for high-tech industry development. Eight high-tech industries are among both the fastest employment growth and the highest paying industries in the state: Motor Vehicles & Equipment, Computer & Data Processing Services, Industrial Inorganic chemicals, Management & Public Relations Services, Drugs, General Industrial Machinery, Industrial Organic Chemicals, and Petroleum Refining.

(Note: As this analysis is based on 1999 data, it should be noted that changes in the Wisconsin business climate could eliminate Motor Vehicles and Equipment from this category.)

Wisconsin's High-Employment Growth Rate, High-Pay Intersections
(1991-1999)

<u>Industry</u>	<u>Employment Growth</u>	<u>Employment Growth Rank</u>	<u>Annual Wage</u>	<u>Wage Rank</u>
Computer & Data Processing Services	114.4%	2 nd	\$51,985	5 th
Industrial Organic Chemicals	112.4%	3 rd	\$41,518	18 th
Drugs	97.4%	4 th	\$43,541	14 th
Industrial Inorganic Chemicals	44.6%	7 th	\$45,505	9 th
Petroleum Refining	38.7%	9 th	\$47,937	6 th
Motor Vehicles & Equipment	35.1%	10 th	\$51,996	4 th
Management & Public Relations Services	21.4%	12 th	\$44,499	10 th
General Industrial Machinery	20.6%	13 th	\$41,668	17 th

Source: Department of Workforce Development, Bureau of Labor Statistics

U.S.

As is the case for Wisconsin, there appears to be little correlation between high employment growth and high wages among the high-tech industries at the national level either. Only Drugs, Computer & Data Processing Services, Management & Public Relations Services, Motor Vehicles & Equipment, and Engineering & Architectural Services rank among both those industries with employment growth of at least 20.0% and those industries paying average annual wages of at least 133% higher than the average annual U.S. wage of \$33,244. Engineering & Architectural Services, Construction & Related Machinery, Special Industrial Machinery, General Industrial Machinery, and Medical Equipment, Instruments & Supplies all exhibit employment growth in the top ten, while ranking in the bottom ten high-tech industries with respect to pay.

U.S High-Employment Growth Rate, High-Pay Intersections
(1991-1999)

<u>Industry</u>	<u>Employment Growth</u>	<u>Employment Growth Rank</u>	<u>Annual Wage</u>	<u>Wage Rank</u>
Computer & Data Processing Services	135.3%	1 st	\$73,371	3 rd
Management & Public Relations Services	67.1%	2 nd	\$55,071	14 th
Motor Vehicles & Equipment	29.1%	3 rd	\$53,222	19 th
Engineering & Architectural Services	27.5%	4 th	\$52,382	21 st
Drugs	20.6%	5 th	\$74,802	2 nd

Source: Bureau of Labor Statistics

Wisconsin-U.S. Comparison

The high-growth, high-pay opportunity vector intersection overlap between Wisconsin and the U.S. is small – four industries. Computer & Data Processing Services, Management & Public Relations Services, Motor Vehicles & Equipment, and Drugs offer significant opportunities for economic development at both the state and national levels. The small intersection between

Wisconsin and the U.S. high-growth, high-pay industries indicates some potential unique opportunities for the state. Additional economic development opportunity industries for Wisconsin include Industrial Inorganic Chemicals, General Industrial Machinery, and Industrial Organic Chemicals.

Wisconsin and U.S High-Employment Growth Rate, High-Pay Intersections

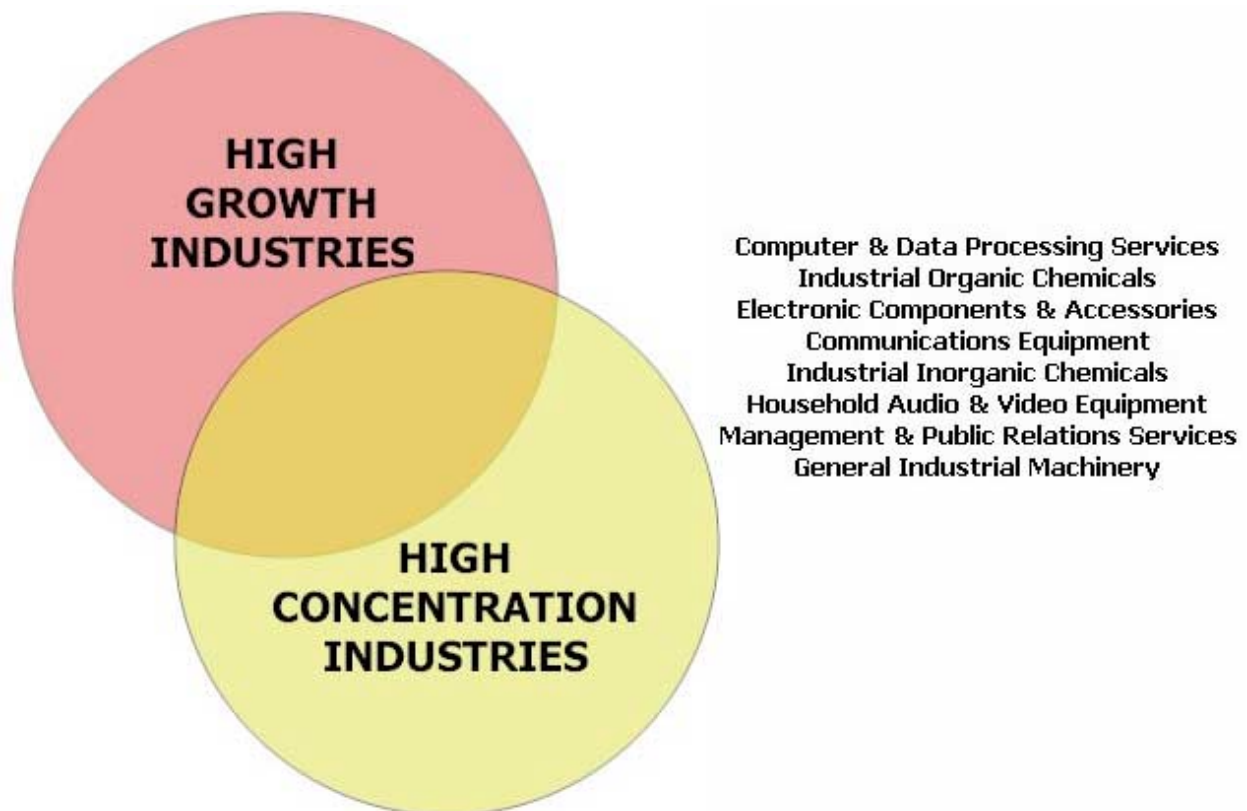
<u>Industry</u>	<u>WI Employment Growth Rank</u>	<u>WI Wage Rank</u>	<u>U.S. Employment Growth Rank</u>	<u>U.S. Wage Rank</u>
Computer & Data Processing Services	2 nd	5 th	1 st	3 rd
Drugs	4 th	15 th	5 th	2 nd
Motor Vehicles & Equipment	10 th	4 th	3 rd	19 th
Management & Public Relations Services	12 th	11 th	2 nd	14 th

Source: Bureau of Labor Statistics, Department of Workforce Development

Intersection of High-Employment Growth Industries with High-Occupational Concentration Industries

Wisconsin

Occupational employment data was available for twenty-nine of the thirty-one high-tech industries in Wisconsin, excepting Guided Missiles and Agricultural Chemicals.



We were unable to attain some occupational employment data for certain industries from DWD due to confidentiality restrictions. In these cases, it was assumed equal concentrations of high-

tech occupations in Wisconsin industries as those for the nation. This assumption may overstate Wisconsin high-tech occupational concentration in some state high-tech industries as explained in the high-tech occupational factors section above.

Out of the twenty-three high-tech industries experiencing high-tech concentrations of at least 9.0%, only eight of them also exhibited employment growth rates of more than 20%: Computer & Data Processing Services, Industrial Organic Chemicals, Electronic Components & Accessories, Communications Equipment, Industrial Inorganic Chemicals, Household Audio & Video Equipment, Management & Public Relations Services, and General Industrial Machinery.

Wisconsin High Employment Growth, High-Tech Occupational Concentration Intersection

<u>Industry</u>	<u>Employment Growth</u>	<u>Employment Growth Rate</u>	<u>High-Tech Occ. Conc.</u>	<u>High-Tech Occ. Conc. Rank</u>
Computer & Data Processing Services	114.4%	2 nd	54.2%	1 st
Industrial Organic Chemicals	112.4%	3 rd	20.2%	8 th
Electronic Components & Accessories	88.4%	5 th	12.2%	18 th
Communications Equipment	53.5%	6 th	20.8%	7 th
Industrial Inorganic Chemicals	44.6%	7 th	9.6%	21 st
Household Audio & Video Equipment	23.6%	11 th	9.2%	23 rd
Management & Public Relations Services	21.4%	12 th	15.6%	11 th
General Industrial Machinery	20.6%	13 th	11.1%	19 th

Source: Department of Workforce Development, Bureau of Labor Statistics

U.S.

Twenty-seven of the thirty-one high-tech industries revealed high-tech occupational concentrations of at least 9.0%, while only five high-tech industries in the U.S. experienced employment growth rates of higher than 20%. The small number of U.S. high-tech industries that grew by more than 20% limited the number of comparable high-tech industries for the high-growth, high-occupation concentration intersection.

Only four high-tech industries were found to have experienced both employment growth of more than 20.0% and high-tech occupational concentrations of more than 9.0%: Computer & Data Processing Services, Management & Public Relations Services, Engineering & Architectural Services, and Drugs.

U.S High Employment Growth, High-Tech Occupational Concentration Intersection

<u>Industry</u>	<u>Employment Growth</u>	<u>Employment Growth Rate</u>	<u>High-Tech Occ. Conc.</u>	<u>High-Tech Occ. Conc. Rank</u>
Computer & Data Processing Services	135.3%	1 st	51.46%	1 st
Management & Public Relations Services	67.1%	2 nd	14.98%	15 th
Engineering & Architectural Services	27.5%	4 th	44.75%	2 nd
Drugs	20.6%	5 th	22.26%	10 th

Source: Bureau of Labor Statistics

Wisconsin-U.S. Comparison

There are only two high-tech industries that lie in the high-growth, high-occupation concentration intersection for both the U.S. and Wisconsin: Computer & Data Processing Services and Management & Public Relations Services.

Motor Vehicles & Equipment is growing quickly, but has extremely low high-tech occupational concentrations in both the U.S. and Wisconsin. Engineering & Architectural Services is ranked second in terms of high-tech occupational concentration in both the U.S. and Wisconsin, but experienced an employment growth rate of higher than 20% in the U.S. only. Its employment growth rate in Wisconsin was 13.8% from 1991 to 1999.

Wisconsin and U.S. High-Employment Growth Rate, High-Occupational Concentration Intersections

<u>Industry</u>	<u>WI Employment Growth Rank</u>	<u>WI Occ. Conc. Rank</u>	<u>U.S. Employment Growth Rank</u>	<u>U.S. Occ. Conc. Rank</u>
Computer & Data Processing Services	2 nd	1 st	1 st	1 st
Management & Public Relations Services	12 th	11 th	2 nd	15 th

Source: Bureau of Labor Statistics, Department of Workforce Development

Intersection of High-Paying Industries with High-Occupational Concentration Industries

Wisconsin

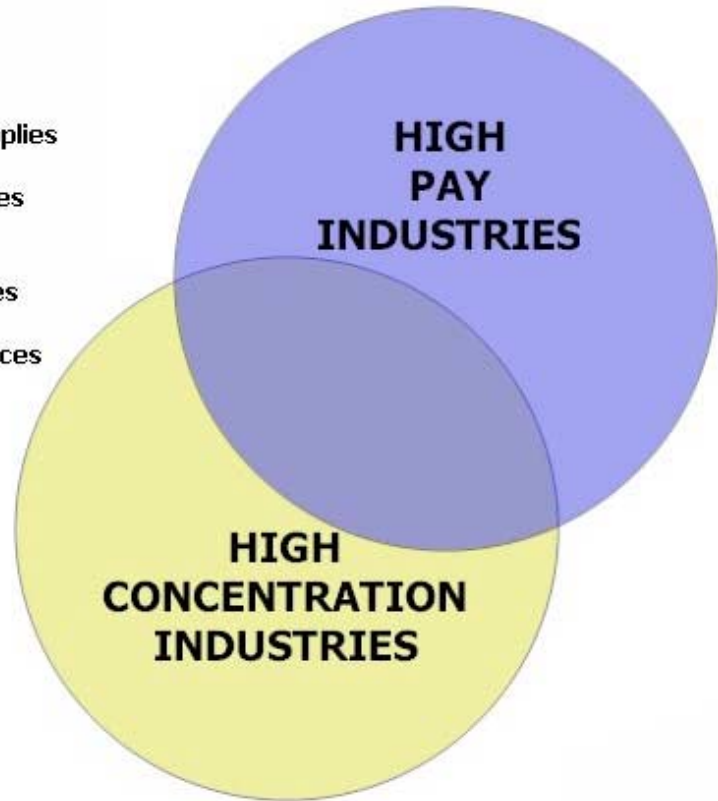
Fifteen high-tech industries in Wisconsin have annual wages of 133% of the Wisconsin average annual wage and high-tech occupational concentrations greater than 9.0%.

Pay and Brain Drain

Wisconsin's opportunity vector intersection for high paying, high-tech occupations holds promise in the respect that the state employs a below national average number of high-tech workers and pays them less than the comparable national average salary. This is further evidence of Wisconsin's "Brain Drain" problem and one indication of its cause – less pay. It is also indicative of Wisconsin's concentration in manufacturing industries (second highest employment share in the nation and low on the spectrum of industry spending on research and development) instead of industries that spend heavily on research and development (Wisconsin companies invest \$1 billion dollars less annually on research and development than the national average).

The opportunities lie in increasing earning levels of high-tech workers and in increasing research and development investment in Wisconsin industries. Research and development infrastructure must be built and competitive wages must be paid if the state wants to attract more high-tech, highly-paid workers.

Medical Equipment, Instruments & Supplies
 Search & Navigation Equipment
 Computer & Data Processing Services
 Miscellaneous Chemical Products
 Engines & Turbines
 Engineering & Architectural Services
 Industrial Inorganic Chemicals
 Management & Public Relations Services
 Special Industrial Machinery
 Measuring & Controlling Devices
 Paint & Allied Products
 Electrical Industrial Apparatus
 General Industrial Machinery
 Industrial Organic Chemicals
 Plastics, Materials & Synthetics



For the most part the high-tech industries pay higher annual wages in the U.S. than in Wisconsin. One exception to this is the Medical Equipment, Instruments, & Supplies industry, which lies in the high-paying, high-occupational concentration intersection. This industry pays an annual wage of \$60,377 in Wisconsin and \$49,567 in the U.S. This industry could offer Wisconsin a comparative advantage.

Wisconsin High-Pay, High-Occupational Concentrations Intersection

<u>Industry</u>	<u>Annual Wage</u>	<u>Wage Rank</u>	<u>Occupational Concentration</u>	<u>Occ. Conc. Rank</u>
Medical Equipment, Instruments & Supplies	\$60,377	2 nd	15.0%	13 th
Search & Navigation Equipment	\$57,993	3 rd	42.9%	4 th
Computer & Data Processing Services	\$51,985	5 th	54.2%	1 st
Miscellaneous Chemical Products	\$47,598	7 th	17.8%	9 th
Engines & Turbines	\$47,555	8 th	9.5%	22 nd
Engineering & Architectural Services	\$46,845	9 th	45.6%	2 nd
Industrial Inorganic Chemicals	\$45,505	10 th	9.6%	21 st
Management & Public Relations Services	\$44,499	11 th	15.6%	11 th
Special Industrial Machinery	\$44,454	12 th	14.9%	14 th
Measuring & Controlling Devices	\$44,412	13 th	21.2%	6 th
Paint & Allied Products	\$42,993	16 th	13.6%	16 th
Electrical Industrial Apparatus	\$41,996	17 th	15.2%	12 th
General Industrial Machinery	\$41,668	18 th	11.1%	19 th
Industrial Organic Chemicals	\$41,518	19 th	20.2%	8 th
Plastics Materials & Synthetics	\$41,292	20 th	13.7%	15 th

Source: Bureau of Labor Statistics, Wisconsin Department of Workforce Development

U.S.

The U.S. has an even larger comparable set of high-tech industries with high annual wages and high-occupational concentrations. There are twenty-three, out of a possible twenty-six high-tech industries, in the U.S. that pay annual wages of at least 133% of the average annual U.S. wage and have high-tech occupational concentrations of at least 9.0%. See chart below for a complete listing of these twenty-three industries.

U.S. High-Pay, High-Occupational Concentrations Intersection

<u>Industry</u>	<u>Annual Wage</u>	<u>Wage Rank</u>	<u>Occupational Concentration</u>	<u>Occ. Conc. Rank</u>
Computer & Office Equipment	\$82,853	1 st	38.7%	4 th
Drugs	\$74,802	2 nd	22.3%	10 th
Computer & Data Processing Services	\$73,371	3 rd	51.5%	1 st
Petroleum Refining	\$72,370	4 th	13.1%	19 th
Industrial Organic Chemicals	\$65,691	5 th	21.8%	11 th
Communications Equipment	\$63,928	7 th	27.9%	6 th
Search & Navigation Equipment	\$63,120	8 th	44.2%	3 rd
Industrial Inorganic Chemicals	\$60,471	9 th	18.4%	12 th
Photographic Equipment & Supplies	\$57,467	10 th	16.8%	14 th
Plastics Materials & Synthetics	\$56,591	11 th	17.6%	13 th
Aircraft & Parts	\$55,179	13 th	22.8%	7 th
Management & Public Relations Services	\$55,071	14 th	15.0%	15 th
Electronic Components & Accessories	\$54,268	15 th	22.3%	8 th
Measuring & Controlling Devices	\$54,087	16 th	22.3%	9 th
Soaps, Cleaners & Toilet Goods	\$53,834	17 th	9.4%	27 th
Engines & Turbines	\$53,824	18 th	12.9%	21 st
Miscellaneous Chemical Products	\$52,874	20 th	14.1%	17 th
Engineering & Architectural Services	\$52,382	21 st	44.8%	2 nd
Research, Development & Testing Services	\$49,980	22 nd	37.8%	5 th
Medical Equipment, Instruments & Supplies	\$49,567	23 rd	13.1%	20 th
Special Industrial Machinery	\$49,273	24 th	14.5%	16 th
Household Audio & Video Equipment	\$47,031	25 th	12.7%	22 nd
Paint & Allied Products	\$45,705	26 th	13.2%	18 th

Source: Bureau of Labor Statistics

Wisconsin-U.S. Comparison

There are thirteen high-tech industries in common between the U.S. and Wisconsin that are high paying and have occupational concentrations of at least 9.0%. Only the Medical Equipment, Instruments, & Supplies industry in Wisconsin outperforms the U.S. counterpart in terms of both wage and high-tech occupation concentration rankings.

Wisconsin and U.S. High-Pay, High-Tech Occupation Concentrations Intersections

Industry	<u>WI Annual Wage</u>	<u>U.S. Annual Wage</u>	<u>WI Occ. Concentration</u>	<u>U.S. Occ. Concentration</u>
Medical Equipment, Instruments & Supplies	\$60,377	\$49,567	15.0%	13.1%
Search & Navigation Equipment	\$57,993	\$63,120	42.9%	44.2%
Computer & Data Processing Services	\$51,985	\$73,371	54.2%	51.5%
Miscellaneous Chemical Products	\$47,598	\$52,874	17.8%	14.1%
Engines & Turbines	\$47,555	\$53,824	9.5%	12.9%
Engineering & Architectural Services	\$46,845	\$52,382	45.6%	44.8%
Industrial Inorganic Chemicals	\$45,505	\$60,471	9.6%	18.4%
Management & Public Relations Services	\$44,499	\$55,071	15.6%	15.0%
Special Industrial Machinery	\$44,544	\$49,273	14.9%	14.5%
Measuring & Controlling Devices	\$44,412	\$54,087	21.2%	22.3%
Paint & Allied Products	\$42,993	\$45,705	13.6%	13.2%
Industrial Organic Chemicals	\$41,518	\$65,691	20.2%	21.8%
Plastics Materials & Synthetics	\$41,292	\$56,591	13.7%	17.6%

Source: Department of Workforce Development, Bureau of Labor Statistics

Opportunity Vector Super-Intersection

Wisconsin

Five of Wisconsin’s high-tech industries exhibit all three opportunity vector criteria of employment growth greater than 20%, annual wages greater than 133% of the average Wisconsin annual wage, and high-tech occupation concentrations of at least 9.0%: Computer & Data Processing Services, Industrial Inorganic Chemicals, Management & Public Relations Services, General Industrial Machinery, and Industrial Organic Chemicals.

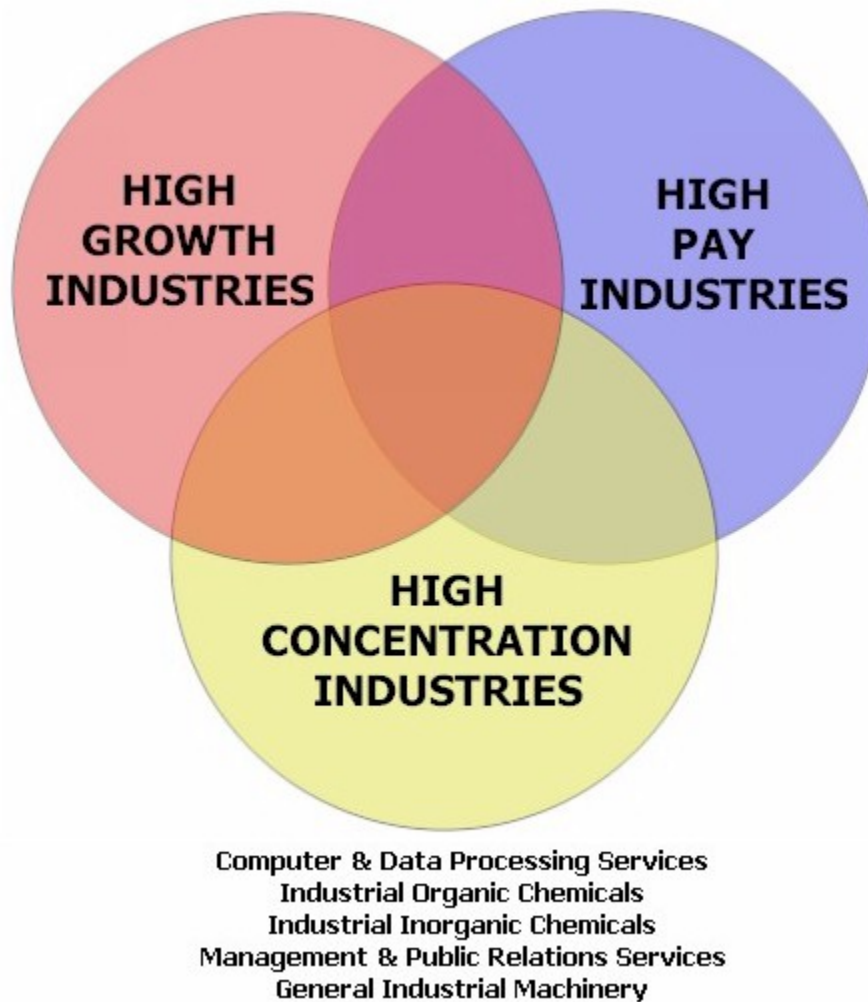
Wisconsin High-Employment Growth, High-Pay, High-Occupation Concentration Super-Intersection

Industry	<u>EmPLY. Growth</u>	<u>EmPLY. Growth Rank</u>	<u>Annual Wage</u>	<u>Wage Rank</u>	<u>Occ. Conc. Share</u>	<u>Occ. Conc. Rank</u>
Computer & Data Processing Services	114.4%	2 nd	\$51,985	5 th	54.2%	1 st
Industrial Organic Chemicals	112.4%	3 rd	\$41,518	19 th	20.2%	8 th
Industrial Inorganic Chemicals	44.6%	7 th	\$45,505	10 th	9.6%	21 st
Management & Public Relations Services	21.4%	12 th	\$44,499	11 th	15.6%	11 th
General Industrial Machinery	20.6%	13 th	\$41,668	18 th	11.1%	19 th

Source: Bureau of Labor Statistics, Department of Workforce Development

Three of these five industries pay annual wages that are greater than 150% of the average Wisconsin annual wage: Computer & Data Processing Services, Industrial Inorganic Chemicals, and Management & Public Relations Services. The Industrial Inorganic Chemicals industry has a high employment growth rate and is the tenth highest-paying high-tech industry in Wisconsin, but it has a relatively low high-tech occupation concentration of only 9.6%. See table above.

The Industrial Organic Chemicals industry ranks eighth in occupation concentration and ranks third in employment growth with a growth rate of 112.4%, but is the nineteenth highest-paying high-tech industry in Wisconsin. Unlike the Industrial Inorganic Chemicals and Industrial Organic Chemicals industries, the Computer & Data Processing Services, Management & Public Relations Services, and General Industrial Machinery industries are all very consistent in their employment growth, annual wage, and occupation concentration rankings.



U.S.

There are four high-tech industries in the U.S. that exhibit employment growth of at least 20.0%, pay annual wages of 133.0% greater than the average annual U.S. wage, and have occupation concentrations of at least 9.0%: Computer & Data Processing Services, Management & Public Relations Services, Engineering & Architectural Services, and Drugs.

The Engineering & Architectural Services industry registered employment growth of 27.5% from 1991-99 and ranks second in the U.S. in terms of occupation concentration, but only ranks twenty-first in the highest-paying high-tech industry list. The Management & Public Relations

Services industry has moderate annual wage and occupation concentrations of fourteenth and fifteenth respectively, but has an employment growth ranking of second with a 67.1% growth rate. The Computer & Data Processing Services and Drugs industries are both consistent across all three of their rankings.

All four of these high-tech industries pay greater than 150% of the average U.S. annual wage. The Computer & Data Processing Services and Drugs industries both pay more than 200% of the average U.S. annual wage.

**U.S. High-Employment Growth, High-Pay, High-Occupation Concentration
Super-Intersection**

<u>Industry</u>	<u>EmPLY. Growth</u>	<u>EmPLY. Growth Rank</u>	<u>Annual Wage</u>	<u>Wage Rank</u>	<u>Occ. Conc. Share</u>	<u>Occ. Conc. Rank</u>
Computer & Data Processing Services	135.3%	1 st	\$73,371	3 rd	51.46%	1 st
Management & Public Relations Services	67.1%	2 nd	\$55,071	14 th	15.0%	15 th
Engineering & Architectural Services	27.5%	4 th	\$52,382	21 st	44.8%	2 nd
Drugs	20.6%	5 th	\$74,802	2 nd	22.3%	10 th
Source: Bureau Of Labor Statistics						

Wisconsin-U.S. Comparison

Wisconsin and the U.S. share two common industries in their high-employment growth, high-paying, and high-occupation concentration intersections: Computer & Data Processing Services and Management & Public Relations Services.

The Industrial Organic Chemicals industry is present in Wisconsin’s high-employment growth, high-paying, and high-occupation concentration super-intersection, but did not make the same intersection for the U.S. However, this industry was very close in making this intersection in the U.S. The Industrial Organic Chemicals industry was the fifth highest-paying, high-tech industry in the U.S. and ranked eleventh in terms of high-tech occupation concentration, but experienced negative growth of –18.6%.

The Industrial Inorganic Chemicals industry experienced U.S. rankings similar to the Industrial Organic Chemicals industry. The industry was the ninth highest-paying, high-tech industry in the U.S. and ranked twelfth in terms of high-tech occupation concentration, but experienced negative growth of –23.5%. To the contrary, the Industrial Inorganic Chemicals industry was present in Wisconsin’s high-employment growth, high-paying, and high-occupation concentration super-intersection.

The Industrial Organic Chemicals and Industrial Inorganic Chemicals industries are two industries in which Wisconsin excels in comparison to the U.S. Employment growth rates for these industries should be monitored to track if Wisconsin employment growth begins to follow the U.S. trend of negative growth in these industries.

**Wisconsin and U.S. High-Employment Growth, High-Pay, High-Occupation Concentration
Super-Intersection**

<u>Industry</u>	<u>WI Empl. Growth Rank</u>	<u>WI Wage Rank</u>	<u>WI Occ. Conc. Rank</u>	<u>U.S. Empl. Growth Rank</u>	<u>U.S. Wage Rank</u>	<u>U.S. Occ. Conc. Rank</u>
Computer & Data Processing Services	2 nd	5 th	1 st	1 st	3 rd	1 st
Management & Public Relations Services	12 th	11 th	11 th	2 nd	14 th	15 th

Source: Bureau of Labor Statistics, Department of Workforce Development

CONCLUSIONS AND RECOMMENDATIONS

Wisconsin has the opportunity to grow a number of promising high-tech industries that already exist in the state. The high-tech industries in the state that show the most promise based upon the opportunity vector intersections analysis conducted in this paper are listed in the following table.

Wisconsin High-Tech Industry Opportunities

<u>Industry</u>	<u>High Employment Growth (≥ 20%)</u>	<u>High Paying (≥ 133%)</u>	<u>High High-Tech Occupational Concentration (≥ 9.0%)</u>
Computer & Data Processing Services	X	X	X
Industrial Organic Chemicals	X	X	X
Industrial Inorganic Chemicals	X	X	X
Management & Public Relations Services	X	X	X
General Industrial Machinery	X	X	X
Drugs	X	X	
Motor Vehicles & Equipment	X	X	
Petroleum Refining	X	X	
Electronic Components & Accessories	X		X
Communications Equipment	X		X
Household Audio & Video Equipment	X		X
Medical Equipment, Instruments & Supplies		X	X
Search & Navigation Equipment		X	X
Miscellaneous Chemical Products		X	X
Engines & Turbines		X	X
Engineering & Architectural Services		X	X
Special Industrial Machinery		X	X
Measuring & Controlling Devices		X	X
Paint & Allied Products		X	X
Electrical Industrial Apparatus		X	X
Plastics Materials & Synthetics		X	X

High employment growth is greater than 20% increase in employment over the 1991 to 1999 period.
 High-paying is average annual industry income is at least 133% of average annual Wisconsin worker income, \$29,607.
 High high-tech occupational concentration is the share of high-tech workers is at least 9% of all the industry's workers.

Other Comparative Advantages

Other Wisconsin industries show some unique items that set them apart from their counterparts at the national level. This set of industries possesses some comparative advantages relative to national averages. The next table lists these industries and how they compared to the national situation.

Wisconsin Comparative Advantage High-Tech Industries

<u>Industry</u>	<u>Comparative Advantage</u>
Industrial Organic Chemicals	High growth in Wisconsin/Negative growth in U.S.
Agricultural Chemicals	High growth in Wisconsin/Negative growth in U.S.
General Industrial Machinery	High growth in Wisconsin/Low growth in U.S.
Soaps, Cleaners, & Toilet Goods	Annual wages higher in Wisconsin than U.S.
Medical Equipment, Instruments & Supplies	Annual wages higher in Wisconsin than U.S.
Electric Distribution Equipment	Higher occupational concentration in Wisconsin than U.S.
Electrical Industrial Apparatus	Higher occupational concentration in Wisconsin than U.S.

Source: Bureau of Labor Statistics, Department of Workforce Development

The industries listed in the two tables above deserve more attention as candidates for focused economic development initiatives. Wisconsin should foster the development of these industries through:

- Developing the cluster infrastructure surrounding these industries
- Encouraging capital investment in these industries
- Networking the financial resources supporting these industries
- Creating educational programs for entrepreneurs and workers in these industries
- Networking the supplier and customer base for these industries
- Assisting in the technology transfer to these industries and of these industries

Obviously, the high-tech industry list presented in this analysis is not an exhaustive list of opportunities for economic development initiatives. There are many emerging businesses that could become the foundations for entire new industry clusters in the state. Wisconsin would best be served by building the supportive infrastructure that will foster the creation and expansion of all businesses and industries that generate high-paying jobs in the state.

Further Study

It is imperative that serious discussions continue about the state of Wisconsin's economy. Wisconsin's per capita income is now 95% of the U.S. average. If Wisconsin Department of Revenue forecasts hold true, Wisconsin's per capita income will decline to 83% of the U.S. average by the year 2024. That puts the state on equal footing with states such as Alabama, Arkansas, Mississippi, Idaho, Kentucky, Oklahoma and West Virginia. Recent data show Wisconsin's income is actually growing relatively slower than the projections noted above.

This study provides an essential benchmark and database of Wisconsin's current high-tech economy. Further analysis and dialogue is required to determine what Wisconsin's desired economic structure should be ten, twenty, thirty years hence. For example,

- What should Wisconsin's per capita income be?
- What should Wisconsin's median income be?
- How many college graduates should Wisconsin have?
- How much research and development investment should be made each year?
- What level of venture capital should be invested in the state each year?
- How many high-tech start-ups should there be each year?
- How many high-tech jobs should be added each year?
- What share of the state's employment should consist of high-tech jobs?

The state's economic development strategy can then be constructed and economic development initiatives can be implemented to achieve the desired economic construct. That analysis should include how high-tech industries mesh with all the other resources the state of Wisconsin has at its disposal, including natural, human, capital and creative resources. All of Wisconsin's resources must be channeled effectively to lead the state's future economic prosperity. Time is not an abundant resource in this endeavor.

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APPENDIX

Milken Institute List of High-Tech Industries

Milken uses 14, 3-digit SIC industries to make regional New Economy comparisons.

<u>SIC</u>	<u>Industry Description</u>
283	Drugs
357	Computer & Office Equipment
366	Communications Equipment
367	Electronic Components & Accessories
372	Aircraft & Parts
376	Guided Missiles, Space Vehicles & Parts
381	Search, Detection, Navigation, Guidance Systems
382	Laboratory Apparatus and Analytical, Optical Instruments
384	Surgical, Medical, & Dental Instruments & Supplies
481	Telephone Communication Services
737	Computer Programming, Data Processing & Other Services
781	Motion Picture Production & Allied Services
871	Engineering, Architectural, & Survey Services
873	Research, Development, & Testing Services

American Electronic Association

AEA uses much the same industry classes as does Milken, but AEA expands the industry listing to 45, 4-digit SIC level. The overlap is not 100%.

<u>SIC</u>	<u>Industry Description</u>
3571	Electronic Computers
3572	Computer Storage Devices
3575	Computer Terminals
3577	Computer Peripherals
3578	Calculating and Accounting Machines
3579	Office Machines
3651	Household Audio & Video Equipment
3652	Phonographic Records & Prerecorded Tapes and Disks
3661	Telephone and Telegraph Apparatus
3663	Radio & TV Broadcast Communications Equipment
3669	Other Communications Equipment
3671	Electron Tubes
3672	Printed Circuit Boards
3674	Semiconductors & Related Devices
3675	Electronic Capacitors
3676	Electronic Resistors
3677	Electronic Coils, Transformers & Inductors
3678	Electronic Connectors
3679	Other Electronic Components
3812	Search & Navigation Systems, Instruments & Equipment
3821	Laboratory Apparatus
3822	Environmental Controls
3823	Process Control Instruments
3824	Fluid Meters & Counting Devices
3825	Instruments to Measure Electricity
3826	Laboratory Analytical Instruments
3827	Optical Instruments & Lenses
3829	Other Measuring & Controlling Devices
3844	X-Ray Apparatus, Tubes & Related Apparatus
3845	Electromedical & Electrotherapeutic Apparatus
3861	Photographic Equipment & Lenses

(continued on next page)

American Electronic Association
(continued from previous page)

<u>SIC</u>	<u>Industry Description</u>
4812	Radiotelephone Communications
4813	Telephone Communications
4822	Telegraph & Other Message Communications
4841	Cable & Other Pay Television Services
4899	Other Communications Services
7371	Computer Programming Services
7372	Prepackaged Software
7373	Computer Integrated Systems Design
7374	Computer Processing & Data Preparation
7375	Information Retrieval Services
7376	Computer Facilities Management Services
7377	Computer Rental & Leasing
7378	Computer Maintenance & Repair
7379	Other Computer-Related Services

Bureau of Labor Statistics

The BLS list consists of 31, 3-digit SIC code industries, 27 in manufacturing and 4 in the services industry group. There is significant overlap with the Milken and AEA list.

<u>SIC</u>	<u>Industry Description</u>
281	Industrial Inorganic Chemicals
282	Plastics Materials & Synthetics
283	Drugs
284	Soaps, Cleaners, & Toilet Goods
285	Paint & Allied Products
286	Industrial Organic Chemicals
287	Agricultural Chemicals
289	Miscellaneous Chemical Products
291	Petroleum Refining
348	Ordnance & Accessories
351	Engines & Turbines
353	Construction & Related Machinery
355	Special Industrial Machinery
356	General Industrial Machinery
357	Computer & Office Equipment
361	Electric Distribution Equipment
362	Electrical Industrial Apparatus
365	Household Audio & Video Equipment
366	Communications Equipment
367	Electronic Components & Accessories
371	Motor Vehicles & Equipment
372	Aerospace
376	Guided Missiles
381	Search & Navigation Equipment
382	Measuring & Controlling Devices
383	Medical Equipment, Instruments and Supplies
386	Photographic Equipment and Supplies
737	Computer & Data Processing Services
871	Engineering & Architectural Services
873	Research, Development & Testing Services
874	Management & Public Relations Services

Humphrey Institute of Public Affairs

The HIPA definition puts the threshold of high-tech occupational concentration to three times the national average and does not include an R&D component. HIPA defines a list of thirty, 3-digit SIC high-tech industries that include manufacturing and services industries.

<u>SIC</u>	<u>Industry Description</u>
131	Crude Petroleum & Natural Gas
148	Nonmetallic Minerals Services, except Fuels
211	Cigarettes
281	Industrial Inorganic Chemicals
282	Plastics Materials & synthetics
283	Drugs
286	Industrial Organic Chemicals
348	Ordnance & Accessories
351	Engines & Turbines
355	Special Industrial Machinery
357	Computer & Office Equipment
366	Communications Equipment
367	Electronic Components and Accessories
372	Aircraft & Parts
376	Guided Missiles & Space Vehicles and Parts
381	Search, Detection, Navigation & Guidance Equipment
382	Laboratory Apparatus & Analytical, Optical
384	Surgical, Medical Equipment, Instruments & Supplies
384	Photographic Equipment & Supplies
482	Telegraph and Other Message Communications Equipment
489	Communications Services, nec
493	Combination Electric and Gas & Other Utility
601	Central Reserve Depository Institutions
631	Life Insurances
671	Holding Offices
737	Computer Programming & Data Processing Services
871	Engineering, Architectural & Surveying Services
873	Research, Development & Testing Services
874	Management & Public Relations Services
899	Other Business Services

Progressive Policy Institute

The PPI takes a broader view of the new economy measures than do the others. PPI measures 17 indicators within 5 broader groupings: Knowledge Jobs, Globalization, Economic Dynamism, Digital Economy, and Innovation Capacity.

Knowledge Jobs

- Percent of workforce working in offices
- Share employed in manager, professional and technology positions
- Education level of workforce

Globalization

- Share of jobs dependent upon exports
- Percent of workforce employed by foreign firms

Economic Dynamism

- Gazelle Jobs – firms with annual revenue growth of 20%/yr for 4 years
- Job Churn – number of new firms plus number of failed firms
- IPOs – value of IPO offerings as percent share of GSP

Digital Economy

- Weighted measure of percent of classrooms wired for Internet, teachers with tech training and schools with greater than 50% of teachers with school-based email address
- Utilization of digital technology by state government

Innovation Capacity

- Employment share of specific high-tech industries
- R&D \$ share of GSP
- VC \$ as percent of GSP
- Percent of scientists and engineers in the workforce
- Number of patents per 1000 workers

Table A - 1

Wisconsin High-Tech Industries Ranked Total Employment, 1998

SIC Code	Industry	High-Tech Employment	Total Employment
371	Motor Vehicles & Equipment	1,507	22,985
737	Computer & Data Processing Services	11,229	20,731
362	Electrical Industrial Apparatus	2,559	16,844
356	General Industrial Machinery	1,724	15,505
355	Special Industrial Machinery	2,200	14,800
871	Engineering & Architectural Services	6,240	13,682
351	Engines & Turbines	1,223	12,873
353	Construction & Related Machinery	1,052	12,074
367	Electronic Components & Accessories	1,125	9,198
384	Medical, Equipment, Instruments, & Supplies	1,316	8,746
874	Management & Public Relations Services	1,338	8,580
382	Measuring & Controlling Devices	1,290	6,080
361	Electric Distribution Equipment	995	5,910
873	Research, Development, & Testing Services	2,374	5,488
357	Computer & Office Equipment	1,448	5,301
284	Soaps, Cleaners, & Toilet Goods	344	4,795
283	Drugs	159	2,272
285	Paint & Allied Products	253	1,865
289	Miscellaneous Chemical Products	324	1,822
381	Search & Navigation Equipment	751	1,749
286	Industrial Organic Chemicals	308	1,525
366	Communication Equipment	222	1,064
365	Household Audio & Video Equipment	92	1,000
282	Plastics, Materials, & Synthetics	123	897
348	Ordnance & Accessories	85	842
281	Industrial Inorganic Chemicals	60	622
372	Aircraft & Parts	21	474
386	Photographic Equipment & Supplies	24	189
291	Petroleum Refining	5	148
Totals		40,389	198,061

Total employment data from Wisconsin Department of Workforce Development
 High-tech employment data found assuming equal concentrations of high-tech occupations in
 Wisconsin industries as those for the nation

Table A - 2

U.S. High-Tech Industries Ranked by Total Employment, 1998

SIC Code	Industry	High-Tech Employment	Total Employment
737	Computer & Data Processing Services	855,620	1,662,750
874	Management & Public Relations Services	159,000	1,061,240
371	Motor Vehicles & Equipment	90,630	1,021,290
871	Engineering & Architectural Services	416,180	929,970
367	Electronic Components & Accessories	143,820	643,950
873	Research, Development, & Testing Services	234,310	620,550
372	Aircraft & Parts	119,750	525,980
357	Computer & Office Equipment	146,910	379,730
382	Measuring & Controlling Devices	66,890	299,680
384	Medical, Equipment, Instruments, & Supplies	36,760	281,510
283	Drugs	62,220	279,540
366	Communication Equipment	77,330	276,870
356	General Industrial Machinery	25,540	265,220
353	Construction & Related Machinery	19,330	251,540
355	Special Industrial Machinery	25,090	173,410
381	Search & Navigation Equipment	71,280	161,240
284	Soaps, Cleaners, & Toilet Goods	14,720	156,600
282	Plastics, Materials, & Synthetics	27,170	154,590
362	Electrical Industrial Apparatus	16,660	152,240
286	Industrial Organic Chemicals	29,440	135,090
281	Industrial Inorganic Chemicals	21,170	114,820
289	Miscellaneous Chemical Products	13,200	93,920
291	Petroleum Refining	12,260	93,590
351	Engines & Turbines	10,640	82,360
365	Household Audio & Video Equipment	10,420	82,000
361	Electric Distribution Equipment	9,390	80,860
386	Photographic Equipment & Supplies	13,100	78,080
285	Paint & Allied Products	6,850	51,840
348	Ordnance & Accessories	5,120	40,880
Totals		2,740,800	10,151,340

Data from U.S. Bureau of Labor Statistics - Occupational Employment Statistics -
1998 OES National 3-digit Industry Estimates - http://www.bls.gov/oes/oes_dl.htm

Table A - 3

Wisconsin High-Tech Industry Employment Growth, 1991-1999

SIC Code	Industry	Employment Growth, '91-'99
372	Aircraft & Parts	136.3%
737	Computer & Data Processing Services	114.4%
286	Industrial Organic Chemicals	112.4%
283	Drugs	97.4%
367	Electronic Components & Accessories	88.4%
366	Communications Equipment	53.50%
281	Industrial Inorganic Chemicals	44.60%
287	Agricultural Chemicals	41.90%
291	Petroleum Refining	38.7%
371	Motor Vehicles & Equipment	35.1%
365	Household Audio & Video Equipment	23.6%
874	Management & Public Relations Services	21.4%
356	General Industrial Machinery	20.6%
285	Paint & Allied Products	18.5%
362	Electrical Industrial Apparatus	16.8%
284	Soaps, Cleaners, & Toilet Goods	14.3%
871	Engineering & Architectural Services	13.8%
873	Research, Development, & Testing Services	8.2%
382	Measuring & Controlling Devices	7.9%
355	Special Industrial Machinery	5.2%
357	Computer & Office Equipment	4.8%
282	Plastics, Materials, & Synthetics	3.9%
289	Miscellaneous Chemical Products	0.8%
384	Medical Equipment, Instruments, & Supplies	0.6%
353	Construction & Related Machinery	-7.4%
351	Engines & Turbines	-7.4%
361	Electric Distribution Equipment	-19.4%
348	Ordnance & Accessories	-40.2%
381	Search & Navigation Equipment	-47.5%
386	Photographic Equipment & Supplies	-66.2%
376	Guided Missiles	***

Data from Wisconsin Division of Workforce Excellence - Tables 209,210,211 of issues #54-62

***Data unavailable due to confidentiality restrictions

Table A - 4

U.S. High-Tech Industry Employment Growth, 1991-1999

SIC Code	Industry	Employment Growth, '91-'99
737	Computer & Data Processing Services	135.3%
874	Management & Public Relations Services	67.1%
371	Motor Vehicles & Equipment	29.1%
871	Engineering & Architectural Services	27.5%
283	Drugs	20.6%
367	Electronic Components & Accessories	15.5%
355	Special Industrial Machinery	12.5%
353	Construction & Related Machinery	11.4%
873	Research, Development, & Testing Services	10.7%
384	Medical Equipment, Instruments, & Supplies	10.0%
366	Communications Equipment	6.9%
356	General Industrial Machinery	6.0%
284	Soaps, Cleaners, & Toilet Goods	2.6%
351	Engines & Turbines	-1.1%
382	Measuring & Controlling Devices	-3.9%
287	Agricultural Chemicals	-4.1%
365	Household Audio & Video Equipment	-5.7%
289	Miscellaneous Chemical Products	-5.9%
362	Electrical Industrial Apparatus	-6.9%
361	Electric Distribution Equipment	-7.1%
285	Paint & Allied Products	-9.9%
357	Computer & Office Equipment	-11.5%
282	Plastics, Materials, & Synthetics	-12.7%
286	Industrial Organic Chemicals	-18.6%
281	Industrial Inorganic Chemicals	-23.5%
386	Photographic Equipment & Supplies	-25.5%
372	Aircraft & Parts	-25.8%
291	Petroleum Refining	-26.5%
381	Search & Navigation Equipment	-37.0%
348	Ordnance & Accessories	-41.1%
376	Guided Missiles	-48.0%

Data from The Bureau of Labor Statistics - National Employment, Hours, and Earnings -
<http://data.bls.gov/labjava/outside.jsp?survey=ee>

Table A - 5

Wisconsin Annual High-Tech Industry Wages, 1999

Average Annual Wage for all industries for WI: \$29,607

SIC Code	Industry	1999 Average Annual Wage	Percent of Average Annual Wage	Wage Level
284	Soaps, Cleaners, & Toilet Goods	\$66,582		
384	Medical Equipment, Instruments, & Supplies	\$60,377	200%	\$59,214
381	Search & Navigation Equipment	\$57,993		
371	Motor Vehicles & Equipment	\$51,996		
737	Computer & Data Processing Services	\$51,985		
291	Petroleum Refining	\$47,937		
289	Miscellaneous Chemical Products	\$47,598		
351	Engines & Turbines	\$47,555		
871	Engineering & Architectural Services	\$46,845		
281	Industrial Inorganic Chemicals	\$45,505		
874	Management & Public Relations Services	\$44,499		
355	Special Industrial Machinery	\$44,454	150%	\$44,419
382	Measuring & Controlling Devices	\$44,412		
353	Construction & Related Machinery	\$44,119		
283	Drugs	\$43,541		
285	Paint & Allied Products	\$42,993		
362	Electrical Industrial Apparatus	\$41,996		
356	General Industrial Machinery	\$41,668		
286	Industrial Organic Chemicals	\$41,518		
282	Plastics, Materials, & Synthetics	\$41,292	133%	\$39,377
361	Electric Distribution Equipment	\$38,562		
366	Communications Equipment	\$38,256		
357	Computer & Office Equipment	\$36,560		
873	Research, Development, & Testing Services	\$34,171		
372	Aircraft & Parts	\$34,049		
348	Ordnance & Accessories	\$33,109		
287	Agricultural Chemicals	\$30,675		
367	Electronic Components & Accessories	\$29,026		
365	Household Audio & Video Equipment	\$23,207		
386	Photographic Equipment & Supplies	\$22,186		
376	Guided Missiles	\$19,529		

Data from the Bureau of Labor Statistics - Covered Employment & Wages Data Query - <http://data.bls.gov/labjava/outside.jsp?survey=ew>

Table A - 6

U.S. Annual High-Tech Industry Wages, 1999

Average Annual Wage for all U.S. Industries: \$33,244

SIC Code	Industry	1999 Average Annual Wage	Percent of Average Annual Wage	Wage Level
357	Computer & Office Equipment	\$82,853		
283	Drugs	\$74,802		
737	Computer & Data Processing Services	\$73,371		
291	Petroleum Refining	\$72,370	200%	\$66,488
286	Industrial Organic Chemicals	\$65,691		
376	Guided Missiles	\$64,603		
366	Communications Equipment	\$63,928		
381	Search & Navigation Equipment	\$63,120		
281	Industrial Inorganic Chemicals	\$60,471		
386	Photographic Equipment & Supplies	\$57,467		
282	Plastics, Materials, & Synthetics	\$56,591		
287	Agricultural Chemicals	\$55,593		
372	Aircraft & Parts	\$55,179		
874	Management & Public Relations Services	\$55,071		
367	Electronic Components & Accessories	\$54,268		
382	Measuring & Controlling Devices	\$54,087		
284	Soaps, Cleaners, & Toilet Goods	\$53,834		
351	Engines & Turbines	\$53,824		
371	Motor Vehicles & Equipment	\$53,222		
289	Miscellaneous Chemical Products	\$52,874		
871	Engineering & Architectural Services	\$52,382		
873	Research, Development, & Testing Services	\$49,980	150%	\$49,866
384	Medical Equipment, Instruments, & Supplies	\$49,567		
355	Special Industrial Machinery	\$49,273		
365	Household Audio & Video Equipment	\$47,031		
285	Paint & Allied Products	\$45,705	133%	\$44,215
348	Ordnance & Accessories	\$43,711		
353	Construction & Related Machinery	\$43,381		
361	Electric Distribution Equipment	\$43,060		
356	General Industrial Machinery	\$41,588		
362	Electrical Industrial Apparatus	\$40,396		

Data from the Bureau of Labor Statistics - Covered Employment & Wages Data Query -
<http://data.bls.gov/labjava/outside.jsp?survey=ew>

Table A - 7

Wisconsin's High-Tech Occupational Annual Wages, 1999

SOC Code	Occupation	1999 Annual Wage
19-2012	Physicists	\$78,120
11-9041	Engineering Managers	\$70,120
11-3021	Comp/Info systems managers	\$64,390
17-2061	Computer Hardware Engineers	\$63,480
15-1011	Computer and Information Scientists, Research	\$63,350
17-2041	Chemical Engineers	\$62,950
17-2071	Electrical Engineers	\$58,230
15-1031	Computer Software Engineers, Applications	\$57,620
17-2081	Environmental Engineers	\$56,470
15-1032	Computer Software Engineers, Systems Software	\$55,430
19-1042	Medical Scientists, Ex. Epidemiologists	\$55,360
17-2112	Industrial Engineers	\$54,700
17-2131	Materials Engineers	\$53,030
17-2141	Mechanical Engineers	\$52,620
17-2151	Mining & Geological Engineers, Inc. Mining Safety Engineers	\$52,210
15-2041	Statisticians	\$52,070
19-1021	Biochemists and Biophysicists	\$51,170
17-2051	Civil Engineers	\$50,840
15-1051	Computer Systems Analysts	\$49,570
17-2111	Health & Safety Engineers, Ex. Mining Safety Engineers & Inspectors	\$48,550
19-1041	Epidemiologists	\$48,410
15-1021	Computer Programmers	\$48,220
17-2072	Electronics Engineers, Except Computer	\$48,150
19-2042	Geoscientists, Ex. Hydrologists & Geographers	\$47,130
15-1061	Database Administrators	\$47,100
19-2043	Hydrologists	\$46,470
19-1010	Agricultural and Food Scientists	\$46,400
19-2021	Atmospheric and Space Scientists	\$45,580
19-2031	Chemists	\$45,230
15-1071	Network and Computer Systems Administrators	\$44,080
19-1022	Microbiologists	\$44,010
17-3027	Mechanical Engineering Technicians	\$42,220
17-2031	Biomedical Engineers	\$42,200
19-2041	Environmental Scientists and Specialists, Inc. Health	\$42,080
19-1031	Conservation Scientists	\$41,790
15-1081	Network Systems & Data Communications Analysts	\$40,840
17-3024	Electro-Mechanical Technicians	\$39,990
17-3025	Environmental Engineering Technicians	\$39,450
17-3026	Industrial Engineering Technicians	\$38,880
15-1041	Computer Support Specialists	\$37,230
19-1023	Zoologists and Wildlife Biologists	\$37,030
17-3022	Civil Engineering Technicians	\$36,520
17-3023	Electrical and Electronic Engineering Technicians	\$36,490
15-2091	Mathematical Technicians	\$33,440
19-4091	Environmental Science & Protection Technicians, Inc. Health	\$30,080
19-4011	Agricultural and Food Science Technicians	\$28,080
19-4021	Biological Technicians	\$27,220
19-4093	Forest and Conservation Technicians	\$26,750
17-3031	Surveying and Mapping Technicians	\$26,630

Data from U.S. Bureau of Labor Statistics - Occupational Employment Statistics - http://www.bls.gov/oes/oes_dl.htm

Table A - 8

U.S. High-Tech Occupational Annual Wages, 1999

SOC Code	Occupation	1999 Annual Wage
11-9041	Engineering Managers	\$81,560
19-2012	Physicists	\$76,140
11-3021	Comp/Info systems managers	\$74,430
15-1011	Computer and Information Scientists, Research	\$67,180
17-2061	Computer Hardware Engineers	\$66,960
15-1032	Computer Software Engineers, Systems Software	\$66,230
15-1031	Computer Software Engineers, Applications	\$65,780
17-2041	Chemical Engineers	\$64,250
17-2072	Electronics Engineers, Except Computer	\$63,410
17-2151	Mining & Geological Engineers, Inc. Mining Safety Engineers	\$61,900
17-2071	Electrical Engineers	\$61,520
19-2042	Geoscientists, Ex. Hydrologists & Geographers	\$61,000
17-2131	Materials Engineers	\$59,370
15-1051	Computer Systems Analysts	\$57,920
17-2112	Industrial Engineers	\$57,450
17-2081	Environmental Engineers	\$57,050
17-2141	Mechanical Engineers	\$57,010
19-1021	Biochemists and Biophysicists	\$56,170
19-1042	Medical Scientists, Ex. Epidemiologists	\$55,880
15-1081	Network Systems and Data Communications Analysts	\$55,710
17-2051	Civil Engineers	\$55,660
15-1021	Computer Programmers	\$54,960
19-2043	Hydrologists	\$54,620
17-2111	Health & Safety Engineers, Ex. Mining Safety Engineers & Inspectors	\$53,680
19-2021	Atmospheric and Space Scientists	\$53,580
15-1061	Database Administrators	\$52,550
17-2031	Biomedical Engineers	\$52,430
19-2031	Chemists	\$51,580
19-1022	Microbiologists	\$50,690
15-2041	Statisticians	\$50,650
15-1071	Network and Computer Systems Administrators	\$50,090
19-1041	Epidemiologists	\$49,020
19-2041	Environmental Scientists and Specialists, Including Health	\$47,000
19-1031	Conservation Scientists	\$45,310
19-1010	Agricultural and Food Scientists	\$45,110
15-2091	Mathematical Technicians	\$43,710
19-1023	Zoologists and Wildlife Biologists	\$43,400
17-3026	Industrial Engineering Technicians	\$43,320
17-3027	Mechanical Engineering Technicians	\$40,560
15-1041	Computer Support Specialists	\$39,410
17-3023	Electrical and Electronic Engineering Technicians	\$39,390
17-3024	Electro-Mechanical Technicians	\$37,250
17-3022	Civil Engineering Technicians	\$35,270
17-3025	Environmental Engineering Technicians	\$35,060
19-4091	Environmental Science and Protection Technicians, Including Health	\$34,270
19-4021	Biological Technicians	\$32,060
19-4093	Forest and Conservation Technicians	\$29,340
19-4011	Agricultural and Food Science Technicians	\$29,310
17-3031	Surveying and Mapping Technicians	\$29,260

Data from U.S. Bureau of Labor Statistics - Occupational Employment Statistics -
http://www.bls.gov/oes/oes_dl.htm

Table A - 9

**Wisconsin High-Tech Industries Ranked by High-Tech Occupational Concentration,
1998**

SIC Code	Industry	High-Tech Employment	Total Employment	High-Tech Concentration
737	Computer & Data Processing Services	11,229	20,731	54.2%
871	Engineering & Architectural Services	6,240	13,682	45.6%
873	Research, Development, & Testing Services	2,374	5,488	43.3%
381	Search & Navigation Equipment	751	1,749	42.9%
357	Computer & Office Equipment	1,448	5,301	27.3%
382	Measuring & Controlling Devices	1,290	6,080	21.2%
366	Communication Equipment	222	1,064	20.8%
286	Industrial Organic Chemicals	308	1,525	20.2%
289	Miscellaneous Chemical Products	324	1,822	17.8%
361	Electric Distribution Equipment	995	5,910	16.8%
874	Management & Public Relations Services	1,338	8,580	15.6%
362	Electrical Industrial Apparatus	2,559	16,844	15.2%
384	Medical, Equipment, Instruments, & Supplies	1,316	8,746	15.0%
355	Special Industrial Machinery	2,200	14,800	14.9%
282	Plastics, Materials, & Synthetics	123	897	13.7%
285	Paint & Allied Products	253	1,865	13.6%
386	Photographic Equipment & Supplies	24	189	12.6%
367	Electronic Components & Accessories	1,125	9,198	12.2%
356	General Industrial Machinery	1,724	15,505	11.1%
348	Ordnance & Accessories	85	842	10.1%
281	Industrial Inorganic Chemicals	60	622	9.6%
351	Engines & Turbines	1,223	12,873	9.5%
365	Household Audio & Video Equipment	92	1,000	9.2%
353	Construction & Related Machinery	1,052	12,074	8.7%
284	Soaps, Cleaners, & Toilet Goods	344	4,795	7.2%
283	Drugs	159	2,272	7.0%
371	Motor Vehicles & Equipment	1,507	22,985	6.6%
372	Aircraft & Parts	21	474	4.5%
291	Petroleum Refining	5	148	3.1%
Totals		40,389	198,061	20.4%

Total employment data from Wisconsin Department of Workforce Development
 High-tech employment data found assuming equal concentrations of high-tech occupations in
 Wisconsin industries as those for the nation

Table A - 10

U.S. High-Tech Industries Ranked by High-Tech Occupational Concentration, 1998

SIC Code	Industry	High-Tech Employment	Total Employment	High-Tech Concentration
737	Computer & Data Processing Services	855,620	1,662,750	51.5%
871	Engineering & Architectural Services	416,180	929,970	44.8%
381	Search & Navigation Equipment	71,280	161,240	44.2%
357	Computer & Office Equipment	146,910	379,730	38.7%
873	Research, Development, & Testing Services	234,310	620,550	37.8%
366	Communication Equipment	77,330	276,870	27.9%
372	Aircraft & Parts	119,750	525,980	22.8%
367	Electronic Components & Accessories	143,820	643,950	22.3%
382	Measuring & Controlling Devices	66,890	299,680	22.3%
283	Drugs	62,220	279,540	22.3%
286	Industrial Organic Chemicals	29,440	135,090	21.8%
281	Industrial Inorganic Chemicals	21,170	114,820	18.4%
282	Plastics, Materials, & Synthetics	27,170	154,590	17.6%
386	Photographic Equipment & Supplies	13,100	78,080	16.8%
874	Management & Public Relations Services	159,000	1,061,240	15.0%
355	Special Industrial Machinery	25,090	173,410	14.5%
289	Miscellaneous Chemical Products	13,200	93,920	14.1%
285	Paint & Allied Products	6,850	51,840	13.2%
291	Petroleum Refining	12,260	93,590	13.1%
384	Medical, Equipment, Instruments, & Supplies	36,760	281,510	13.1%
351	Engines & Turbines	10,640	82,360	12.9%
365	Household Audio & Video Equipment	10,420	82,000	12.7%
348	Ordnance & Accessories	5,120	40,880	12.5%
361	Electric Distribution Equipment	9,390	80,860	11.6%
362	Electrical Industrial Apparatus	16,660	152,240	10.9%
356	General Industrial Machinery	25,540	265,220	9.6%
284	Soaps, Cleaners, & Toilet Goods	14,720	156,600	9.4%
371	Motor Vehicles & Equipment	90,630	1,021,290	8.9%
353	Construction & Related Machinery	19,330	251,540	7.7%
Totals		2,740,800	10,151,340	27.0%

Employment data from U.S. Bureau of Labor Statistics - Occupational Employment Statistics -
1998 OES National 3-digit Industry Estimates - http://www.bls.gov/oes/oes_dl.htm

Table A - 11

Wisconsin's High-Tech Industry Employment, 1999

SIC Code	Industry	1999 Employment
737	Computer & Data Processing Services	26,581
371	Motor Vehicles & Equipment	22,269
362	Electrical Industrial Apparatus	16,300
356	General Industrial Machinery	15,034
871	Engineering & Architectural Services	13,941
355	Special Industrial Machinery	13,498
351	Engines & Turbines	12,682
353	Construction & Related Machinery	11,598
367	Electronic Components & Accessories	10,384
874	Management & Public Relations Services	8,678
384	Medical Equipment, Instruments, & Supplies	8,478
382	Measuring & Controlling Devices	6,905
361	Electric Distribution Equipment	5,666
873	Research, Development, & Testing Services	5,659
284	Soaps, Cleaners, & Toilet Goods	4,795
357	Computer & Office Equipment	4,606
283	Drugs	2,311
285	Paint & Allied Products	1,862
289	Miscellaneous Chemical Products	1,800
381	Search & Navigation Equipment	1,643
286	Industrial Organic Chemicals	1,434
366	Communications Equipment	998
365	Household Audio & Video Equipment	911
287	Agricultural Chemicals	901
282	Plastics, Materials, & Synthetics	895
348	Ordnance & Accessories	781
372	Aircraft & Parts	723
281	Industrial Inorganic Chemicals	613
386	Photographic Equipment & Supplies	238
291	Petroleum Refining	190
376	Guided Missiles	***

Data from Wisconsin Division of Workforce Excellence - Tables 209,210,211 of issues #54-62

***Data undisclosable due to confidentiality restrictions

Table A - 12

U.S. High-Tech Industry Employment, 1999

SIC Code	Industry	1999 Employment
737	Computer & Data Processing Services	1,409
874	Management & Public Relations Services	939
371	Motor Vehicles & Equipment	986
871	Engineering & Architectural Services	865
367	Electronic Components & Accessories	650
873	Research, Development, & Testing Services	588
372	Aircraft & Parts	501
357	Computer & Office Equipment	376
283	Drugs	269
382	Measuring & Controlling Devices	301
384	Medical Equipment, Instruments, & Supplies	276
366	Communications Equipment	277
356	General Industrial Machinery	264
353	Construction & Related Machinery	244
355	Special Industrial Machinery	179
381	Search & Navigation Equipment	161
284	Soaps, Cleaners, & Toilet Goods	156
282	Plastics, Materials, & Synthetics	159
362	Electrical Industrial Apparatus	154
286	Industrial Organic Chemicals	138
281	Industrial Inorganic Chemicals	117
289	Miscellaneous Chemical Products	94
291	Petroleum Refining	98
376	Guided Missiles	91
351	Engines & Turbines	83
361	Electric Distribution Equipment	82
365	Household Audio & Video Equipment	80
386	Photographic Equipment & Supplies	86
287	Agricultural Chemicals	52
285	Paint & Allied Products	52
348	Ordnance & Accessories	43

Data from The Bureau of Labor Statistics - National Employment, Hours, and Earnings -
<http://data.bls.gov/labjava/outside.jsp?survey=ee>
 Employment data is in thousands of employees

Table A - 13

Wisconsin High-Tech Occupational Employment, 1999

SOC Code	Occupation	1999 Employment
15-1041	Computer Support Specialists	9,120
15-1021	Computer Programmers	8,100
17-2141	Mechanical Engineers	6,160
11-3021	Comp/Info systems managers	5,280
15-1051	Computer Systems Analysts	5,140
11-9041	Engineering Managers	4,900
17-2112	Industrial Engineers	4,870
17-2051	Civil Engineers	3,590
17-3023	Electrical and Electronic Engineering Technicians	3,530
17-2071	Electrical Engineers	3,360
15-1071	Network and Computer Systems Administrators	3,300
15-1031	Computer Software Engineers, Applications	2,110
17-3022	Civil Engineering Technicians	2,080
15-1032	Computer Software Engineers, Systems Software	2,030
15-1081	Network Systems & Data Communications Analysts	1,840
17-3031	Surveying and Mapping Technicians	1,650
17-3027	Mechanical Engineering Technicians	1,630
15-1061	Database Administrators	1,460
17-3024	Electro-Mechanical Technicians	1,270
19-4011	Agricultural and Food Science Technicians	1,180
17-3026	Industrial Engineering Technicians	1,140
17-2081	Environmental Engineers	1,100
17-2072	Electronics Engineers, Except Computer	1,050
19-2031	Chemists	1,040
19-2041	Environmental Scientists and Specialists, Inc. Health	920
19-4021	Biological Technicians	750
17-2111	Health & Safety Engineers, Ex. Mining Safety Engineers & Inspectors	690
17-2041	Chemical Engineers	570
17-2131	Materials Engineers	570
19-2043	Hydrologists	490
19-1022	Microbiologists	430
19-1031	Conservation Scientists	430
19-4091	Environmental Science & Protection Technicians, Inc. Health	350
19-4093	Forest and Conservation Technicians	350
19-1023	Zoologists and Wildlife Biologists	250
17-3025	Environmental Engineering Technicians	230
19-1010	Agricultural and Food Scientists	210
15-2041	Statisticians	200
17-2031	Biomedical Engineers	170
19-2042	Geoscientists, Ex. Hydrologists & Geographers	90
19-2012	Physicists	60
19-2021	Atmospheric and Space Scientists	40
19-1041	Epidemiologists	30
17-2061	Computer Hardware Engineers	***
15-1011	Computer and Information Scientists, Research	***
19-1042	Medical Scientists, Ex. Epidemiologists	***
17-2151	Mining & Geological Engineers, Inc. Mining Safety Engineers	***
19-1021	Biochemists and Biophysicists	***
15-2091	Mathematical Technicians	***

Data from The Bureau of Labor Statistics - Occupational Employment Statistics -

http://www.bls.gov/oes/oes_dl.htm

***Estimates not released due to high relative standard error

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U.S. High-Tech Occupational Employment, 1999

SOC Code	Occupation	1999 Employment
15-1021	Computer Programmers	528,600
15-1041	Computer Support Specialists	462,840
15-1051	Computer Systems Analysts	428,210
15-1031	Computer Software Engineers, Applications	287,600
11-3021	Comp/Info systems managers	280,820
11-9041	Engineering Managers	248,210
17-3023	Electrical and Electronic Engineering Technicians	242,160
17-2051	Civil Engineers	209,100
15-1032	Computer Software Engineers, Systems Software	209,030
15-1071	Network and Computer Systems Administrators	204,680
17-2141	Mechanical Engineers	202,910
17-2112	Industrial Engineers	155,910
17-2071	Electrical Engineers	149,210
17-2072	Electronics Engineers, Except Computer	106,830
15-1061	Database Administrators	101,460
15-1081	Network Systems and Data Communications Analysts	98,330
17-3022	Civil Engineering Technicians	91,040
19-2031	Chemists	73,840
17-2061	Computer Hardware Engineers	60,420
17-3027	Mechanical Engineering Technicians	57,560
19-2041	Environmental Scientists and Specialists, Including Health	53,610
17-3026	Industrial Engineering Technicians	51,690
17-2081	Environmental Engineers	51,450
17-3031	Surveying and Mapping Technicians	47,330
17-2111	Health & Safety Engineers, Ex. Mining Safety Engineers & Inspectors	40,470
17-3024	Electro-Mechanical Technicians	40,310
19-4021	Biological Technicians	39,580
17-2041	Chemical Engineers	28,630
15-1011	Computer and Information Scientists, Research	26,280
19-4091	Environmental Science and Protection Technicians, Including Health	26,240
17-2131	Materials Engineers	21,730
19-1042	Medical Scientists, Ex. Epidemiologists	21,200
19-2042	Geoscientists, Ex. Hydrologists & Geographers	20,940
17-3025	Environmental Engineering Technicians	18,640
19-4093	Forest and Conservation Technicians	17,140
19-1022	Microbiologists	15,630
19-4011	Agricultural and Food Science Technicians	15,050
15-2041	Statisticians	14,620
19-1031	Conservation Scientists	12,240
19-1021	Biochemists and Biophysicists	11,810
19-1023	Zoologists and Wildlife Biologists	11,120
19-2012	Physicists	10,290
19-1010	Agricultural and Food Scientists	9,720
19-2021	Atmospheric and Space Scientists	7,170
17-2151	Mining & Geological Engineers, Inc. Mining Safety Engineers	7,160
19-2043	Hydrologists	6,890
17-2031	Biomedical Engineers	6,450
19-1041	Epidemiologists	2,270
15-2091	Mathematical Technicians	1,560

Data from The Bureau of Labor Statistics - Occupational Employment Statistics - http://www.bls.gov/oes/oes_dl.htm