Tri-Cities Index of Innovation and Technology

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Preface

Technology-based industries have led the development of the economy in the state of Washington for many years. The aerospace industry, followed by health-related business and research, and the growth of highly successful software firms in the central Puget Sound area over the last two decades have made a significant impact on the economic base of the state. This impact has been chronicled in a series of annual index reports published by the Washington Technology Center (most recently the *2006 Washington Index of Innovation and Technology*), and a series of benchmarking and impact reports published by the Technology Alliance (most recently *The Economic Impact of Technology-Based Industries in Washington State, 2010*).

In 2001 and 2004, the Economic Development Office of Pacific Northwest National Laboratory published companion reports to the Washington Technology Center Index studies that provided additional information on the Tri-Cities (Kennewick-Richland-Pasco) area of the state, its technology businesses, and important advantages that the Tri-Cities have as places to live and do business. These reports also compared the Tri-Cities area to other technology-based metropolitan areas in the Pacific Northwest and nation along critical dimensions known to be important to technology firms. This report updates the material in these earlier reports, and highlights a growing Tri-Cities metropolitan area that

- has been successful in founding and sustaining technology companies based on physics, chemical engineering, materials science, measurement equipment, information technology, and services;
- has considerable technical and entrepreneurial talent which has led to a significant amount of high-tech industry business growth and employment in the last five years;
- has not yet experienced many of the downsides of growth such as traffic congestion and high cost of living; and
- has overcome one of the two factors that has impeded technology-based economic development – a need for greater local high-bandwidth connectivity – but continues to experience a shortage of local equity capital.

This report is available to read/download online at http://www.pnl.gov/edo/resources/publications.asp. The U.S. Department of Energy funded the research that went into this report.

We hope the information that appears in this report will serve as a useful resource that will help continue to inform technology entrepreneurs and businesses of the attributes of Tri-Cities and surrounding region.

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INTRODUCTION

Innovation and technology are considered by many observers to be key drivers in local economic growth and development for today and for the future. However, to be successful at establishing a local technology industry base, it is important for a community such as the Tri-Cities (Kennewick-Richland-Pasco metropolitan statistical area, encompassing Benton and Franklin counties of Washington) to understand the relationship between the needs of technology companies and the attributes of the community. It is also important for the community to understand how it stacks up against the competition.

This report updates similar reports published in 2001 and 2004 by the Pacific Northwest National Laboratory's Economic Development Office. It provides and discusses a set of indicators that compare the needs of technology firms to key Tri-Cities features. For the most part, the report compares Benton County to other counties and regions, but sometimes includes Franklin County or specific cities when this is more appropriate, or where county data are not available. Some economic data and other indicators that technology companies find important are not always in published form or up-to-date at the local level, and this is especially true in smaller metropolitan areas. Thus, the story is necessarily less complete than at the state or national level, or even when comparing larger metropolitan areas. Where possible, we have directly updated data that appeared in the earlier studies and have included additional economic and social indicators. In some cases we have substituted indicators when data are no longer available or were no longer deemed relevant. As a whole, the indicators provide a picture of a community with considerable strengths as well as a few weaknesses.

Indicator Areas

The indicators in this report are organized into five key areas: innovation, competitiveness, growth, financial capacity, and quality of life. A sixth area that is sometimes reported at the state level, human potential, is more difficult to track at the local level, but some data that indicate the potential of the area have been included under innovation and quality of life.

Innovation

The Tri-Cities area is very innovative, especially for an area of its population size. While not as many new commercial exploitable ideas flow out of science and technology in the Tri-Cities in absolute terms as in the much-larger Puget Sound area, the Tri-Cities area has very respectable new-patent statistics; and high growth rates in its high-technology sector, backed by a high percentage of high-technology output and employment; and a higher percentage of technology occupations than the Seattle area.

Research and development (R&D) is clearly alive and well in the Tri-Cities. Reflecting the historical makeup of the local high-technology sector, most patented innovations are in applications of physics, chemical engineering, and materials sciences rather than computer software and hardware, the mainstay of many other high-technology centers. The Tri-Cities area is also very successful in attracting federal research and development funding and procurements.

Competitiveness

The Tri-Cities are competitive in developing, attracting, and keeping new technology industry, but the area has had to address some disadvantages in order to do so. The recent installation of a modern broadband infrastructure, for example, reduced concerns about the need for local high-bandwidth connection improvements. The business climate is very pro-business, with a long list of business-assistance organizations and significant business incubator capacity. The tax burden is slightly lower locally, but labor costs are higher in certain occupations compared to other key competitor areas.

Growth

While the Tri-Cities have not shown the spectacular growth in high-technology employment and income that the Puget Sound area experienced in the late 1990s, the growth in the number of high-tech industries and employment in the Tri-Cities from 2006-2009 has far outpaced the rest of the state of Washington. This growth has fueled the overall non-farm growth which has also been well ahead the state for most of the decade. Additionally, from September 2009 to September 2010, the Tri-Cities led the nation in over-the-year percentage increase in employment. The Tri-Cities also seem to be emerging from the historical boom-bust cyclic behavior that once depended almost exclusively on employment at the Department of Energy's (DOE's) Hanford Site.

Financial Capacity

As is true to a lesser degree for Washington State as a whole, local financial capacity to bankroll new and innovative businesses is a significant weakness for the Tri-Cities. The area compensates for this weakness by being very assertive with the regional "angel" and venture capital communities and in substituting federal R&D dollars for private investment dollars.

Quality of Life

Because it is not a large metropolitan area and has not become overcrowded, the Tri-Cities has several distinct quality-of-life advantages that it can market when competing with other areas of the country. Among these advantages are a mild, sunny climate and very good air and water quality; very short commute times and comparatively uncrowded roadways; overall low cost of living and very reasonable housing costs; low crime rates; strong public school systems; and easily accessible outdoor recreation opportunities.

Summary Findings

The Tri-Cities rank highly for innovation and entrepreneurial activity and talent, especially compared in per capita terms to much more famous innovation centers. While the vast majority of Washington State's technology employment is found in the Puget Sound area and has grown faster than elsewhere in the state, the Tri-Cities area is actually more technology-oriented in certain key respects and offers several important quality-of-life advantages.

INNOVATION

Table 1. 2010 Best Performing Cities Index for Pacific Northwest Cities

	Best Performing Cities Index[1]	High Tech GDP Location Quotient[2]	
Metropolitan Area, State	**Rank**	**Score**	**Rank**
Kennewick-Richland-Pasco, WA	*5*	*1.56*	*35*
Olympia, WA	36	0.57	173
Seattle-Bellevue-Everett, WA	37	2.58	5
Tacoma, WA	47	0.71	146
Spokane, WA	74	0.76	134
Salem, OR	68	0.81	121
Portland-Vancouver-Beaverton, OR-WA	107	2.11	9
Eugene-Springfield, OR	160	1.02	81
Boise City-Nampa, ID	154	0.98	88

[1]Rank of 200 largest U.S. metropolitan areas based on how well they are creating and sustaining jobs and economic growth. The components include job, wage and salary, and technology growth.

[2]Location Quotient (LQ) is a measure of high-tech concentration (U.S. = 1.0). A metro with an LQ higher than 1.0 is said to be more concentrated than the United States and vice versa.

Source: Milken Institute

Innovation is the most important difference between a technology-based economy and a traditional resource-based economy. A technology economy survives on its ability to produce new products and services that are based on new ideas. A high rate of innovation and dependence on innovation is the primary factor that distinguishes technology companies from more traditional firms.

While there is no single indicator of local innovation capacity, one can begin to make an aggregate assessment based on a number of indicators that are published for local areas.

Indicators:

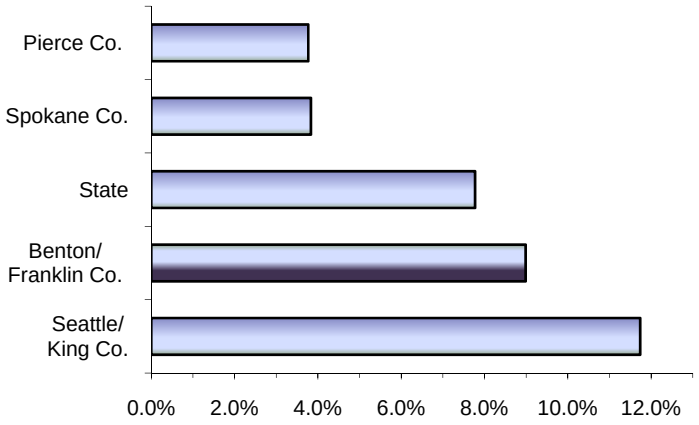
- Technology orientation
- Technology occupations
- Education of the workforce
- Patent generation
- Research and development expenditures

Technology Orientation

Metropolitan areas that have high concentrations of technology-oriented industries offer greater potential for innovative ideas and products. Several organizations publish data and analyses that attempt to rate states and localities on how “technically-oriented” they are. For example, two of the components of the Milkin Institute’s annual ‘Best Performing Cities Index’ are location quotient, which is a measure of high-tech concentration, and high-tech output growth.

How well do the Tri-Cities perform?

The Tri-Cities area is in the top 20% of metropolitan areas of the country in terms of technology orientation, and its high-tech sector output growth ranks in the top 5%. These factors, coupled with a 1-year job growth that ranked #1 in the nation from 2008-2009 and 2009-2010, resulted in the Tri-Cities ranking #5 among the 200 metropolitan areas in the 2010 Best Performing Cities Index.



Source: Washington State Employment Security Department

Figure 1. High-Tech Occupations as % of Total Employment

Table 2. Technology-Based Industry Employment and Wages

2009 High-Tech Industry Totals	Benton/ Franklin Co.	Washington State
Units	406	12,477
Employment	12,519	288,887
Wages (million)	$1,080	$23,951
Average Wage	$86,302	$82,909
2009 High-Tech as a % of Total	**Benton/ Franklin Co.**	**Washington State**
Units	5.5%	6.2%
Employment	11.9%	10.2%
Wages	23.6%	17.8%
Average Wage	197.5%	174.7%

Source: Washington State Employment Security Department

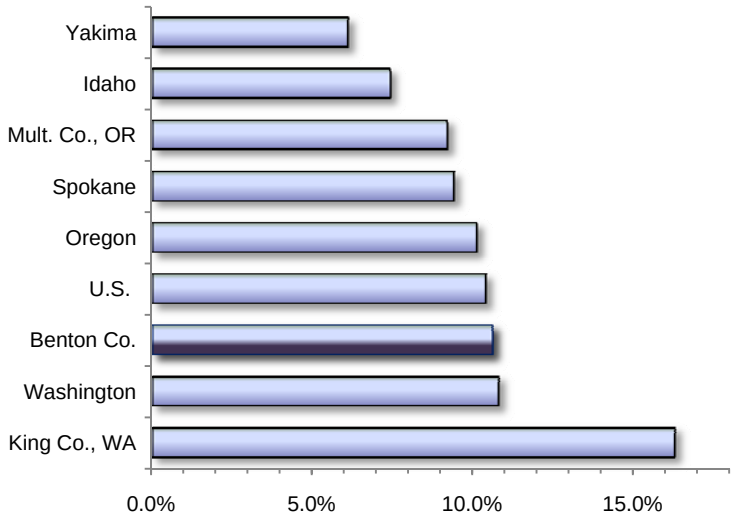
Technology Occupations

A workforce oriented toward technology makes it easier for high-technology companies to start up and develop. A large grouping of such firms makes it easier for high-tech companies to find the services and allies they need to grow and prosper.

How well do the Tri-Cities perform?

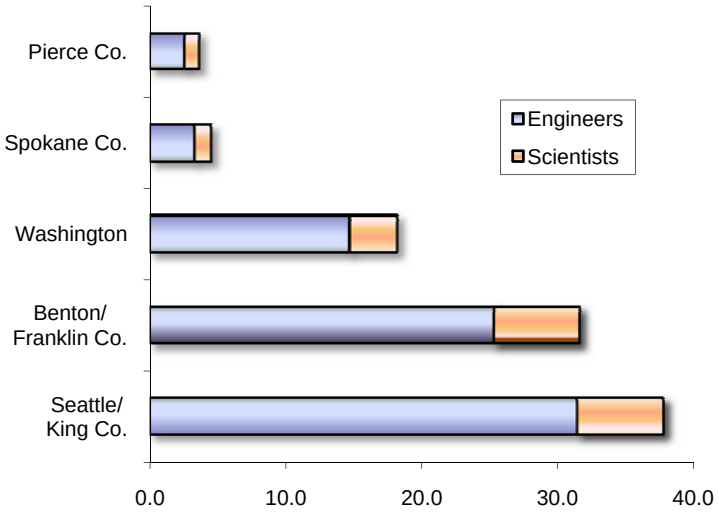
The Tri-Cities area has a greater percentage of its workforce in "technology occupations" (defined in Appendix B) than does Washington State. The Tri-Cities area is not a significant player in the software and internet industries, and therefore lags behind the technology-oriented Seattle/King County area. The Tri-Cities technical strengths are in physics, chemical engineering, materials and instrumentation-related businesses, research and development, engineering services, and advanced agricultural services. In 2009, over 9,800 people were employed in computer, mathematical, architecture, engineering, life science, physical, and social science occupations in Benton and Franklin counties.

When seen from the perspective of technology-based industry (defined in Appendix C), employment, the Tri-Cities have over 400 technology units (establishments) with over 12,500 employees. This is a similar percentage of units in high-technology industries as are found in the technology-dominated Washington State as a whole. However, employment and wages in high-tech industries in Benton and Franklin counties have grown in recent years, and in 2009 were both higher as a percentage of total employment and as a percentage of wages than Washington State as a whole.



Source: U.S. Census Bureau

Figure 2. Percentage of Population with Graduate or Professional Degree, 2006-2008



Source: Washington State Employment Security Department

Figure 3. Scientists and Engineers per 1,000 Population

Education of the Workforce

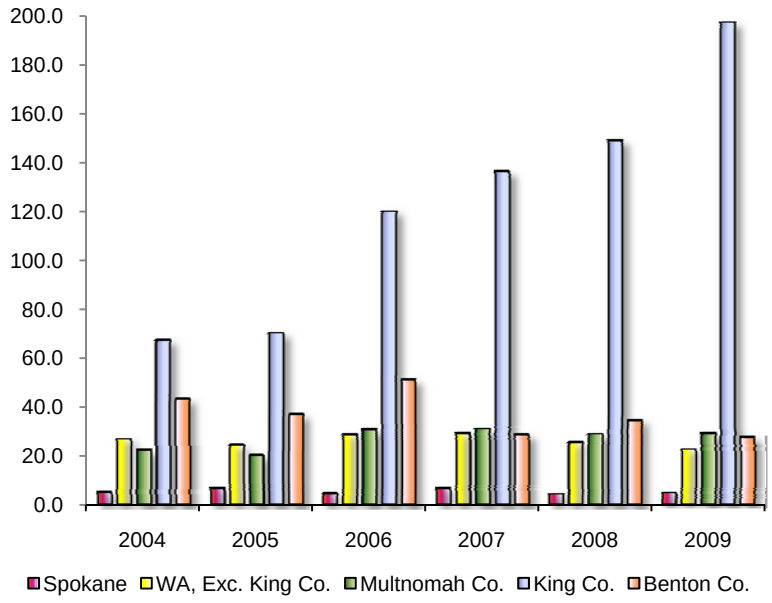
Experts advise that areas successful in the technology-based economy are those that are able to attract smart people. These people generate the ideas on which a high-technology economy runs. In technology-based economies (i.e., metropolitan areas which increasingly specialize in high-skilled, knowledge-based production), future prosperity of local areas stems from an educated and skilled workforce.

How well do the Tri-Cities perform?

On a percentage basis, the Tri-Cities area is ahead of Oregon; Idaho; the rest of the counties in Washington State, except for King County; and the U.S. average in attaining advanced degrees. The Tri-Cities area also places ahead of the rest of the nation in general educational attainment; over 87% of the population of Benton County are high school graduates or higher, as compared to the U.S. average of 84%.

In addition, the Tri-Cities area has far more active scientists and engineers per capita than other areas of Washington State except the Seattle/King County area. In 2009, there were 32 scientists or engineers for every 1,000 people employed in Benton and Franklin counties, which is nearly 80% more than that of Washington State.

The bulk of the engineers employed in the Seattle/King County area were computer software engineers. There were nearly 36,000 computer software engineers employed in 2009, which is over 83% of the computer software engineers in Washington State. Not including computer software engineers, Benton-Franklin counties have the greatest number of engineers per capita in the state.



Source: LexisNexis

Figure 4. Patents per 100,000 Population, 2004-2009

Table 3. Tri-Cities Area Patents by Category, 2004-2009

Patent Category	Number
Class 340, Communications: electrical	27
Class 423, Chemistry of inorganic compounds	25
Class 073, Measuring and testing	24
Class 250, Radiant energy	24
Class 427, Coating processes	12
Class 424, Drug, bio-affecting and body treating compositions	10
Class 422, Chemical apparatus and process disinfecting, deodorizing, preserving, or sterilizing	10
Class 600, Surgery	10
Class 502, Catalyst, solid sorbent, or support therefor: product or process of making	9
Class 060, Power plants	8
Class 356, Optics: measuring and testing	8
Class 532-570 series, Organic compounds	8
Class 702, Data processing: measuring, calibrating, or testing	7
Class 342, Communications: directive radio wave systems and devices (e.g., radar, radio navigation)	7
Class 435, Chemistry: molecular biology and microbiology	7
Subtotal – top 15	**196**
Total Patents	**356**
Top 15 Categories % of Total	**55%**

Source: LexisNexis

Patent Generation

The number of patents generated by a region's companies, universities, and laboratories is a good general indicator of how active the new idea creation process is. These new ideas are the basis for future products and companies. Without a sufficient number of these ideas, technology businesses will not grow as quickly and new businesses will not be founded.

How well do the Tri-Cities perform?

The number of patents granted to inventors in the Tri-Cities (the bulk of which are in Benton County) has fallen since 2006. However, since 2004, Benton County has cumulatively outpaced the rest of the Washington State and the larger metropolitan counties of the Northwest, excluding King County. From 2004 through 2009, Benton County has averaged over 37 patents per 100,000 population, compared to 27 in Multnomah County, Oregon; and 27 across all of Washington State.

In King County, the number of patents granted to the Microsoft Corporation has risen dramatically in the last few years. 3,151 patents were granted to Microsoft in 2009, which accounted for 67% of all patents granted in Washington State.

The top 15 categories of innovation in the Tri-Cities over the last six years have been in the areas of physics, chemical engineering, materials, energy, communications, and measurement devices. Over 50% of all patents were in these categories.

The major patenting organization in the Tri-Cities area is the Pacific Northwest National Laboratory (PNNL), operated by Battelle for the U.S. Department of Energy. PNNL was granted 307 of the 356 patents in the area from 2004-2009. PNNL generates technology ideas, in much the same way major research universities do, and provides much of the intellectual "seed corn" for the growth of new firms.

Other organizations that were granted five or more patents during this time frame include: Infinia Corp., Isoray Medical Inc., Cadwell, Conagra Foods Lamb Weston Inc., and Vista Engineering Technologies.

Table 4. Federal Grants and Procurement Contracts, 2009

	Per Capita	Total Grants and Procurement Contracts (in millions)
Benton County	*$18,805*	*$3,164,840*
King Co., WA (Seattle)	$2,745	$5,260,051
Washington	$1,680	$11,196,224
Multnomah Co., OR (Portland)	$2,186	$1,589,101
Oregon	$879	$3,363,984
Santa Clara Co., CA (Palo Alto, San Jose)	$4,540	$8,103,003
Cambridge, MA	$28,670	$3,118,519
U.S.	$1,987	$610,110,947

Source: U.S. Census Bureau, Consolidated Federal Funds Report

Research and Development Expenditures and Assistance

Companies that generate a large number of ideas provide a "spin-off" effect that has a positive impact on the economy. In addition, large blocks of research expenditures provide opportunities for smaller technology companies to develop. Very little information is available at the local level for private R&D expenditures, but data on federal expenditures are available.

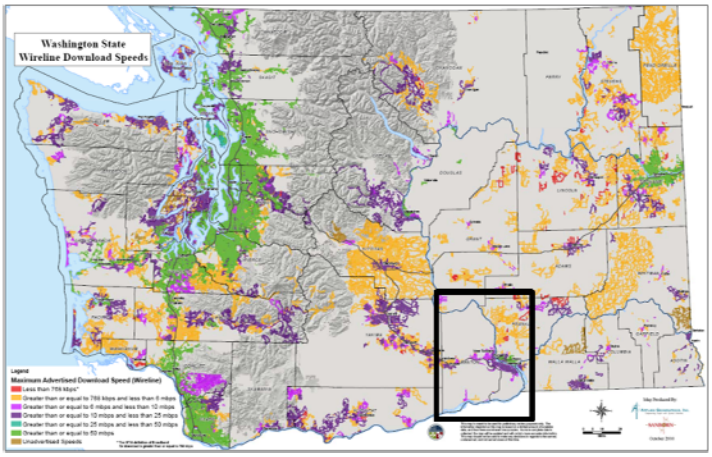
How well do the Tri-Cities perform?

The Tri-Cities attracted over $3 billion in non-defense federal procurement contracts in 2009, up from $2.3 billion in 2002. Most of these funds were directed toward research, development, and science-based operations expenditures at the Hanford Site and PNNL.

These contracts represent a large pool of resources for smaller, specialized technology companies. The Tri-Cities area compares favorably with other technology communities in per capita grants and procurements, especially when it is recognized that the Hanford contractors are generally not eligible to participate in the National Science Foundation (NSF) grants programs. NSF provides a large portion of the federal grants for R&D elsewhere in the nation.

PNNL is the second largest research organization in terms of federal research and development dollars in Washington State, just behind the University of Washington. This statistic represents a huge potential for economic development of the Tri-Cities area which is being steadily fulfilled. PNNL provides technology and entrepreneurial assistance, access to user facilities and equipment, connections to sources of equity capital, and other expertise to help strengthen and diversify the local economy. PNNL has provided free technology assistance to more than 600 small and local firms nationwide in the last 16 years. Of these, at least 240 local companies received more than 17,000 hours of technology assistance by PNNL staff on 440 projects. Over 90 technology companies founded in the Tri-Cities area in the last 45 years have had their technology and/or management roots in PNNL.

COMPETITIVENESS

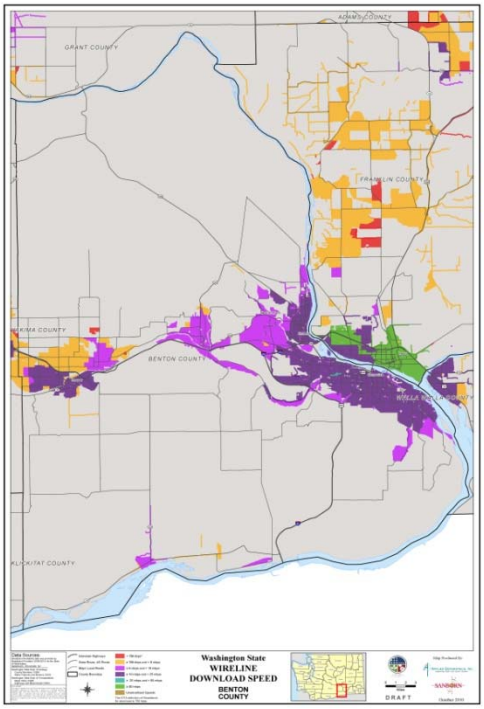


Greater than or equal to 10 mbps

Greater than or equal to 50 mbps

Source: Washington State Department of Information Services

Figure 5. Washington State Wireline Download Speeds



Greater than or equal to 10 mbps

Greater than or equal to 50 mbps

Source: Washington State Department of Information Services

Figure 6. Benton County Wireline Download Speeds

States and regions that are competitive are able to attract the people, businesses, and capital that will help them grow. Continued economic growth depends on this ability to renew and expand the area's talent and resources. Technology infrastructure and services to technology firms enhance competitiveness in the regional, national, and global marketplace. Tax burden and labor costs are costs of doing business that need to be in line with principal competitor regions.

Indicators:

- Technology infrastructure
- Services to technology firms
- Tax burden
- Labor costs

Technology Infrastructure

A modern broadband infrastructure is invaluable for R&D collaboration among institutions and for businesses to connect with regional, national, and global markets.

How well do the Tri-Cities perform?

The Tri-Cities has a newly established state-of-the-art broadband network available for homes and businesses, as well as an expanding network of Wi-Fi wireless hotspots. The Tri-Cities have some of the highest available maximum advertised download speeds (both wireline and wireless) in the state (rivaling the I-5 corridor). The Franklin PUD broadband system, which uses fiber optic cable, makes Pasco one of only a handful of locations that offer download speeds equal to or greater than 1 gigabyte per second.

A broadband initiative is currently underway to extend high-speed broadband service to nearly every unserved area of the state. The planned construction of more than 1,300 miles of new fiber will enhance connectivity and help attract economic investment to the rural areas of Benton, Franklin, and neighboring counties.

Table 5. Business Assistance Organizations

Alphabetical List of Tri-Cities Area Business Assistance Organizations
Applied Process Engineering Laboratory
Benton-Franklin Council of Governments
City of Benton City
City of Kennewick
City of Pasco, Department of Community Development
City of Richland - Economic Development Office
City of West Richland
Columbia Basin College
Economic Development Office, Pacific Northwest National Laboratory
Franklin County Public Utility District
Greater Pasco Area Chamber of Commerce
Hanford Area Economic Investment Fund Committee
Hanford Technical Library, PNNL
Kennewick Irrigation District
Service Corp of Retired (and non-retired) Executives
Pasco Downtown Development Association
Port of Benton
Port of Kennewick
Port of Pasco
Procurement Technical Assistance Center
Prosser Economic Development Association
Public Utility District No. 1 of Benton County
Sirti
Small Business Development Center Columbia Basin College
Tri-Cities Research District
Tri-Cities Visitor and Convention Bureau
Tri-City Development Council
Tri-City Regional Chamber of Commerce
Volpentest HAMMER Training and Education Center
Washington Innovation Assessment Center in Pullman
Washington Manufacturing Services
Washington State University Tri-Cities
Washington Technology Center
WorkSource Columbia Basin
Yakima Valley Entrepreneur Network

Source: Economic Development Office, Pacific Northwest National Laboratory

Services to Technology Firms

Economic development experts advise governments to "foster an innovative business climate." Governments are advised to recognize and celebrate innovation and support the formation of high-tech business councils to encourage networking and learning. They are generally advised to reinvent and streamline land processes to have a smoothly functioning real estate market. Governments that succeed in the technology-based economy also encourage public and private partnerships. Successful governments in a technology-based economy form strategic visioning and managing partnerships across local government boundaries, with all the key players in a region (private sector, universities, labor, and community organizations).

Some services critical to young technology companies are often found in business "incubators," which may provide building space, access to communications, financing, management expertise, and many other forms of assistance.

How well do the Tri-Cities perform?

Local government and industries partner to provide management, regulatory, and financial assistance to startups. The Tri-Cities' particular technical strengths are in physics; chemical process; materials and instrumentation-related businesses; research, development, and engineering services; and advanced agricultural services. The Tri-Cities area has nearly three dozen organizations and government partnerships that assist in economic development. These organizations include the Economic Development Office at PNNL, the Tri-Cities Development Council (TRIDEC), and organizations of local city and county governments, port districts, etc. Additionally several of these organizations provide incubator facilities.

Tri-Citians serve on boards of directors of all state-wide technology-based economic development associations.

Tax Burden

The level of business and personal taxes can influence business location and operations decisions and recruitment practices. Washington State has a unique tax structure, featuring a Business and Occupations Tax (B&O Tax) on gross sales and no personal or corporate income tax. Due largely to the absence of certain taxes, the state's "tax climate" index is ranked 9th best in the country by the Tax Foundation. The portion of state and local taxes paid by Washington businesses (15th highest in the nation) and overall state tax burden per capita (19th highest in the nation) are the highest of the states in the Northwest, however these figures have improved since 2003, from 10th and 12th respectively.

Washington State allows a credit against the B&O tax for high-technology businesses that perform research and development in specific high-technology areas. State law also provides for a sales/use tax deferral for expenditures by certain high-technology firms on new R&D or pilot scale manufacturing operations, or expenditures to expand or diversify a current operation by expanding, renovating, or equipping an existing facility.

How well do the Tri-Cities perform?

The Tri-Cities have minimal control over Washington State's tax structure. However, the local property tax and sales tax burden is lower than other areas of the state and region.

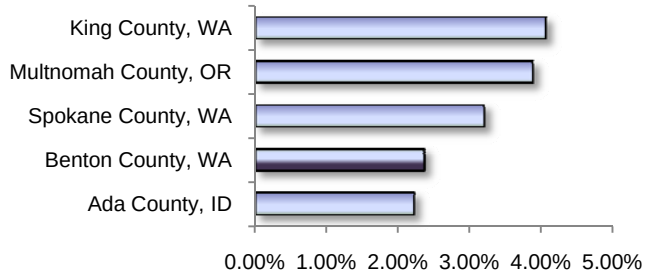
The 2009 property tax rate for Benton County ($11.54/$1000) was among the highest in the state (e.g., $8.81 in King County; $9.41 State average), but on the basis of property taxes as a percentage of median income, Benton County ranks among the lowest in the region, owing to the area's favorable ratio of income to property values.

The 2009 combined sales and use tax rate of 8.3% in the Tri-Cities is more than a percentage point lower than the Seattle area, and is one of the lowest of the incorporated areas in Washington State.

Table 6. State Government Tax Rankings 2009

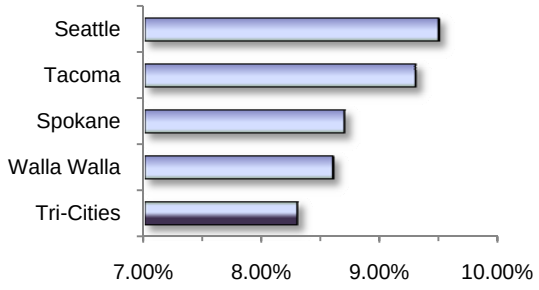
State Per Capita Tax Collections[1]	WA	OR	ID	Nation
Property Taxes	$268	$6	$0	$43
Sales & Gross Receipts	1,967	195	1,018	1,115
Licenses	139	222	174	162
Individual Income	0	1421	761	801
Corporate Net Income	0	68	92	131
Other	88	29	7	77
Total Tax Collections	$2,462	$1,941	$2,052	$2,329
Rank	*19*	*42*	*40*	
Business Taxes	**WA**	**OR**	**ID**	**Nation**
Tax Climate Index[2]	5.81	5.59	5.21	5.00
(Note: higher scores = more favorable for business)				
Rank	*9*	*14*	*18*	
Business Share of all Taxes[3]	51%	37%	41%	45%
Rank	*15*	*48*	*38*	
Business Taxes Percent of Private Economic Activity[3]	5.30%	3.50%	4.20%	4.70%
Rank	*15*	*50*	*37*	

Sources: [1]U.S. Census Bureau; [2]Tax Foundation; [3]Ernst & Young



Source: Tax Foundation

Figure 7. Property Taxes Paid as a Percentage of Median Income, 2009



Source: Washington State Department of Revenue

Figure 8. Washington State Sales Tax Rates, 2009

Table 7. Ranking of Mean Annual Wages, Total All Occupations, 2010

Metropolitan Statistical Areas	Annual Wage	Rank
Washington State	$48,329	-
Seattle-Bellevue-Everett	$53,867	1
Portland-Vancouver, OR-WA	$46,619	2
Kennewick-Richland -Pasco	*$46,487*	*4*
Tacoma	$45,006	6
Spokane	$41,493	10
Wenatchee	$38,205	14
Yakima	$37,569	16

Source: Washington State Employment Security Department

Table 8. Mean Annual Wages, Selected Technical Occupations, 2010

Occupation	Kennewick-Richland-Pasco MSA	Seattle-Bellevue-Everett MSA	Washington State
Civil Engineers	$88,824	$84,202	$81,411
Computer and Info. Systems Managers	$135,013	$137,047	$127,452
Computer Software Engineers, Applications	$101,966	$96,022	$94,484
Computer Support Specialists	$47,599	$52,843	$50,067
Computer Systems Analysts	$77,407	$87,361	$84,697
Electrical & Electronic Engineering Technicians	$65,520	$55,945	$56,754
Electrical Engineers	$89,533	$88,440	$87,223
Engineering Managers	$128,460	$132,199	$126,343
Env. Scientists and Specialists, Incl. Health	$88,827	$70,245	$69,508
Graphic Designers	$44,286	$54,189	$50,048
Life, Physical, and Social Sciences	$76,029	$73,683	$67,803
Natural Sciences Managers	$142,835	$135,628	$119,881

Source: Washington State Employment Security Department

Labor Costs

Labor costs are usually the largest component of cost for any industry, but particularly for young technology companies. Other things equal, a less-expensive and more productive labor force is attractive to many firms.

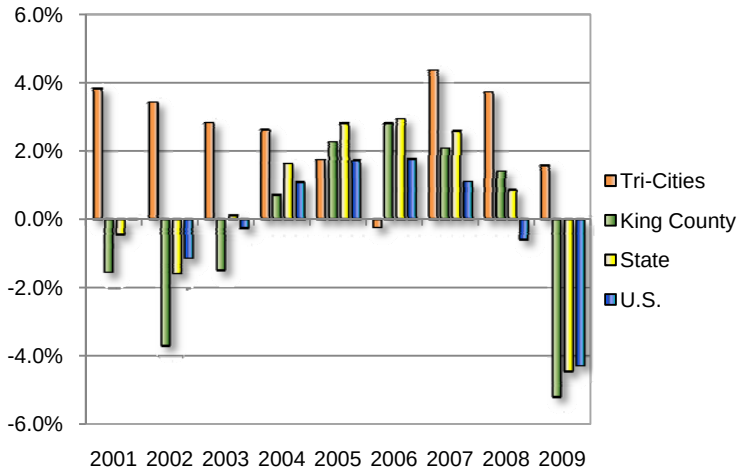
How well do the Tri-Cities perform?

Average annual wages for all occupations in the Tri-Cities area are below the state average and the Portland, Oregon and Seattle metropolitan areas where employers must pay more because of the relatively high cost of living. The Seattle area leads the state in average wages for computer and mathematical occupations with an average annual wage of $89,203, compared to $72,941 in the Tri-Cities (ranked 4th in the state).

However, overall wages in the Tri-Cities are the highest in Eastern Washington, and the Tri-Cities rank first in the state in the occupation categories of architecture and engineering with an average annual wage of $84,726, compared to $81,154 in the Seattle area; and life, physical, and social sciences, with an average annual wage of $76,029, compared to $73,683 in the Seattle area.

The Tri-Cities also ranks high in the occupation categories of management (2nd); business and financial operations (3rd); protective services (3rd); and community and social services (4th).

GROWTH



Source: Washington State Employment Security Department

Figure 9. NonAg Employment Annual Growth, 2001-2009

Table 9. Non-Ag Employment, September 2009-2010

Area	September 2009	September 2010	% change
Kennewick-Richland-Pasco	*96,700*	*102,200*	*5.7*
Yakima	77,700	78,200	0.6
Seattle-Tacoma-Bellevue	1,653,500	1,652,700	0
Spokane	207,700	203,900	-1.8
Washington	**2,812,900**	**2,819,700**	**0.2**
Boise City-Nampa	254,800	250,300	-1.8
Idaho	**615,100**	**614,800**	**0**
Portland-Vancouver-Hillsboro	961,900	950,900	-1.1
Oregon	**1,603,900**	**1,599,100**	**-0.3**

Source: U.S. Department of Labor

Growth is measured both as an increase in available jobs and in the kind of jobs provided. The growth and vitality of individual companies improves the general ambience of the area and provides a ready market for locally produced goods and services. Many areas are concerned not just with the number of jobs created but in the quality of those jobs, with a preference for the so-called "family wage" jobs.

Indicators:

- Total Employment
- High-technology employment and wages
- Growth in Startups
- Sensitivity to economic downturn

Total Employment

Overall short-term and long-term job growth is an important indicator of the economic health of an area, as most companies want to be located in places that are growing and where they believe their business will have a chance to thrive.

How well do the Tri-Cities perform?

Over the course of the last decade, the Tri-Cities have far outpaced the growth of the rest of the state and have been one of the fastest growing areas in the nation. Since 2001, the non-agricultural employment in the Tri-Cities has grown nearly 3% annually, compared to 0.5% in Washington State. Non-agricultural employment in Benton and Franklin counties has grown from 78,400 in 2001 to 95,600 in 2009.

According to the U.S. Department of Labor, the Tri-Cities experienced the highest average monthly over-the-year percentage increase in employment in the nation from December 2008 to December 2009, and were one of only a handful of U.S. metropolitan areas to have any growth at all. This growth has continued into 2010; the Tri-Cities led the United States in over-the-year increase in September while most of the nation and the Northwest region continued to experience declines.

Table 10. High-Technology Industry Growth 2006-2009

	Benton/ Franklin Co.		Washington State	
	High-tech	**Total**	**High-tech**	**Total**
2006				
Units	354	6,491	10,871	192,055
Employment	11,137	94,070	308,980	2,850,892
Avg. Annual Wage	$78,070	$38,741	$85,977	$42,888
2009				
Units	406	7,409	12,477	202,595
Employment	12,519	104,948	288,887	2,837,136
Avg. Annual Wage	$86,302	$43,698	$82,909	$47,458
2006-2009 % Change				
Units	14.7%	14.1%	14.8%	5.5%
Employment	12.4%	11.6%	-6.5%	-0.5%
Avg. Annual Wage	10.5%	12.8%	-3.6%	10.7%

Source: Washington State Employment Security Department

High-Technology Employment and Wages

Employment in technology firms has been a key indicator for the growth of Washington State's economy during the last 30 years and has offset cycles in airframe manufacture, agriculture, pulp and paper and wood products, primary metals, and agriculture. Employment in these industries is an indicator of how large and healthy these industries are.

How well do the Tri-Cities perform?

Although the majority of the high-technology firms in the Tri-Cities are still relatively small, a few have reached 100 to 200 employees. The growth of many of these firms has been rapid, as reflected in the growing employment and payrolls in Tri-Cities high-tech units compared with Washington State.

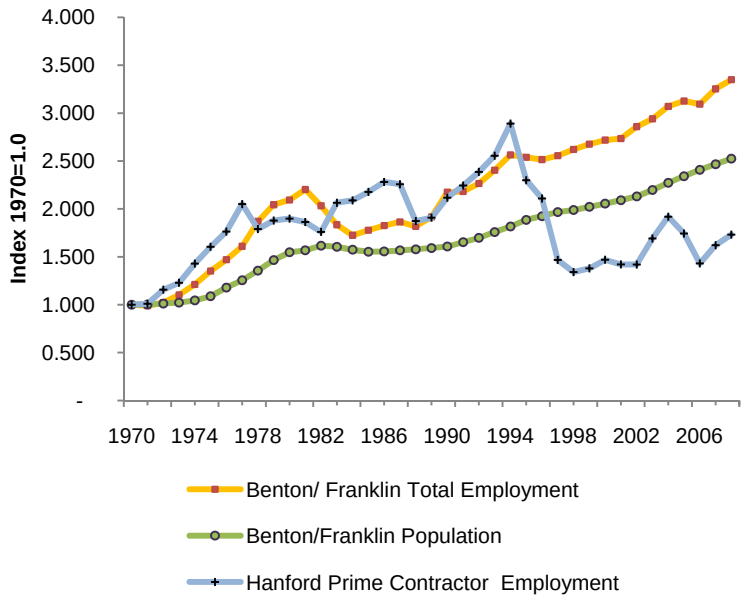
Growth in Startups

Small companies have the potential to provide a majority of job growth. Rapid job growth in startup companies can significantly affect the overall increase in employment for the state. This measure also reflects the extent to which local entrepreneurs have an effect on the overall economy.

How well do the Tri-Cities perform?

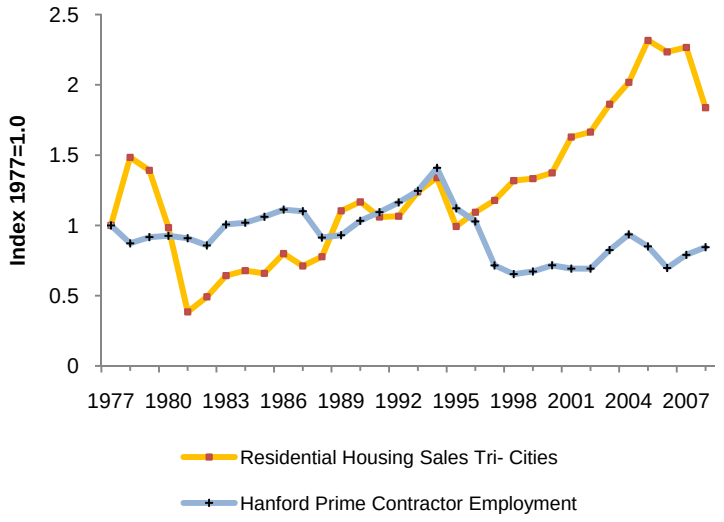
Local technology startups are still a very small part of the local Tri-Cities economy, but are rapidly growing in importance. The various services provided to startups and technical assistance from DOE and PNNL have helped foster this growth.

It is difficult to track startups and fast-growing "gazelle" companies in areas as small as the Tri-Cities because of disclosure issues in government-sourced data. However, dozens of new technology-oriented companies have been started in or attracted to the Tri-Cities area since the mid-1990s, and nearly all of them continue to grow and prosper.



Source: Pacific Northwest National Laboratory

Figure 10. Hanford and Tri-Cities Employment and Population Indexes, 1970 to 2008



Source: Pacific Northwest National Laboratory

Figure 11. Hanford and Tri-Cities Residential Housing Sales Indexes, 1977 to 2008

Sensitivity to Economic Downturn

Washington State's major industries historically have been sensitive to business cycles. For example, the Boeing recession of the early 1970s severely affected the economy of the Seattle area and similar impacts were felt in both aircraft and technology firms in the early 2000 period, while business cycles in construction and wood products in particular have adversely affected many of the state's smaller communities. Understanding the sensitivity of technology firms to business cycles provides some forewarning about future economic difficulties.

How well do the Tri-Cities perform?

Although grouped around energy production and defense activities funded with federal dollars, the Tri-Cities economy has also shown a marked cyclical sensitivity. Diversification of the local economy is one way to mitigate such cycles. Signs of diversity have developed in the Tri-Cities the last 15 years.

Historically, the Tri-Cities area economy has been driven by budget cycles at the DOE, rather than the U.S. economy. However, since the mid-1990s, the Tri-Cities economy has become increasingly independent of Hanford; area employment, total income, population, and residential real estate sales and building permits have increased significantly despite very few changes in Hanford employment levels.

A portion of the growth the Tri-Cities has experienced in the last two years can be attributed to stimulus funding received by Hanford contractors. However, there has also been strong growth in the food processing industry, manufacturing, and health care sectors.

This growth is a sign of increased maturity and depth of the local economy. It is not yet clear how dependent local technology firms may be on continued DOE budgets.

FINANCIAL CAPACITY

Table 11. Financial Support Resources

Alphabetical List of Tri-Cities Area Financial Support Resources for Technology Businesses
Business and Industry Loan Guarantee Program
Columbia Regional Economic Development Trust (CREDIT)
Community Development Block Grants
Community Economic Revitalization Board (CERB)
Electrical Infrastructure Financing (Franklin PUD)
Enterprise Cascadia
Facility Rent Programs (Port Districts)
Hanford Area Economic Investment Fund
Regional Revolving Loan Fund
RTD Grants (Washington Technology Center)
Rural Business Enterprise Grants
Rural Business Opportunity Grants
Rural Economic Development Loan and Grant Program
SBIR Grants
Sirti Technology Growth Fund
Southeastern Washington Development Association (SWDA)
Spokane Angel Alliance
Tax Exempt Economic Development Bonds
US SBA 504 Loans
US SBA 7(a) Loans
Washington Department of Commerce
Washington Economic Development Finance Authority

Source: Economic Development Office, Pacific Northwest National Laboratory

Financial capacity is the ability of local firms to grow by attracting local capital investment. Ready access to capital is one of the most important success factors for technology companies, since they often make relatively large front-end investments. Especially in the technology sectors, strong capital backing is needed to ensure that new ideas can be translated into new products.

Indicators:

Both private (venture capital) and public (state and federal) sources of technology capital are important to measure financial capacity. Some indicators that are usually used include:

- Regional Venture Investment
- Growth in Venture Investment
- Distribution of Venture Investment
- Small Business Innovation Research (SBIR) Program Awards

Venture Investment

There is frequently a strong geographic tie between capital investment and management guidance, and between a company and its investors. Thus, when a local company can attract local capital, it has a much higher chance of remaining in the locality.

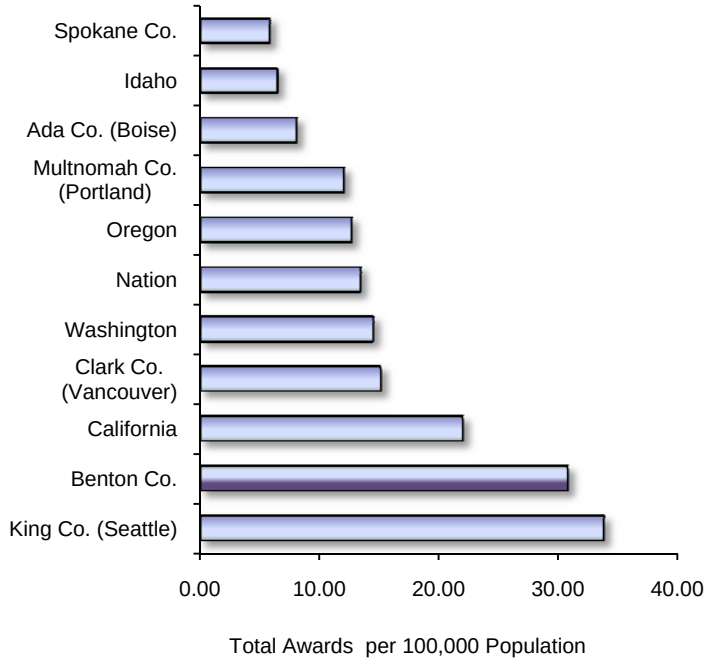
How well do the Tri-Cities perform?

Lack of local private capital sources is a fundamental problem in the Tri-Cities. As the overall Washington State capital markets grow, this will become less of a constraint on growth, but for now entrepreneurs have to show considerable ingenuity and persistence to attract capital investment. Tri-Cities entrepreneurs aggressively pursue the funding that is available in the Pacific Northwest. Organizations such as the Northwest Entrepreneur Network, Alliance of Angels, and the Washington Technology Industry Association are useful in helping to identify local and out-of-area funding sources.

Table 12. SBIR Awards, 2003-2009

Area	No. of Awards	Total Dollars (1,000)
Benton Co.	*52*	*$13,860*
Spokane Co.	27	$9,231
Clark Co. (Vancouver)	52	$15,161
King Co. (Seattle)	645	$242,363
Washington	964	$330,355
Multnomah Co. (Portland)	87	$31,306
Oregon	484	$180,337
Ada Co. (Boise)	31	$7,616
Idaho	99	$24,104
California	8025	$2,593,366
Nation	40748	$12,857,327

Source: U.S. Small Business Administration TECH-Net



Source: U.S. Small Business Administration TECH-Net

Figure 12. SBIR Awards per 100,000 Population, 2003-2009

Local private investment in the Pacific Northwest has grown in the last few years, but still lags behind other technology regions of the country. PricewaterhouseCooper's "Money Tree" reports rank the Pacific Northwest, 7th out of 19 technology growth regions in the number of venture investment deals in 2009 (up from 9th in 2003), and 8th in total private venture investment (up from 11th in 2003). The $728 million invested in 2009 is one-tenth the amount invested in the Silicon Valley region. The Tri-Cities have a very small (unreported) share of the venture investment dollars in the Northwest.

SBIR Program Awards

The ability of small businesses to attract competitive research money is an indicator of the research competence and relevance of these firms to the federal sector. One indicator is the awards of the Small Business Innovative Research (SBIR) Program from the various federal agencies.

How well do the Tri-Cities perform?

Washington companies have been active in the SBIR program this decade. Washington State ranked 12th in the nation in total awards, with nearly 1,000 grants awarded; and 10th in total dollar award amounts, bringing in over $330 million from 2003-2009.

Small Tri-Cities area firms were also successful in attracting SBIR money during this period, bringing in nearly $14 million in awards. On a per capita basis, the Tri-Cities received awards at a rate higher than state and county averages (except for King County) of the Pacific Northwest and the nation.

The Tri-Cities area received 30.72 SBIR awards per 100,000 population, which was twice the rate in Washington State. The Tri-Cities per capita rate was 40% higher than California, the most successful state overall in obtaining SBIR grants, which received only 21.94 awards per 100,000 population.

QUALITY OF LIFE

Table 13. Climate and Air Quality

	Tri-Cities	Boise	Portland	Seattle	Spokane	U.S.
Rainfall (in.)	7	12	36	36	18	37
Snowfall (in.)	13	21	6	7	50	25
Precipitation Days	71	88	154	155	89	100
Sunny Days (less than .8 avg. sky cover)	196	206	144	152	171	205
Avg. Temp - July High	90	90	79	75	86	87
Avg. Temp - Jan. Low	26	22	37	37	24	21
EPA Air Quality Index (% days ranked 'good')	92	79	85	83	89	92

Source: Sperling's Best Places; WeatherReports.com; U.S. EPA

A pleasant physical and social environment is important to technology workers. These factors are important both in attracting and retaining qualified individuals. Technology economy authorities advise metropolitan areas to "create a great quality of life." To make a region more attractive to knowledge workers, metropolitan areas need to take steps to boost forward-looking amenities like outdoor recreation facilities, quality schools, and intelligent transportation systems. To gauge the quality of life in the Tri-Cities, we quantify some of the non-economic factors that make life enjoyable for residents and attract others to the area.

Indicators:

- Climate
- Air and Water Quality
- Local Transportation
- Cost of Living
- Crime Rates
- Quality of Schools
- Leisure Activities

Climate

Workers tend to prefer warm climates with low precipitation and with considerable sun.

How well do the Tri-Cities perform?

The Tri-Cities area has a sunny, dry climate with warm-to-hot summers and mild winters. The area does not experience the high summer humidity or cold winters that characterize most of the eastern U.S. It also avoids much of the heavy cloud cover that characterizes many Pacific Northwest locations. Cloud cover in the Tri-Cities is largely confined to the period from mid-November to early February, with May-October mostly clear.

Air and Water Quality

Superior air and water quality is an important feature that attracts technology workers into an area.

How well do the Tri-Cities perform?

The Tri-Cities' air and water quality compares favorably, and in some cases better than the larger metropolitan areas of the Pacific Northwest.

Local Transportation

As is true in most small metropolitan areas, traveling to work, shopping, entertainment, and other activities is primarily done by car. Ease of commute and low traffic congestion levels are an important aspect of quality of life. Access to major metropolitan areas is also important, especially for senior management and sales staff of high-technology companies.

How well do the Tri-Cities perform?

As reflected in average commuting delays, traffic congestion is practically non-existent in the Tri-Cities. As compared with Seattle or Portland metropolitan areas, the typical driver spends far less time on the road to accomplish the same work commute. The average commuting time in the Tri-Cities area is about 21 minutes and involves less than 12 minutes delay (round trip) for peak-hour Hanford workers due to traffic.

Use of mass transit is much lower than larger cities; however, the Tri-Cities area does have a quality bus-based public transportation system with reasonably frequent service that averages over 3 million boardings annually, as well as vanpool and transportation assistance such as Dial-a-Ride.

Four commercial air carriers with over 250,000 enplanements per year offer direct flights to many of the major cities in the western half of the U.S. The Tri-Cities area is also served by two major railroads and has five port facilities on the Columbia-Snake River barge system.

Table 14. Local Transportation Commute

	Tri-Cities	Seattle	Portland	San Jose	Los Angeles	U.S.
Commute Time						
Average Minutes	20.6	27.1	25.3	30.6	31.8	27.8
Commute Less Than 15 min.	44%	22%	25%	17%	19%	29%
Commute 15 to 29 min.	37%	43%	46%	40%	36%	36%
Commute 30 to 44 min.	11%	24%	19%	26%	26%	19%
Commute 45 to 59 min.	5%	7%	5%	9%	9%	8%
Commute greater than 60 min.	3%	5%	5%	8%	11%	8%
Commute Mode						
Auto (alone)	81%	56%	63%	76%	65%	76%
Carpool	11%	11%	12%	14%	15%	12%
Mass Transit	1%	18%	12%	4%	10%	4%
Work at Home	4%	5%	4%	2%	4%	3%
Congestion						
Annual Hours of Delay per Traveler	3	37	43	53	70	36
Percent of Peak Period Travel that is Congested	25%	68%	66%	81%	86%	55%

Source: Sperling's Best Places; Texas Transportation Institute

Cost of Living

High costs of living mean that workers must work longer hours and employers must pay higher wages to support an equivalent lifestyle. Larger metropolitan areas typically have higher costs of living (especially housing). Smaller metropolitan areas frequently do not show costs that are as high.

How well do the Tri-Cities perform?

The Tri-Cities area has the lowest cost of living of the major metropolitan areas in Washington State. As of the 2nd Quarter of 2010, the relative price levels for groceries, housing, utilities, health care, and transportation in the Tri-Cities were at or near the lowest in the region, and among the lowest in the nation. In 2009, the median home price in Benton County was $166,800, which was less than half of the $380,000 median price of homes in King County, and well below the state median of $250,400. Thanks to low electricity and gas prices and relatively mild weather, utility bill prices in the area are also among the lowest in the nation.

Table 15. Cost of Living

	Composite Index	Grocery Items	Housing	Utilities	Health Care
Washington					
Tri-Cities	*94.5*	*90.5*	*88.8*	*84.9*	*110.9*
Spokane	96	93.7	88.1	90.5	111.4
Yakima	97.6	96.4	88.4	84.8	115.8
Portland-Van., OR-WA	111.6	104	131.9	87.5	113.3
Seattle	119.8	109.3	136.5	86.9	121.9
Other					
Oakland, CA	144	116.2	211.5	95.9	121.3
Reno, NV	100.5	102.8	96.9	90.4	101.1
Los Alamos, NM	108.3	97.1	122.2	89.6	103.6

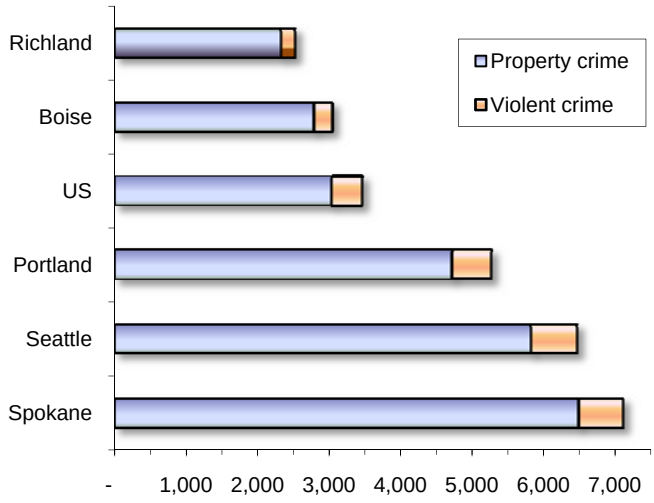
Source: Council for Community and Economic Research ACCRA Cost of Living Index

Crime Rates

Violent crime and property crime are both serious issues in many parts of the United States. If workers are to be attracted to, and retained in, an area, they must believe that they are safe in their homes and at work and that their children are safe in their schools and after-school lives.

How well do the Tri-Cities perform?

Tri-Cities crime rates are very low for a metropolitan area, and there is very little violent crime. This makes the area an exceptionally safe place to live and work.



Source: U.S. FBI

Figure 13. Crimes per 100,000 Population, 2009

Quality of Schools

Experts advise that a strong K-12 school system in an area is important not only because it produces better workers, but also because it is a key amenity in drawing knowledge workers. It is impossible for a city or region to be successful in the technology-based economy over the long run if its schools are failing or even mediocre.

How well do the Tri-Cities perform?

The Tri-Cities public schools do a good job of educating the area's children. Richland 10th graders scored at or above the state average in the math, writing, and science sections of the newly implemented MSP/HSPE exam. Kennewick and Richland scored higher than Seattle schools in most categories, but lagged behind schools in eastern and northern King County.

On-time high school graduation rates in the Richland school district are also above Seattle and Washington State averages, and dropout rates are well below the Washington State average. Graduation rates in Kennewick are behind both the Seattle and Washington State averages, and dropout rates are slightly higher than the Washington State average.

In 2009, The Washington State STEM Education Foundation (WSSEF) was established in the Tri-Cities to develop an innovative curriculum in science, technology, engineering, and math (STEM) designed to help develop students into the next generation of American leaders who understand and solve global challenges. The Foundation maintains and operates an Educational Endowment Fund to support the mission and goals of the organization. Delta High School, which opened in August 2009 in Richland, is the first school created by the Foundation.

Table 16. High School Proficiency Test Scores

Percent of 10th Grade Students Meeting the Washington State Measurements of Student Progress (MSP) / High School Proficiency Exam (HSPE), 2009-2010

	Reading	Math	Writing	Science
Benton County				
Richland	78%	42%	90%	50%
Kennewick	81%	43%	88%	37%
King County				
Seattle	75%	45%	84%	47%
Bellevue	90%	68%	94%	71%
Other				
Spokane	76%	39%	83%	47%
Washington State	79%	42%	86%	45%

Source: Washington State Office of Superintendent of Public Instruction

Table 17. High School Graduation and Dropout Rates, 2008-2009

	On-Time Graduation Rate	Annual Dropout Rate
Benton County		
Richland	76.7%	3.3%
Kennewick	67.8%	5.2%
King County		
Seattle	70.1%	7.1%
Bellevue	87.8%	0.7%
Other		
Spokane	62.1%	7.9%
Washington State	73.5%	5.1%

Source: Washington State Office of Superintendent of Public Instruction

Leisure Activities

Technology workers are interested in an environment with a variety of leisure activities, especially those involving outdoor recreation.

How well do the Tri-Cities perform?

Thanks to its climate, the Tri-Cities area offers a variety of outdoor activities centered on golf; team sports; and river-based recreation, with more than 4 million visitor-days per year to the area's parks, beaches, and marinas. The nearby Hanford Reach National Monument, which was created in 2000, offers over 57,000 acres of hunting, fishing, and hiking opportunities.

Golf opportunities are particularly abundant, with year-round play possible in most years. The Tri-Cities is home to minor-league hockey and baseball franchises and numerous local arts organizations, including a symphony orchestra, and a light opera company.

Known as "The Heart of Washington Wine Country,"® Benton/Franklin counties lead the Pacific Northwest in the number of wineries per capita by far. In 2010, there were 58 wineries in the Tri-Cities area, and more than 160 wineries within 50-mile radius – many of which have tours and tasting rooms available. There are also several farmers markets and historical museums in the area, including the Columbia River Exhibition of History, Science, and Technology (CREHST) museum which received nearly 10,000 visitors in 2009.

Table 18. Selected Outdoor Recreation Opportunities

	Miles of Paved Bike Trails per 100K	Park Acres per 1 K	Boat Ramps, Launch Areas per 1K	Public Golf Holes per 100K
Benton/Franklin counties	*13.2*	*23.0*	*12.8*	*59.5*
King County	9.2	20.3	2.1	28.6
Multnomah Co. (Port OR)	32.4	51.1	2.3	27.9
Ada County (Boise ID)	9.9	9.1	0.8	110.7
Spokane County	8.0	7.5	4.5	58.5

Source: Various local agencies

Table 19. Selected Leisure Opportunities per 100,000 Population

	Farmers Markets	Wineries	Museums
Benton/Franklin counties	*1.65*	*23.97*	*1.65*
King County	0.89	2.88	1.41
Spokane County	0.86	3.01	1.29
Multnomah Co. (Port OR)	1.52	2.21	2.21
Ada County (Boise ID)	0.52	1.56	2.86

Source: Various local agencies

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Appendix A

Summary Comparisons:
Tri-Cities, Seattle, Washington State and the U.S.

Appendix A

Summary Comparisons: Tri-Cities, Seattle, Washington State and the U.S.

The following table summarizes some comparisons between the Tri-Cities and Washington State and/or the Seattle area as a location for high-technology activity.

Indicator	Tri-Cities (Benton County)	Seattle Area (King County)	Washington State	U.S.
Innovation				
Best Performing Cities Index, 2010 (Milken Institute)	206.0 (5th in nation)	420.1 (37th in nation)	--	--
High Tech GDP Location Quotient, 2009 (Milken Institute)	1.56 (35th in nation)	2.58 (5th in nation)	--	1.0
High-Tech Occupations as % of Total Employment, 2009	9.0%	11.7%	7.8%	--
High-Tech Industries as % of Total, 2009	5.5%	--	6.2%	--
% of Population with Graduate or Professional Degree, 2009	10.6%	16.3%	10.8%	10.4%
Scientists and Engineers Per 1000 Population, 2009	31.6	37.8	18.2	--
Patents per 100 Thousand Population, 2009	27.9	197.8	70.5	--
Federal Grants and Procurement Contracts Per Capita, 2009	$18,805	$2,745	$1,680	$1,987
Competitiveness				
Business Share of State Tax Collections	--	--	51% (15th in nation)	45%
Property Tax Rate, 2009	($11.54/$1,000)	($8.81/$1,000)	($9.41/$1,000)	--
Property Taxes Paid as a Percentage of Median Income, 2009	2.35%	4.06%	--	3.03%
Mean Annual Wages, All Occupations, 2010	$46,487	$53,867	--	--
Mean Annual Wages in Technical Occupations, 2010	Above state average for 9 out of 12 occupations	Above state average for 11 out of 12 occupations	--	--
Average Wage in High-Tech Industries, 2009	$86,302	--	$82,909	--
Growth				
Growth in Non-Ag Employment, September 2009-2010	5.70%	0.00%	0.20%	0.45%
Average Annual Growth in Non-Ag Employment, 2001-2009	2.70%	-0.30%	0.50%	-0.10%
Growth in High-Tech Industry Units, 2006-2009	14.70%	--	14.80%	--
Growth in High-Tech Employment, 2006-2009	12.40%	--	-6.50%	--
Growth in High-Tech Average Annual Wages, 2006-2010	10.50%	--	-3.60%	--

Indicator	Tri-Cities (Benton County)	Seattle Area (King County)	Washington State	U.S.
Financial Capacity				
SBIR Awards Per 100,000 population, 2003-2009	$30.71	$33.78	$14.46	$13.39
Quality of Life				
Annual Rainfall (in.)	7.1	35.9	36.9	36.5
EPA Air Quality Index (% days ranked 'good')	92	83	83	82.8
Annual Lost Hours in Commuting Time Due to Congestion	3	37	--	36
Cost of Living Index, 2nd Quarter 2010	94.5	119.8	--	--
Median Home Price, 2009	$166,800	$380,000	$250,400	
Crimes per 100 Thousand Population, 2009	Violent: 196 Property: 2,328	Violent: 641 Property: 5,824	Violent: 331 Property: 3,667	Violent: 429 Property: 3,036
Percent of 10th Grade Students Meeting the Washington State MSP/HSPE, 2009-2010	Math: 42% Science: 50%	Math: 45% Science: 47%	Math: 42% Science: 45%	--
Miles Paved Bike Trails per 100,000 People	13.2	9.2	--	--
Public Golf Holes per 100,000 People	59.5	28.6	--	--

Appendix B

Technology Occupations

Appendix B

Technology Occupations

Technology occupations are occupations considered by the NSF to be R&D intensive.

This report included engineering, scientific and computer related occupations in Standard Occupational Categories (SOC) 15, 17, and 19 as outlined in *The Economic Impact of Technology-Based Industries in Washington State* study published by the Technology Alliance in 2010. The occupations in Washington State meeting this technology-based definition are listed below in the order of their SOC number.

SOC	Title
15-0000	*Computer and Mathematical Occupations*
15-1000	Computer Specialists
15-1011	Computer and Information Scientists, Research
15-1021	Computer Programmers
15-1031	Computer Software Engineers, Applications
15-1032	Computer Software Engineers, Systems Software
15-1041	Computer Support Specialists
15-1051	Computer Systems Analysts
15-1061	Database Administrators
15-1071	Network and Computer Systems Administrators
15-1081	Network Systems and Data Communications Analysts
15-1099	Computer Specialists, All Other
15-2000	Mathematical Scientists
15-2011	Actuaries
15-2021	Mathematicians
15-2031	Operations Research Analysts
15-2041	Statisticians
15-2091	Mathematical Technicians
15-2099	Mathematical Science Occupations, All Other

SOC	Title
17-0000	*Architecture and Engineering Occupations*
17-1000	Architects, Surveyors, and Cartographers
17-1011	Architects, Except Landscape and Naval
17-1012	Landscape Architects
17-1021	Cartographers and Photogrammetrists
17-1022	Surveyors
17-2000	Engineers
17-2011	Aerospace Engineers
17-2021	Agricultural Engineers
17-2031	Biomedical Engineers
17-2041	Chemical Engineers
17-2051	Civil Engineers
17-2061	Computer Hardware Engineers
17-2071	Electrical Engineers
17-2072	Electronics Engineers, Except Computer
17-2081	Environmental Engineers
17-2111	Health and Safety Engineers, Except Mining
17-2112	Industrial Engineers
17-2121	Marine Engineers and Naval Architects
17-2131	Materials Engineers
17-2141	Mechanical Engineers
17-2151	Mining and Geological Engineers, Inc.Safety
17-2161	Nuclear Engineers
17-2171	Petroleum Engineers
17-2199	Engineers, All Other
17-3000	Drafters, Engineering, and Mapping Technicians
17-3011	Architectural and Civil Drafters
17-3012	Electrical and Electronics Drafters
17-3013	Mechanical Drafters
17-3019	Drafters, All Other
17-3021	Aerospace Eng. and Operations Technicians
17-3022	Civil Engineering Technicians
17-3023	Electrical and Electronic Eng. Technicians
17-3024	Electro-Mechanical Technicians
17-3025	Environmental Engineering Technicians
17-3026	Industrial Engineering Technicians
17-3027	Mechanical Engineering Technicians
17-3029	Eng. Technicians, Except Drafters, All Other
17-3031	Surveying and Mapping Technicians

SOC	Title
19-0000	*Life, Physical, and Social Science Occupations*
19-1000	Life Scientists
19-1011	Animal Scientists
19-1012	Food Scientists and Technologists
19-1013	Soil and Plant Scientists
19-1021	Biochemists and Biophysicists
19-1022	Microbiologists
19-1023	Zoologists and Wildlife Biologists
19-1029	Biological Scientists, All Other
19-1031	Conservation Scientists
19-1032	Foresters
19-1041	Epidemiologists
19-1042	Medical Scientists, Except Epidemiologists
19-1099	Life Scientists, All Other
19-2000	Physical Scientists
19-2011	Astronomers
19-2012	Physicists
19-2021	Atmospheric and Space Scientists
19-2031	Chemists
19-2032	Materials Scientists
19-2041	Env. Scientists and Specialists, Including Health
19-2042	Geoscientists, Except Hydrologists and Geographers
19-2043	Hydrologists
19-2099	Physical Scientists, All Other
19-3000	Social Scientists and Related Workers

SOC	Title
19-0000	*Life, Physical, and Social Science Occupations (cont'd)*
19-3011	Economists
19-3021	Market Research Analysts
19-3022	Survey Researchers
19-3031	Clinical, Counseling, and School Psychologists
19-3032	Industrial-Organizational Psychologists
19-3039	Psychologists, All Other
19-3041	Sociologists
19-3051	Urban and Regional Planners
19-3091	Anthropologists and Archeologists
19-3092	Geographers
19-3093	Historians
19-3094	Political Scientists
19-3099	Social Scientists and Related Workers, All Other
19-4000	Life, Physical, and Social Science Technicians
19-4011	Agricultural and Food Science Technicians
19-4021	Biological Technicians
19-4031	Chemical Technicians
19-4041	Geological and Petroleum Technicians
19-4051	Nuclear Technicians
19-4061	Social Science Research Assistants
19-4091	Env. Science and Protection Technicians, Inc. Health
19-4092	Forensic Science Technicians
19-4093	Forest and Conservation Technicians
19-4099	Life, Physical, and Social Sci. Technicians, All Other

Appendix C

Technology-Based Industries in Washington State

Appendix C

Technology-Based Industries in Washington State

Technology industries are industries that employ a high percentage of workers in technology occupations. This report used the definition of 'technology-based industry' that was outlined in *The Economic Impact of Technology-Based Industries in Washington State* study published by the Technology Alliance in 2010, which included industries with total employment of workers in engineering, scientific and computer related occupations (SOC codes beginning with 15, 17, and 19) at percentages greater than 15.62%. The industries in Washington State meeting this technology-based definition are listed below in the order of their North American Industry Classification System (NAICS) number.

NAICS	Industry Description
324	Petroleum and Coal Products Manufacturing
325	Chemical Manufacturing
334	Computer and Electronic Product Manufacturing
335	Electrical Equipment, Appliance, & Component Manufacturing
3361	Motor Vehicle Manufacturing
3364	Aerospace Product and Parts Manufacturing
4234	Professional & Commercial Equipment and Supplies Merchant Wholesalers
4541	Electronic Shopping and Mail-Order Houses
5112	Software Publishers
517	Telecommunications
5182	Data Processing, Hosting, and Related Services
519	Other Information Services
5413	Architectural, Engineering, and Related Services
5415	Computer Systems Design and Related Services
5416	Management, Scientific, and Technical Consulting Services
5417	Scientific Research and Development Services
5511	Management of Companies and Enterprises
5622	Waste Treatment and Disposal
5629	Remediation and Other Waste Management Services

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