

Economic Development Potential of the
MAREA and BRUSA
Undersea Fiber Optic Cables



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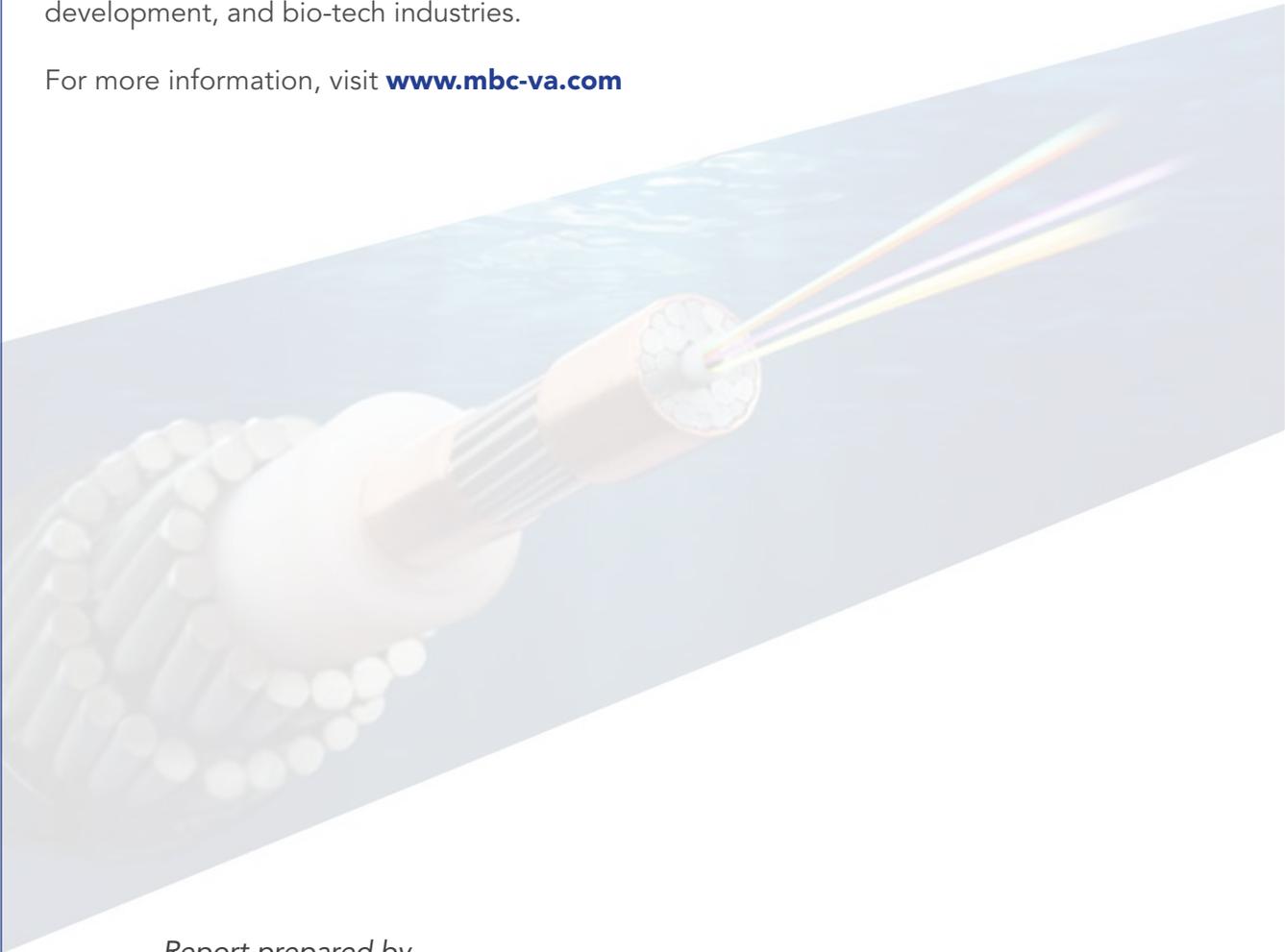


Acknowledgements

ABOUT MID-ATLANTIC BROADBAND COMMUNITIES CORPORATION

Mid-Atlantic Broadband Communities Corporation (MBC) is a non-profit 501(c)(4) organization, committed to providing economic development leadership to Southern Virginia. MBC promotes economic development in Southern Virginia through the operation of a successful advanced open access fiber optic network, providing wholesale telecommunications transport services, colocation and tower leasing. Since its inception in 2004 and by offering a state-of-the art fiber optic network, MBC has supported the recruitment of major investments including data centers, call center/operations centers, advanced manufacturing, research and development, and bio-tech industries.

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EXECUTIVE SUMMARY

Virginia Beach will be the site of at least two international undersea fiber optic cables. The cable referred to as MAREA will link Virginia Beach and Bilbao, Spain and the cable referred to as BRUSA will link Virginia Beach with San Juan, Puerto Rico; Fortaleza, Brazil and Rio de Janeiro, Brazil. (Virginia Beach is also the US landing site of for other planned subsea cables.) The MAREA-BRUSA connection at Virginia Beach makes the Hampton Roads area a top high-speed nexus of the Iberian-Latin American internet. If American entities can cultivate and facilitate increased interactions between Spain, Portugal, Puerto Rico, Brazil and the Latino community in the US, then the cable landing in Virginia Beach, in combination with the Mid-Atlantic Broadband Communities Corporation's (MBC's) extensive fiber network in Southern Virginia, will increase in value to overseas users and facilitate increased regional economic development.

This report provides a detailed assessment of that economic development potential. The principal findings from that assessment are as follows:

1) The new MAREA and BRUSA undersea fiber optic cable landing at Virginia Beach will provide a number of ongoing economic development opportunities to Hampton Roads and Southern Virginia and those opportunities will likely be driven by:

- Foreign and domestic data centers choosing to locate near the new cable landing.
- US businesses that depend on internet traffic with Southern Europe or Brazil.
- Southern European business that depend on internet traffic with the US or Brazil.

2) It is important to understand that economic development in the region will not occur spontaneously because of the presence of the cables:

- The experience of other localities with cable landings shows that undersea internet cables do not in and of themselves create high-tech economies with high-tech jobs.
- Instead, targeted efforts by local and regional economic development agencies will be necessary to maximize the economic opportunities made possible by the cable landings.

3) The industries most likely to be attracted by the MAREA and BRUSA cables comprise a High-Tech Service Industry Cluster. Those industries are:

- Architectural, Engineering, and Related Services
- Business Support Services (e.g., Telephone call centers and Business service centers)
- Computer Systems Design and Related Services
- Data Processing, Hosting, and Related Services
- Electronic Shopping and Mail-Order Houses
- International Trade Financing
- Management of Companies and Enterprises
- Management, Scientific, and Technical Consulting Services
- Other Financial Investment Activities (e.g., Portfolio management)
- Other Information Services (e.g., News syndicates, Internet publishing and broadcasting, and web search portals)
- Scientific Research and Development Services
- Securities and Commodity Contracts Intermediation and Brokerage
- Software Publishers
- Telecommunications

4) To assist MBC in its recruitment efforts we investigated the location of these industries in the contiguous United States by metropolitan statistical area (MSA). Through that analysis, we identified 68 MSAs that had High-Tech Service Industry Cluster industries that exhibited an employment footprint that was two or more times greater than one would expect based on the national norm and paid wages that were higher than the prevailing industry wage in the Virginia Beach-Norfolk-Newport News MSA. A separate spreadsheet accompanying this report provides names and contact information for businesses in those identified industries that have more than 50 employees.

5) The initiation of the MAREA cable connecting Virginia Beach to Bilbao, Spain in the Basque Country comes at a time when the European economy is strengthening and that creates opportunities:

- Virginia economic developers may be able to attract European businesses that already operate in the US or that are interested in expanding to the US.
- European firms doing research in pharmaceuticals and automobile technology have already made major investments in facilities in the US and may be interested in establishing a presence in Southern Virginia.



6) The initial advantages of the BRUSA cable may be limited for economic development:

- Currently, Florida offers the best practical example of the economic development generated as a result of Latin American cable landings. However, the weak economic conditions in Latin America, coupled with the limited amount of fiber in the region and the lack of strong high-tech industries there seem to mean that, to date, the undersea internet cables to Latin America have offered little economic development opportunities for localities in the Florida.
- However, Latin America contains many emerging markets and developing economies. As the region grows and develops the cable connections to Latin America, such as BRUSA, should result in economic development opportunities into the future.

7) Of the five Virginia regions that comprise the cable landing site and the MBC service area:

- All five regions have existing labor pools that can meet a large portion of the workforce needs of the 14 industries within the High-Tech Service Industry Cluster that are likely to be attracted by the MAREA and BRUSA cables.
- These regions are already hosting many (and in the case of Hampton Roads, all) of the industries identified in that cluster and, in some cases, those industries already have a strong existing presence within the region and/or have demonstrated themselves to be strong performers in terms of long-term employment and wage growth.

8) In sum, the MAREA and BRUSA undersea fiber optic cable landing at Virginia Beach will provide substantial economic development opportunities to Hampton Roads and Southern Virginia:

- Those opportunities are likely to be greatest within the High-Tech Service Industry Cluster, and specifically with firms that do business in Southern Europe (especially Spain, the Basque Community, and Portugal) and in Brazil.
- Experience demonstrates that those opportunities need not be restricted to the cable landing site itself and can extend to localities that are some distance from the landing site.
- Experience also demonstrates that the presence of the cables does not guarantee that economic development will occur spontaneously and that targeted efforts by local and regional economic development agencies will be necessary to maximize the economic opportunities made possible by the cable landings.



INTRODUCTION

Virginia Beach will be the site of at least two international undersea fiber optic cables. The cable referred to as MAREA will link Virginia Beach and Bilbao, Spain and the cable referred to as BRUSA will link Virginia Beach with San Juan, Puerto Rico; Fortaleza, Brazil and Rio de Janeiro, Brazil. (Virginia Beach is also the US landing site of for other planned subsea cables.) The MAREA-BRUSA connection at Virginia Beach makes the Hampton Roads area a top high-speed nexus of the Iberian-Latin American internet. If American entities can cultivate and facilitate increased interactions between Spain, Portugal, Puerto Rico, Brazil and the Latino community in the US, then the cable landing in Virginia Beach, in combination with the Mid-Atlantic Broadband Communities Corporation's (MBC's) extensive fiber network in Southern Virginia, will increase in value to overseas users and facilitate increased regional economic development. This report provides a detailed assessment of that economic development potential.

The remainder of this report is divided into three sections. The *Broader Implications* section provides details on the MAREA and BRUSA undersea fiber optic cables, identifies a High-Tech Service Industries Cluster that is likely to be attracted by the opportunities created by those cables, and places those opportunities in the context of potential development opportunities in Europe and Brazil. While the *Regional Economic Development Potential* section provides more granular information on the current economic footprint of the targeted High-Tech Service Industries Cluster in the five Virginia regions that comprise the landing site in Virginia Beach and MBC's service area. Finally, the *Conclusion* section draws together these previous findings to provide a summary and conclusion to our analysis.

BROADER IMPLICATIONS

In this section, we discuss the MAREA and BRUSA undersea fiber optic cables and the broader implications for cable-related economic development that can be derived from an analysis of national and international data.

The Cable Landing at Virginia Beach

Virginia Beach will be the site of at least two international undersea internet cables. The MAREA cable will link Virginia Beach and Bilbao, Spain and the BRUSA cable will link Virginia Beach with San Juan, Puerto Rico; Fortaleza, Brazil and Rio de Janeiro, Brazil.

MAREA

Microsoft and Facebook have invested in laying the fiber optic cable referred to as MAREA between Bilbao in the Basque Country of northern Spain and Virginia Beach. The two companies will use the cable for their own traffic between their data centers in Virginia and North Carolina and facilities and users in Europe. MAREA will be operated by Telxius, a subsidiary of the Spanish telecommunication company, Telefónica. The eight-stranded cable will have the capacity to carry 160 Tbps which by itself is equivalent to over half of the existing total trans-Atlantic capacity.¹ It will be the largest capacity cable in the Atlantic. The new cable will help to accommodate the explosion of data use for commercial cloud-computing and the personal sharing of video on Facebook.



Figure 1: The MAREA Cable²

The cable will also provide the companies with redundancy and geographical dispersion for their networks. Most of the trans-Atlantic cables run from New England to Northern Europe. MAREA will be the first internet cable with one end in the middle Atlantic region of the United States. This makes MAREA the route with the lowest latency to Europe from Northern Virginia and the technology hub around Washington, DC. It will also be the first trans-Atlantic cable with one end in northern Spain, near the French border. This is the first cable to run through this route. As such, MAREA provides network redundancy not only in terms of being an additional cable, but also in terms of not being subject to the same geographical risks as the cables that take a more northerly route across the Atlantic.

¹ Source: Submarine Telecoms Forum.

² Photo Source: Microsoft

MAREA is an example of the major technology companies taking control of the global infrastructure that they need. Amazon, Google, and Microsoft have built cables in the Pacific Ocean, and MAREA is Microsoft's third cable investment in the Atlantic Ocean.³ Because MAREA will belong to Facebook and Microsoft, the cable will only be available for traffic if Facebook and Microsoft are not using all of the bandwidth and make the excess capacity available for other users.

BRUSA

Spanish telecommunications company, Telefónica will lay BRUSA, a new undersea cable linking Rio de Janeiro and Fortaleza, Brazil with San Juan, Puerto Rico, and Virginia Beach. The cable will reinforce Telefónica's infrastructure leadership in the Americas. Leading edge technology will allow BRUSA to support ultrafast transmission capacity and to increase end-to-end connectivity and the availability of ultra-high-speed broadband services. Telefónica intends to use the cable to target business-to-business customers, telecom operators, over-the-top players (such as those using services like WhatsApp, Skype, PlayStation 4, Xbox One, Roku and Google TV) and end-consumers.



Figure 2: The BRUSA Cable⁴

³ Source: Wall Street Journal.

⁴ Source: Telecomramblings.com



This new cable will improve communication reliability and deliver enhanced resilience by increasing the number of US landing points, overall network performance, and end-to-end security. BRUSA will also provide one of the lowest latency communication links between the two largest economies in the region, Brazil, and the USA, and will offer a greater flexibility and scalability than existing cables.

BRUSA will compete with the cables in Florida that run to Latin America and a new cable, SEABRAS-1, that will run from Monmouth County, New Jersey to Brazil. Some of the advertising points that Seaborn Networks is making for SEABRAS-1 really make the best case for BRUSA. We quote Seaborn:⁵

“Shorter distance to most of the Mid-Atlantic region in the [United States]. Virginia, Maryland, North Carolina, and Washington, D.C. are closer to the New York metropolitan area than to Miami.” [BRUSA offers at much shorter distance to the Mid-Atlantic US than SEABRAS-1.]

“Improved route diversity with no dependencies on hurricane-prone Florida. With the majority of other cables landing in Florida, Seabras-1 offers a compelling alternative route or protection route.” [BRUSA offers route diversity over a shorter route than SEABRAS-1, while still offering less exposure to hurricanes and tropical storms than Florida.]

The Other Cable Landings in the Contiguous United States

There are a number of other undersea cable landings on the coasts of the Pacific and Atlantic oceans in the contiguous United States. It is common to refer to the cable landings by their general locations. For example, the Seattle and New York area cable landings. These areas are widely recognized as global leaders in the technology economy. This way of referring to the cable landings reinforces in our minds the idea that undersea fiber optic cables are associated with technology hubs and tech economies. By implication we might conclude that building a new cable landing in a place, such as Virginia Beach, will consequently lead to the development of a tech economy in Virginia Beach or wherever the cable is located.

⁵ Source: SEABRAS-1 Overview <http://www.seabornnetworks.com/seabras-1-system-highlights/>

If we look at the more specific locations of the existing undersea cable landings we can get a clearer and more instructive picture of the effect of a cable landing on a local economy. Figure 3 shows the localities in the contiguous United States with international undersea cable landings. There are 18 localities with operating undersea cable landings.

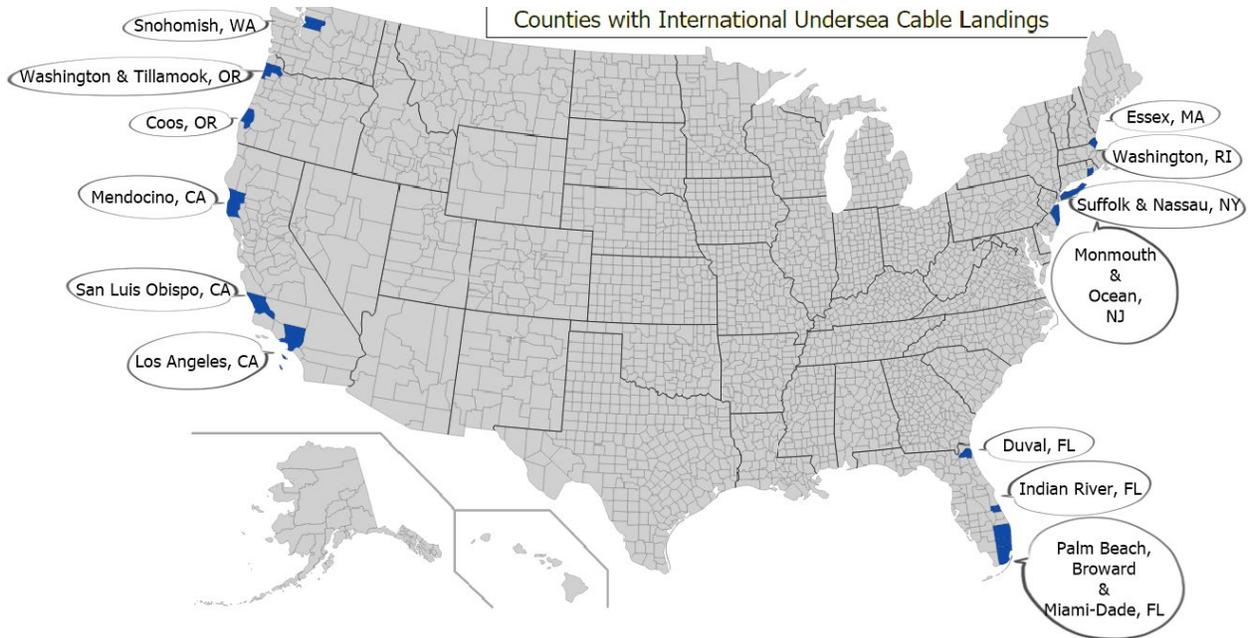
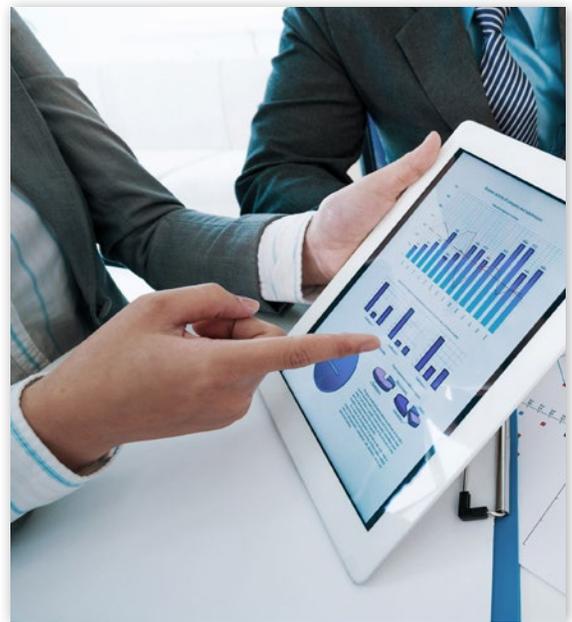


Figure 3: U.S. Counties with International Undersea Cable Landings

Each of these locales has maintained a fairly distinct character. The most common industries across all of these localities are the following 11, in order of prevalence:

- Amusement, Gambling, and Recreation
- Religious and Civic Organizations
- Farming
- Fishing
- Food Manufacturing
- Wholesaling
- Food and Beverage Retailing
- Transportation Support
- Professional, Scientific and Technical Services
- Administrative and Support Services
- Performing Arts and Spectator Sports



But on average each locality was strong in only four of those eleven industries (with little correlation in which four industries). Note that only one of those eleven industries only Professional, Scientific and Technical Services is considered a high-tech services industry. This indicates that the introduction of a cable to a locality does not by itself transform the local economy. In almost every case it does not create a high-tech economy. High-tech jobs will not come to a locality just because an undersea cable landing is built there.

One way in which this is changing to some degree is the increasing practice of data center colocation facilities choosing to locate right at the cable landing.⁶ Doing so reduces tolls on data traffic, and in some markets land is cheaper near cable landings than it is nearer to high-tech industry hubs. A 64,000 square foot colocation data center is being constructed at the cable landing in Monmouth County, NJ to offer any of up to 1,000 occupants of the data center the advantage of the cables there. This approach is already occurring in the Hampton Roads area with EdgeConneX building a colocation data center in Norfolk to take advantage of the MAREA and BRUSA cables coming to Virginia Beach. It is important to remember that while data centers provide local tax revenue and important high-tech services to high-tech industries, they alone do not provide large numbers of jobs.

The High-Tech Service Industries

Before we look at the locations of high-tech industries in the US we must first determine what industries to count as high-tech industries. It is not a settled issue. Over the last ten years, the Census Bureau and the Bureau of Labor Statistics have used a few different iterations of definitions. For this report, we have used the high-tech services industries identified as those that provide high-tech jobs in a 2016 report from the Bureau of Labor Statistics. From that report we take the following industries:⁷

- Architectural, Engineering, and Related Services
- Computer Systems Design and Related Services
- Data Processing, Hosting, and Related Services
- Management of Companies and Enterprises
- Management, Scientific, and Technical Consulting Services
- Other Information Services (e.g., News syndicates, Internet publishing and broadcasting, and web search portals)
- Scientific Research and Development Services
- Software Publishers
- Telecommunications

⁶ <http://datacenterfrontier.com/the-cloud-brings-colo-to-cable-landings/>

⁷ The Bureau of Labor Statistics also includes the Pipeline Transportation industry in its list of high-tech service industries. We have not included that industry in this report because such an industry is very unlikely to be affected by an international undersea internet cable. Pipeline Transportation is also the smallest of BLS's list of high-tech service industries, so our results would probably not be very different if we did include that industry in this report.

In 2014 (the most recent year available), the service sector industries listed above accounted for 53 percent of high-tech employment, compared with 17 percent in the manufacturing sector.⁸ In the 1990s employment in high-tech services was just slightly larger than high-tech manufacturing. However, over the past 20 years, employment in high-tech service industries increased by 3 million jobs, while employment in high-tech manufacturing industries decreased by 1 million jobs. BLS projects that this trend will continue, with high-tech service industries adding another 1 million jobs by 2024 while high-tech manufacturing industries lose 200,000 jobs. That increase will bring the service sector share of high-tech employment over to 56 percent.

Based on our own research on industries that are heavy users of telecommunications services and industries closely associated with data centers we have added the following as high-tech services industries:

- Business Support Services (e.g., Telephone call centers and Business service centers)
- Electronic Shopping and Mail-Order Houses
- International Trade Financing
- Other Financial Investment Activities (e.g., Portfolio management) • Securities and Commodity Contracts Intermediation and Brokerage

In combination, these two lists will comprise the 14 industry High-Tech Service Industries Cluster that we will employ as the basis of our analysis of the economic development potential of the MAREA and BRUSA undersea fiber optic cables.

The Top 1 Percent High-Tech Service Counties in the United States

Using the High-Tech Service Industries Cluster identified in the previous section we can quantify the 31 localities out of the 3,142 localities in the US that have both the most high-tech service jobs and the highest concentration of high-tech service jobs relative to the size of the locality. Figure 4 shows the 31 localities with the largest concentrations of high-tech service jobs in purple while the cable landings are in blue.

The most common industries across all of these localities are the following eight, in order of prevalence:

- Professional, Scientific and Technical Services
- Wholesaling
- Education Services
- Securities and Commodity Contracts Intermediation and Brokerage
- Other Information Services (e.g., News syndicates, Internet publishing and broadcasting, and web search portals)
- Traditional and Software Publishing
- Chemical Manufacturing
- Religious and Civic Organizations

But on average each locality was strong in only three of those eight industries. Half or more of these high-tech localities are strong in Professional, Scientific and Technical Services and Wholesaling.

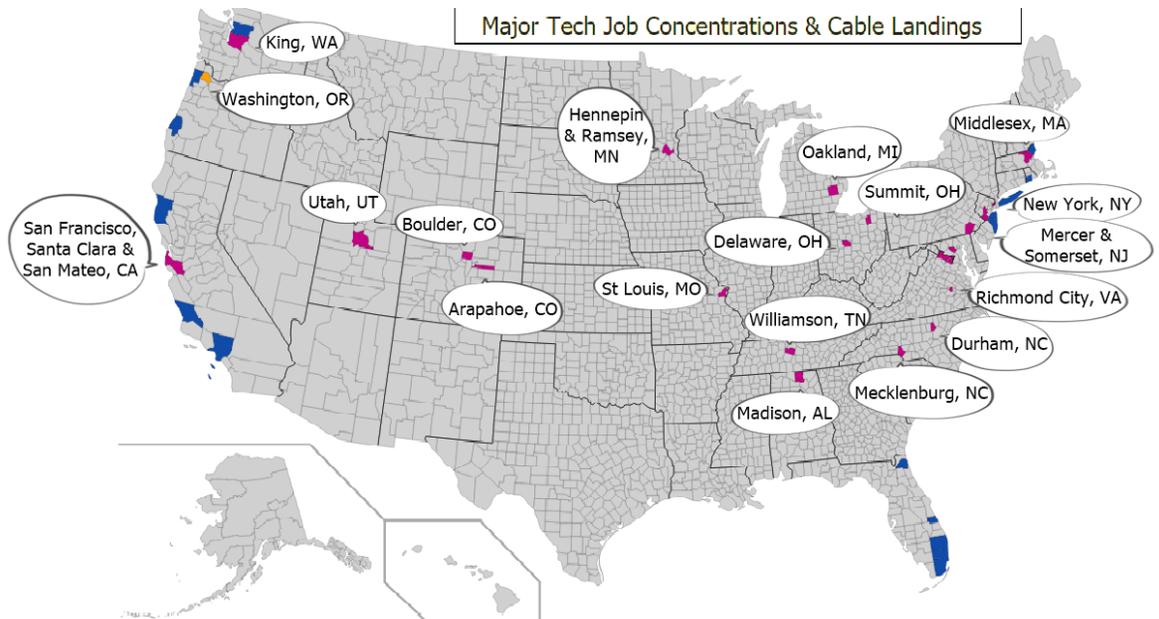


Figure 4: Major High-Tech Concentrations and International Undersea Cable Landings⁹

The map clarifies what we have already noted. With one exception, Washington County, OR, the localities with cable landings do not have major high-tech job concentrations (Washington County is just west of Portland, OR). However, most of the localities with undersea cable landings are adjacent to or relatively near to localities with a major concentration of high-tech services. This fact offers some important hope to the localities of Southern Virginia that are served by MBC that will be connected to the Virginia Beach landing by fiber. Those localities can benefit from the landing even if they are a few counties away from the actual landing itself. Southern Virginia localities that make a concerted effort to attract high-tech service businesses using the new cables as a selling point.

There are notable localities with undersea cable landings that are not located within a few counties of a major high-tech services locality – Los Angeles County, CA; Coos County, OR; and the counties in Florida. Los Angeles County, CA does have a large number of high-tech service jobs and above average concentrations of workers in high-tech service industries – just not enough to make it into the top 31 localities. Los Angeles is stronger in other industries. Coos County, OR is a good example of a locality that has made no significant effort to use the cable landing as a way to develop a high-tech economy. Two cables land there – one owned by a variety of telecommunications companies since 2000 and a new cable financed in part by Google – that connect to Japan, Taiwan, Korea, the Philippines and China. Nevertheless, the Coos County website shows no indication that the county has an economic development office. The county primarily has a rural materials economy – logging, fishing, farming, and mining. The Coos County Strategic Plan 2015-2020 mentions technology only in terms of its internal use by the county government.¹⁰ This reinforces the lesson that a high-tech economy won't develop around a cable landing just because it is built. There is no substitute for an active economic development effort.

⁹ The high-tech service hub in the Washington, DC area is unlabeled for space reasons. It is comprised of the following localities: Howard Co, MD; Washington, D C; Alexandria, VA; Arlington Co, VA; Fairfax, Co, VA; and Loudoun Co, VA.

¹⁰ Coos County Strategic Plan 2015 -2020.
<http://www.co.coos.or.us/Portals/0/Board%20of%20Commissioners/finalcoosp.pdf>



The lack of a high-tech service economy developing anywhere near the Florida undersea cable landings may offer a warning signal about limitations to the advantage of the BRUSA cable. All but one of the cables that have one end in any of the landings in Florida have their other end somewhere in Latin America. (The only exception is the cable known as Columbus-III, a cable laid in 1999 that connects Broward County with southern Portugal, Spain, and Italy.) It does not appear that so far having a landing for a Latin American cable offers a lot of upside potential for developing a high-tech services economy around the landing.

The experience of Duval County, FL provides more similar evidence. That county has two undersea cable landings at Jacksonville. The first cable began operating in 2014 and the second in 2015. In the first quarter of 2012, 52,700 people were employed in non-government high-tech services out of a total of 385,100 private sector employees. In the first quarter of 2016, 49,500 people were employed in non-government high-tech services out of a total of 427,400 private sector employees. So high-tech service employment decreased in absolute terms and also decreased as a percentage of the overall economy of Duval County after the cables were in operation. A similar double decrease occurred in the Jacksonville, FL Metropolitan Statistical Area.

This does not mean that BRUSA will offer no benefit to the economies of Virginia Beach and other localities served by MBC. However, given the Florida experience, limited expectations are probably warranted. We will discuss potential economic development relating to Brazil later in this report.

Target Industries and Geographies for Recruitment to Southern Virginia

Based on our analysis, we believe that the MAREA and BRUSA undersea fiber optic cable landings in Virginia Beach will make the 14 industries that comprise the previously identified High-Tech Service Industries Cluster good economic development recruitment targets for Southern Virginia:

- Architectural, Engineering, and Related Services
- Business Support Services (e.g., Telephone call centers and Business service centers)
- Computer Systems Design and Related Services
- Data Processing, Hosting, and Related Services
- Electronic Shopping and Mail-Order Houses
- International Trade Financing
- Management of Companies and Enterprises
- Management, Scientific, and Technical Consulting Services
- Other Financial Investment Activities (e.g., Portfolio management)
- Other Information Services (e.g., News syndicates, Internet publishing and broadcasting, and web search portals)
- Scientific Research and Development Services
- Securities and Commodity Contracts Intermediation and Brokerage
- Software Publishers
- Telecommunications

To assist MBC in its recruitment efforts we investigated the location of these industries in the contiguous United States by metropolitan statistical area (MSA). For each industry, we identified MSAs outside of Virginia where average weekly wages in the first quarter of 2016 (the latest data available) were higher than in the Virginia Beach-Norfolk-Newport News MSA and where the location quotient for employment (a measure of the relative size of an industry's employment footprint) in the industry was also 2.0 or greater.¹¹ Table 1 below identifies the 68 MSAs with High-Tech Service Industries Cluster industries that met these criteria. An accompanying Microsoft Excel spreadsheet provides names and contact information for businesses with 50 or more employees in high-tech service industries in these MSAs.

¹¹ Location quotients (LQ) are a measure of an industry's relative employment footprint within a given geographic area. They are calculated as the percentage of total employment that industry accounts for within the region, divided by the percentage of total employment that industry accounts for within a benchmark geography (e.g., state or, as in this case, the nation as a whole). As a result, a LQ greater than one indicate that the industry has a larger regional employment footprint than one would expect based on the benchmarked norm. While an LQ below one indicates that the industry has a smaller employment footprint than one would expect.

Albany-Schenectady-Troy, NY	Dallas-Fort Worth-Arlington, TX	Omaha-Council Bluffs, NE-IA
Ann Arbor, MI	Denver-Aurora-Lakewood, CO	Orlando-Kissimmee-Sanford, FL
Atlanta-Sandy Springs-Roswell, GA	Detroit-Warren-Dearborn, MI	Oshkosh-Neenah, WI
Augusta-Richmond County, GA-SC	Durham-Chapel Hill, NC	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
Austin-Round Rock, TX	Eau Claire, WI	Phoenix-Mesa-Scottsdale, AZ
Battle Creek, MI	Fargo, ND-MN	Pittsburgh, PA
Bend-Redmond, OR	Fort Collins, CO	Pittsfield, MA
Boston-Cambridge-Newton, MA-NH	Glens Falls, NY	Provo-Orem, UT
Boulder, CO	Hartford-West Hartford-East Hartford, CT	Raleigh, NC
Bremerton-Silverdale, WA	Houston-The Woodlands-Sugar Land, TX	Salt Lake City, UT
Bridgeport-Stamford-Norwalk, CT	Huntsville, AL	San Antonio-New Braunfels, TX
Burlington-South Burlington, VT	Indianapolis-Carmel-Anderson, IN	San Diego-Carlsbad, CA
California-Lexington Park, MD	Ithaca, NY	San Francisco-Oakland-Hayward, CA
Cedar Rapids, IA	Kennewick-Richland, WA	San Jose-Sunnyvale-Santa Clara, CA
Champaign-Urbana, IL	Kingston, NY	Santa Maria-Santa Barbara, CA
Charlotte-Concord-Gastonia, NC-SC	Knoxville, TN	Seattle-Tacoma-Bellevue, WA
Chico, CA	Madison, WI	St. Louis, MO-IL
Cincinnati, OH-KY-IN	Manchester-Nashua, NH	State College, PA
Colorado Springs, CO	Medford, OR	Tampa-St. Petersburg-Clearwater, FL
Columbia, MO	Miami-Fort Lauderdale-West Palm Beach, FL	Trenton, NJ
Columbus, OH	Midland, MI	Washington-Arlington-Alexandria, DC-VA-MD-WV
Corvallis, OR	Milwaukee-Waukesha-West Allis, WI	
Crestview-Fort Walton Beach-Destin, FL	New York-Newark-Jersey City, NY-NJ-PA	

Table 1: Identified MSA Targets for High-Tech Service Industries Cluster Recruitment in Southern Virginia



The European Economic Context of MAREA

Background

In a time of growing globalization and the increased importance of international connection and cooperation, the strong ties between the United States and the countries of the European Union represent an important element of both countries' economic development and activity, as the US and Europe are each other's primary source and destination for foreign direct investment. In 2015, foreign direct investment flowing from the European Union to the United States amounted to \$384 billion.¹²

The Spanish economy is anticipated to continue along its path of recovery with a projected growth rate of 2.3 percent in 2017. That rate of growth will be slower than in 2016 as a result of lower oil and commodity prices and less fiscal stimulus in 2017.¹³ While a ten-month political gridlock recently plagued the country, with two consecutive elections leaving no clear majority in Parliament, Spanish Prime Minister Mariano Rajoy has finally been able to form a minority government. The end of this political impasse may positively affect the country by providing some reassurance to investors and paving the way for the incoming administration to successfully address the country's fiscal deficit.¹⁴

In France, the rate of economic growth is anticipated to increase to 1.5 percent in 2017. Positive economic stimuli include lower energy prices, tax cuts on labor and business and low-interest rates. The fiscal deficit is predicted to decrease to 3 percent of GDP in 2017, protecting the still fragile economy as it continues to undergo the recovery process. While productivity growth has been weak, recent reforms could work to boost the employment chances of low-skilled workers, fostering productivity growth.¹⁵

The MAREA undersea cable landing in Europe is in Bilbao, located on the northeast coast of Spain near the French border. Bilbao is located in the Basque Country, an autonomous community in Spain that has the status of its own nationality. A small additional part of the Basque community is located in the southwestern corner of France, though it has no autonomy there. Geographically, the Basque region as a whole is about the size of New Jersey with a population the size of Iowa, so that population density is a little less than twice the population density of Virginia (or about equal with Florida and New York). The Basque people have a unique culture that is more-or-less independent of Spain and France. In general, the Basque economy has had somewhat higher productivity, lower unemployment, and higher per capita GDP than the overall European Union.

¹² Source: Transatlantic Economy 2016

¹³ Source: Organization for Economic Cooperation and Development Economic Outlook Volume 2016

¹⁴ Source: Focus Economics

¹⁵ Source: Focus Economics



Like the Hampton Roads area, the Basque Country has a modern service-based economy, but with an important manufacturing tradition. Major exports are machine tools, vehicles, and transportation equipment, machine tools, and energy-related equipment. The main companies in the Basque Country are the bank BBVA, the energy company Iberdrola (both of them have their headquarters in Bilbao), Mondragón Cooperative Corporation (which has divisions specializing in banking, research and development, architectural and engineering services, and machine tools), the wind turbine manufacturer Gamesa, and the railroad car producer CAF. There is also a European aerospace cluster in the Basque region called HEGAN that is working to promote the Basque aerospace industry and develop strategic partnerships for it.

The economic similarities of Hampton Roads and the Basque Country may be able to be cultivated so as to yield strategic international partnerships for economic development. The new undersea cable could be a catalyst for such cooperation that could boost the economies on both sides of the Atlantic.

High-Tech Service Sector

High-tech sectors are key elements that catalyze economic growth and competitiveness. Within Europe, high-tech industries are expanding into international trade and their resilient positive performance helps to boost the competitiveness of other sectors of the economy. For this reason, investment in technical innovation, as well as research and development, has become an important policy-making area. This is reflected in the Europe 2020 strategy, which underlines the priority of smart growth and developing an economy based on knowledge and innovation. In 2012 there were almost 46,000 high-tech manufacturing enterprises operating within the European Union. Research and development also represent an important element of the technology sector in Europe, research and development spending in high-tech sectors by EU countries increased by an average of 4 percent per year between the years of 2005 and 2013.¹⁶

In 2015, 33.9 million people were employed in the manufacturing sector in Europe, with 2.4 million employed in high-tech manufacturing (1.1 percent of total employment) and approximately three times as many employed in high-tech knowledge-intensive services (2.9 percent of total employment).¹⁷ The statistics concerning employment and strength of the technology sector in the countries which may experience the effects of MAREA can be found in Table 2 below.

Country	% of Total Employment	Average Annual Rate of Growth 2008-2015
European Union Overall	2.9%	1.3%
Spain	3.0%	-0.3%
France	3.0%	2.0%
Italy	2.5%	0.9%
Portugal	2.3%	3.3%
Switzerland	3.5%	4.0%

Table 2: Employment in High-Tech Services in European Countries Impacted by the MAREA Cable

Within the 28 countries of the European Union, the average annual growth rate for employment in the high-tech service sector was positive between the years 2008 and 2015, in contrast to the average annual growth rate for employment in the manufacturing sector. In 2010 Europe was hit by financial crisis, which is shown in the decrease in manufacturing sector growth as well as the relatively slow growth in the service sector between 2008 and 2015. However, high-tech industry appeared to be slightly more resilient to economic crisis with average annual growth in rate for employment in the high-tech manufacturing sector falling at a rate of only 1 percent (as opposed to 1.6 percent for total manufacturing, and the average annual growth rate for employment in high-tech knowledge-intensive services measuring at 1.3 percent (a higher rate than the 0.6 percent growth of the total services sector).

The European Union is the second-largest economy in the world and is the home of many major companies working in industries such as financial services (AXA, Allianz, Aviva, Prudential, UniCredit, Zurich Insurance Group, CNP Assurances) aeronautics and defense (EADS, BAE Systems, Leonardo-Finmeccania), as well as telecommunications (Telefónica, Deutsche Telekom, Vodafone, Orange, Telecom Italia, BT Group). Furthermore, southern and central European companies in sectors such as telecommunications (Alcatel-Lucent), software (Dassault Systemes Americas), and information technology consulting (Sogeti) already have a presence in mid-Atlantic states neighboring Virginia.

¹⁷ Source: Eurostat

Research and Development

Research and development partnerships between the US and the countries of the EU are also numerous, in 2013 US affiliates invested \$30 billion in research and development projects in Europe including a \$3.7 billion investment in Switzerland and a \$2.4 billion investment in France.¹⁸

Total European research and development investment in the United States in 2013 amounted to \$39.7 billion, with the largest investment coming from Switzerland (\$10 billion). As of 2015, the European firms in the table below were among the top research and development spenders and are in countries in the general region of the MAREA cable landing.

Company	Country of Origin	Investment (in billions)
Roche	Switzerland	\$10.8
Novartis	Switzerland	\$9.1
Daimler	Switzerland	\$7.6
Sanofi-Aventis	France	\$6.4

Table 3: Research and Development Spending of Select Major European Firms¹⁹

Not only are the European Union and the United States important trading and investment partners, there are each other's number one partner for the cross-border flow of digitally deliverable services, with data flowing between Europe and the US at 15 Tbps.²⁰ In 2014 the US exported \$187 billion worth of digitally deliverable services to Europe and imported \$110 billion, with US digitally deliverable exports to Europe accounting for 70 percent of bilateral services exports and US imports of digitally deliverable services from Europe accounting for 54 percent of all bilateral service imports. The important digital connection between Europe and the United States underscores the importance and advantage of enabling high levels of data to flow quickly, cheaply, and reliably between Europe and the United States, catalyzing the already blooming area of digitally deliverable services and data and information flow.

EU Regulations on the Storage of EU Data

The main regulations concerning the storage of European data in the United States are centered on the privacy of personal data. As the EU boasts stricter privacy laws than the United States, there was some concern over the security and availability of European data stored in the United States. A new framework for an executive agreement between the US and the EU guarantees that European data stored within the United States will be protected from government monitoring and that government agencies access to data for security purposes will be strictly limited and subject to safeguards and oversight mechanisms, ensuring the protection of EU citizens' rights. However, suspicion surrounding the power of the US government and its intelligence agencies to access data stored within the US remains high.

¹⁸ Source: Transatlantic Economy 2016

¹⁹ Source: Transatlantic Economy 2016

²⁰ Source: Transatlantic Economy 2016. Recall that MAREA undersea fiber optic cable will have a bandwidth capacity of 160 Tbps.

A 2016 Directive proposed by the European Commission regulates the transfer of personal data from European member states to third countries. An official text of the Directive was published in the EU Official Journal in May 2016 and all member states of the European Union must transpose it into their national law by May 6, 2018. Transfer of data to third countries is specifically covered in Article 33 through Article 38, which states that personal data from Europe can only be transferred to a third country in the event that the third country complies with European privacy and security standards. The current governing directive is the result of a comprehensive reform of data protection regulations, designed to ensure that citizens have control over their personal data and to simplify the regulatory environment for businesses.

The issue of security and privacy regulation surrounding the transatlantic flow of personal data between the United States and Europe has sparked a recent wave of conflict and concern as many in Europe (which traditionally boasts higher level of privacy protection) question the extent of the United States Government's ability to access personal data stored within the country. Suspicions were raised in 2013 when Edward Snowden revealed the fact that US intelligence agencies were cooperating with Internet giants to engage in the bulk collection of communications data.

Later, an Austrian student, Maximilian Schrems, made a complaint to the data protection authority in Ireland, arguing that the United States did not offer sufficient data privacy protection. This complaint was rejected by the Irish data protection authority but later referred to the European Court of Justice. As a result, "Safe Harbour," the EU-US agreement that previously served as a guideline for handling data stored overseas, was invalidated in October 2015. This led to a wave of negotiations and proposals as the European Commission and the US worked to form a new agreement that would address European privacy concerns.

On July 12, 2016, the European Commission adopted "Privacy Shield," a new framework designed to protect the rights of anyone living within the European Union whose personal data are transferred to the United States as well as bringing a higher level of legal clarity to businesses engaging in transatlantic data transfers. The new framework includes strong data protection obligations on companies receiving personal data from the EU, safeguards on US government access to data, effective protection and redress for individuals, and an annual joint review to monitor the implementation process.

The Privacy Shield is one of multiple options that can be used to transfer personal data from the EU to the US (others include contractual clauses and binding corporate rules). US companies wishing to take advantage of the privacy shield agreement must first sign up with the United States Department of Commerce, which is responsible for managing and administering the program. These companies must renew their membership annually to ensure that their practices surrounding the use and storage of personal data from Europe respect the rights of data users which are guaranteed by European law.

The bottom line on EU data privacy rules for MAREA and economic development in Virginia is that companies will store in Europe data that might be considered sensitive or private. MAREA will provide operations in the US with faster access to information stored in European data centers. The closer that those operations are located to the cable landing, the lower the latency will be in accessing that data in Europe. However, data that is not sensitive or private and that will be frequently accessed in the US or distributed to the US can be stored in data centers in the US.

European Recruitment Targets

Some Spanish companies already have a presence in the US and may be persuaded to locate facilities in the Hampton Roads area. The following organizations have facilities in other parts of the US, but may be attracted to Virginia by the installation of the cable:

- From its New York office, SPRI specializes in introducing Basque companies and their products onto the American market, regardless of their sector of activity. It offers a customized service to encourage exports and imports, promote activities aimed at better positioning in strategic markets, facilitate technical assistance in business and productive installation, as well as providing support in projects funded by multilateral organizations.
- Avangrid Renewables is the second-largest provider of clean, renewable wind power in the U.S. with more than 6,000 MW of owned and controlled wind and solar power facilities. We produce an economic windfall for numerous rural communities while providing clean, affordable power to our customers. The company also operates 636 MW of natural gas-fired generation and a state-of-the-art 24-7 National Control Center, which acts as the nerve center of the company's generation portfolio, making it one of the few companies capable of providing structured energy solutions and allowing large industrial and commercial customers to manage risks and uncertainty in the natural gas and power industries. Avangrid Renewables is a subsidiary of AVANGRID, Inc., and part of the IBERDROLA, S.A. Group which is headquartered in Bilbao. The US company is headquartered in Oregon with offices in Houston and Philadelphia.
- To meet the demands of modern electrical systems ZIV USA focuses on developing innovative solutions with the flexibility to adapt the particular requirements of each client. Over a decade ago, ZIV introduced integrated Protection and Control Systems with substantial cost savings compared to traditional solutions. Their areas of expertise are: Power System Protection; Integrated Protection and Control Systems; Substation automation; Distribution systems; Industrial systems; Windfarm systems; and Utility Metering and Communications.
- Bolsas y Mercados Españoles (BME) is a Spanish company that deals with the organizational aspects of the Spanish stock exchanges and financial markets, including the stock exchanges in Madrid, Barcelona, Bilbao, and Valencia. In addition to the trading of shares and bonds, BME offers a number of other financial services. BME is also developing a technology consulting business that operates in 23 countries mainly providing trading systems.
- Prosegur Compañía de Seguridad, S.A is a multinational security company, headquartered in Madrid, Spain. It began as a private security company, with a particular focus on power plants, industrial facilities, and shopping centers. It is the largest company in the private security industry in Spain. Its services now extend to every aspect of facility security from physical security to cyber security risk and threat control. Prosegur has created several global security operation centers both at national and international levels, built up teams of subject matter experts in information security, deployed advanced tools and technologies, and formed alliances with market-leading technology partners.

Virginia Beach will also be a high speed connecting point between the Iberian Peninsula and Latin America. Spain is Brazil's second largest foreign investor investing the equivalent of about US \$21 billion in 2014. Spain runs a US\$1 billion trade surplus with Brazil (about US\$4 billion from Spain to Brazil and about US\$3 billion from Brazil to Spain in 2014). Most of Brazil's exports to Spain are agricultural commodities. Major Spanish exports to Brazil are chemical products, machinery, transportation equipment and gasoline. Spanish and Portuguese language firms doing business on both continents may find Virginia Beach to be an excellent midpoint to store data needed for operations on both continents. Examples include the following companies:

- Privalia Venta Directa, SA is an online fashion outlet, with operations across Spain, Italy, Brazil and Mexico. Privalia, which holds the leading market share in all these markets, organizes short, single-brand campaigns (lasting between 3 and 5 days) to which registered members are invited to shop via an email message and mobile alerts. Companies have an easy and profitable way of selling the remaining items in their product lines, and its customers obtain leading brand-name products with significantly lower prices than what they would find in stores. Privalia is headquartered in Barcelona Spain, and has subsidiaries in Milan, Italy, São Paulo, Brazil and Mexico City. It employs over 900 people and has over 24 million registered users worldwide. About 75 percent of Privalia's sales come outside of Spain, with Brazil coming as the main international market. In November 2015, Privalia announced that 60 percent of its sales come from the mobile channel. Since 2010, Privalia has obtained over 12 Million of downloads of its mobile apps.
- Terra Networks, SA is a Spanish Internet multinational company with headquarter in Spain and offices in Brazil, Chile, Colombia, Mexico, United States and Peru. Part of Telefónica Group (the former Spanish public telephone monopoly), Terra operates as a web portal and/or an internet access provider in the U.S., Spain, and 16 Latin American countries.
- Marfeel is a Spanish-based cloud-solution company offering a platform that provides website and advertisement space display optimization in mobile websites. Marfeel has been acknowledged as one of the Top 100 European startups for 2015 by Wired Magazine. and one of Spain's Top 50 most promising startups by Emprendedores Magazine in 2016. In April 2016, Marfeel was named a Gartner's Cool Vendor in Mobile Marketing recognizing the company's 360 mobile solution for content publishers as innovative, Impactful & Intriguing.
- Akamon Entertainment is a developer and operator of social network games focused on the Latin-American and South European markets. The company offers multi-platform, multiplayer casino and traditional games with via portals, Facebook, and mobile devices. Gambling games could not be operated from the US without a change in law. But non-gambling games could be.
- Aernnova Aerospace S.A. designs, manufactures, and markets aerostructures and components for original equipment manufacturers and top companies in Spain and internationally. The company also offers specialized activities that include value-added product and manufacturing engineering services; designing and manufacturing composite aerostructures and components; providing metallic components and subassemblies; and delivering in-service product support services. The company is headquartered in Alava, Spain. It has plants, engineering offices, and projects in Spain, Mexico, Brazil, the United States, India, China, Romania, and Finland.
- CTA is an aerospace test laboratory specializing in testing for development and certification of aerospace materials, systems, and structures. CTA is located in the Basque Country in the north of Spain.

- ITP is the ninth-largest aircraft engine and components company in the world by revenue. The company has production facilities in Spain, the United Kingdom, Mexico, the United States, Malta, and India with over 3,000 employees. ITP includes among its activities the design, research and development, manufacturing and casting, assembly and testing of aeronautical engines. It also provides MRO services for a wide range of engines for regional airlines, business aviation, helicopters, industrial and defense applications. Its US subsidiary, Aeromaritime America Inc., is a Rolls-Royce Authorized Maintenance Repair and Overhaul Center specializing in the Model 250. It has two facilities at the Mesa Falcon Field Airport in Phoenix, AZ.
- The Santander Group is a Spanish banking group. The group has expanded since 2000 through a number of acquisitions, with operations across Europe, Latin America, North America and Asia. In 2016, Santander was ranked as 37th in the Forbes Global 2000 list of the world's biggest public companies. In 2007 Grupo Santander acquired ABN AMRO's subsidiary in Brazil, Banco Real, and its subsidiary in Italy, Banca Antonveneta. Santander has a number of banking operations in the US, including Santander Private Banking, Santander Bank, and Santander Consumer USA Inc. In 2010, Grupo Santander invested \$270 million Campinas, Brazil in a technology center for research and data processing and a data center, that was to support operations across North America, Central America, and South America.
- Indra Sistemas, S.A. is a Spanish information technology and defense systems company. Indra is organized around three business areas: information technology, simulation & automatic test equipment, and defense electronic equipment. Approximately a third of the company's annual revenues come from international markets. Europe and the United States are the two markets with the greatest weight and growth for Indra. Indra also operates in Latin America.
- Antena 3 is a Spanish television channel owned by Atresmedia which also owns Onda Cero, one of Spain's most listened to radio stations. Antena 3 Internacional is another channel owned by Grupo Antena 3, with distribution handled by MVS Comunicaciones. The channel serves the Americas (including the United States, Mexico, and Central America) and the Caribbean. The channel retransmits programs from the domestic Antena 3 schedule, along with live news programming.
- Planeta Corporación, S.R.L., doing business as Grupo Planeta, is a Spanish media group based in Barcelona. The company operates in Spain, Portugal, France and Latin America. Planeta owns over 70 publishing houses worldwide. It publishes the newspaper La Razón. Besides publishing, the group operates in the areas of collectibles, training, direct marketing, distance learning, and audiovisual media. With its purchase of Editis in 2009, it became one of the largest publishers in the world, with over \$1 billion of revenue that year. In 2014 the company was the eighth largest book publisher in the world.
- Private Media Group, Inc. is a production and distribution company that distributes adult entertainment via print publications, DVDs, the internet, and mobile. The firm provides content through DVD, Video on Demand, Internet Protocol Television, mobile and magazines. It supplies adult entertainment films to thousands of major hotels around the world through their Hotel Pay Per View services. The company also runs the adult channels Private TV in Europe and Private Gold in Latin America.
- Zinkia Entertainment is Madrid, Spain. Its main focus is to create animated series for TV and games for mobile devices and for game platforms. The company has more than 100 employees and their series have been sold in more than 95 countries worldwide. Zinkia's main goal is to create and develop brands with a global scope in the entertainment sector. They can create brands as a television series, a movie, a console or computer game or an online community. The company's goal is to create a market brand, and then develop contents that support it on every possible entertainment platform.



The Brazilian Economic Context of BRUSA

Background

Brazil, one of the main drivers of growth in Latin America, is virtually paralyzed. During 2015, Brazil fell into technical recession with two consecutive quarters of negative growth figures. After stagnating in 2014 and 2015, the International Monetary Fund estimates that by the end of 2016 the economy will contract by a very serious 3.3 percent. While some external factors such as the falling price of raw materials explain part of the contraction in activity, domestic factors represent the largest brake on growth according to the IMF. Exports to the United States fell due to the sharp drop in the volume of basic materials shipped, lower prices of goods shipped (strongly influenced by lower oil prices), and low manufacturing productivity. Overall exports from Brazil fell by 11 percent. The poor economic situation in Brazil will probably seriously limit the ability of Brazilian businesses to invest in new activities in Southern Virginia related to BRUSA. Nevertheless, the US offers significant cost advantages over Brazil for high-tech initiatives.

Data Center Costs in Brazil²¹

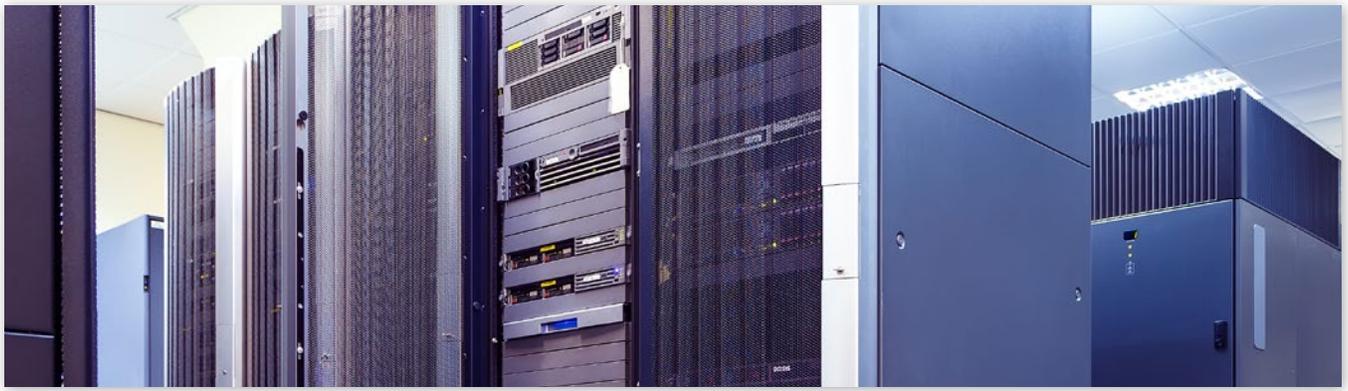
The size of the data center infrastructure in Brazil is still small compared to other countries, especially the United States. A recent study by Crushman & Wakefield counted 500,000 square feet of operational data centers in Brazil, which is less than the data center capacity in Miami alone.²² A number of factors can be seen as the cause for the difficulty to construct and maintain data centers in Brazil: taxes and bureaucracy, energy and labor costs. By some calculations, taxes and the high costs of electricity make data centers in Brazil up to 100 percent more expensive than in the United States, according to Esteban Israel.²³

Equipment taxes negatively impact Brazilian competitiveness dramatically because they raise the cost of importing. The average regional tax on electric refrigeration components, for example, is approximately 200 percent higher than the taxes paid in the US, while taxes levied on the telecommunications infrastructure are on average 285 percent above that of the US.

²¹ http://www.cisco.com/c/dam/global/es_mx/assets/pdfs/fs_white_paper_cisco_es.pdf

²² <http://www.cushmanwakefield.com/en/news/2014/05/marketbytes/>

²³ <http://vweb2.knight-sac-media.com/readmsgs.aspx?subjectid=57203&msgnum=1044&batchsize=10&batchtype=Next>



Electrical connectivity and infrastructure capacity are also major issues in Brazil. From the point of view of connectivity, the backbone in the region is overloaded and the last mile has little capillarity, especially in regions far from the major centers. Electrical capacity is one of the greatest challenges faced by CIOs in the region, considering that the regional energy supply infrastructure is insufficient, there are constant interruptions and fluctuations in the power supply affecting the performance of data centers and consequently the objectives of business. Eighty percent of electricity in Brazil depends on hydroelectric generation.

High capital costs are another barrier to high-tech development in Latin America. In the region, high import costs and limited physical space can cause data center construction costs to be up to 41 percent higher than in the United States. Brazil is the most expensive country in terms of capital costs, coming in at 23 percent above the of the regional average. Energy and cooling equipment costs in Brazil are 56 percent higher than costs in the rest of the region. This keeps data centers in Brazil from being competitive with the rest of the region.

Operating expenses in the region are also higher than in other countries, mainly due to factors such as equipment maintenance, electrical service, cooling, and labor costs. When analyzing the monthly expenses of a datacenter in Latin America, energy and labor costs represent more than 50 percent of the monthly operational expenses of a data center. Monthly building and equipment maintenance costs in Latin America are 15 percent higher than in the US. The cost of labor is one of the main factors that create such a disadvantage. The cost of sufficiently skilled labor in Brazil can reach up to 47 percent above the cost of similar labor in the United States. Workers with high-tech skills are in very short demand. In Brazil alone, it will be necessary to train 750,000 IT professionals by 2020 to supply the national demand. The quality of the educational system combined with the low number of individuals enrolled in higher education compared to other countries are factors that directly affect the quality of the labor available in the region.



Brazilian Recruitment Targets

In spite of all of these barriers, the last few years have seen a number of companies build large data centers in Brazil. This is a trend that shows no signs of coming to a halt, considering the increasing demand for internet and data services. Although Brazil faces large cost disadvantages, the size of the domestic market and the representativeness of its economy in the region offer great opportunities in the region and will continue to attract investment in local data centers.

Best practice is for data centers to operate with redundancy so that any unit downtimes do not completely shut down the service. Ideally, redundancy isn't accomplished just by replicating service in the same location subject to the same geographical risk, but to diversify location as well. With the BRUSA cable, Southern Virginia may provide a secure, reliable, low natural disaster risk, low cost, low tax, low latency opportunity for Brazilian data centers to add redundancy to their systems.

The following firms with data centers in Brazil may be interested in investing in data centers in Virginia to provide redundancy for their Brazilian data centers:

- Algar
- Alog
- Ascenty
- Ativas
- BM&F BOVESPA
- CapGemini
- Embratel
- Equinix
- GetNet
- Globo
- IBM
- Internexa
- Level 3
- Locawebs
- Oi
- Petrobras
- Santander
- Telefônica-Vivo
- Tivit
- TOTVS
- T-Systems
- UOL Diveo
- Verizon

REGIONAL ECONOMIC DEVELOPMENT POTENTIAL

In this section, we provide an assessment of the economic development potential of the 14 industry High-Tech Service Industries Cluster identified in the previous section, in the five Virginia regions that comprise the MAREA-BRUSA cable landing site in Virginia Beach and MBC's service area.

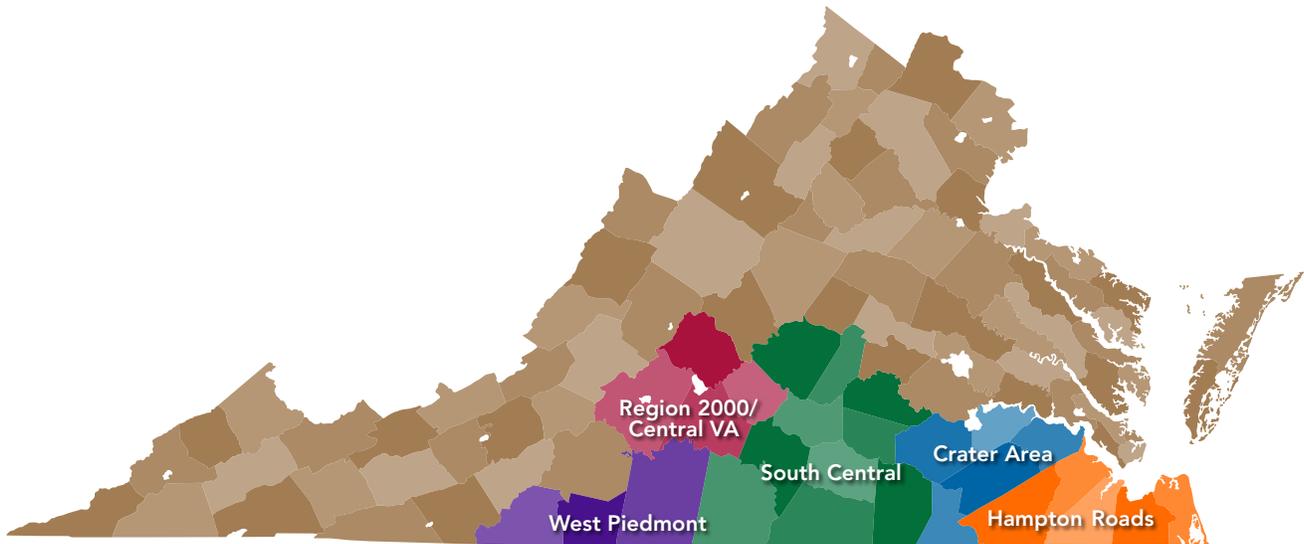


Figure 5: The Five Regions Comprising the Cable Landing Site and MBC Service Area

Crater Area²⁴

Overall Employment Trend

Starting at the most aggregate level, Figure 6 depicts the year-over-year change in total employment in the Crater Area for the period from the first quarter of 2011 through the first quarter of 2016, and benchmarks those data against the state of Virginia as a whole. Any point above the zero line in this graph indicates positive year-over-year employment growth, while any point below the zero line indicates a decline in year-over-year employment. As these data indicate, the Crater Area experienced year-over-year employment losses through much of 2012 and 2013. Employment growth rebounded in 2015, however, and has since generally trended with the state-wide average. As of the first quarter of 2016, year-over-year employment growth stood at 1.2 percent in the Crater Area as compared to 2.2 percent statewide.

²⁴ For purposes of this analysis, the Crater Area is defined to include the nine localities that comprise the Crater Area Workforce Investment Area. Those localities are the cities of Colonial Heights, Emporia, Hopewell, and Petersburg, and the counties of Dinwiddie, Greensville, Prince George, Surry, and Sussex.



Figure 6: Year-Over-Year Change in Total Employment – 2011:Q1 to 2016:Q1²⁵

High-Tech Service Industries Cluster – Regional Economic Footprint and Performance

In this portion of the section, we provide data on the regional economic footprint and performance of the High-Tech Service Industries Cluster in the Crater Area. Table 3 provides a profile of the regional economic footprint of the 14 industries that comprise this cluster in the first quarter of 2016. In this table:

- *Industry* refers to the specific industry within the cluster.
- *Establishments* refers to the number of regional establishments in that industry.
- *Employment* refers to the number of regional jobs in that industry.
- *LQ* refers to the employment location quotient for that industry (a measure of the relative footprint of the industry).²⁶
- *Average Weekly Wage* refers to the regional average weekly wage for that industry.
- *As % of Regional Wage* refers to the industry average weekly wage as a percentage of the regional average weekly wage.
- *Type I Multiplier* quantifies the size of the economic ripple effect that industry has within the region (the larger this number, the larger the proportion of the industry’s expenditures that remain within the region).²⁷

²⁵ Data Source: Virginia Employment Commission.

²⁶ Location quotients (LQ) are calculated as the percentage of total employment that industry accounts for within the region, divided by the percentage of total employment that industry accounts for within the state. As a result, a LQ greater than one indicates that the industry has a larger regional employment footprint than one would expect based on the state-wide norm. While an LQ below one indicates that the industry has a lower employment footprint than one would expect.

²⁷ Type I Multipliers measure the sum of the direct, indirect, and induced multipliers. Economic multipliers measure the ripple effects that an expenditure has as it makes its way through the economy. For example, as when an industry purchases goods and services – or when industry employees use their salaries and wages to make household purchases – thereby generating income for someone else, which is in turn spent, thereby becoming income for yet someone else, and so on, and so on. Through this process, one dollar in expenditures generates multiple dollars of income. The mathematical relationship between the initial expenditure and the total income generated is the economic multiplier.

As the data provided in Table 4 indicate, all but one (*International Trade Financing*) of the 14 of the industries identified within the High-Tech Service Industries Cluster had a presence in the Crater Area in the first quarter of 2016 (although employment in *Data Processing, Hosting, and Related Services*; *Other Information Services*; and *Software Publishers* was small enough to trigger the Virginia Employment Commission's non-disclosure requirements). The three largest regional industries in this cluster were: *Computer Systems Design and Related Services* (453 jobs), *Management, Scientific, and Technical Consulting* (364 jobs), and *Management of Companies and Enterprises* (253 jobs). Of the ten cluster industries within the Crater Area for which LQs could be calculated, none exhibited an LQ greater than one, which indicates that all were under-represented in the region relative to the statewide norm.



Average weekly wages in the Crater Area's High-Tech Service Industries Cluster were highest in *Securities and Commodities Contracts Intermediaries* (\$1,927/wk.), *Scientific Research and Development Services* (\$1,871/wk.), and *Computer Systems Design and Related Services* (\$1,406/wk.). Finally, although the Type 1 Multipliers (a measure of an industry's proportional economic impact on the region) for all existing cluster industries within the region were relatively low, the industry with the highest multiplier was *Other Financial Investment Activities* (1.3).

Industry	Establishments	Employment	LQ	Avg. Weekly Wage	as % of Reg. Wage	Type I Multiplier
Architectural, Engineering, & Related Serv.	35	244	0.2	\$1,274	159%	1.2
Business Support Services	6	53	0.1	\$593	74%	1.1
Computer Systems Design & Related Serv.	58	453	0.2	\$1,406	176%	1.1
Data Processing, Hosting, & Related Serv.	1	N/A	N/A	N/A	N/A	1.2
Electronic Shopping & Mail-Order Houses	8	10	0.1	\$327	41%	1.2
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	14	253	0.2	\$846	106%	1.1
Mgmt., Scientific, & Technical Consulting	46	364	0.3	\$948	118%	1.2
Other Financial Investment Activities	6	6	0.0	\$788	98%	1.3
Other Information Serv.	6	N/A	N/A	N/A	N/A	1.2
Scientific Research & Development Serv.	10	74	0.2	\$1,871	234%	1.2
Securities & Commodity Contracts Intermediaries	6	19	0.2	\$1,927	241%	1.2
Software Publishers	2	N/A	N/A	N/A	N/A	1.1
Telecommunications	4	25	0.1	\$1,085	135%	1.2

Table 4: Economic Footprint of the High-Tech Service Industries Cluster – Crater Area²⁸

²⁸ Data Source: Virginia Employment Commission and IMPLAN.

Table 5 provides additional detail on the employment performance of the High-Tech Service Industries Cluster in the Crater Area. In this table:

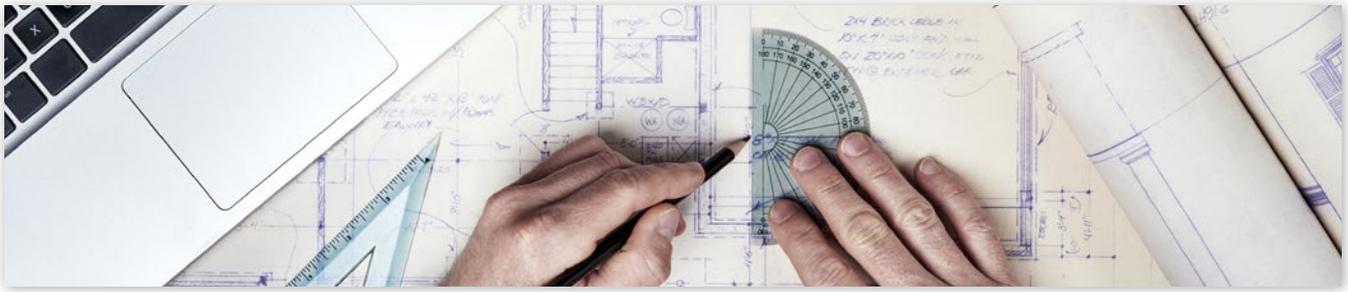
- *Industry* refers to the specific industry within the cluster.
- *1 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2015 and the first quarter of 2016.
- *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative).
- *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).
- *5 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2011 and the first quarter of 2016.
- *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative).
- *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

As these data show, the largest regional short-term (one-year) employment growth in this cluster occurred in *Management, Scientific, and Technical Consulting* (19.0 percent), *Scientific Research and Development Services* (17.5 percent), and *Computer Systems Design and Related Services* (1.1 percent). With regard to long-term (five-year) employment growth, the largest increases occurred in *Scientific Research and Development Services* (196.0 percent), *Business Support Services* (140.9 percent), and *Computer Systems Design and Related Services* (61.8 percent).

Industry	1 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State	5 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State
Architectural, Engineering, & Related Serv.	0.8%	0.7	4.5	-44.5%	N/A	N/A
Business Support Services	-1.9%	N/A	N/A	140.9%	62.9	9.1
Computer Systems Design & Related Serv.	1.1%	1.0	0.2	61.8%	27.6	6.4
Data Processing, Hosting, & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	42.9%	19.1	4.9
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	0.8%	0.7	N/A	29.1%	13.0	76.3
Mgmt., Scientific, & Technical Consulting	19.0%	16.5	3.6	51.0%	22.8	8.2
Other Financial Investment Activities	-14.3%	N/A	N/A	-57.1%	N/A	N/A
Other Information Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Scientific Research & Development Serv.	17.5%	15.2	N/A	196.0%	87.4	N/A
Securities & Commodity Contracts Intermediaries	0.0%	N/A	N/A	35.7%	15.9	N/A
Software Publishers	N/A	N/A	N/A	N/A	N/A	N/A
Telecommunications	-34.2%	N/A	N/A	-66.2%	N/A	N/A

Table 5: Employment Performance of High-Tech Service Industries Cluster – Crater Area²⁵

²⁹ Data Source: Virginia Employment Commission.



Finally, Table 6 details the wage performance of the High-Tech Service Industries Cluster in the Crater Area. In this table:

- *Industry* refers to the specific industry within the cluster.
- *1 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2015 and the first quarter of 2016.
- *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative).
- *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).
- *5 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2011 and the first quarter of 2016.
- *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative).
- *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

As the data in Table 6 indicate, the largest regional short-term (one-year) wage growth in this cluster occurred in *Telecommunications* (6.2 percent), *Management, Scientific, and Technical Consulting* (4.3 percent), and *International Trade Financing* (3.9 percent). With regard to long-term (five-year) wage growth, the largest increases occurred in *Other Financial Investment Activities* (83.3 percent), *Scientific Research and Development Services* (52.6 percent), and *Business Support Services* (23.2 percent).

Industry	1 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State	5 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State
Architectural, Engineering, & Related Serv.	-1.6%	N/A	N/A	6.1%	0.6	0.7
Business Support Services	-17.7%	N/A	N/A	23.2%	2.3	3.2
Computer Systems Design & Related Serv.	-3.0%	N/A	N/A	8.6%	0.9	0.7
Data Processing, Hosting, & Related Serv.	0.0%	N/A	N/A	-5.3%	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	N/A	N/A	N/A
International Trade Financing	3.9%	N/A	N/A	0.0%	0.0	0.0
Management of Companies & Enterprises	2.6%	N/A	N/A	20.5%	2.0	1.7
Mgmt., Scientific, & Technical Consulting	4.3%	N/A	N/A	16.7%	1.7	3.7
Other Financial Investment Activities	3.7%	N/A	N/A	83.3%	8.3	4.3
Other Information Serv.	-3.6%	N/A	N/A	15.6%	1.6	0.4
Scientific Research & Development Serv.	-0.4%	N/A	N/A	52.6%	5.3	8.6
Securities & Commodity Contracts Intermediaries	-20.4%	N/A	N/A	15.1%	1.5	2.8
Software Publishers	-2.0%	N/A	N/A	-20.6%	N/A	N/A
Telecommunications	6.2%	N/A	4.3	19.6%	2.0	0.7

Table 6: Wage Performance of High-Tech Service Industries Cluster – Crater Area³⁰

³⁰ Data Source: Virginia Employment Commission.

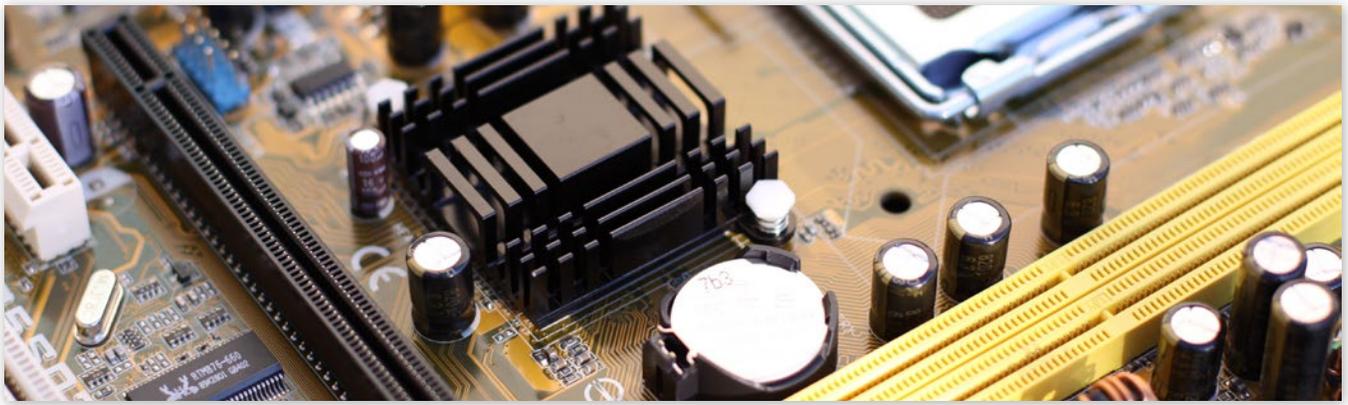
High-Tech Service Industries Cluster – Available Regional Labor Pool

In this portion of the section, we provide an analysis of the regional labor pool available in the Crater Area to meet the needs of the 14 industries identified in the High-Tech Service Industries Cluster. This analysis is based on the U.S. Department of Labor, Employment and Training Administration’s *O*Net Career Switchers Matrix*. The *Career Switchers Matrix* identifies the ten occupations that are most closely related to a target occupation based on required skills. By: 1) using the Virginia Employment Commission’s most recent state-wide industry staffing matrix to identify those occupations typically employed in the 14 industries that comprise the *High-Tech Services Cluster*, then 2) mapping that list of occupations through the *Career Switchers Matrix* to identify the broader list of occupations that require similar skill sets, and then 3) mapping that broader list into the Virginia Employment Commission’s estimates of occupational employment for the Crater Area, we are able to quantify the total regional labor pool available to meet the workforce needs of the High-Tech Service Industries Cluster.

The result of that analysis is provided in Table 7. As these data show, in all cases the Crater Area is able to offer a large labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

Industry	Current Regional Employment	Total Available Regional Labor Pool	Current Employment as % of Available Labor Pool
Architectural, Engineering, & Related Serv.	244	8,440	3%
Business Support Services	53	5,867	1%
Computer Systems Design & Related Serv.	453	9,754	5%
Data Processing, Hosting, & Related Serv.	N/A	5,424	N/A
Electronic Shopping & Mail-Order Houses	10	8,865	0%
International Trade Financing	N/A	9,347	N/A
Management of Companies & Enterprises	253	16,842	2%
Mgmt., Scientific, & Technical Consulting	364	10,237	4%
Other Financial Investment Activities	6	2,554	0%
Other Information Serv.	N/A	3,915	N/A
Scientific Research & Development Serv.	74	11,273	1%
Securities & Commodity Contracts Intermediaries	19	2,554	1%
Software Publishers	N/A	3,376	N/A
Telecommunications	25	5,564	<1%

Table 7: High-Tech Service Industries Cluster
Available Labor Pool – Crater Area³¹



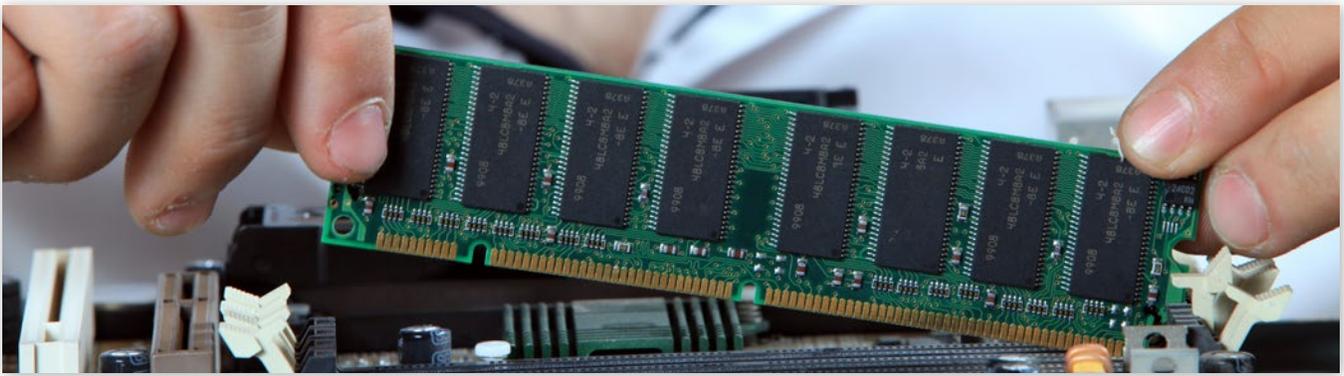
In Sum

Although all but one (*International Trade Financing*) of the 14 of the industries identified within the High-Tech Service Industries Cluster had a presence in the Crater Area in the first quarter of 2016, the three largest were *Computer Systems Design and Related Services* (453 jobs), *Management, Scientific, and Technical Consulting* (364 jobs), and *Management of Companies and Enterprises* (253 jobs). In addition, the three highest paying industries within the cluster were: *Securities and Commodities Contracts Intermediaries* (\$1,927/wk.), *Scientific Research and Development Services* (\$1,871/wk.), and *Computer Systems Design and Related Services* (\$1,406/wk.).

In terms of performance, the High-Tech Service Industries Cluster industries with the strongest long-term (five-year) regional employment growth were: *Management, Scientific, and Technical Consulting* (19.0 percent), *Scientific Research and Development Services* (17.5 percent), and *Computer Systems Design and Related Services* (1.1 percent). The cluster industries with the strongest long-term (five-year) regional wage growth were: *Scientific Research and Development Services* (196.0 percent), *Business Support Services* (140.9 percent), and *Computer Systems Design and Related Services* (61.8 percent). While the cluster industry with the largest proportional economic impact on the region was *Other Financial Investment Activities* (Type 1 Multiplier of 1.3).

Taken together these data indicate that, of the 14 industries identified in the High-Tech Service Industries Cluster: 1) *Computer Systems Design and Related Services* has a strong existing presence in the Crater Area as a high-wage industry with a large employment footprint, and is a strong performer in terms of both long-term employment and wage growth, 2) *Scientific Research and Development Services* is a high-wage industry within the region that is also a strong performer in terms of both long-term employment and wage growth, and 3) *Management, Scientific, and Technical Consulting* has a large regional employment footprint and is a strong performer in terms of long-term employment growth.

Lastly, The Crater Area is able to offer a significant labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.



Hampton Roads³²

Overall Employment Trend

Figure 7 depicts the year-over-year change in total employment in Hampton Roads for the period from the first quarter of 2011 through the first quarter of 2016, and benchmarks those data against the state of Virginia as a whole. Any point above the zero line in this graph indicates positive year-over-year employment growth, while any point below the zero line indicates a decline in year-over-year employment. As these data indicate, year-over-year employment growth in Hampton Roads initially underperformed the state-wide norm during this period, but has since generally mirrored the statewide trend. It is important to note that in both cases, however, there was a significant deceleration and even decline in employment after the 2013 federal sequester, which bottomed out in 2014 and was then followed by rapid acceleration in employment growth throughout 2015.



Figure 7: Year-Over-Year Change in Total Employment – 2011:Q1 to 2016:Q1³³

³² For purposes of this analysis, Hampton Roads is defined to include the eight localities that comprise the Hampton Roads Workforce Investment Area. Those localities are the cities of Chesapeake, Franklin, Norfolk, Portsmouth, Suffolk, and Virginia Beach, and the counties of Isle of Wight and Southampton.

³³ Data Source: Virginia Employment Commission.

High-Tech Service Industries Cluster – Regional Economic Footprint and Performance

In this portion of the section, we provide data on the regional economic footprint and performance of the High-Tech Service Industries Cluster in Hampton Roads. A profile of the regional economic footprint of the 14 industries identified in this cluster in the first quarter of 2016 is provided in Table 8.³⁴

As these data demonstrate, all 14 of the industries identified within the High-Tech Service Industries Cluster had a presence in Hampton Roads in the first quarter of 2016 (although employment in *Electronic Shopping and Mail-Order Houses* was small enough to trigger the Virginia Employment Commission’s non-disclosure requirements). The three largest regional industries in this cluster were: *Architectural, Engineering, and Related Services* (11,104 jobs), *Computer Systems Design and Related Services* (8,553 jobs), and *Management of Companies and Enterprises* (6,208 jobs). Of the 13 cluster industries for which an LQ could be calculated in Hampton Roads, *Architectural, Engineering, and Related Services* and *Business Support Services* exhibited LQs of 1.4, which indicates that their employment footprint in the region is 40 percent greater than one would expect based on the statewide norm. All other cluster industries exhibited LQs less than one, which indicates they are under-represented in the region relative to the statewide norm.



Average weekly wages were highest in *Securities and Commodities Contracts Intermediaries* (\$3,412/wk.), *Other Financial Investment Activities* (\$2,057/wk.), and *Management of Companies and Enterprises* (\$1,940/wk.). In addition, in all cases except for one (*Other Information Services*) the average weekly wages paid by these industries were substantially above the average regional wage. Finally, the industries with the largest Type I Multipliers, which means the industries with the largest relative economic impact on the region, were: *Other Financial Investment Activities* (1.8), *Data Processing, Hosting, and Related Services* (1.6), and *Electronic Shopping and Mail-Order Houses; Other Information Services; and Scientific Research and Development Services* (1.5).

³⁴ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *Establishments* refers to the number of regional establishments in that industry, 3) *Employment* refers to the number of regional jobs in that industry, 4) *LQ* refers to the employment location quotient for that industry (a measure of the relative footprint of the industry), 5) *Average Weekly Wage* refers to the regional average weekly wage for that industry, 6) *As % of Regional Wage* refers to the industry average weekly wage as a percentage of the regional average weekly wage, and 7) *Type I Multiplier* quantifies the size of the economic ripple effect that industry has within the region (the larger this number, the larger the proportion of the industry’s expenditures that remain within the region).

Industry	Establishments	Employment	LQ	Avg. Weekly Wage	as % of Reg. Wage	Type I Multiplier
Architectural, Engineering, & Related Serv.	483	11,104	1.4	\$1,405	166%	1.4
Business Support Services	148	4,815	1.4	\$936	111%	1.3
Computer Systems Design & Related Serv.	631	8,553	0.4	\$1,432	169%	1.3
Data Processing, Hosting, & Related Serv.	41	1,360	0.9	\$900	106%	1.6
Electronic Shopping & Mail-Order Houses	54	N/A	N/A	N/A	N/A	1.5
International Trade Financing	1	1	0.7	\$1,714	202%	1.4
Management of Companies & Enterprises	229	6,208	0.6	\$1,940	229%	1.4
Mgmt., Scientific, & Technical Consulting	583	3,930	0.4	\$1,305	154%	1.3
Other Financial Investment Activities	116	849	0.8	\$2,057	243%	1.8
Other Information Serv.	47	978	0.8	\$778	92%	1.5
Scientific Research & Development Serv.	54	2,184	0.7	\$1,586	187%	1.5
Securities & Commodity Contracts Intermediaries	90	578	0.8	\$3,412	403%	1.4
Software Publishers	18	359	0.5	\$1,254	148%	1.3
Telecommunications	73	1,004	0.3	\$1,619	191%	1.4

Table 8: Economic Footprint of the High-Tech Service Industries Cluster in Hampton Roads³⁵

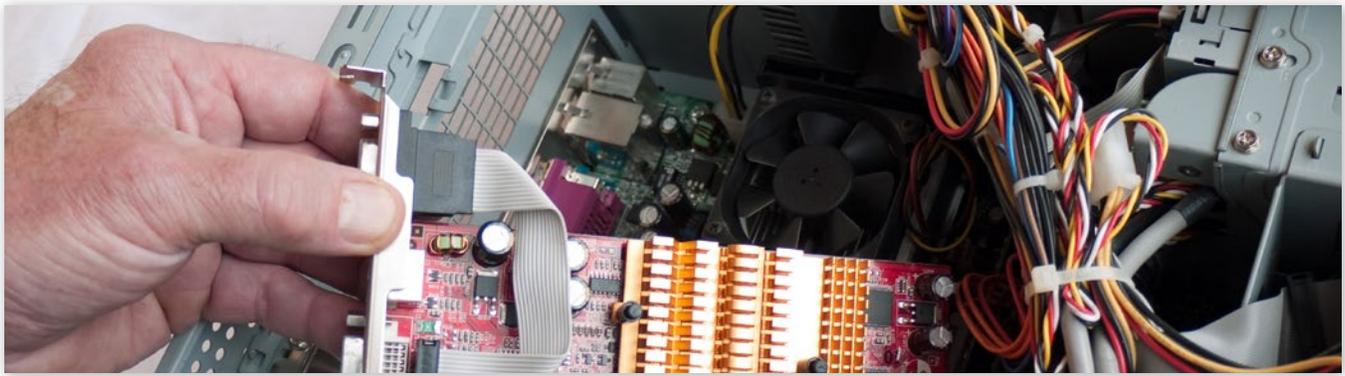


Table 9 provides additional detail on the employment performance of the High-Tech Service Industries Cluster in Hampton Roads.³⁶ As these data show, the largest regional short-term (one-year) employment growth in this cluster occurred in *Telecommunications* (18.1 percent), *Other Information Services* (9.5 percent), and *Management, Scientific, and Technical Consulting* (6.7 percent). These three industries, along with *Software Publishers*, also exhibited regional one-year employment growth that was far greater than the state-wide average for these industries. With regard to long-term (five-year) employment growth, the largest increases occurred in *Software Publishers* (217.7 percent), *Scientific Research and Development Services* (80.8 percent), and *Management, Scientific, and Technical Consulting* (54.0 percent). Moreover, at a regional level these three industries also significantly out-performed their growth at a state-wide level over the same period.

³⁶ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), 4) *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative), 5) *5 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), and 7) *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

Industry	1 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State	5 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State
Architectural, Engineering, & Related Serv.	2.3%	1.4	12.4	-8.5%	N/A	N/A
Business Support Services	-3.6%	N/A	N/A	4.7%	0.8	0.3
Computer Systems Design & Related Serv.	-0.4%	N/A	N/A	12.2%	2.1	1.3
Data Processing, Hosting, & Related Serv.	1.5%	0.9	N/A	18.1%	3.1	1.3
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	N/A	N/A	N/A
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	-2.8%	N/A	N/A	2.2%	0.4	5.7
Mgmt., Scientific, & Technical Consulting	6.7%	4.2	1.3	54.0%	9.2	8.7
Other Financial Investment Activities	-2.1%	N/A	N/A	-3.0%	N/A	N/A
Other Information Serv.	9.5%	6.1	1.3	19.3%	3.3	1.2
Scientific Research & Development Serv.	-13.1%	N/A	N/A	80.8%	13.8	N/A
Securities & Commodity Contracts Intermediaries	4.0%	2.5	2.4	-7.7%	N/A	N/A
Software Publishers	6.5%	4.2	46.5	217.7%	37.2	N/A
Telecommunications	18.1%	11.5	N/A	-11.3%	N/A	N/A

Table 9: Employment Performance of High-Tech Service Industries Cluster – Hampton Roads³⁷



Finally, Table 10 details the wage performance of the High-Tech Service Industries Cluster in Hampton Roads.³⁸ As these data indicate, the largest regional short-term (one-year) wage growth in this cluster occurred in *Telecommunications* (6.2 percent), *Management, Scientific, and Technical Consulting* (4.3 percent), and *International Trade Financing* (3.9 percent). With regard to long-term (five-year) wage growth, the largest increases occurred in *Other Financial Investment Activities* 83.3 percent), *Scientific Research and Development Services* (52.6 percent), and *Business Support Services* (23.2 percent). Moreover, these three industries (and *Management of Companies and Enterprises; Management, Scientific, and Technical Consulting*; and *Securities and Commodity Contracts Intermediaries*) also significantly out-performed average regional wage growth and their own state-wide wage growth over the same period.

³⁸ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), 4) *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative), 5) *5 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), and 7) *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

Industry	1 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State	5 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State
Architectural, Engineering, & Related Serv.	-1.6%	N/A	N/A	6.1%	0.6	0.7
Business Support Services	-17.7%	N/A	N/A	23.2%	2.3	3.2
Computer Systems Design & Related Serv.	-3.0%	N/A	N/A	8.6%	0.9	0.7
Data Processing, Hosting, & Related Serv.	0.0%	N/A	N/A	-5.3%	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	N/A	N/A	N/A
International Trade Financing	3.9%	N/A	N/A	0.0%	0.0	0.0
Management of Companies & Enterprises	2.6%	N/A	N/A	20.5%	2.0	1.7
Mgmt., Scientific, & Technical Consulting	4.3%	N/A	N/A	16.7%	1.7	3.7
Other Financial Investment Activities	3.7%	N/A	N/A	83.3%	8.3	4.3
Other Information Serv.	-3.6%	N/A	N/A	15.6%	1.6	0.4
Scientific Research & Development Serv.	-0.4%	N/A	N/A	52.6%	5.3	8.6
Securities & Commodity Contracts Intermediaries	-20.4%	N/A	N/A	15.1%	1.5	2.8
Software Publishers	-2.0%	N/A	N/A	-20.6%	N/A	N/A
Telecommunications	6.2%	N/A	4.3	19.6%	2.0	0.7

Table 10: Wage Performance of High-Tech Service Industries Cluster – Hampton Roads³⁹

High-Tech Service Industries Cluster – Available Regional Labor Pool

In this portion of the section, we provide an analysis of the regional labor pool available in Hampton Roads to meet the needs of the 14 industries identified in the High-Tech Service Industries Cluster.⁴⁰ The result of that analysis is provided in Table 11. As these data show, in all cases Hampton Roads is able to offer an extensive labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

Industry	Current Regional Employment	Total Available Regional Labor Pool	Current Employment as % of Available Labor Pool
Architectural, Engineering, & Related Serv.	11,104	94,665	12%
Business Support Services	4,815	57,668	8%
Computer Systems Design & Related Serv.	8,553	98,491	9%
Data Processing, Hosting, & Related Serv.	1,360	57,723	2%
Electronic Shopping & Mail-Order Houses	N/A	63,877	N/A
International Trade Financing	1	83,252	0%
Management of Companies & Enterprises	6,208	132,524	5%
Mgmt., Scientific, & Technical Consulting	3,930	102,038	4%
Other Financial Investment Activities	849	36,549	2%
Other Information Serv.	978	45,711	2%
Scientific Research & Development Serv.	2,184	101,607	2%
Securities & Commodity Contracts Intermediaries	578	36,549	2%
Software Publishers	359	40,070	1%
Telecommunications	1,004	69,941	1%

Table 11: High-Tech Service Industries Cluster Available Labor Pool – Hampton Roads⁴¹

⁴⁰ This analysis is based on the U.S. Department of Labor, Employment and Training Administration's *O*Net Career Switchers Matrix*. The *Career Switchers Matrix* identifies the ten occupations that are most closely related to a target occupation based on required skills. By: 1) using the Virginia Employment Commission's most recent state-wide industry staffing matrix to identify those occupations typically employed in the 14 industries that comprise the *High-Tech Services Cluster*, then 2) mapping that list of occupations through the *Career Switchers Matrix* to identify the broader list of occupations that require a similar skill set, and then 3) mapping that broader list into the Virginia Employment Commission's estimates of occupational employment for Hampton Roads, we are able to quantify the total regional labor pool available to meet the workforce needs of the *High-Tech Service Cluster*.

⁴¹ Data Source: Virginia Employment Commission.

In Sum

Although all 14 of the industries identified within the High-Tech Service Industries Cluster had a presence in Hampton Roads in the first quarter of 2016, the three largest were: *Architectural, Engineering, and Related Services* (11,104 jobs), *Computer Systems Design and Related Services* (8,553 jobs), and *Management of Companies and Enterprises* (6,208 jobs). In addition, while all but one industry within the cluster (*Other Information Services*) paid wages that were above the regional average, the three highest paying were: *Securities and Commodities Contracts Intermediaries* (\$3,412/wk.), *Other Financial Investment Activities* (\$2,057/wk.), and *Management of Companies and Enterprises* (\$1,940/wk.) industries.

In terms of performance, the High-Tech Service Industries Cluster industries with the strongest long-term (five-year) regional employment growth were: *Software Publishers* (217.7 percent), *Scientific Research and Development Services* (80.8 percent), and *Management, Scientific, and Technical Consulting* (54.0 percent). The cluster industries with the strongest long-term (five-year) regional wage growth were: *Other Financial Investment Activities* (83.3 percent), *Scientific Research and Development Services* (52.6 percent), and *Business Support Services* (23.2 percent). While, the cluster industries with the largest proportional economic impact on the region were *Other Financial Investment Activities* (Type 1 Multiplier of 1.8), *Data Processing, Hosting, and Related Services* (Type 1 Multiplier of 1.6), and *Electronic Shopping and Mail-Order Houses; Other Information Services; and Scientific Research and Development Services* (Type 1 Multiplier of 1.5).

Taken together these data indicate that, of the 14 industries identified in the High-Tech Service Industries Cluster: 1) *Management of Companies and Enterprise* has a strong existing presence in Hampton Roads as a high-wage industry with a large employment footprint, 2) *Scientific Research and Development Services* (the industry category that includes the region's biotech sector) is a strong performer in the region in terms of long-term employment and wage growth, and proportional economic impact, and 3) *Other Financial Investment Activities* is a high-paying regional industry that is also a strong performer with regard to long-term wage growth and proportional economic impact.

Lastly, Hampton Roads is able to offer an extensive labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

Region 2000/Central Virginia⁴²

Overall Employment Trend

As in earlier sections, Figure 8 depicts the year-over-year change in total employment in Region 2000/Central Virginia for the period from the first quarter of 2011 through the first quarter of 2016, and benchmarks those data against the state of Virginia as a whole. Any point above the zero line in this graph indicates positive year-over-year employment growth, while any point below the zero line indicates a decline in year-over-year employment. As these data show, year-over-year employment growth in Region 2000/Central Virginia fell below the state-wide average for most of this period. As of the first quarter of 2016, year-over-year employment growth stood at 1.4 percent in Region 2000/Central Virginia as compared to 2.2 percent statewide.

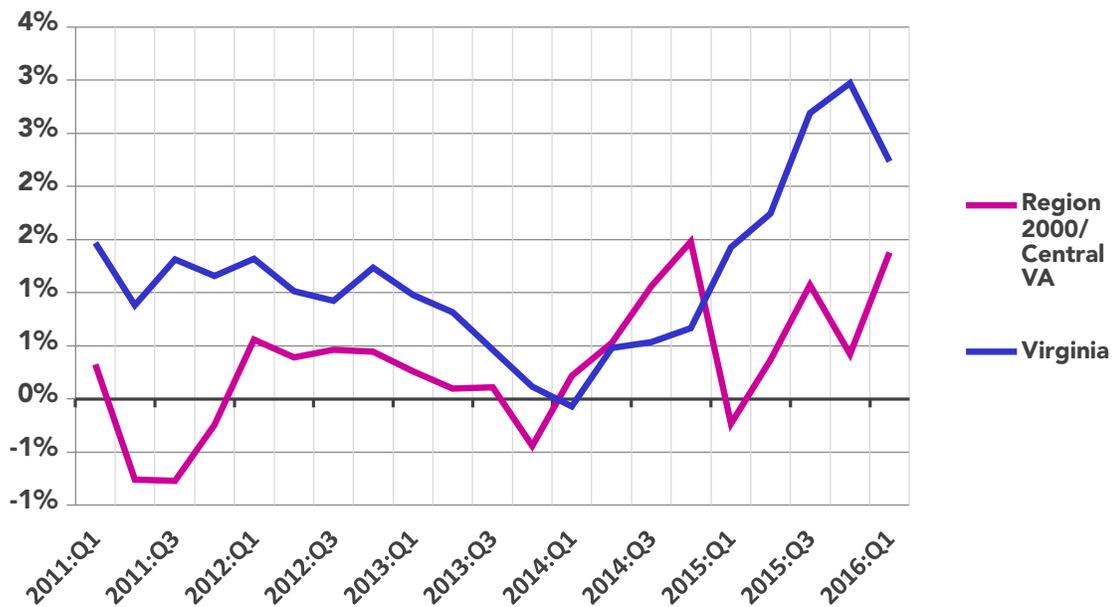


Figure 8: Year-Over-Year Change in Total Employment – 2011:Q1 to 2016:Q1⁴³

⁴² For purposes of this analysis, Region 2000/Central Virginia is defined to include the five localities that comprise the Region 2000/Central Virginia Workforce Investment Area. Those localities are the city of Lynchburg, and the counties of Amherst, Appomattox Bedford, and Campbell.

⁴³ Data Source: Virginia Employment Commission.



High-Tech Service Industries Cluster – Regional Economic Footprint and Performance

Table 12 profiles the economic footprint of the 14 industries identified in the High-Tech Service Industries Cluster in Region 2000/Central Virginia in the first quarter of 2016.⁴⁴ As these data indicate, all but one (*International Trade Financing*) of the 14 of the industries identified within this cluster had a presence in Region 2000/Central Virginia in the first quarter of 2016 (although employment in *Data Processing, Hosting, and Related Services* and *Electronic Shopping and Mail-Order Houses* was small enough to trigger the Virginia Employment Commission’s non-disclosure requirements). The three largest regional industries in this cluster were: *Architectural, Engineering, and Related Services* (2,055 jobs), *Management of Companies and Enterprises* (1,201 jobs), and *Management, Scientific, and Technical Consulting* (380 jobs). Of the 11 High-Tech Service Industries Cluster industries in Region 2000/Central Virginia for which LQs could be calculated, *Architectural, Engineering, and Related Services* exhibited an LQ of 1.3, indicating that its regional employment footprint was 30 percent larger than one would expect based on the statewide norm. All other cluster industries exhibited LQs less than one, indicating that they are under-represented in the region relative to the statewide norm.

Average weekly wages were highest in *Securities and Commodities Contracts Intermediaries* (\$2,465/wk.), *Architectural, Engineering, and Related Services* (\$2,072/wk.), and *Computer Systems Design and Related Services* (\$1,753/wk.). In addition, in all cases except for two (*Business Support Services* and *Other Information Services*) the average weekly wages paid by these industries were well-above the average regional wage. Finally, the industries with the largest Type I Multipliers, which means the industries with the largest relative economic impact on the region, were: *Other Financial Investment Activities* (1.7), and *Data Processing, Hosting, and Related Services*; *Other Information Services*; and *Scientific Research and Development Services* (1.5).

⁴⁴ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *Establishments* refers to the number of regional establishments in that industry, 3) *Employment* refers to the number of regional jobs in that industry, 4) *LQ* refers to the employment location quotient for that industry (a measure of the relative footprint of the industry), 5) *Average Weekly Wage* refers to the regional average weekly wage for that industry, 6) *As % of Regional Wage* refers to the industry average weekly wage as a percentage of the regional average weekly wage, and 7) *Type I Multiplier* quantifies the size of the economic ripple effect that industry has within the region (the larger this number, the larger the proportion of the industry’s expenditures that remain within the region).

Industry	Establishments	Employment	LQ	Avg. Weekly Wage	as % of Reg. Wage	Type I Multiplier
Architectural, Engineering, & Related Serv.	84	2,055	1.3	\$2,072	274%	1.3
Business Support Services	24	165	0.3	\$398	53%	1.3
Computer Systems Design & Related Serv.	84	353	0.1	\$1,753	232%	1.3
Data Processing, Hosting, & Related Serv.	12	N/A	N/A	N/A	N/A	1.5
Electronic Shopping & Mail-Order Houses	18	N/A	N/A	N/A	N/A	1.3
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	45	1,201	0.6	\$1,188	157%	1.3
Mgmt., Scientific, & Technical Consulting	92	380	0.2	\$1,616	214%	1.3
Other Financial Investment Activities	31	115	0.6	\$1,427	189%	1.7
Other Information Serv.	13	154	0.6	\$374	50%	1.5
Scientific Research & Development Serv.	5	18	0.0	\$1,199	159%	1.5
Securities & Commodity Contracts Intermediaries	25	111	0.8	\$2,465	326%	1.4
Software Publishers	6	28	0.2	\$796	105%	1.2
Telecommunications	25	303	0.5	\$1,431	190%	1.3

Table 12: Economic Footprint of the High-Tech Service Industries Cluster in Region 2000/Central Virginia⁴⁵

⁴⁵ Data Source: Virginia Employment Commission and IMPLAN.



Table 13 provides metrics on the employment performance of the High-Tech Service Industries Cluster in Region 2000/Central Virginia.⁴⁶ As these data show, the largest regional short-term (one-year) employment growth in this cluster occurred in *Software Publishers* (55.6 percent), *Computer Systems Design and Related Services* (8.3 percent), and *Securities and Commodities Contracts Intermediaries* (4.7 percent). These three industries, along with *Architectural, Engineering, and Related Services*, also exhibited regional one-year employment growth that was far greater than the state-wide average for these industries. With regard to long-term (five-year) employment growth, the largest increases occurred in *Computer Systems Design and Related Services* (27.4 percent), *Management, Scientific, and Technical Consulting* (16.6 percent), and *Other Information Services* (8.5 percent). Moreover, at a regional level these three industries also significantly out-performed their growth at the state-wide level over the same period.

⁴⁶ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), 4) *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative), 5) *5 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), and 7) *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

Industry	1 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State	5 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State
Architectural, Engineering, & Related Serv.	1.3%	1.0	7.3	-19.0%	N/A	N/A
Business Support Services	-30.4%	N/A	N/A	-47.5%	N/A	N/A
Computer Systems Design & Related Serv.	8.3%	6.0	1.6	27.4%	12.5	2.8
Data Processing, Hosting, & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	N/A	N/A	N/A
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	-6.6%	N/A	N/A	-36.3%	N/A	N/A
Mgmt., Scientific, & Technical Consulting	0.8%	0.6	0.2	16.6%	7.6	2.7
Other Financial Investment Activities	0.0%	0.0	0.0	2.7%	1.2	0.1
Other Information Serv.	1.3%	1.0	0.2	8.5%	3.9	0.5
Scientific Research & Development Serv.	-69.0%	N/A	N/A	-66.7%	N/A	N/A
Securities & Commodity Contracts Intermediaries	4.7%	3.4	2.9	-12.6%	N/A	N/A
Software Publishers	55.6%	40.3	396.0	N/A	N/A	N/A
Telecommunications	-10.1%	N/A	N/A	-18.8%	N/A	N/A

Table 13: Employment Performance of High-Tech Service Industries Cluster – Region 2000/Central Virginia⁴⁷

⁴⁷ Data Source: Virginia Employment Commission.



Table 14 provides similar metrics for the wage performance of the High-Tech Service Industries Cluster in Region 2000/Central Virginia.⁴⁸ As these data indicate, the largest regional short-term (one-year) wage growth in this cluster occurred in *Scientific Research and Development Services* (35.5 percent), *Business Support Services* (14.4 percent), and *Management of Companies and Enterprises* (13.9 percent). With regard to long-term (five-year) wage growth, the largest increases occurred in *Scientific Research and Development Services* (68.2 percent), *Business Support Services* (45.8 percent), and *Computer Systems Design and Related Services* (39.8 percent).

⁴⁸ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), 4) *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative), 5) *5 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), and 7) *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

Industry	1 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State	5 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State
Architectural, Engineering, & Related Serv.	12.8%	19.2	N/A	-5.9%	N/A	N/A
Business Support Services	14.4%	21.6	N/A	45.8%	7.6	6.3
Computer Systems Design & Related Serv.	1.0%	1.6	N/A	39.8%	6.6	3.2
Data Processing, Hosting, & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	N/A	N/A	N/A
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	13.9%	20.9	N/A	26.1%	4.3	2.1
Mgmt., Scientific, & Technical Consulting	-1.6%	N/A	N/A	20.7%	3.4	4.6
Other Financial Investment Activities	-13.1%	N/A	N/A	-2.5%	N/A	N/A
Other Information Serv.	3.3%	5.0	N/A	0.8%	0.1	0.0
Scientific Research & Development Serv.	35.5%	53.2	N/A	68.2%	11.3	11.2
Securities & Commodity Contracts Intermediaries	-12.1%	N/A	N/A	-3.9%	N/A	N/A
Software Publishers	-54.1%	N/A	N/A	N/A	N/A	N/A
Telecommunications	6.6%	9.9	4.6	17.4%	2.9	0.6

Table 14: Wage Performance of High-Tech Service Industries Cluster – Region 2000/Central Virginia⁴⁹

⁴⁹ Data Source: Virginia Employment Commission.

High-Tech Service Industries Cluster – Available Regional Labor Pool

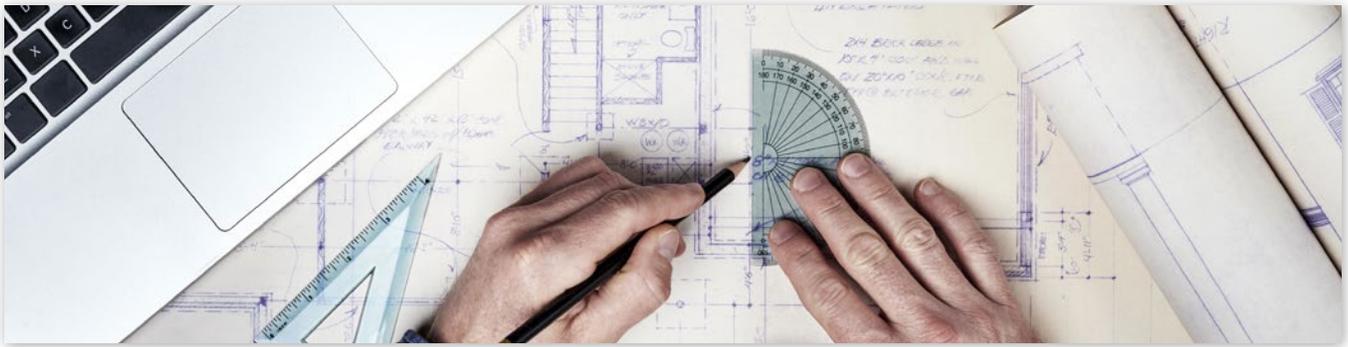
In this portion of the section, we provide an analysis of the regional labor pool available in Region 2000/Central Virginia to meet the needs of the 14 industries identified in the High-Tech Service Industries Cluster.⁵⁰ The result of that analysis is provided in Table 15. As these data show, in all cases Region 2000/Central Virginia is able to offer a significant labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

Industry	Current Regional Employment	Total Available Regional Labor Pool	Current Employment as % of Available Labor Pool
Architectural, Engineering, & Related Serv.	2,055	13,528	15%
Business Support Services	165	7,324	2%
Computer Systems Design & Related Serv.	353	10,412	3%
Data Processing, Hosting, & Related Serv.	N/A	5,653	N/A
Electronic Shopping & Mail-Order Houses	N/A	12,747	N/A
International Trade Financing	N/A	8,603	N/A
Management of Companies & Enterprises	1,201	19,947	6%
Mgmt., Scientific, & Technical Consulting	380	10,874	3%
Other Financial Investment Activities	115	4,108	3%
Other Information Serv.	154	4,194	4%
Scientific Research & Development Serv.	18	11,598	0%
Securities & Commodity Contracts Intermediaries	111	4,108	3%
Software Publishers	28	4,124	1%
Telecommunications	303	6,999	4%

Table 15: High-Tech Service Industries Cluster Available Labor Pool – Region 2000/Central Virginia⁵¹

⁵⁰ This analysis is based on the U.S. Department of Labor, Employment and Training Administration's *O*Net Career Switchers Matrix*. The *Career Switchers Matrix* identifies the ten occupations that are most closely related to a target occupation based on required skills. By: 1) using the Virginia Employment Commission's most recent state-wide industry staffing matrix to identify those occupations typically employed in the 14 industries that comprise the *High-Tech Services Cluster*, then 2) mapping that list of occupations through the *Career Switchers Matrix* to identify the broader list of occupations that require a similar skill set, and then 3) mapping that broader list into the Virginia Employment Commission's estimates of occupational employment for Region 2000/Central Virginia, we are able to quantify the total regional labor pool available to meet the workforce needs of the *High-Tech Service Cluster*.

⁵¹ Data Source: Virginia Employment Commission.



In Sum

All but one (*International Trade Financing*) of the 14 industries that comprise the High-Tech Service Industries Cluster had a presence in Region 2000/Central Virginia in the first quarter of 2016 and the three largest were: *Architectural, Engineering, and Related Services* (2,055 jobs), *Management of Companies and Enterprises* (1,201 jobs), and *Management, Scientific, and Technical Consulting* (380 jobs). In addition, the average weekly wages paid by industries in this cluster were in almost all cases well above the average regional wage, and the three highest-paying were: *Securities and Commodities Contracts Intermediaries* (\$2,465/wk.), *Architectural, Engineering, and Related Services* (\$2,072/wk.), and *Computer Systems Design and Related Services* (\$1,753/wk.).

In terms of performance, the High-Tech Service Industries Cluster industries with the strongest long-term (five-year) regional employment growth were: *Computer Systems Design and Related Services* (27.4 percent), *Management, Scientific, and Technical Consulting* (16.6 percent), and *Other Information Services* (8.5 percent). The cluster industries with the strongest long-term (five-year) regional wage growth were: *Scientific Research and Development Services* (68.2 percent), *Business Support Services* (45.8 percent), and *Computer Systems Design and Related Services* (39.8 percent). While the cluster industries with the largest proportional economic impact on the region were: *Other Financial Investment Activities* (Type 1 Multiplier of 1.7), and *Data Processing, Hosting, and Related Services; Other Information Services; and Scientific Research and Development Services* (Type 1 Multiplier of 1.5).

Taken together these data indicate that of the 14 industries identified in the High-Tech Service Industries Cluster: 1) *Architectural, Engineering, and Related Services* has a strong existing presence in Region 2000/Central Virginia as a high-wage industry with a large employment footprint, 2) *Computer Systems Design and Related Services* is a high-paying industry within the region, and is also a strong performer in terms of both long-term employment and wage growth, 3) *Management, Scientific, and Technical Services* has a large employment footprint in the region and is a high performer in regard to long-term employment growth, 4) *Scientific Research and Development Services* is a high performer in the region in terms of long-term wage growth and proportional economic impact, and 5) *Other Information Services* is a high performer in the region in regard to long-term employment growth and proportional economic impact.

Lastly, Region 2000/Central Virginia is able to offer a significant labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

South Central⁵²

Overall Employment Trend

Figure 9 depicts the year-over-year change in total employment in South Central for the period from the first quarter of 2011 through the first quarter of 2016, and benchmarks those data against the state of Virginia as a whole. Any point above the zero line in this graph indicates positive year-over-year employment growth, while any point below the zero line indicates a decline in year-over-year employment. As these data indicate, South Central experienced year-over-year employment losses over the initial portion of this period, but starting in the third quarter of 2013 the region's year-over-year employment change moved back into positive territory and it has since generally trended with the state-wide average. As of the first quarter of 2016, year-over-year employment growth stood at 1.3 percent in South Central as compared to 2.2 percent statewide.



Figure 9: Year-Over-Year Change in Total Employment – 2011:Q1 to 2016:Q1⁵³

⁵² For purposes of this analysis, South Central is defined to include the ten localities that comprise the South Central Workforce Investment Area. Those localities are the counties of Amelia, Brunswick, Buckingham, Charlotte, Halifax, Lunenburg, Mecklenburg, Nottoway, and Prince Edward.

⁵³ Data Source: Virginia Employment Commission.



High-Tech Service Industries Cluster – Regional Economic Footprint and Performance

Table 16 details the economic footprint of the 14 industries identified in the High-Tech Service Industries Cluster in South Central in the first quarter of 2016.⁵⁴ As these data indicate, all but one (*International Trade Financing*) of the 14 of the industries identified within this cluster had a presence in South Central in the first quarter of 2016 (although employment in *Data Processing, Hosting, and Related Services*; *Scientific Research and Development Services*, and *Software Publishers* was small enough to trigger the Virginia Employment Commission’s non-disclosure requirements). The three largest regional industries in this cluster were: *Management of Companies and Enterprises* (394 jobs), *Architectural, Engineering, and Related Services* (214 jobs), and *Computer Systems Design and Related Services* (186 jobs). Of the ten High-Tech Service Industries Cluster industries in South Central for which LQs could be calculated, none exhibited an LQ greater than one, which indicates that all industries in this cluster were under-represented in the region relative to the statewide norm.

Average weekly wages were highest in *Computer Systems Design and Related Services* (\$1,984/wk.), *Other Financial Investment Activities* (\$1,942/wk.), and *Management, Scientific, and Technical Consulting* (\$1,935/wk.), and in most cases the average weekly wages paid by industries in the region’s High-Tech Service Industries Cluster were well-above the average regional wage. Finally, the industries with the largest Type I Multipliers, which means the industries with the largest relative economic impact on the region, were: *Data Processing, Hosting, and Related Services* (1.4), and *Electronic Shopping and Mail-Order Houses; Other Information Services; Scientific Research and Development Services; and Securities and Commodities Contracts Intermediaries* (1.3).

⁵⁴ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *Establishments* refers to the number of regional establishments in that industry, 3) *Employment* refers to the number of regional jobs in that industry, 4) *LQ* refers to the employment location quotient for that industry (a measure of the relative footprint of the industry), 5) *Average Weekly Wage* refers to the regional average weekly wage for that industry, 6) *As % of Regional Wage* refers to the industry average weekly wage as a percentage of the regional average weekly wage, and 7) *Type I Multiplier* quantifies the size of the economic ripple effect that industry has within the region (the larger this number, the larger the proportion of the industry’s expenditures that remain within the region).

Industry	Establishments	Employment	LQ	Avg. Weekly Wage	as % of Reg. Wage	Type I Multiplier
Architectural, Engineering, & Related Serv.	33	214	0.3	\$982	156%	1.2
Business Support Services	4	164	0.5	\$306	48%	1.2
Computer Systems Design & Related Serv.	30	186	0.1	\$1,984	314%	1.2
Data Processing, Hosting, & Related Serv.	3	N/A	N/A	N/A	N/A	1.4
Electronic Shopping & Mail-Order Houses	3	13	0.1	\$443	70%	1.3
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	28	394	0.4	\$1,341	213%	1.2
Mgmt., Scientific, & Technical Consulting	39	92	0.1	\$1,935	307%	1.2
Other Financial Investment Activities	6	27	0.2	\$1,942	308%	1.4
Other Information Serv.	8	74	0.6	\$299	47%	1.3
Scientific Research & Development Serv.	2	N/A	N/A	N/A	N/A	1.3
Securities & Commodity Contracts Intermediaries	9	28	0.4	\$1,648	261%	1.3
Software Publishers	1	N/A	N/A	N/A	N/A	1.2
Telecommunications	19	123	0.3	\$1,242	197%	1.3

Table 16: Economic Footprint of the High-Tech Service Industries Cluster in South Central⁵⁵



Table 17 details the employment performance of the High-Tech Service Industries Cluster in South Central.⁵⁶ As these data show, the largest regional short-term (one-year) employment growth in this cluster occurred in *Computer Systems Design and Related Services* (232.1 percent), *Telecommunications* (1.7 percent), and *Management of Companies and Enterprises* (1.5 percent). With regard to long-term (five-year) employment growth, the largest increases occurred in *Business Support Services* (382.4 percent), *Computer Systems Design and Related Services* (376.9 percent), and *Electronic Shopping and Mail-Order Houses* (85.7 percent). Moreover, at a regional level these three industries also significantly out-performed their growth at the state-wide level over the same period.

⁵⁶ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), 4) *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative), 5) *5 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Total Employment Growth in Region* benchmarks the industry's employment growth against the region's total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), and 7) *Relative to Industry Employment Growth in State* benchmarks the industry's regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

Industry	1 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State	5 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State
Architectural, Engineering, & Related Serv.	-10.1%	N/A	N/A	2.4%	N/A	N/A
Business Support Services	N/A	N/A	N/A	382.4%	N/A	24.6
Computer Systems Design & Related Serv.	232.1%	172.2	46.0	376.9%	N/A	38.9
Data Processing, Hosting, & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	85.7%	N/A	9.7
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	1.5%	1.1	N/A	-35.3%	N/A	N/A
Mgmt., Scientific, & Technical Consulting	-6.1%	N/A	N/A	4.5%	N/A	0.7
Other Financial Investment Activities	N/A	N/A	N/A	3.8%	N/A	0.1
Other Information Serv.	N/A	N/A	N/A	-16.9%	N/A	N/A
Scientific Research & Development Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Securities & Commodity Contracts Intermediaries	N/A	N/A	N/A	12.0%	N/A	N/A
Software Publishers	N/A	N/A	N/A	N/A	N/A	N/A
Telecommunications	1.7%	1.2	N/A	-16.9%	N/A	N/A

Table 17: Employment Performance of High-Tech Service Industries Cluster – South Central⁵⁷

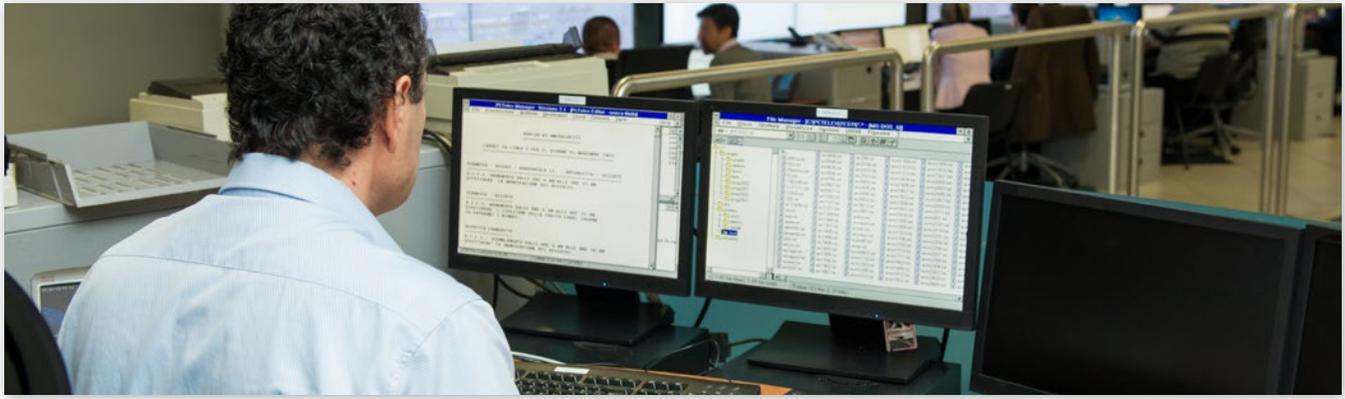


Table 18 details the wage performance of the High-Tech Service Industries Cluster in South Central.⁵⁸ As these data indicate, the largest regional short-term (one-year) wage growth in this cluster occurred in *Computer Systems Design and Related Services* (33.5 percent), *Telecommunications* (12.2 percent), and *Other Financial Investment Activities* (8.2 percent). While the largest long-term (five-year) wage growth occurred in *Computer Systems Design and Related Services* (142.2 percent), *Telecommunications* (29.8 percent), and *Securities and Commodities Contracts Intermediaries* (27.7 percent).

⁵⁸ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), 4) *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative), 5) *5 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Average Wage Growth in Region* benchmarks the industry's wage growth against the region's average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the "growth" rates was negative), and 7) *Relative to Industry Wage Growth in State* benchmarks the industry's regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the "growth" rates was negative).

Industry	1 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State	5 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State
Architectural, Engineering, & Related Serv.	-2.3%	N/A	N/A	4.8%	0.4	0.5
Business Support Services	N/A	N/A	N/A	-4.7%	N/A	N/A
Computer Systems Design & Related Serv.	33.5%	9.7	N/A	142.2%	11.6	11.3
Data Processing, Hosting, & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	-12.1%	N/A	N/A
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	4.6%	1.3	N/A	9.0%	0.7	0.7
Mgmt., Scientific, & Technical Consulting	2.5%	0.7	N/A	-25.9%	N/A	N/A
Other Financial Investment Activities	8.2%	2.4	N/A	2.7%	0.2	0.1
Other Information Serv.	N/A	N/A	N/A	-6.3%	N/A	N/A
Scientific Research & Development Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Securities & Commodity Contracts Intermediaries	-2.9%	N/A	N/A	27.7%	2.3	5.2
Software Publishers	N/A	N/A	N/A	N/A	N/A	N/A
Telecommunications	12.2%	3.5	8.5	29.8%	2.4	1.0

Table 18: Wage Performance of High-Tech Service Industries Cluster – South Central⁵⁹

High-Tech Service Industries Cluster – Available Regional Labor Pool

In this portion of the section, we provide an analysis of the regional labor pool available in South Central to meet the needs of the 14 industries identified in the High-Tech Service Industries Cluster.⁶⁰ The result of that analysis is provided in Table 19. As these data show, in all cases South Central is able to offer a large labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

Industry	Current Regional Employment	Total Available Regional Labor Pool	Current Employment as % of Available Labor Pool
Architectural, Engineering, & Related Serv.	214	4,015	5%
Business Support Services	164	2,353	7%
Computer Systems Design & Related Serv.	186	4,160	4%
Data Processing, Hosting, & Related Serv.	N/A	2,154	N/A
Electronic Shopping & Mail-Order Houses	13	5,501	0%
International Trade Financing	N/A	3,699	N/A
Management of Companies & Enterprises	394	8,638	5%
Mgmt., Scientific, & Technical Consulting	92	4,227	2%
Other Financial Investment Activities	27	1,503	2%
Other Information Serv.	74	1,246	6%
Scientific Research & Development Serv.	N/A	4,969	N/A
Securities & Commodity Contracts Intermediaries	28	1,503	2%
Software Publishers	N/A	1,397	N/A
Telecommunications	123	2,284	5%

Table 19: High-Tech Service Industries Cluster Available Labor Pool – South Central⁶¹

⁶⁰ This analysis is based on the U.S. Department of Labor, Employment and Training Administration's *O*Net Career Switchers Matrix*. The *Career Switchers Matrix* identifies the ten occupations that are most closely related to a target occupation based on required skills. By: 1) using the Virginia Employment Commission's most recent state-wide industry staffing matrix to identify those occupations typically employed in the 14 industries that comprise the *High-Tech Services Cluster*, then 2) mapping that list of occupations through the *Career Switchers Matrix* to identify the broader list of occupations that require a similar skill set, and then 3) mapping that broader list into the Virginia Employment Commission's estimates of occupational employment for South Central, we are able to quantify the total regional labor pool available to meet the workforce needs of the *High-Tech Service Cluster*.

⁶¹ Data Source: Virginia Employment Commission.

In Sum

Of the 13 industries within the High-Tech Service Industries Cluster that had a presence in South Central in the first quarter of 2016, the three largest were: *Management of Companies and Enterprises* (394 jobs), *Architectural, Engineering, and Related Services* (214 jobs), and *Computer Systems Design and Related Services* (186 jobs). In most cases the average weekly wages paid by industries in this cluster were well-above the average regional wage and the three highest-paying were: *Computer Systems Design and Related Services* (\$1,984/wk.), *Other Financial Investment Activities* (\$1,942/wk.), and *Management, Scientific, and Technical Consulting* (\$1,935/wk.).

In terms of performance, the High-Tech Service Industries Cluster industries with the strongest long-term (five-year) regional employment growth were: *Business Support Services* (382.4 percent), *Computer Systems Design and Related Services* (376.9 percent), and *Electronic Shopping and Mail-Order Houses* (85.7 percent). The cluster industries with the strongest long-term (five-year) regional wage growth were: *Computer Systems Design and Related Services* (142.2 percent), *Telecommunications* (29.8 percent), and *Securities and Commodities Contracts Intermediaries* (27.7 percent). While, the cluster industries with the largest proportional economic impact on the region were: *Data Processing, Hosting, and Related Services* (Type 1 Multiplier of 1.4), and *Electronic Shopping and Mail-Order Houses; Other Information Services; Scientific Research and Development Services; and Securities and Commodities Contracts Intermediaries* (Type 1 Multiplier of 1.3).

Taken together these data indicate that, of the 14 industries identified in the High-Tech Service Industries Cluster: 1) *Computer Systems Design and Related Services* has a strong existing presence in South Central as a high-wage industry with a large employment footprint, and is a high performer in terms of both long-term employment and wage growth, 2) *Electronic Shopping and Mail-Order Houses* is a high performer within the region in terms of long-term employment growth and proportional economic impact, and 3) *Securities and Commodity Contracts Intermediaries* is a high performer within the region in terms of long-term wage growth and proportional economic impact.

Lastly, South Central is able to offer a significant labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

West Piedmont⁶²

Overall Employment Trend

The year-over-year change in total employment in West Piedmont for the period from the first quarter of 2011 through the first quarter of 2016 is depicted in Figure 10, and that trend is benchmarked against the state of Virginia as a whole. Any point above the zero line in this graph indicates positive year-over-year employment growth, while any point below the zero line indicates a decline in year-over-year employment. As these data demonstrate, employment growth in West Piedmont generally fell below the state-wide average throughout the period. As of the first quarter of 2016, year-over-year employment growth stood at 1.8 percent in West Piedmont as compared to 2.2 percent statewide.

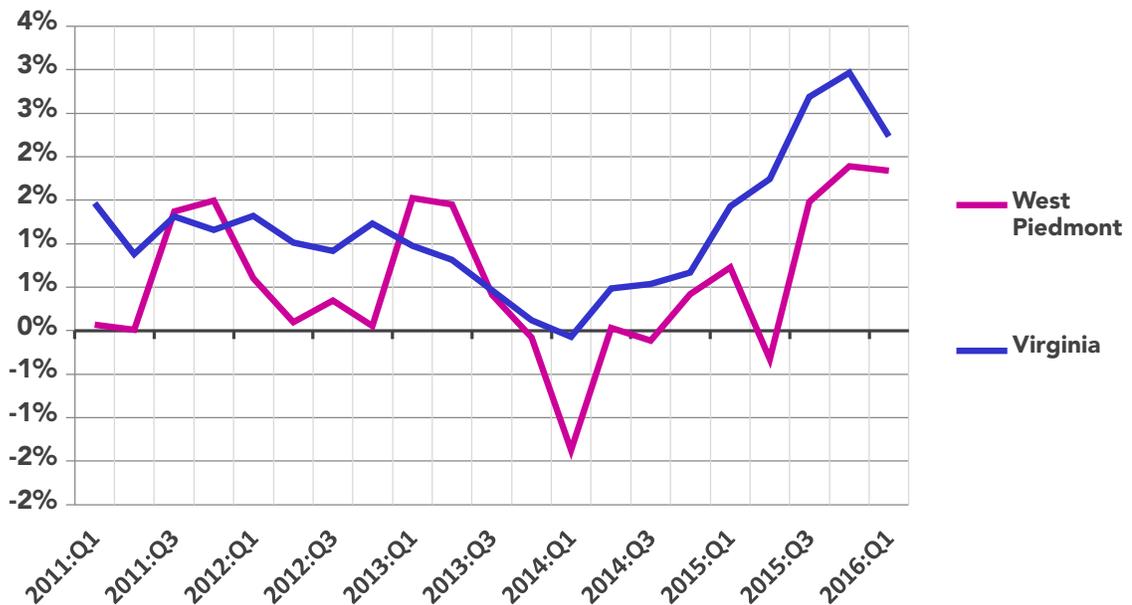


Figure 10: Year-Over-Year Change in Total Employment – 2011:Q1 to 2016:Q1⁶³

⁶² For purposes of this analysis, West Piedmont is defined to include the five localities that comprise the West Piedmont Workforce Investment Area. Those localities are the cities of Danville and Martinsville, and the counties of Henry, Patrick, and Pittsylvania.

⁶³ Data Source: Virginia Employment Commission.



High-Tech Service Industries Cluster – Regional Economic Footprint and Performance

Table 20 provides data on the economic footprint of the 14 industries identified in the High-Tech Service Industries Cluster in West Piedmont in the first quarter of 2016.⁶⁴ As shown in this table, all but two (*International Trade Financing* and *Software Publishers*) of the 14 of the industries identified within this cluster had a presence in West Piedmont in the first quarter of 2016 (although employment in *Computer Systems Design and Related Services*; *Electronic Shopping and Mail-Order Houses*; and *Other Information Services* was small enough to trigger the Virginia Employment Commission’s non-disclosure requirements). The three largest regional industries in this cluster were: *Business Support Services* (1,009 jobs), *Management of Companies and Enterprises* (473 jobs), and *Management, Scientific, and Technical Consulting* (282 jobs). Of the nine High-Tech Service Industries Cluster industries in West Piedmont for which LQs could be calculated, *Business Support Services* exhibited an LQ of 2.2, indicating that its employment footprint within the region was more than twice what one would expect based on the statewide norm. All other cluster industries had LQs that were less than one, indicating that they are under-represented in the region relative to the statewide norm.

Average weekly wages were highest in *Securities and Commodity Contracts Intermediaries* (\$2,535/wk.), *Management of Companies and Enterprises* (\$1,429/wk.), and *Telecommunications* (\$1,152/wk.). With the exception of *Business Support Services*, average weekly wages paid by all industries in the region’s High-Tech Service Industries Cluster were well-above the average regional wage. Finally, the industries with the largest Type I Multipliers, which means the industries with the largest relative economic impact on the region, were: *Other Financial Investment Activities* (1.6), and *Data Processing, Hosting, and Related Services* (1.4).

⁶⁴ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *Establishments* refers to the number of regional establishments in that industry, 3) *Employment* refers to the number of regional jobs in that industry, 4) *LQ* refers to the employment location quotient for that industry (a measure of the relative footprint of the industry), 5) *Average Weekly Wage* refers to the regional average weekly wage for that industry, 6) *As % of Regional Wage* refers to the industry average weekly wage as a percentage of the regional average weekly wage, and 7) *Type I Multiplier* quantifies the size of the economic ripple effect that industry has within the region (the larger this number, the larger the proportion of the industry’s expenditures that remain within the region).

Industry	Establishments	Employment	LQ	Avg. Weekly Wage	as % of Reg. Wage	Type I Multiplier
Architectural, Engineering, & Related Serv.	24	163	0.2	\$1,006	164%	1.3
Business Support Services	14	1,009	2.2	\$401	66%	1.2
Computer Systems Design & Related Serv.	21	N/A	N/A	N/A	N/A	1.3
Data Processing, Hosting, & Related Serv.	5	153	0.7	\$698	114%	1.4
Electronic Shopping & Mail-Order Houses	6	N/A	N/A	N/A	N/A	1.2
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	30	473	0.4	\$1,429	233%	1.2
Mgmt., Scientific, & Technical Consulting	16	282	0.2	\$743	121%	1.3
Other Financial Investment Activities	5	5	0.0	\$649	106%	1.6
Other Information Serv.	11	N/A	N/A	N/A	N/A	1.3
Scientific Research & Development Serv.	6	115	0.3	\$1,068	175%	1.3
Securities & Commodity Contracts Intermediaries	19	69	0.7	\$2,535	414%	1.3
Software Publishers	N/A	N/A	N/A	N/A	N/A	N/A
Telecommunications	17	206	0.5	\$1,152	188%	1.2

Table 20: Economic Footprint of the High-Tech Service Industries Cluster in West Piedmont⁶⁵

⁶⁵ Data Source: Virginia Employment Commission and IMPLAN.



Table 21 provides employment performance metrics for West Piedmont’s High-Tech Service Industries Cluster.⁶⁶ As these data indicate, the largest regional short-term (one-year) employment growth in this cluster occurred in *Scientific Research and Development Services* (22.3 percent), *Securities and Commodities Contracts Intermediaries* (13.1 percent), and *Business Support Services* (3.6 percent). With regard to long-term (five-year) employment growth, the largest increases occurred in *Scientific Research and Development Services* (784.6 percent), *Management, Scientific, and Technical Consulting* (370.0 percent), and *Business Support Services* (40.1 percent).

⁶⁶ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Total Employment Growth in Region* benchmarks the industry’s employment growth against the region’s total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the “growth” rates was negative), 4) *Relative to Industry Employment Growth in State* benchmarks the industry’s regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the “growth” rates was negative), 5) *5 yr. Employment Growth* refers to the percentage growth in industry employment in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Total Employment Growth in Region* benchmarks the industry’s employment growth against the region’s total employment growth over the same period (a number above one indicates the industry grew faster than total employment in the region, a number below one indicates that it grew slower than total employment in the region, and N/A indicates that data are not available or one of the “growth” rates was negative), and 7) *Relative to Industry Employment Growth in State* benchmarks the industry’s regional employment growth against employment growth in that industry at the state-wide level over the same period (a number above one indicates that the industry grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the “growth” rates was negative).

Industry	1 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State	5 yr. Emp. Growth	Relative to Total Emp. Growth in Region	Relative to Industry Emp. Growth in State
Architectural, Engineering, & Related Serv.	-28.8%	N/A	N/A	-0.6%	N/A	N/A
Business Support Services	3.6%	2.0	1.0	40.1%	12.1	2.6
Computer Systems Design & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Data Processing, Hosting, & Related Serv.	2.0%	1.1	N/A	-27.5%	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	N/A	N/A	N/A
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	-6.3%	N/A	N/A	-7.3%	N/A	N/A
Mgmt., Scientific, & Technical Consulting	-17.1%	N/A	N/A	370.0%	111.2	59.4
Other Financial Investment Activities	0.0%	N/A	N/A	-78.3%	N/A	N/A
Other Information Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Scientific Research & Development Serv.	22.3%	12.1	N/A	784.6%	235.7	N/A
Securities & Commodity Contracts Intermediaries	13.1%	7.1	8.0	9.5%	2.9	N/A
Software Publishers	N/A	N/A	N/A	N/A	N/A	N/A
Telecommunications	0.0%	0.0	N/A	-21.1%	N/A	N/A

Table 21: Employment Performance of High-Tech Service Industries Cluster – West Piedmont⁶⁷

⁶⁷ Data Source: Virginia Employment Commission.



Table 22 provides wage performance metrics for West Piedmont’s High-Tech Service Industries Cluster.⁶⁸ As these data indicate, the largest regional short-term (one-year) wage growth in this cluster occurred in *Computer Systems Design and Related Services* (33.5 percent), *Telecommunications* (12.2 percent), and *Other Financial Investment Activities* (8.2 percent). While the largest long-term (five-year) wage growth occurred in *Computer Systems Design and Related Services* (142.2 percent), *Telecommunications* (29.8 percent), and *Securities and Commodities Contracts Intermediaries* (27.7 percent).

⁶⁸ In this table: 1) *Industry* refers to the specific industry within the cluster, 2) *1 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2015 and the first quarter of 2016, 3) *Relative to Average Wage Growth in Region* benchmarks the industry’s wage growth against the region’s average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the “growth” rates was negative), 4) *Relative to Industry Wage Growth in State* benchmarks the industry’s regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the “growth” rates was negative), 5) *5 yr. Wage Growth* refers to the percentage growth in industry wage in the region between the first quarter of 2011 and the first quarter of 2016, 6) *Relative to Average Wage Growth in Region* benchmarks the industry’s wage growth against the region’s average wage growth over the same period (a number above one indicates that industry wage grew faster than the average wage in the region, a number below one indicates that it grew slower than the average wage in the region, and N/A indicates that data are not available or one of the “growth” rates was negative), and 7) *Relative to Industry Wage Growth in State* benchmarks the industry’s regional wage growth against state-wide wage growth in that industry over the same period (a number above one indicates that industry wage grew faster in the region than at the state-wide level, a number below one indicates that it grew slower in the region than at the state-wide level, and N/A indicates that data are not available or one of the “growth” rates was negative).

Industry	1 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State	5 yr. Wage Growth	Relative to Avg. Wage Growth in Region	Relative to Industry Wage Growth in State
Architectural, Engineering, & Related Serv.	-2.3%	N/A	N/A	4.8%	0.4	0.5
Business Support Services	N/A	N/A	N/A	-4.7%	N/A	N/A
Computer Systems Design & Related Serv.	33.5%	9.7	N/A	142.2%	11.6	11.3
Data Processing, Hosting, & Related Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Electronic Shopping & Mail-Order Houses	N/A	N/A	N/A	-12.1%	N/A	N/A
International Trade Financing	N/A	N/A	N/A	N/A	N/A	N/A
Management of Companies & Enterprises	4.6%	1.3	N/A	9.0%	0.7	0.7
Mgmt., Scientific, & Technical Consulting	2.5%	0.7	N/A	-25.9%	N/A	N/A
Other Financial Investment Activities	8.2%	2.4	N/A	2.7%	0.2	0.1
Other Information Serv.	N/A	N/A	N/A	-6.3%	N/A	N/A
Scientific Research & Development Serv.	N/A	N/A	N/A	N/A	N/A	N/A
Securities & Commodity Contracts Intermediaries	-2.9%	N/A	N/A	27.7%	2.3	5.2
Software Publishers	N/A	N/A	N/A	N/A	N/A	N/A
Telecommunications	12.2%	3.5	8.5	29.8%	2.4	1.0

Table 22: Wage Performance of High-Tech Service Industries Cluster – West Piedmont⁶⁹

⁶⁹ Data Source: Virginia Employment Commission.

High-Tech Service Industries Cluster – Available Regional Labor Pool

In this portion of the section, we provide an analysis of the regional labor pool available in West Piedmont to meet the needs of the 14 industries identified in the High-Tech Service Industries Cluster.⁷⁰ The result of that analysis is provided in Table 23. As these data show, in all cases West Piedmont is able to offer a large labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

Industry	Current Regional Employment	Total Available Regional Labor Pool	Current Employment as % of Available Labor Pool
Architectural, Engineering, & Related Serv.	163	7,105	2%
Business Support Services	1,009	3,144	32%
Computer Systems Design & Related Serv.	N/A	3,995	N/A
Data Processing, Hosting, & Related Serv.	153	2,270	7%
Electronic Shopping & Mail-Order Houses	N/A	8,683	N/A
International Trade Financing	N/A	3,888	N/A
Management of Companies & Enterprises	473	11,342	4%
Mgmt., Scientific, & Technical Consulting	282	4,255	7%
Other Financial Investment Activities	5	1,811	0%
Other Information Serv.	N/A	1,684	N/A
Scientific Research & Development Serv.	115	4,845	2%
Securities & Commodity Contracts Intermediaries	69	1,811	4%
Software Publishers	N/A	1,528	N/A
Telecommunications	206	2,379	9%

Table 23: High-Tech Service Industries Cluster Available Labor Pool – West Piedmont⁷¹

⁷⁰ This analysis is based on the U.S. Department of Labor, Employment and Training Administration's O*Net Career Switchers Matrix. The Career Switchers Matrix identifies the ten occupations that are most closely related to a target occupation based on required skills. By: 1) using the Virginia Employment Commission's most recent state-wide industry staffing matrix to identify those occupations typically employed in the 14 industries that comprise the High-Tech Services Cluster, then 2) mapping that list of occupations through the Career Switchers Matrix to identify the broader list of occupations that require a similar skill set, and then 3) mapping that broader list into the Virginia Employment Commission's estimates of occupational employment for South Central, we are able to quantify the total regional labor pool available to meet the workforce needs of the High-Tech Service Cluster.

⁷¹ Data Source: Virginia Employment Commission.



In Sum

Of the 12 industries within the High-Tech Service Industries Cluster that had a presence in West Piedmont in the first quarter of 2016, the three largest were: *Business Support Services* (1,009 jobs), *Management of Companies and Enterprises* (473 jobs), and *Management, Scientific, and Technical Consulting* (282 jobs). With the exception of *Business Support Services*, average weekly wages paid by all industries in the region's High-Tech Service Industries Cluster were well-above the average regional wage and the three highest-paying were: *Securities and Commodity Contracts Intermediaries* (\$2,535/wk.), *Management of Companies and Enterprises* (\$1,429/wk.), and *Telecommunications* (\$1,152/wk.).

In terms of performance, the High-Tech Service Industries Cluster industries with the strongest long-term (five-year) regional employment growth were: *Scientific Research and Development Services* (784.6 percent), *Management, Scientific, and Technical Consulting* (370.0 percent), and *Business Support Services* (40.1 percent). The cluster industries with the strongest long-term (five-year) regional wage growth were: *Computer Systems Design and Related Services* (142.2 percent), *Telecommunications* (29.8 percent), and *Securities and Commodities Contracts Intermediaries* (27.7 percent). While the cluster industries with the largest proportional economic impact on the region were: *Other Financial Investment Activities* (Type 1 Multiplier of 1.6), and *Data Processing, Hosting, and Related Services* (Type 1 Multiplier of 1.4).

Taken together these data indicate that, of the 14 industries identified in the High-Tech Service Industries Cluster: 1) *Management of Companies and Enterprises* has a strong existing presence in West Piedmont as a high-wage industry with a large employment footprint, 2) *Management, Scientific, and Technical Services* has a large employment footprint in the region and is a high performer in regard to long-term employment growth, 3) *Business Support Services* has a large employment footprint in the region and is a high performer in regard to long-term employment growth, and 4) *Securities and Commodity Contracts Intermediaries* is a high-wage industry in the region that is also a high performer in terms of long-term wage growth.

Lastly, West Piedmont is able to offer a large labor pool to satisfy the needs of the 14 industries identified in the High-Tech Service Industries Cluster.

CONCLUSION

Virginia Beach will be the site of at least two international undersea fiber optic cables. The cable referred to as MAREA will link Virginia Beach and Bilbao, Spain, and the cable referred to as BRUSA will link Virginia Beach with San Juan, Puerto Rico; Fortaleza, Brazil and Rio de Janeiro, Brazil (Virginia Beach is also the US landing site of for other planned subsea cables). The new MAREA and BRUSA undersea fiber optic cable landings at Virginia Beach will provide a number of ongoing economic development opportunities to Hampton Roads and Southern Virginia. Cable-related economic development in the region will occur as: 1) foreign and domestic data centers choose to locate near the cable landing, 2) US businesses that depend on internet traffic with Brazil or southern Europe open facilities in the region, and 3) Southern European businesses that depend on internet traffic with the US or Brazil open facilities in the region.

It is important to understand, however, that economic development in the region will not occur spontaneously because of the presence of the cables. The experience of other localities with cable landings shows that undersea internet cables do not in and of themselves create high-tech economies with high-tech jobs. This is easiest to see in Florida where there has not been much high-tech job development in spite of the fact that five counties in the state have undersea cable landings. However, for the most part, many high-tech economies in the US are located near to undersea internet cable landings. This provides strong encouragement to localities throughout Southern Virginia served by MBC to engage in efforts to draw new businesses to the area to take advantage of the new cable landing.

Our analysis identified a High-Tech Service Industry Cluster that is comprised of 14 industries that are likely to be attracted by the MAREA and BRUSA cables. Those industries are:

- Architectural, Engineering, and Related Services
- Business Support Services (e.g., Telephone call centers and Business service centers)
- Computer Systems Design and Related Services
- Data Processing, Hosting, and Related Services
- Electronic Shopping and Mail-Order Houses
- International Trade Financing
- Management of Companies and Enterprises
- Management, Scientific, and Technical Consulting Services
- Other Financial Investment Activities (e.g., Portfolio management)
- Other Information Services (e.g., News syndicates, Internet publishing and broadcasting, and web search portals)
- Scientific Research and Development Services
- Securities and Commodity Contracts Intermediation and Brokerage
- Software Publishers
- Telecommunications

In addition, to assist MBC in its recruitment efforts we investigated the location of these industries in the contiguous United States by metropolitan statistical area (MSA). Through that analysis, we identified 68 MSAs that had High-Tech Service Industry Cluster industries that exhibited an employment footprint that was two or more times greater than one would expect based on the national norm and paid wages that were higher than the prevailing industry wage in the Virginia Beach-Norfolk-Newport News MSA. A separate spreadsheet accompanying this report provides names and contact information for businesses in those identified industries that have more than 50 employees.

More generally, the individual businesses in the High-Tech Service Industries Cluster that are most likely to be attracted by the MAREA and BRUSA cables are those that do business in Southern Europe (especially Spain, the Basque Community, and Portugal) and in Brazil. High-tech service businesses that operate or want to expand to both of these areas would especially benefit from the nexus of the two cables at Virginia Beach.

The initiation of the MAREA cable connecting Virginia Beach to Bilbao, Spain in the Basque Country comes at a time when the European economy is strengthening. Virginia economic developers may be able to attract European businesses that already operate in the US or that are interested in expanding to the US. European firms doing research in pharmaceuticals and automobile technology have already made major investments in facilities in the US and may be interested in establishing a presence in Southern Virginia. The Basque community in Europe has a number of similarities to the Hampton Roads areas. The MAREA cable may be able to facilitate strategic partnerships between firms in both areas that could enhance economic development. Finally, Spain is home to a number of firms that do business in Brazil. Even if those firms are not interested in serving customers or initiating major operations in the US at this time, they may find that the junction of MAREA and BRUSA at Virginia Beach makes Southern Virginia an excellent intermediate connection for data centers serving operations in Europe and Brazil.

The initial advantages of the BRUSA cable may be limited for economic development. Almost all of the Florida cables connect to Latin America. The weak economic conditions in Latin America, the limited amount of fiber in the region and the lack of strong high-tech industries there seem to mean that, to date, the undersea internet cables to Latin America have offered little economic development opportunities for localities in the Florida. However, Latin America contains many emerging markets and developing economies. As the region grows and develops the cable connections to Latin America, such as BRUSA, should result in economic development opportunities into the future. Certainly, the BRUSA cable from Brazil landing at Virginia Beach offers better service in a number of ways compared to the SEABRAS-1 cable from Brazil landing in New Jersey. SEABRAS-1 in northern New Jersey advertises a shorter distance from Brazil to the mid-Atlantic region than cable landings in New York or Florida, but BRUSA can beat that claim by hundreds of miles. By some reputable estimates data centers in Brazil cost twice as much as data centers in the US. Companies with data centers may want to build low-cost, low-tax, secure data centers in Southern Virginia to build in cheap redundancy for their Brazilian customers.

Finally, our analysis of the five Virginia regions that comprise the cable landing site and the MBC service area has shown that all five regions have existing labor pools that can meet a large portion of the workforce needs of the 14 industries within the High-Tech Service Industry Cluster that is likely to be attracted by the MAREA and BRUSA cables. Moreover, these regions are already hosting many (and in the case of Hampton Roads, all) of the industries identified in that cluster and, in some cases, those industries already have a strong existing presence within the region and/or have demonstrated themselves to be strong performers in terms of long-term employment and wage growth.



More specifically:

Crater Area:⁷² 1) *Computer Systems Design and Related Services* has a strong existing presence in the Crater Area as a high-wage industry with a large employment footprint, and is a strong performer in terms of both long-term employment and wage growth, 2) *Scientific Research and Development Services* is a high-wage industry within the region that is also a strong performer in terms of both long-term employment and wage growth, and 3) *Management, Scientific, and Technical Consulting* has a large regional employment footprint and is a strong performer in terms of long-term employment growth.

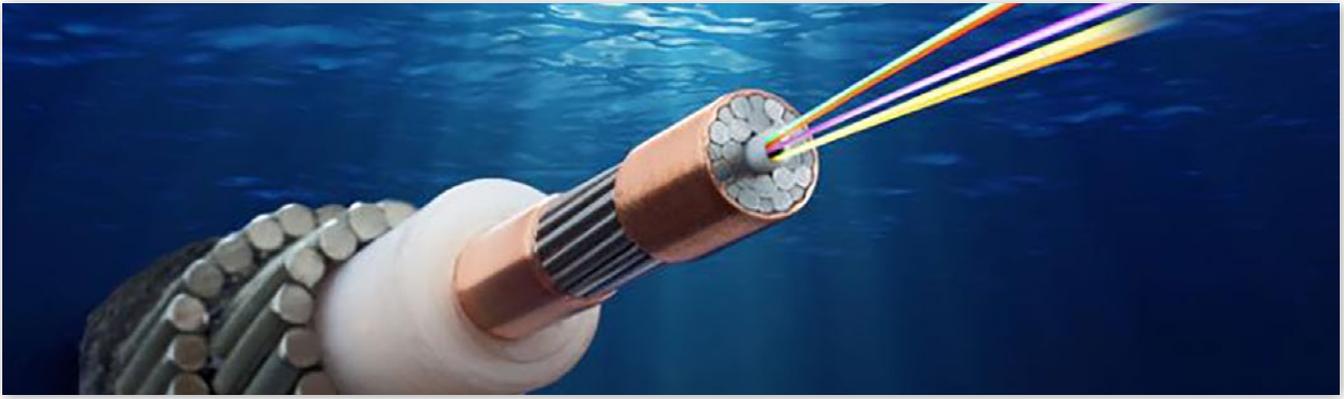
Hampton Roads:⁷³ 1) *Management of Companies and Enterprise* has a strong existing presence in Hampton Roads as a high-wage industry with a large employment footprint, 2) *Scientific Research and Development Services* (the industry category that includes the region's biotech sector) is a strong performer in the region in terms of long-term employment and wage growth, and proportional economic impact, and 3) *Other Financial Investment Activities* is a high-paying regional industry that is also a strong performer with regard to long-term wage growth and proportional economic impact.

Region 2000/Central Virginia:⁷⁴ 1) *Architectural, Engineering, and Related Services* has a strong existing presence in Region 2000/Central Virginia as a high-wage industry with a large employment footprint, 2) *Computer Systems Design and Related Services* is a high-paying industry within the region, and is also a strong performer in terms of both long-term employment and wage growth, 3) *Management, Scientific, and Technical Services* has a large employment footprint in the region and is a high performer in regard to long-term employment growth, 4) *Scientific Research and Development Services* is a high performer in the region in terms of long-term wage growth and proportional economic impact, and 5) *Other Information Services* is a high performer in the region in regard to long-term employment growth and proportional economic impact.

⁷² For purposes of this analysis, the Crater Area is defined to include the nine localities that comprise the Crater Area Workforce Investment Area. Those localities are the cities of Colonial Heights, Emporia, Hopewell, and Petersburg, and the counties of Dinwiddie, Greensville, Prince George, Surry, and Sussex.

⁷³ For purposes of this analysis, Hampton Roads is defined to include the eight localities that comprise the Hampton Roads Workforce Investment Area. Those localities are the cities of Chesapeake, Franklin, Norfolk, Portsmouth, Suffolk, and Virginia Beach, and the counties of Isle of Wight and Southampton.

⁷⁴ For purposes of this analysis, Region 2000/Central Virginia is defined to include the five localities that comprise the Region 2000/Central Virginia Workforce Investment Area. Those localities are the city of Lynchburg, and the counties of Amherst, Appomattox, Bedford, and Campbell.



South Central:⁷⁵ 1) *Computer Systems Design and Related Services* has a strong existing presence in South Central as a high-wage industry with a large employment footprint, and is a high performer in terms of both long-term employment and wage growth, 2) *Electronic Shopping and Mail-Order Houses* is a high performer within the region in terms of long-term employment growth and proportional economic impact, and 3) *Securities and Commodity Contracts Intermediaries* is a high performer within the region in terms of long-term wage growth and proportional economic impact.

West Piedmont:⁷⁶ 1) *Management of Companies and Enterprises* has a strong existing presence in West Piedmont as a high-wage industry with a large employment footprint, 2) *Management, Scientific, and Technical Services* has a large employment footprint in the region and is a high performer in regard to long-term employment growth, 3) *Business Support Services* has a large employment footprint in the region and is a high performer in regard to long-term employment growth, and 4) *Securities and Commodity Contracts Intermediaries* is a high-wage industry in the region that is also a high performer in terms of long-term wage growth.

In sum, the MAREA and BRUSA undersea fiber optic cable landing at Virginia Beach will provide substantial economic development opportunities to Hampton Roads and Southern Virginia. Those opportunities are likely to be greatest within the High-Tech Service Industry Cluster, and specifically with firms that do business in Southern Europe (especially Spain, the Basque Community, and Portugal) and in Brazil. Moreover, experience demonstrates that those opportunities need not be restricted to the cable landing site itself and can extend to localities that are some distance from the landing site. However, experience also demonstrates that the presence of the cables does not guarantee that economic development will occur spontaneously, and that targeted efforts by local and regional economic development agencies will be necessary to maximize the economic opportunities made possible by the cable landings.

⁷⁵ For purposes of this analysis, South Central is defined to include the ten localities that comprise the South Central Workforce Investment Area. Those localities are the counties of Amelia, Brunswick, Buckingham, Charlotte, Halifax, Lunenburg, Mecklenburg, Nottoway, and Prince Edward.

⁷⁶ For purposes of this analysis, West Piedmont is defined to include the five localities that comprise the West Piedmont Workforce Investment Area. Those localities are the cities of Danville and Martinsville, and the counties of Henry, Patrick, and Pittsylvania.



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