

GROW CAPITAL JOBS
GROWTH AND DIVERSIFICATION PLAN UPDATE
2022-2024
DECEMBER 9, 2021

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EXECUTIVE SUMMARY

Employment and Wages

Between 2016 and 2019, overall employment in Region 4 grew 3%. Information Technology (8.5%) and Logistics (5.2%) had the fastest growth while Bioscience/Life Sciences (2.9%) and Manufacturing (.6%) saw more modest growth. In 2020, overall employment in Region 4 declined by 5.3% and Logistics was the only targeted cluster to see employment growth, up 6.7%. Year over year declines in Region 4's targeted clusters were 4.3% in Bioscience/Life Sciences, 4.2% in Manufacturing, and 3.1% in Information Technology.

Between 2016 and 2019, annual wages increased by 8.6% to \$57,966. Logistics saw the largest increase, up 9.8% to \$51,339. Average wages in Bioscience/Life Sciences grew to 9.3% \$56,140, wages in manufacturing increased 7.4% to \$66,603, and wages in Information Technology grew 5.2% to \$74,274. In 2021, the COVID pandemic drove wages up. Overall, annual wages in Region 4 increased by 7.8% between 2019-2020. Logistics saw the fastest growth (7.8%) to reach \$55,367. Bioscience and Life Sciences increased 4.8% to \$58,997, Manufacturing 3.3% to \$68,972, and Information Technology 1.9% to \$76,067. As of the first quarter of 2021, wages continued to increase with the average wage reaching \$59,061.

There were distinct intraregional differences in the employment and wage trends. While overall employment in Region 4 grew 3% from 2016-2019, employment in the southern part of the region declined by 0.3% during the period, including declines in all of Grow Capital Jobs targeted clusters. In addition, the Crater District was recovering more slowly from the pandemic. While by the end of 2020 the entirety of Region 4 had recovered 60% of lost jobs, the southern part of the region had recovered only 50%.

Council/Foundation Members' Project Assessments

Council and Foundation members were surveyed to obtain their assessment of the projects that had been funded in GO Virginia's 4 priority areas- Workforce, Start-up Ecosystem, Cluster Scale-up and Site Development- and to receive guidance for future project directions. Each project area was assessed along 4 dimensions - Quality, Geographic Coverage, Strategic Focus, and Anticipation of Future Needs. Overall, projects assessments were positive in all categories. Distinctions emerged, however, when only "Excellent" or "Very Good" ratings were considered. Cluster Scale-up and Start-up Ecosystem projects

rated higher than Workforce and Site Development awards. Council and Foundation members expressed interest in supporting the emergent pharmaceutical manufacturing cluster, linking most projects even more closely to priority clusters, and developing a tighter, strategic focus on workforce projects to increase participation in high paying jobs. Council members also highlighted the importance that GO Virginia projects provide equitable opportunities across the range of its strategic priorities, both across the region and with communities that have been historically excluded.

Trends and Changes

The report examines key changes and changes that have occurred since the 2019 update to the original Growth and Diversification Plan, with special attention to those that have arisen since the onset of the pandemic that have affected the priority areas of workforce, start-up ecosystem, cluster scale-up and site/infrastructure development.

The largest changes appear to have occurred with workforce. Business leaders and economic officials consistently described how the terms of engagement between employers and workers have been altered. In several respects, these changes have exacerbated challenges that had been previously highlighted such as finding and retaining skilled talent and have reinforced the necessity of building a better pipeline, making transitioning military programs more effective, creating innovative programs that combine upskilling with paid employment, and finding ways of shaping the trend toward remote work to the region's advantage.

The pandemic resulted in fewer jobs in cluster scale-up priority areas such as advanced manufacturing, information technology and bioscience, but there are clear opportunities for the region to capitalize on the national emphasis on reshoring manufacturing and using technology to increase productivity. In particular, the pre-pandemic commitment of the region to building a pharmaceutical manufacturing cluster brings together the region's strength in bioscience, advanced manufacturing and logistics in a unique manner that holds the potential for national and global leadership. Logistics has been the cluster priority that fared best through the pandemic. The global supply chain disruption enhanced the natural locational advantages of Region 4, adding jobs and increasing incomes. The logistics cluster should continue to prosper with attractive sites located along I-64, I-95, and I-85, with attention to specialized facilities such as cold storage and by encouraging organizations such as Commonwealth Center for Advanced Logistics Systems (CCALS) to work with its university consortium to meet the identified need for degreed logisticians.

The landscape for site/infrastructure development has also changed since the pandemic. Region 4 is site rich compared to other locales in the Commonwealth and could benefit significantly from the focus on reshoring and the massive changes in the logistics space. In addition, federal and state infrastructure funding should ameliorate the broadband issues that inhibited economic development in the more rural parts of the region. But local governments and economic development officials report that potential clients are less willing to wait 12-18 months for a site to become business ready. Elevating priority sites to business-ready more quickly and increasing the region's capability for addressing utility and transportation infrastructure issues will be crucial to taking full advantage of its site inventory.

Recommendations

The report contains 16 recommendations, 4 in each of GO Virginia's priority areas.

- Workforce/Talent recommendations call for focusing intently on "pipeline" projects and identifying the locations on the pipeline where Grow Capital Jobs can be most effective in catalyzing high paying jobs. Recommendations also include developing an effective model for recruiting transitioning military and implementing models for upskilling workers while maintaining paid employment.
- Start-up Ecosystem Recommendations call for Activation Capital to apply for a Regional Entrepreneurial Initiative grant that will fill-in the most prominent gaps in the ecosystem, to align projects with the Council's priority clusters and with innovation-based larger firms, and to include lab space needs in the Council's site development considerations.
- Cluster Scale-up recommendations call for prioritizing the emergent pharmaceutical manufacturing cluster, for working more closely with regional and local economic development officials to address gaps that can inhibit relocation or expansion decisions of firms in priority areas, and to explore with Region 5 the potential for creating a global internet hub that could create more tech-based employment in the region.
- Site/Infrastructure recommendations include using projects to enhance the pharmaceutical manufacturing cluster, identifying and funding a few high potential sites that can be elevated to user-ready status expeditiously, capitalizing on supply chain disruption to develop specialized logistics facilities such as cold storage and to enhance activity near the Richmond Marine terminal, and to develop partnerships to address utility/infrastructure issues earlier in the site readiness process.

INTRODUCTION

The 2022-2024 update to Region 4's Growth and Diversification (G&D) Plan focuses on developing a set of recommendations in the four major GO Virginia priority areas - Workforce/Talent, Start-up Ecosystem, Cluster Scale-up and Site/Infrastructure Development - that provide a strategic framework for guiding the work of Grow Capital Jobs for the next two years. The report begins with an analysis from Chmura Economics and Analytics of employment and wage trends in the region and how these have been affected by the pandemic. The body of the report offers an in-depth analysis for each priority area. This analysis includes results of a Council/Foundation member survey, key trends that have emerged since the 2020-2022 update, and major findings from studies and reports produced by other regional and local organizations.

The analysis for each priority area concludes with a short set of recommendations intended to guide project development in 2022-2024 and to tie the Council's priorities together in a tighter and more strategic manner. The emergent pharmaceutical manufacturing cluster occupies a more central and strategic role in this report than it did in earlier iterations. Council members also highlighted the importance that GO Virginia projects embed equitable opportunities across the range of its strategic priorities, both across the region and with communities that have been historically excluded.

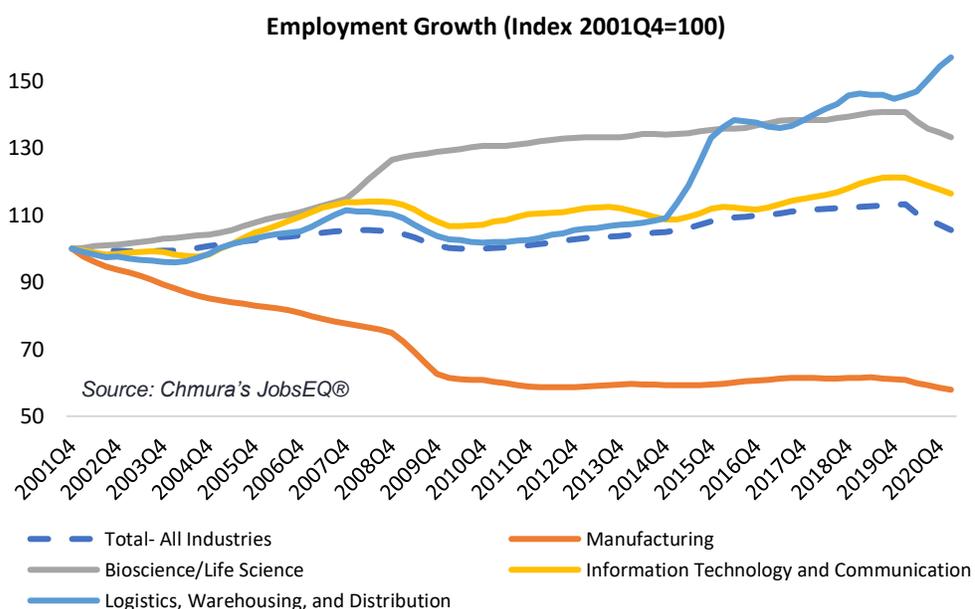
Grow Capital Jobs set up a G&D Plan update Task Force to provide guidance and direction for the report. The Task Force membership was drawn primarily from the Regional Council and the staff of Grow Capital Jobs, but also drew upon priority area experts in the wider community. Besides the survey of Council and Foundation members, the report was informed by discussions with local government officials, with business leaders and with the directors of regional and local economic development organizations, and by the TEconomy data that was shared with the Regional Councils. In addition, Grow Capital Jobs and individuals who have helped to shape this report have been active participants in major regional and inter-regional initiatives while the update was being formulated. GROW Capital Jobs was engaged in the creation of the Advanced Pharmaceutical Manufacturing and R&D Cluster Accelerator, in the development of a COVID-19 Resilience and Recovery Report that the Crater PDC is producing for the U.S. Economic Development Administration, and in the formation of RVA-757 Connects that works to advance common interests shared between our region and Hampton Roads. The strategies articulated in this report complement these major initiatives.

EMPLOYMENT AND WAGES

Introduction

Over the five years since the original Growth & Diversification Plan was completed, Region 4 has seen significant growth in employment and wages both in the targeted industry clusters (manufacturing; logistics, warehousing, and distribution; information technology and communication and bioscience/life science) and overall, in the region. However, the COVID-19 pandemic in 2020 and 2021 has had significant impacts in every industry globally, including in Region 4. This report details employment and wage growth in Region 4 since the start of the original Growth & Diversification Plan as well as the impacts due to the COVID-19 pandemic.

Employment Between 2016 and 2019 (prior to the pandemic), overall employment in Region 4 grew 3.0%, reaching 684,459 workers. In the targeted industry clusters, information



technology and communication experienced the fastest growth at 8.5% to 43,350 workers, followed by logistics, warehousing, and distribution, up 5.2% to 34,337 workers. Manufacturing and bioscience/life sciences saw more modest growth of 0.6% (to 33,054 workers) and 2.9% (to 70,666), respectively.

In 2020, the COVID-19 pandemic disrupted all aspects of the global economy. Employment in Region 4 dropped sharply in the second quarter of 2020, down 9.7% over the prior quarter, as stay-at-home orders took effect. By the end of 2020, the region had recovered about 60% of lost jobs. Overall employment in Region 4 declined by 5.3% to 648,391 workers over the year ending 2020Q4. Over this period, logistics, warehousing, and distribution was the only targeted cluster to see employment growth, up 6.7% and adding 2,284 jobs. As people increasingly adopted e-commerce during the pandemic, demand for drivers,

warehouses, and logistics grew. The other three clusters saw year-over-year declines in employment: bioscience/ life sciences down 4.3% (3,049 jobs lost), manufacturing down 4.2% (-1,402); and information technology and communication down 3.1% (-1,325).

As of the first quarter of 2021, overall employment in the region is 639,487, a 6.8% decline since the start of the pandemic in 2020Q1. Over the same period, logistics, warehousing, and distribution increased 7.9%, adding 2,714 new jobs. Bioscience/life science saw the largest decline, down 5.3% for a loss of 3,754 jobs, driven by declines in hospitals and nursing facilities. Looking ahead, however, there have been several recent announcements related to pharmaceutical manufacturing in Petersburg, with employers expected to add nearly 1,200 jobs over the next few years. Manufacturing is down 4.9% (-1,633) in Region 4, and information technology and communication is down 3.9% (-1,703 jobs) over this period.

Employment in GO Virginia 4 (Four Quarter Moving Average)

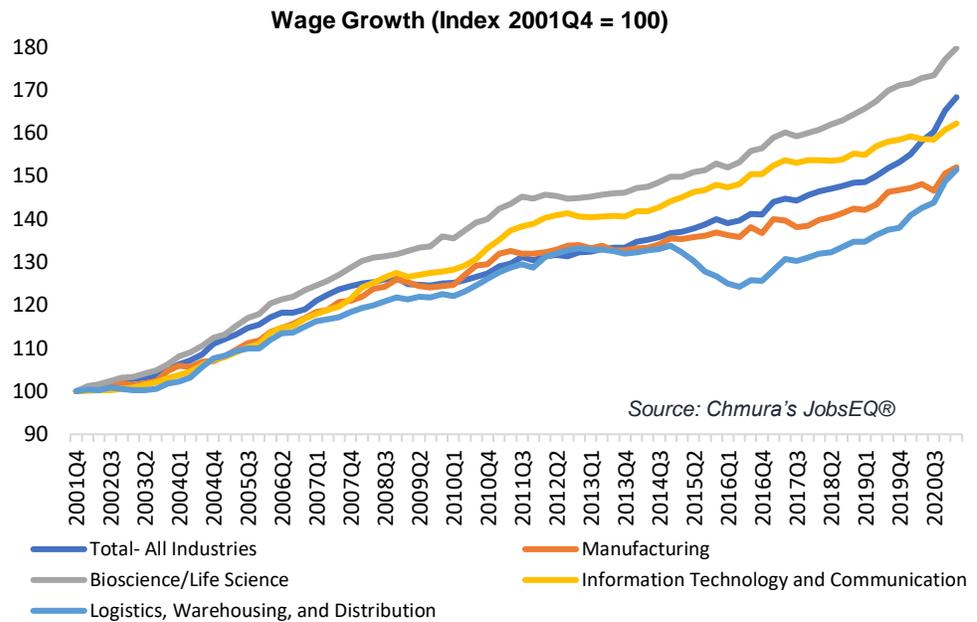
2016 to 2020

	2016	2017	2018	2019	2020	2021		
						Q1	%	#
Manufacturing	32,842	33,310	33,236	33,054	31,652	31,352	-3.6%	-1,190
Logistics, Warehousing and Distribution	32,645	32,762	34,558	34,337	36,621	37,266	12.2%	3,976
Information Technology and Communication	39,957	41,074	42,203	43,350	42,025	41,620	5.2%	2,068
Bioscience/Life Sciences	68,650	69,462	69,979	70,666	67,617	66,900	-1.5%	-1,033
Total - All Industries	664,839	674,220	679,547	684,459	648,391	639,487	-2.5%	-16,448

Source: Chmura's JobsEQ®

Wages

Between 2016 and 2019 (prior to the pandemic), wages in Region 4 grew 8.6%, reaching an annual average of \$53,764 by the end of 2019. Among the targeted industry clusters, wages in logistics, warehousing, and



distribution remain below the average but have been catching up—the cluster saw the fastest growth over this period, up 9.8% to \$51,339. Average wages in bioscience/ life science grew 9.3% to \$56,140, wages in manufacturing grew 7.4% to \$66,603, and wages in information technology and communication grew 5.2% to \$74,274.

In 2020 and 2021, the COVID-19 pandemic disruptions and a tight labor market drove wages up. Overall, average annual wages in Region 4 increased by 7.8% between 2019 and 2020, reaching \$57,966. In the target industry clusters, logistics, warehousing and distribution continued to see the fastest growth in wages (7.8%), to reach \$55,367, driven by increased demand for transportation and e-commerce. Average wages in bioscience and life sciences increased 3.5% to \$58,100, while wages in other clusters grew at more modest rates: manufacturing wages rose 2.5% to \$68,288 and information technology and communication wages advanced 1.5% to \$75,415.

As of the first quarter of 2021, the overall annual average wage in the region is \$59,061, an 8.5% increase since the start of the pandemic in 2020Q1. Over the same period, all targeted industry clusters continued to experience wage growth. Average wages in logistics, warehousing and distribution rose 7.5% to \$56,364, followed by bioscience/life sciences (4.8% to \$58,997), manufacturing (3.3% to \$68,972), and information, technology and communication (1.9% to \$76,067).

Average Annual Wages by Cluster, GO Virginia Region 4

2016-2020

	2016	2017	2018	2019	2020	2021		
						Q1	%	#
Manufacturing	\$62,031	\$62,815	\$64,642	\$66,603	\$68,288	\$68,972	10.0%	\$6,257
Logistics, Warehousing and Distribution	\$46,755	\$48,751	\$50,132	\$51,339	\$55,367	\$56,364	18.4%	\$8,612
Information Technology and Communication	\$70,573	\$72,083	\$72,766	\$74,274	\$75,415	\$76,067	6.9%	\$4,842
Bioscience/Life Sciences	\$51,340	\$52,530	\$53,914	\$56,140	\$58,100	\$58,997	13.2%	\$6,760
Total-All Industries	\$49,485	\$51,070	\$52,067	\$53,764	\$57,966	\$59,061	8.6%	\$8,481

Source: Chmura's JobsEQ®

Intraregional Differences

As of the first quarter of 2021, overall employment in the region is 69,916, a 6.3% decline since the start of the pandemic in 2020Q1. Over the same period, logistics, warehousing, and distribution is the only targeted industry cluster that experienced growth, reaching employment of 5,784.

Employment in Crater PDC Region (Four Quarter Moving Average)

2016 to 2020

	2016	2017	2018	2019	2020	2021		
						Q1	%	#
Manufacturing	7,055	7,124	7,137	7,037	6,717	6,591	-4.8%	-338
Logistics, Warehousing and Distribution	5,945	5,837	6,067	5,683	5,683	5,784	-4.4%	-262
Information Technology and Communication	2,660	2,644	2,531	2,453	2,315	2,271	-12.9%	-344
Bioscience/Life Sciences	9,167	8,949	8,729	8,717	8,131	8,019	-11.3%	-1,036
Total - All Industries	74,906	75,022	75,694	74,702	70,925	69,916	-5.3%	-3,981

Source: Chmura's JobsEQ®

Between 2016 and 2019 (prior to the pandemic), average annual wages in the Crater PDC region rose 8.2% to \$44,634. Among the targeted industry clusters, logistics, warehousing, and distribution saw the largest increase in wages followed by manufacturing and bioscience/life sciences. Average wages in information technology and communication declined slightly, along with job losses in higher-paying industries such as computer systems design and related services.

As of the first quarter of 2021, the average annual wage in the Crater PDC region is \$48,655, an 8.3% increase since the start of the pandemic in 2020Q1. Over the same period all the target industry clusters experienced wage growth, led by logistics, warehousing and distribution and manufacturing.

Change in Average Annual Wages by Cluster, Crater PDC Region

2016-2020

	2016	2017	2018	2019	2020	2021		
						Q1	%	#
Manufacturing	\$63,221	\$64,725	\$68,051	\$69,803	\$70,922	\$71,340	12.2%	\$7,701
Logistics, Warehousing and Distribution	\$41,685	\$42,320	\$43,086	\$46,134	\$53,071	\$54,927	27.3%	\$11,386
Information Technology and Communication	\$52,247	\$50,535	\$50,340	\$50,878	\$53,906	\$54,690	3.2%	\$1,659
Bioscience/Life Sciences	\$37,394	\$38,624	\$39,357	\$41,021	\$43,445	\$44,285	16.2%	\$6,052
Total-All Industries	\$41,261	\$42,522	\$43,623	\$44,634	\$47,662	\$48,655	15.5%	\$6,401

Source: Chmura's JobsEQ®

WORKFORCE/TALENT DEVELOPMENT

Region 4 Projects

Workforce and Talent development Initiatives typically fall into four major categories:

1. Pipeline Development: Programs intended to foster a continued supply of trained workers in a single industry or across industry sectors.
2. Addressing Targeted Shortages and Upskilling: Initiatives designed to address identified skill and occupational shortages that are either immediately evident or foreseeable in the near term.
3. Retention Programs: Initiatives designed to ensure that prospective or current workers remain in the region and seek careers and career advancement within it.
4. Attraction Programs: Initiatives intended to attract workers to a region who do not presently reside within it.

Since the initiation of the statewide GO Virginia Program, The Region 4 Council has supported 13 Workforce/Talent Development projects with grants totaling \$2, 566,308. Workforce/Talent

	ALL REGION 4	WORKFORCE ONLY
PROJECTS	28	13 (38%)
FUNDING	\$11,876M	\$2,556M (25%)

Development grants have been 38% of the funded projects and have received 25% of the funds distributed by the Council.

The majority of projects supported by the Council have focused on pipeline development and addressing targeted skill shortages. Pipeline programs have focused on high-skill manufacturing positions, and growing tech talent in the region. These grants have included a CCAM Pilot Program in Mechatronics, the Advanced Manufacturing Program at John Tyler, the establishment of A Federation for Advanced Manufacturing (FAME) technician program, Success Squared and an award to VCU engineering for a strategic plan to expand the tech talent pipeline.

Projects addressing targeted skill shortages have focused on unmanned aerial systems, logistics technicians, and welders. Besides these projects, the Council has also supported a major retention initiative, CAMPUS RVA (renamed RVA Now) designed to increase the retention of college graduates in the region and housed at Chamber RVA.

Grow Capital Jobs also supported two initiatives made available through a special COVID-19 Recovery program to support workers negatively affected by the pandemic.

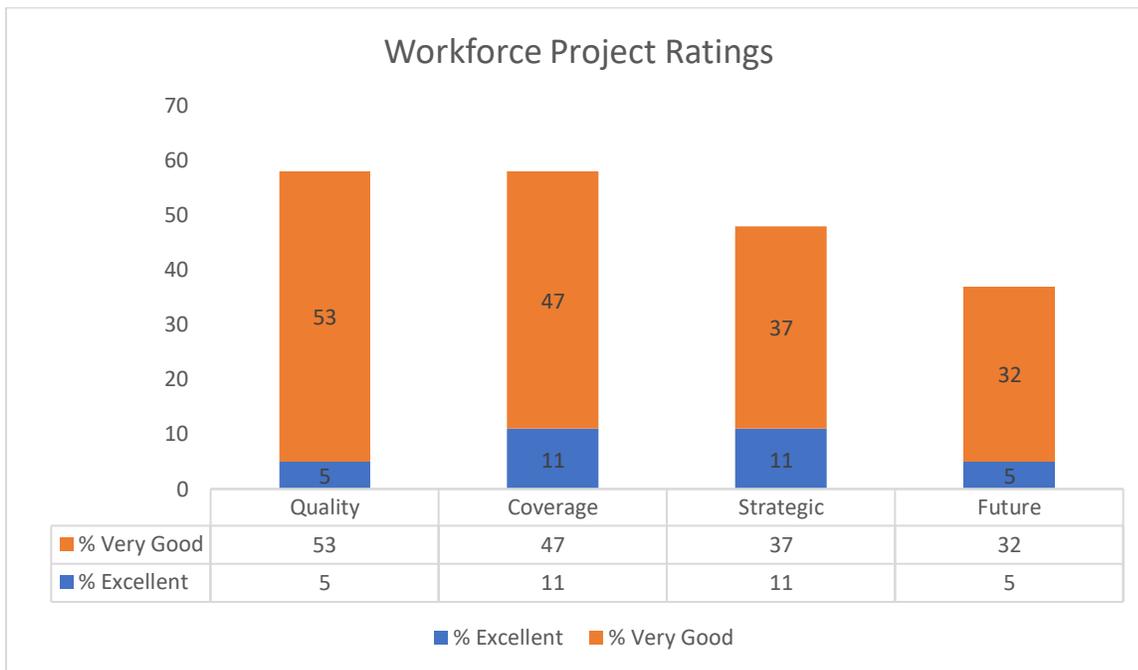
GROW CAPITAL JOBS WORKFORCE/TALENT PROJECT LIST

PROJECT	FUNDING	TYPE	BRIEF DESCRIPTION
CCAM PILOT	\$430,000	PIPELINE	MECHATRONICS AND TRANSITIONING MILITARY
CCAM BUSINESS PLAN	\$50,000	PIPELINE	ADVANCED MANUFACTURING ACADEMY WITH BRIGHTPOINT
VCU TECH TALENT	\$100,000	PIPELINE	STRATEGIC PLAN TO EXPAND TECH TALENT PIPELINE
FAME	\$613,000	PIPELINE	ESTABLISHED ADVANCED MANUFACTURING TECHNICIAN PROGRAM
VIRGINIA VIRTUAL WORKFORCE	\$61,295	PIPELINE	STATE OF THE ART VITUAL TRAINING FOR MANUFACTURRS
SUCCESS SQUARED	\$39,200	PIPELINE	INTERNSHIPS FOR ENGINEERING AND MANUFACTURING TALENT PIPELINE
RICHARD BLAND AERONAUTICS	\$50,000	UPSKILLING	BUSINESS PLAN FOR UNMANNED AERIAL SYSTEMS CREDENTIAL
ROWANTY TECHNICAL LOGISTICS	\$110,000	UPSKILLING	GLOBAL LOGISTICS PROGRAM CERTIFICATION
NEW KENT WELDING	\$300,000	UPSKILLING	MEET CRITICAL NEEDS FOR WELDERS
CAMPUS RVA (RVA Now)	\$100,000	RETENTION	BUSINESS PLAN TO RETAIN RECENT COLLEGE GRADUATES
CAMPUS RVA PHASE 2 (RVA Now)	\$500,000	RETENTION	IMPLEMENTATION BY CHAMBER RVA
VIRTUAL CONNECTIONS	\$80,600	COVID RECOVERY	IMPROVE CONNECTION BETWEEN JOB SEEKERS AND BUSINESSES
COVID RECOVERY AND UPSKILLING	\$132,000	COVID RECOVERY	TRAIN AND UPSKILL UN/UNDEREMPLOYED WORKERS

Council/Foundation Assessment

58% of the Council/Foundation respondents to the survey rated the quality of workforce/talent development programs as Excellent (5%) and Very Good (53%). 37% rated these as “Good” and 5% gave a “Fair” rating.

58% of respondents also rated the project coverage across the different geographic areas of Region 4 as Excellent (11%) or Very Good (47%).



48% of respondents believed that the strategic focus of the workforce/talent projects were Excellent (11%) or Very Good (37%). And 37% of respondents believe that the workforce/talent development projects have been Excellent (5%) or Very Good (32%) in addressing the challenges and gaps that will enable Region 4 to prosper in the future economy.

Common themes also emerged in the responses to the open-ended questions. Several respondents expressed a view that it is time to review the projects that have been funded to have a clearer sense of what is working and where the ROI is highest.

Respondents also suggested that there be a tighter strategic focus on workforce development projects. Several respondents proposed that there be less emphasis on jobs that don’t have the potential to be

high paying and more on tech talent opportunities. Some respondents noted that the Council should focus on supplying equitable opportunities for all individuals throughout the region, including the rural counties that often receive less attention.

Multiple respondents also expressed a preference for projects that create a sustainable pipeline that can meet the foreseeable needs in the upcoming years over one-off efforts that are tailored to an immediate need.

Workforce coverage ratings were the highest in any of the four priority areas - workforce, startup ecosystem, cluster scale-up and site/infrastructure development - surveyed. Yet workforce projects were rated clearly lower than start-up ecosystem or cluster scale-up projects in the three other categories. In particular, 37% of respondents rated workforce projects Excellent or Very Good in anticipating future needs compared with 61% who rated cluster scale-up and 56% who rated start-up ecosystem projects Excellent or Very Good.

Trends in the Post-Pandemic Work World

Data from Chmura Economics and Analytics show that between 2019 - and the first quarter of 2021, Logistics was the only priority sector that added jobs in Region 4. Manufacturing, Bioscience, and Information Technology all saw job losses.

Jobs	2019	2021
Manufacturing	33,054	31,352
Logistics	34,337	37,266
Information Technology	43,350	41,620
Bioscience	70,666	66,900

In addition to the Chmura data, Chamber RVA commissioned a Talent Attraction, Retention and Migration study by EMSI/Burning Glass. The research complemented the RVA Now program that was funded by GO Virginia and focused on retaining college graduates in the region. The Burning Glass research used the GO Virginia Region 4 communities as the unit of analysis.

- The study concluded that software engineers, degreed logisticians, and financial services sales agents were likely to be areas of significant job growth for college graduates in the region.

- The study noted that post-college retention lagged among bioscience students, University of Richmond graduates, and individuals who resided in the southern part of the region.
- The study noted the region's success (especially in the northern section) in growing the population provides an opportunity to capitalize on a post-pandemic work environment where remote work is more possible, and jobs are shifting from major population areas to mid-sized regions.

The last bullet points to a growing perception that the workforce/talent situation in 2021 is fundamentally different from what has normally been evident in periods when economic conditions and external events result in significant job loss. We are accustomed to seeing initial stages of economic recoveries where there are far more people looking for jobs than available openings. Today, however, employers continually report that they cannot find enough workers for the jobs that they can make available. In recent years, employers have often spoken about the mismatch between the training of workers and the skills needed to perform their jobs. In recent months, however, employers and economic development officials report difficulties with simply finding an available supply of people interested in being employed.

Initial analyses often attributed the imbalance between available jobs and workers willing to perform these to expanded federal unemployment benefits that made not working more financially beneficial than working. But the expiration of federal unemployment benefits has not resulted in a rush to re-enter the workforce, at least to the same jobs that were left during the pandemic.

Our conversations with economic development officials and employers in Region 4 indicate that multiple factors are at play. Child tax credits may have made it easier for families to consider having a parent leave the workforce. The difficulty of finding affordable childcare may have impacted return to work decisions. Data also show that self-employment has risen since the pandemic. The U.S. Labor Department reports that nationally there has been a 6% increase in the self-employed while total U.S. employment still is nearly 3% lower than before the pandemic. Individuals may be shifting away from low paid jobs to other opportunities that offer either higher pay or/and easier working conditions. Community colleges in Region 4, for example, report lower enrollments in academic degrees, but higher demand for certification programs that bring higher wages.

There may also be long-term demographic shifts that are impacting the overall supply of workers. The previous G&D Plans noted the aging of the region's population, especially in the more rural areas.

Studies of COVID-19's impact have shown that older workers have been less inclined to return to the job and more likely simply to retire. And while the region may have an opportunity to use its lower cost of living and appealing quality of life to attract residents from more expensive metropolitan areas, there are also concerns that teleworking possibilities will enable the region's residents to be recruited by out-of-state firms.

Businesses and economic development organizations have developed a remarkably wide range of responses to the shortage of workers. Higher wages, more flexible working conditions, and more extensive use of robots and other automation techniques have been commonly employed. Economic development officials in the Crater District told us that they are considering unprecedented measures such as approaching the jails/prisons to explore the possibility of using work release programs. They also mentioned that "placemaking" responses which make communities in their footprint more desirable places to live are likely to be an essential feature of a longer term-response.

The bottom line is that in the post-pandemic work world the terms of engagement between employers and workers appear to have changed in ways that are influencing the willingness to perform certain jobs, the wages that need to be paid to attract them, and the balance between onsite and remote work. But it is difficult to separate the signal from the noise. Grow Capital Jobs will have to make decisions when it is not absolutely certain what changes are permanent and which are temporary.

Recommendations

At the inception of GO Virginia, workforce and talent development were seen as the critical barriers that needed to be overcome to ensure that the region could continue to support and grow high paying jobs. In the post-pandemic times, this issue has become even more urgent as the overall supply of workers has been added to the challenges of developing a more effective pipeline, educating young people about the potential for high paying employment that didn't require a college degree, bridging the mismatch between skills and available jobs, and retaining and attracting college graduates with desirable tech-based credentials in the region.

The challenge for the Regional Council in 2022-2024 is to decide upon its focus area for projects when the breadth of needs has become more extensive. Where should the Council focus its limited resources

when there are extensive needs in all areas. The survey results show that Council/Foundation members want workforce projects that are strategic and anticipate future needs.

Focus on the Workforce “Pipeline” for Projects, But Stake Out Locations on the Pipeline Where Grow Capital Jobs Can Be Most Effective

Council and Foundation members expressed a clear interest in emphasizing “pipeline development” over one-off projects. The workforce pipeline is, however, quite extensive - it includes, at a minimum, middle school career pathways initiatives, efforts to educate parents about CTE programs in secondary school, apprentice programs, leaver and career switcher initiatives, stackable credential programs offered by the community colleges, degree programs from the associate level to the PhD in technical and scientific disciplines, and retention efforts to keep college graduates in the region. It is important that Grow Capital Jobs stake out a place on the pipeline where it can make a discernible impact and leave “early pipeline” programs such as career pathways and parental education to other organizations. The Council should focus on projects creating a sustainable and diverse talent pipeline in its priority, high wage areas such as advanced manufacturing (including pharmaceutical), bioscience, and tech-based jobs in information technology and logistics

Develop Models for Upgrading Skills While Maintaining Employment

A major obstacle to upgrading and stacking skills is that working individuals find it exceedingly difficult to combine the necessary education/training needed to enhance their job-related skills while also working sufficient hours to support themselves and their familial obligations. The Council should support projects where organizations such as the Community College Workforce Alliance, CCAM, and workforce boards and local foundations partner with employers on establishing creative ways of solving this challenge through programs that combine upskilling with paid employment. The Central Virginia FAME program for Advanced Manufacturing Technicians could serve as an excellent model.

Develop a Workable Program for Transitioning Military

It is recognized that people exiting the military possess the self-discipline and teamwork skills that employers value today. Projects in Region 4 have had features that include outreach to transitioning military. But there is not an organized effort to coordinate recruitment, address training needs and employer contacts with individuals leaving the services. The Council should remedy this in 2022-2024. The Council should consider projects (and replicate programs in other regions) that can address the

need and coordinate efforts with Fort Lee and other military locations, workforce boards, the Community College Workforce Alliance, the Virginia Department of Veterans Affairs, and employers in our priority areas.

Assess Project Success to Inform Council of Where It Achieves the Best ROI

Council and Foundation members expressed an interest on the survey in better understanding the impacts of the projects that have been funded to date. Several projects have reached the point where it is possible to assess the metrics that can gauge success and measure return on investment. This is a task that Grow Capital Jobs should undertake in 2022.

START-UP ECOSYSTEM

GO Virginia’s emphasis on the start-up ecosystem has become increasingly more important since the inception of the initiative as the growth of tech-based firms is crucial to generating high paying jobs. In the previous G&D Plan update, all regions were requested to identify a coordinating entity for start-up ecosystem activities. Grow Capital Jobs chose Activation Capital as the coordinating organization for Region 4. Activation Capital has been instrumental in bringing several project proposals to the Council and in linking start-up ecosystem projects with the development of the emerging pharmaceutical manufacturing cluster. For 2022-2024, it plans to apply for a GO Virginia Regional Entrepreneurial Initiative grant that will address the major gaps in the region’s start-up ecosystem.

Projects:

5 of the 28 grants funded by GO Virginia in Region 4 focused on enhancing the startup ecosystem. These projects totaled \$2,032,000, 17.1% of the total grants approved by the Council. Lighthouse Labs was the largest recipient, obtaining

\$1,429,000 for two projects constituting 70% of the total funding in the category. Lighthouse received \$1 million to prepare students and recent graduates in Virginia colleges and

	ALL REGION 4	STARTUP ECO ONLY
PROJECTS	28	5
FUNDING	\$11,876,368M	\$2,032M

universities to launch their own businesses. The second Lighthouse project targeted post-acceleration services to alumni companies by providing an additional 9 months of support for early-stage companies with high growth potential.

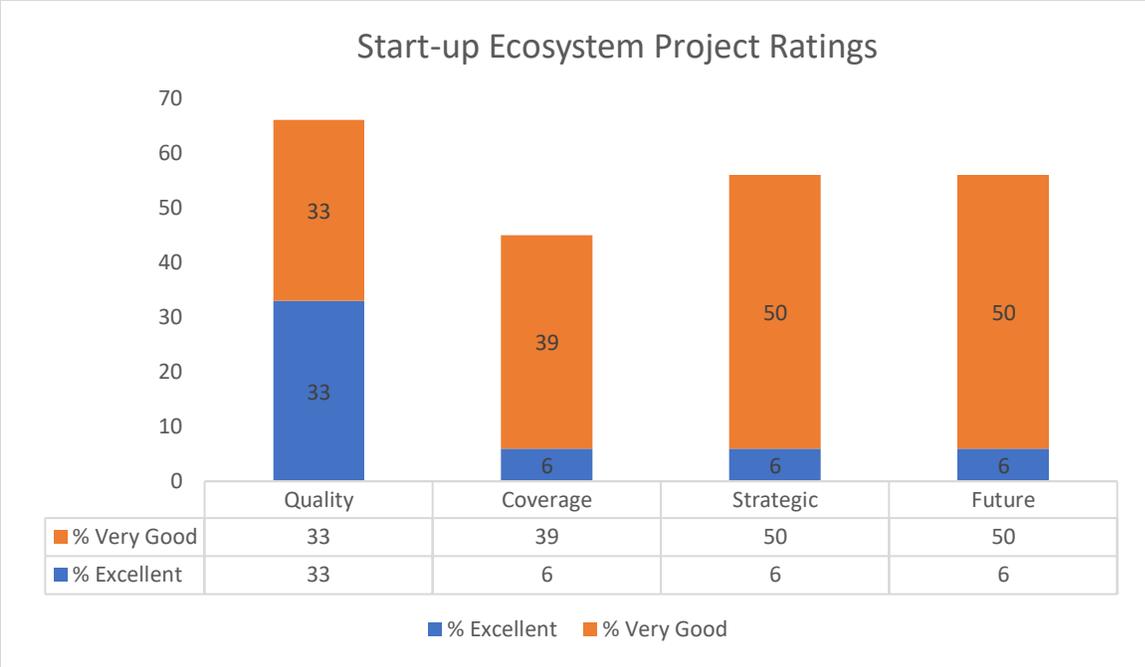
The Council also supported a large (\$453,000) grant to Virginia State University for a Minority Small Business Launch Center. This project was intended to capitalize on the region’s diverse small business community and to aid in filling out the geographic breadth of the entrepreneurial ecosystem. Activation Capital received project support (\$100,000) to create a learning platform for entrepreneurs and to help in grant writing for the federal Small Business Innovation Research program. The Idea Factory was awarded \$50,000 to create new businesses and jobs through the support of aspiring entrepreneurs, including those whose employment was displaced by COVID 19.

START-UP ECOSYSTEM PROJECTS

PROJECT	FUNDING	TYPE	BRIEF DESCRIPTION
LIGHTHOUSE U	\$1,000,000	STUDENT ENTREPRENEURS	PREPARE STUDENTS AND RECENT GRADUATES TO LAUNCH THEIR OWN BUSINESSES
ACTIVATION CAPITAL	\$100,000	LEARNING AND GRANT-WRITING ASSISTANCE	CREATE/MAINTAIN RESOURCE GUIDE AND ASSIST WITH SBIR GRANTWRITING FOR ENTREPRENEURS
IDEA FACTORY (STARTUP VIRGINIA PROGRAM)	\$50,000	NEW BUSINESS SUPPORT	SUPPORT ASPIRING ENTREPRENEURS, INCLUDING THOSE OUT OF WORK DUE TO COVID-19
VSU MINORITY SMALL BUSINESS LAUNCH CENTER	\$453,000	FACILITATIVE AND SUPPORTUVE SERVICES	A CENTER TO INCREASE THE NUMBER OF SCALABLE, MINORITY ENTERPRISE BY PROVIDING SUPPORTIVE SERVICES
LIGHTHOUSE LABS	\$429,000	POST-ACCELERATION	POST-ACCELERATION TO ALUMNI FIRMS- 9 MONTHS ADDITIONAL SUPPORT

Council-Foundation Assessment

In general, Council and Foundation members have positive assessments of the entrepreneurial projects that have been supported. 66.5% of Council and Foundation respondents to the survey rated the quality of the entrepreneurial projects funded in Region 4 Excellent or Very Good. 56% of respondents rated both the strategic focus of the projects and their future orientation as excellent and very good. Geographic project coverage was the lowest rated question in this section with 44% of respondents rating it as Excellent or Very Good, with a single respondent (6.25%) rating it as “Excellent.” Comparing ratings across priority areas, only cluster scale-up activities received a higher rating than the entrepreneurial ecosystem projects in the “quality” category.



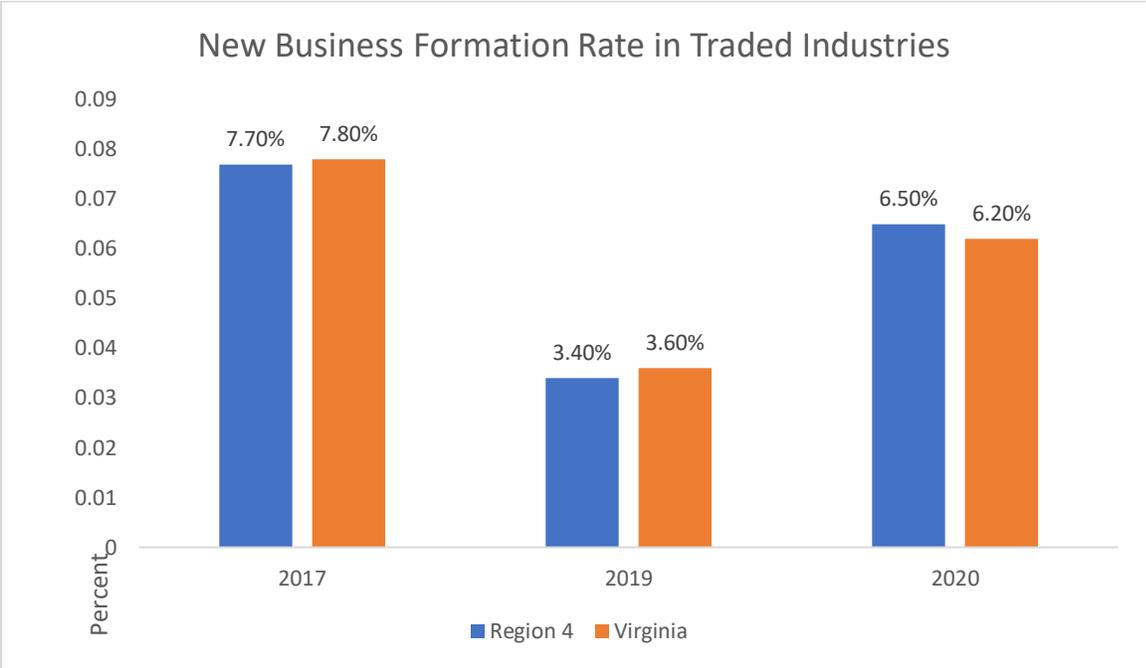
Key Trends

The GO Virginia statewide board reengaged TEconomy to update the data that the firm had previously produced for the regional councils detailing the nature of startup activities and how the trends in each region on key measures compare to statewide and national metrics. The wealth of data provided by TEconomy includes a decade-long analysis of venture capital activity, academic research expenditures, Small Business Innovation Research (SBIR) awards, and patents invented in the region. TEconomy also produced information on employment and employment growth in traded sector jobs by age of firm, data comparisons of startup activity in Region 4 versus statewide numbers, and a profile of new business formation in the traded sectors and the region’s identified clusters.

The data portray a startup ecosystem that is increasingly vigorous and competitive but faces significant challenges in achieving the national reputation to which it aspires.

From 2010-2017 and again in 2019, the region slightly lagged the statewide average in the new business formation rate in traded industries, 7.7% to 7.8% from 2010-2017 and 3.4% to 3.6% in 2019. In 2020,

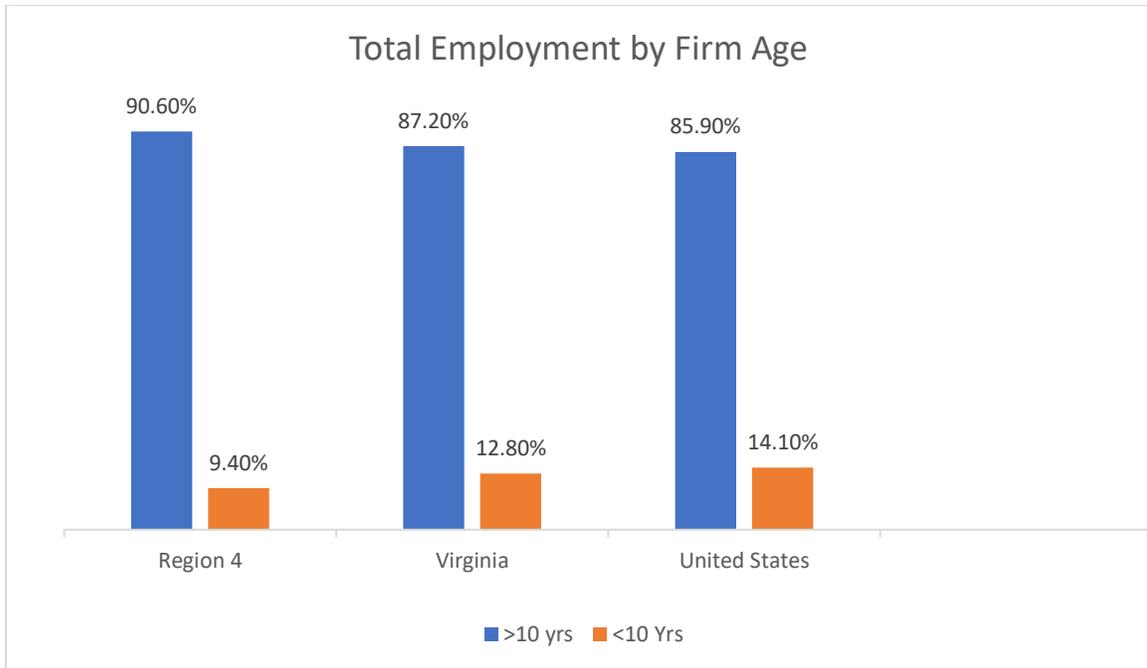
however, the region’s performance improved. In terms of the absolute number of startups in traded industry sectors, the region increased from 377 to 632. The startup rate in the region also rose above the state average, 6.5% compared to the 6.2% state average.



In the last two years, the region has also seen its largest growth in the number and amount of Small Business Innovation Research awards. The 23 awards in the last two years were essentially 50% higher than any previous two-year period since 2010. The \$5.5M in awards in 2019 and the \$4.7M in 2020 were more than \$1.2M higher than any previous year since 2010.

The growth in venture capital investment in Region 4 during the last decade 2010-2020 was also impressive, outpacing and almost doubling the state average. Venture Capital Investments in Region 4 grew by 261% over the decade compared to 138% statewide.

The TEconomy data also illustrates, however, several of the challenges facing the startup ecosystem in the region. The level of total employment in Region 4 provided by firms less than 10 years old lags both Virginia and the nation at large. 9.4% of employment in Region is within companies 10 years old or less compared to 12.8% statewide and 14.1% nationally.



TEconomy believes this is an important data point because of the role that new firms play in job creation. TEconomy notes that firms less than 5 years old created 85,167 jobs in the region while firms 11 years or older lost 11,646 jobs. Relatively speaking, Region 4’s older companies perform well and lost a lower percentage of jobs in the last decade than the statewide average for firms older than 11 years. But the above average employment levels in older companies have placed the region in a catch-up position in creating a vibrant and nationally prominent start up community.

The TEconomy report also notes that growth in R&D expenditures at the region’s colleges and universities lagged the state average in the 2010-2020 decade, increasing by 29% compared to 51% statewide. In addition, Region 4’s utilization of SBA loans from 2010-2020 (2.99 per 1,000 establishments) lagged by the state (3.29) and national (4.66) averages.

Activation Capital Founder Interviews

Activation Capital recently conducted a set of interviews in the Richmond Innovation ecosystem with 39 founders of high growth, technology-centered companies, 15 leaders of entrepreneurial support organizations and 15 individuals involved with community building, investing or mentoring. A set of common themes emerged in the interviews about the potential for and obstacles to accelerating Richmond’s innovation growth. Several of the themes have been prominent in the Council’s discussion

of the entrepreneurial ecosystem during the previous update of the G&D Plan. Overall, the interviews supply a granular, street-level narrative of the promise and challenge of the start-up ecosystem that complements the TEconomy data presentation.

- Founders are optimistic that the region can develop a thriving startup community. Many have returned to the area from larger metro areas and can see genuine potential here.
- They believe that VCU will be a critical part of the ecosystem as it increases the rate of commercialization and spinoffs from its research breakthroughs and inventions.
- Most of those interviewed believe that the quantity of science and engineering talent needs to be increased and that Virginia has significant challenges in keeping its talent at home.
- There is concern that investors in startups are stretched too thin and that access to capital remains an issue, especially after the initial startup investment.
- The interviewees believe that more attention should be given to publicizing the successes that companies have achieved in order to develop a more compelling narrative of and reputation for the region's entrepreneurial ecosystem.

Diversity and Small Business

In 2020-2021, Next Street and Common Future was engaged to study the gaps in the small business support ecosystem, with special attention to entrepreneurs and small business owners of color. The study described the fundamental challenges to business growth and development faced by owners of color and how these were affected by the pandemic.

- Small businesses with owners of color were seen to be in areas of the economy that were actually more insulated from the most immediate COVID impacts. Black-owned businesses have significant representation in healthcare industries such as ambulatory services, social assistance, and residential care while Latino industries are prominent in specialty contracting construction.
- At the same time, COVID has aggravated traditional barriers to owners of color such as access to capital and resources to serve business owners of colors, especially those outside the high growth industry nexus. Low levels of SBA funding, easy access to business support organizations and services such as business planning and government regulation navigation affect entrepreneurial activities.

Grow Capital Jobs' support for standing up VSU's Minority Small Business Launch Center is a practical step toward addressing the challenges named in the Next Street/Common Future report. The Council

should continue to develop options for taking better advantage of the region’s diversity in growing the start-up ecosystem.

RECOMMENDATIONS

Apply and Implement a Regional Entrepreneurial Initiative Grant through Activation Capital.

The GO Virginia statewide program has set up a Regional Entrepreneurial Initiative (REI) grant program that can provide up to \$300,000 for each Regional Council to develop an integrated strategy for supporting the entrepreneurial ecosystem. Region 4’s innovation and entrepreneurial ecosystem has been widely recognized as more advanced than most other regions in the Commonwealth and in many similarly sized regions across the nation. The REI grant will not be used to create an initial strategic plan, but will instead focus on:

- “Filling the gaps” that entrepreneurs have identified in the ecosystem in areas such as funding, stage-specific strategies, and step-up space
- Exploring the potential for expanding the Community Innovation Hubs such as the one that Dominion established in Ashland to develop cross fertilization between startup and established companies with an innovation portfolio.
- Developing explicit strategies across the range of entrepreneurial activities from Intellectual property-based university spinoffs to high growth tech-based firms, and to small business efforts.
- Expanding the ecosystem’s reach across the geographic footprint of Region 4
- Building upon the Diversity, Equity and Inclusion commitment that was manifested in Grow Capital Jobs support for VSU’s Minority Business Launch Center.
- Designing an integrated entrepreneurial pipeline characterized by collaboration, networking, and cross pollination

Link GO Virginia Entrepreneurial Ecosystem Support to Align with the Council’s Priority Clusters

The survey responses of Council and Foundation members expressed a strong interest in ensuring that projects are integrated and that funding in one priority area has a reinforcing and multiplying effect on the dollars distributed. Besides its centrality in fostering tech-based entrepreneurial initiatives, Activation Capital has been a central organizing entity in the creation of a region-wide effort to establish a Pharmaceutical Manufacturing cluster. It is well positioned to identify the entrepreneurial activities

needed to support the build out of the cluster. The Council should work with Activation Capital to support those efforts that can enhance the cluster in 2022-2024.

Align Entrepreneurial Projects with Innovation-Based Larger Firms in the Region

The Council should work with Activation Capital, regional economic development organizations, and local economic development officials in exploring the potential for expanding Community Innovation Hubs such as the one created by Dominion Resources in Ashland in other jurisdictions throughout the region. Establishing mutually beneficial linkages between existing companies and entrepreneurial innovations could become a distinctive feature of the region's ecosystem. Capital One, for example, has leveraged its human capital to support the technical side of multiple startups. Projects that replicate and expand upon this model could accelerate the growth of the startup ecosystem.

Include Entrepreneurial space needs in the Council's Site/Infrastructure Development Priorities

The paucity of wet lab space in the region was flagged in the earlier update of the G&D Plan as an emerging challenge. It is no longer emerging and is widely perceived to be an obstacle to entrepreneurial expansion and the development of the pharmaceutical manufacturing cluster. The Council should request proposals for innovative solutions to the financial barriers and other considerations that limit the supply of wet lab facilities for potential clients.

CLUSTER SCALE-UP

Projects

While the original impetus for GO Virginia highlighted the importance of cluster development, it has been far easier to develop workforce and talent projects than cluster scale-up proposals. The Region 4 Council has supported 5 cluster scale-up, though two of these are more accurately described as COVID-19 Recovery awards than genuine cluster development efforts. Total awards for the 5 projects have amounted to \$3,230,153, 27% of the GO Virginia dollars supported by the Council.

The majority of funding has been dedicated to enhancing the biosciences and the emerging pharmaceutical manufacturing cluster. The major projects are: \$1,599,653 for Virginia Bio-Connect to

	ALL REGION 4	CLUSTER SCALE-UP
PROJECTS	28	5
FUNDING	\$11,876,368	\$3,230,153

support the formation of 4 new Bio-Hubs, to connect all regional Bio-Hubs across the state, and to elevate workforce development and provide mentorship. These dollars were shared with other Regional Councils.

Grow Capital Jobs also approved \$1,500,000 for two advanced pharmaceutical manufacturing projects. The first was an enhanced capacity grant (\$100K) for a comprehensive strategic plan to support the commercialization of new pharmaceutical manufacturing processes for producing vital generic medicines developed at the VCU College of Engineering by Dr. Frank Gupton's and the Medicines for All Institute. The second ongoing grant (\$1.4M) is to execute the strategy and to accelerate the growth of the cluster with the desired long-term outcome of enabling the region to become an international leader. The strategic plan resulted in the creation of the Advanced Pharmaceutical Manufacturing and R&D Cluster Accelerator.

The two proposals intended to support COVID recovery established a Small Business Development Center and assisting businesses with COVID employee safety.

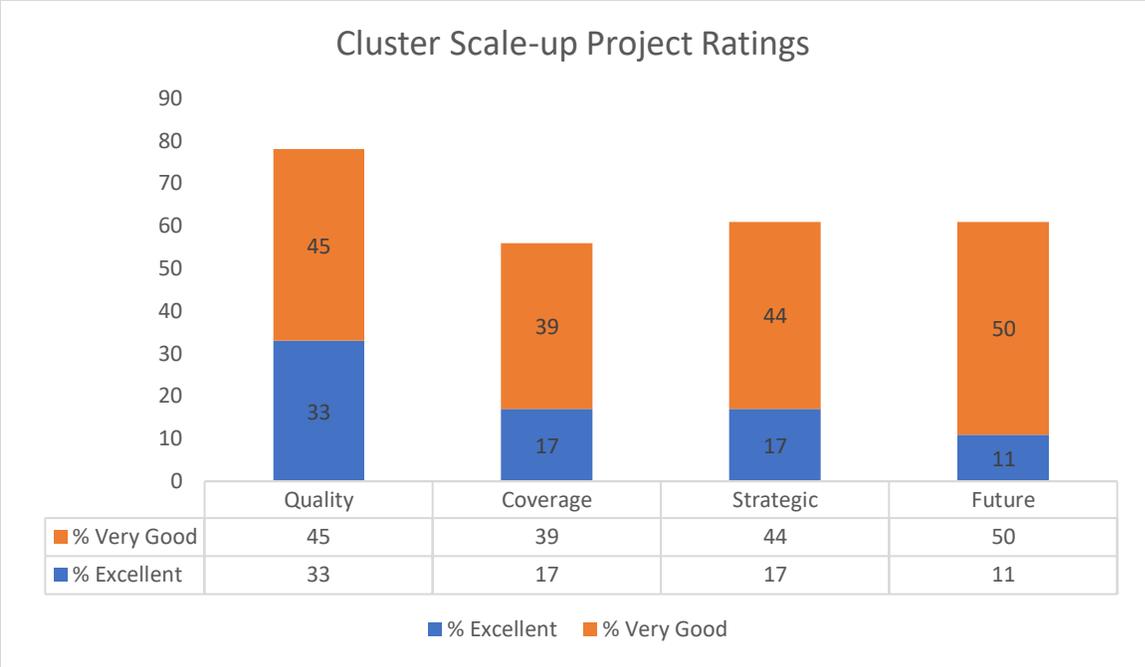
CLUSTER SCALE-UP PROJECTS

PROJECT	FUNDING	TYPE	BRIEF DESCRIPTION
VIRGINIA BIO-CONNECT	\$1,599,653	BIO-HUBS FORMATION AND NETWORKING	SUPPORT 4 NEW BIO-HUBS, CONNECT ALL REGIONAL BIO- HUBS, ELEVATE WORKFORCE DEVELOPMENT
VCU PHARMACEUTICAL ENGINEERING COMMERCIALIZATION	\$100,000	STRATEGIC PLAN	COMPREHENSIVE PLAN TO SUPPORT COMMERCIALIZATION OF PHARMACEUTICAL MANUFACTURING
PHARMACEUTICAL MANUFACTURING SCALE- UP	\$1,400,000 (+\$1,100,000 LEVERAGED RESOURCES)	EXECUTE STRATEGIC PLAN	ACCELERATE GROWTH OF PHARMACEUTICAL MANUFACTURING CLUSTER
CAPITAL REGION SBDC LAUNCH	\$30,500	FILL GAP AND PROVIDE COVID ASSISTANCE	ESTABLISH A SMALL BUSINESS CENTER IN THE REGION AND RESPOND TO COVID CRISIS
FORWARD RVA	\$100,000	COVID SUPPORT	SUPPORT SMALL BUSINESS WITH EMPHASIS ON EMPLOYEE SAFETY

Council/Foundation Assessment

78% of respondents believe that the quality of the cluster- scale-up projects approved for funding by the Regional Council has been Excellent (33%) or Very Good (45%). 6% of respondents rate the projects as “Good” and 17% give these a “Fair” rating. 61% of respondents rate the strategic focus and future orientation of cluster scale-up projects as Excellent or Very Good.

56% of Council/Foundation respondents rated the geographic coverage of the cluster scale-up projects as Excellent (18%) or Very Good (35%). 29% rated the geographic coverage as “Good” and 18% rated these fair. In the open-ended questions about priorities going forward, 50% of respondents pointed to bioscience and the pharmaceutical manufacturing cluster as the priority focus for 2022-2024.



It is fair to say that the high ratings for cluster scale-up are 1) an indication of the significant role that Council and Foundation members believe cluster development can play in moving the region forward and 2) an appreciation for the pathbreaking potential of the emergent pharmaceutical manufacturing cluster.

Trends in Key Clusters

Advanced Manufacturing/Pharmaceutical Manufacturing

The Regional Council has emphasized the importance of advanced manufacturing since the start of GO Virginia. Although advanced manufacturing does not rank high on location quotients or job growth numbers, it is an area of historic strength in the region and continues to supply wages higher than the regional average. More recently, the Council has named pharmaceutical manufacturing as an emerging sub-cluster where the region has a realistic potential to reshore pharmaceutical manufacturing to the U.S. and become a national and global leader in the production of essential medicines. In the earlier update to the G&D Plan, the promise of developing a pharmaceutical manufacturing cluster based on the research discoveries of Dr. Frank Gupton’s Medicines for All Institute at the VCU College of Engineering was highlighted as a potentially pathbreaking opportunity for the region.

Since the 2019 update, a series of developments have confirmed the reality of this opportunity.

- The establishment of the Phlow Corporation and the expansion of AMPAC Fine Chemicals in Petersburg along with the decision by Civica RX to locate a plant for producing injectable medicines adjacent to Phlow has provided the core manufacturing infrastructure for advancing the scientific innovations of M4ALL.
- In 2020, the federal government launched a major initiative to address the problems associated with the outsourcing of pharmaceutical manufacturing to secure the nation's supply of essential medicines. The U.S. Biomedical Advanced Research and Development Authority (BARDA) awarded a contract to the Phlow Corp. to lead a multiyear effort with its partners to: (i) create and supply a national Strategic API (Active Pharmaceutical Ingredients) Reserve for essential medicines at risk of shortage; (ii) to create the capability to manufacture API using innovative continuous process advanced manufacturing technologies; and (iii) ultimately to manufacture essential medications end-to-end. The contract included a four-year base award of \$354 million and \$458 million more in potential options long term for a total value of \$812 million. Phlow has started construction of a manufacturing facility adjacent to AMPAC Fine Chemicals in Petersburg. The facility will be the nation's most advanced for the manufacturing of API for essential medicines and support the continuous flow process manufacturing of API. Key partners in this important project are AMPAC Fine Chemicals which is investing heavily in expanding the capacity of its Petersburg API plant, and Civica Rx, which is investing over \$100 million to construct a dose manufacturing plant at the same location.
- In 2021, Phlow created the Children's Hospital Coalition in partnership with the nation's leading pediatric hospitals to raise awareness about the broken supply chain for pediatric medicines and supply a solution. Phlow will work with the hospitals to identify the most critical shortages, use its manufacturing processes to provide greater access to high quality, essential medicines and to do so with transparent cost-plus pricing.
- As a result of the two grants supported by the Regional Council, the region has formed an Advanced Pharmaceutical Manufacturing and R&D Cluster Accelerator that includes key businesses, universities, regional economic development officials, and local government representatives. The Accelerator will address key workforce, infrastructure, marketing issues and strategic opportunities crucial to cluster development. Recently through the efforts of the Accelerator and Activation Capital, the region's emerging advanced pharmaceutical manufacturing cluster was named a national finalist in the Build Back Better Regional Challenge of the US Economic Development Administration.

The creation of a pharmaceutical manufacturing cluster brings together the major focus areas that the Region 4 Council has prioritized in a unique and powerful manner. It combines bioscience, entrepreneurialism, advanced manufacturing and logistics to address global supply chain issues. At its

inception, the GO Virginia initiative emphasized that cluster development was the key to regional economic progress. Pharmaceutical manufacturing is a cluster that draws upon the historical strengths of the region while addressing the promise of the future. It also demonstrates how an economically stressed community can be an essential participant in a scientifically advanced economic development project.

Information Technology

The Council identified Information Technology as a key cluster in its G&D Plan and in its first update. This was the way that the Council aggregated a set of clusters where the region had shown both historic and current strength such as professional/business services, creative services, and finance/insurance.

The Council wanted to focus workforce initiatives, for example, on IT and digitally based skill building that would be relevant across industries and that would not apply only to banking, insurance, or commercial real estate. Companies looking to expand or relocate business divisions would be seeking more workers who had cutting edge IT and digital skills than individuals with specific degrees in content area majors. In 2020-21, the Council funded VCU Engineering for a workforce grant to establish a plan for enhancing digital skills throughout the region in conjunction with employers and educational institutions.

In addition, the Council recognized that tech-based businesses formed the largest portion of entrepreneurial firms that were potentially high growth. This was the case regardless of the general focus area of the company.

More recently, RVA-757 Connects has proposed that a mega-region linking the two metropolitan areas could collaborate on establishing a global internet hub that is made possible by the convergence of a unique set of assets, the undersea cables in Virginia Beach, the termination point of the cables in Henrico County, and the international interconnection there. Data centers have been a tremendous economic boost for local government tax revenues in Virginia and are a special target for local and regional economic development organizations. The promise of a global internet hub is that unique

technology assets on the I-64 corridor could become a driver for attracting a host of other tech-based companies and create a powerful innovative technology cluster in GO Virginia Regions 4 and 5.

Logistics

The Regional Council named logistics as a growth-oriented cluster in the original G&D Plan and in its first update as have the major regional economic organizations in the Region 4 footprint. The natural locational advantages of the region, proximity to major interstates, and ability to service the Port of Virginia at the Richmond Marine Terminal, have only become more important since the inception of GO Virginia.

The global supply chain disruption that accompanied the pandemic has increased the significance of the logistics cluster. Businesses have become more interested in getting closer to their customer base. “Just-in-time” inventory practices left businesses without crucial supplies and core ingredients. Specialized logistics operations such as “cold storage” have seen increased demand.

In the communities that form the Crater PDC, logistics has been the highest growth cluster since 2019. Wage growth in the logistics space has also increased since the pandemic as shortages of truck drivers and warehouse workers have led employers to increase pay at a rate higher than the Council’s other priority clusters.

Logistics operations are also inextricably related to site development opportunities. While the most affluent jurisdictions prioritize data centers, advanced manufacturing, bioscience activity and tech-based professional services, less affluent and more rural areas consider logistics operations an integral part of their economic development program. In addition, the siting of logistics facilities is a growing part of the build-out of the area next to the Richmond Marine Terminal.

The priority that Grow Capital Jobs should place on logistics is a question that council members should consider. On one hand, even with recently increased wages, it is not clear that logistics facilities will be a source of the high paying jobs that has been the major focus of GO Virginia. But as logistics operations proliferate, the demand for technically trained logisticians is also increasing. The EMSI/Burning Glass study commissioned by Chamber RVA specified that employees with advanced logistics skills was an

unmet need in the region. Partnering with the Commonwealth Center for Advanced Logistics Systems, a consortium of 5 public universities in Virginia, could assist in meeting this need.

Moreover, the region's focus on logistics is a logical complement to the emphasis that the Commonwealth places on the Port of Virginia as a unique economic development asset. And, if Grow Capital Jobs is to be consistent with the priorities established by regional organizations and localities in the southern and more rural parts of its footprint, logistics is a vital component.

Bioscience

The Regional Council designated bioscience as a priority cluster in the initial G&D Plan and in the 2019 update. The aggregated data about the cluster includes significant numbers of non-traded sector jobs involved in the provision of health care, including hospital care, nursing home facilities, and in-home services. There have been large workforce needs in these areas and significant interest in the programs offered by the region's educational institutions.

The Council's focus in bioscience has been more specific, related to traded sector jobs in research, manufacturing, and entrepreneurial initiatives and how the region can take advantage of the intellectual property developed at Virginia Commonwealth University.

The data produced by Chmura show that traded sector jobs in the bioscience area constitute some of the highest average wages in the region. And the TEconomy report shows that entrepreneurial activity in the region is constituted by significant numbers of bioscience related firms.

Bioscience is a highly competitive cluster, both nationally and globally. An historic challenge for the region's bioscience focus has been the identification of a specific focus area that could provide the region with a distinctive niche and competitive advantage. The emergence of a pharmaceutical manufacturing cluster has the potential for not only supporting an advanced manufacturing cluster but also supplying an identity that will generate even more research-related firms and employment on the region.

Recommendations

Prioritize the buildout of the advanced pharmaceutical manufacturing and R&D cluster

Capitalizing on the opportunity for the region to become a national and global leader in the advanced pharmaceutical manufacture and R&D of critical medicines should be the primary focus for Grow Capital Jobs in 2022-2024. It is an opportunity that potentially benefits the two major parts of the region including some of the communities at most economic need. It builds upon the historic manufacturing strengths of the region while incorporating innovative bioscience and chemical engineering research created here. And it can supply high paying jobs across a wide spectrum of occupations, ranging from manufacturing technicians to Ph.D. researchers. Grow Capital Jobs should work closely with the newly formed Advanced Pharmaceutical Manufacturing and R&D Cluster Accelerator to define the role that GO Virginia can best play in the next few years in advancing the buildout of this potentially transformative cluster.

Partner with Regional and Local Economic Development Organization to Address Gaps in Cluster Development

There is considerable overlap between Grow Capital Jobs' priority clusters and those chosen as priorities by local and regional economic development organizations. These organizations work daily with businesses looking to expand operations or relocate to the area and gain relevant intelligence about the gaps in the region's workforce and site development practices that impact the decisions of desired companies. Grow Capital Jobs should partner with these organizations to address the gaps in workforce development and site availability that can limit the growth of the priority clusters that have been mutually identified.

Explore the Potential of RVA-757 Becoming a Global Internet Hub

RVA-757 Connects has established the creation of a global internet hub as a major priority for the two regions that can be the pathway to explosive growth in tech-based companies and tech talent jobs. The potential global internet hub will build upon the critically important subsea cables housed in Virginia Beach and the Richmond NAP in Henrico County, the location where subsea cables converge with terrestrial fiber optic network and data center infrastructure. The Richmond NAP is the only international Interconnection point and the only termination point for the Virginia Beach subsea cables. It is widely recognized that while data centers have supplied substantial tax revenues, employment in

the centers themselves is relatively low. Grow Capital Jobs should explore the potential for the data centers becoming a pathway to attracting other tech companies and tech talent to the region.

Collaborate with Activity Led by VCU on the Region's Role in the Commonwealth Cyber Initiative

Virginia Commonwealth University's School of Engineering was the lead on a strategic plan to enhance the region's tech talent pipeline and serves as the lead (with seven community college and university partners) for one of Virginia's 4 major nodes in the Commonwealth Cyber Initiative (CCI). Grow Capital Jobs should partner with the CCI in developing the cybersecurity niche for the region in research, business attraction and workforce development. In addition, Grow Capital Jobs should explore cloud computing opportunities as a component of developing the tech talent pipeline.

SITE/INFRASTRUCTURE DEVELOPMENT

Grow Capital Jobs has pursued site development opportunities since the start of the GO Virginia initiative. Localities in the southern and more rural part of the region that need financial assistance to upgrade sites to business-ready status have been more involved in this aspect of Grow Capital Jobs than some of the larger and more affluent jurisdictions. In 2020, Grow Capital Jobs completed a Strategic Sites Plan as a follow up to the major statewide study that the Virginia Economic Development Partnership (VEDP) had commissioned. Stephen Moret, President and CEO of VEDP, had noted that the paucity of available sites, along with workforce issues, were major factors inhibiting the ability of Virginia to compete for manufacturing and logistics companies looking to relocate. The Strategic Sites Plan had 7 major recommendations that would enable Region 4 in upgrading sites to business-ready status. Grow Capital Jobs has been able to move forward on two major recommendations in 2021, but several others will still be relevant in 2022-2024.

Projects

Region 4 has supported 4 site/infrastructure development projects. These have totaled \$4,047,907 or 34% of the total GO Virginia projects supported by the Council.

The MAMac Mega-site project received \$2,217,500 to advance the 1600-acre mega-site to Tier 4 by completing engineering plans to upgrade the Greenville County Water and Sewer Authority's Water Treatment Plant, constructing

	ALL REGION 4	SITE ONLY
PROJECTS	28	4
FUNDING	\$11,876,368	\$4,047,907

the gravity fed sewer system to the site and a wetlands mitigation bank necessary to accommodate future development. The Virginia Gateway Region's Site Readiness project was awarded \$100,000 to evaluate a portfolio of sites less than 25 acres and to develop a plan for advancing selected sites to Tier 4 status with specific cost estimates included. The project was grounded in the premise that the region had a set of attractive sites with excellent locations that could be upgraded with limited investments. As a follow-up to the study, The VGR Sites project received \$1,634,407 to elevate 15 sites totaling approximately 1,600 acres to Tier 4 by completing all due diligence work associated with the sites. The Sussex County Water Study was awarded \$96,000 to develop a plan for addressing the water supply issues that are limiting the marketability of the site. The Sussex site is officially categorized as a mega-site but has experienced difficulty in attracting potential end users, at least in part, because of water capacity issues.

SITE/INFRASTRUCTURE PROJECTS

PROJECT	FUNDING	TYPE	BRIEF DESCRIPTION
MAMaC Mega-Site	\$2,217,500	DEVELOPMENT	ADVANCE TO TIER 4 w/ENGINEERING PLANS, SEWER, AND WETLANDS MITIGATION
VIRGINIA GATEWAY REGION-SITE READINESS	\$100,000	EVALUATION, CHARACTERIZATION	EVALUATE SITE PORTFOLIO TO DEVELOP PLAN FOR ADVANCING TIERS
VIRGINIA GATEWAY REGION SITES	\$1,634,407	DEVELOPMENT	ELEVATE 15 SITES TO TIER 4
SUSSEX COUNTY WATER	\$96,000	STUDY	STUDY TO ADDRESS WATER CAPACITY BARRIERS TO SUPPORT MARKETABILITY OF MEGASITE

Council and Foundation Member Assessments

56% of survey respondents rated the quality of site development projects Excellent (17%) or Very Good (39%). 33% rated the quality of projects Good and 11% rated project quality as Fair.

45% of survey respondents rated the project coverage across different geographic areas as Excellent or Very Good. 33% rated project coverage as Good and 22% rated it Fair.

34% of survey respondents rated the strategic focus and future orientation of the projects as Excellent or Very Good.

Several themes emerged in the open-ended responses. Multiple respondents suggested that a clearer focus would be valuable, linking priority sites to the Council’s expressed priorities and developing one or two sites that are most likely to attract business. A number of respondents want site development efforts to continue focusing on “historically excluded” communities and linking site development to broader infrastructure issues such as energy supply and broadband.

It should be noted that the Council/Foundation members’ overall assessment of site projects was the lowest in the 4 priorities examined in the survey. In every category- quality, coverage, strategic focus,

and anticipating future needs - site projects were either the lowest rated or tied for lowest rated in the percentage of Excellent and Very Good scores.

For example, 34% of respondents rated the Strategic Focus of site projects as Excellent or Very Good as compared to 61% for cluster scale-up projects, 56% for start-up ecosystem projects and 37% for workforce projects.



Region 4, the 2020 VEDP Study and What’s Changed

Region 4 is “Site Central “for Virginia. Of the 466 sites VEDP characterized in its 2019 study, 127 or 27% were located in Region 4, including several potential mega-sites. No other GO Virginia region had a comparable number of sites.

VEDP SITES BY TIER-STATEWIDE AND REGION 4

GO Virginia	Tiers 0-2	Tier 3	Tiers 4-5	Total
Statewide	418 (90%)	18 (4%)	30 (6%)	466 (100%)
Region 4	116 (91%)	3 (2%)	8 (6%)	127 (100%)

The VEDP study also listed considerable advantages that the region possessed in terms of site development.

VEDP REGION 4 SITE ADVANTAGES

Strengths	Details
Interstates	96% of sites within 5 miles of Interstate or 4 lane highways 76% within 2 miles
Electrical Availability	89% could power a medium industrial user in 12-18 months 44% currently have bridging and long-term availability on-site
Fiber	80% could have fiber on site in 12 months or less
Geology	Lack of karst or bedrock concerns in the region

Despite these site advantages, Region 4 had a small number of sites that had achieved Tier 4 status (business-ready within 12-18 months) in the VEDP rating system. In addition, a majority of sites were privately owned, and it was not completely clear what the rules and processes were for utilizing state programs to assist private owners with site development. VEDP noted a set of specific obstacles to getting Region 4’s sites to business-ready status.

Challenges	Details
Access Roads	21% of sites require major roadway improvements to provide adequate Access.
Wet Utilities	35% require major water and sewer system upgrades to service a medium industrial user.

Since the VEDP Study and Region 4’s Strategic Sites Project, there have been several developments that will impact Grow Capital Jobs site/infrastructure development strategy.

On the positive/opportunity side of the ledger:

- DHCD and the GO Virginia State Board responded to the questions that had been raised about state assistance to private owners for site development and clarified the rules/processes, including claw back provisions that would safeguard the use of state dollars.
- Region 4’s Gateway program will enable up to 15 sites be moved expeditiously to Tier 4 status, increasing the site supply in the region.
- The build-out of the pharmaceutical manufacturing cluster is clearly occurring, making it possible to develop a strategic plan for site needs in the emerging industry.

- The post-pandemic environment has increased the demand for logistics facilities, including specialized warehouses such as cold storage, a demand that the region is well-positioned to fulfill.
- Funds from the American Rescue Plan and the Cares Act will enable historically significant investments in broadband coverage - commercial and residential - that has inhibited economic development opportunities in the southern and more rural parts of the district.

On the challenge side of the ledger:

- The post-pandemic environment for site selection is broadly perceived within the region to have changed. Leaders of economic development organizations consistently report that companies and site selection consultants are looking for sites that can be “user ready” and are less willing to wait the 12-18 months that was the earlier standard.
- Infrastructure issues with utilities and transportation remain a significant barrier to site upgrading in the more rural, less affluent parts of the region. While the CARES Act and the American Rescue Plan is likely to result in historically significant increases in broadband coverage, addressing challenges in providing power supply, an adequate water supply, effective wastewater treatment, and easy access from nearby interstates will be vital in fully capitalizing on the region’s site capacity.
- Addressing infrastructure issues with utilities also requires examining state constraints, especially SCC limits on cost recoveries for “speculative” projects where a fully committed customer has not been identified.
- The paucity of available wet lab space is a major obstacle to the scale-up of the pharmaceutical manufacturing cluster and, more generally, to the enhancement of the bio-life sciences cluster in the region.

Recommendations

The set of recommendations described below are drawn from Grow Capital Jobs’ 2020 strategic plan for site development with modifications relevant to the challenges and opportunities that have emerged in the wake of the pandemic. The recommendations also respond to the Council/Foundation members’ site project assessment emphasizing the need for a clearer strategic focus and a plan for addressing the broader infrastructure issues that can affect upgrading sites to business ready. Governor Northam’s outgoing budget includes \$150 million for the development of mega-sites and mid-sized sites. If dollars for site development remain in the budget of incoming Governor Youngkin, Grow Capital Jobs should examine how these funds could be utilized to support the region’s priorities.

Utilize Site Development Projects to Enhance Pharmaceutical Manufacturing

Site development will be crucial to the build out of the pharmaceutical manufacturing cluster in several important ways: added sites for manufacturers and suppliers in Crater and RVA (including a possible development park) as well as lab space issues for pharmaceutical and bioscience research. Grow Capital Jobs should work with the recently formed Advanced Pharmaceutical Manufacturing and R&D Accelerator to develop and execute a site needs plan.

Identify and Upgrade Priority Sites that can be Elevated to User-Ready Status Expeditiously

Grow Capital Jobs should respond to the shortening of time frame for relocation decisions and place heavier emphasis on elevating sites to “user-ready” status. One strategy may be to work with VEDP and regional economic development officials to identify a short list of sites linked to the Council’s strategic priorities that can be upgraded expeditiously.

Develop Partnerships to Address Utility/Infrastructure Issues Earlier in the Site Readiness Process.

Neither GO Virginia statewide nor the Regional Council is presently funded to surmount all the barriers that may prevent otherwise desirable sites from being fully built out. The Council can, as it did with the private sector ownership issue, identify the barriers, seek input from potential partners in defining solutions, and explore alternative approaches. In particular, the Council should continue to collaborate with Virginia’s gas and power companies in creating better front-end approaches to solving utility issues that reduce the competitiveness of the region’s sites.

Capitalize on Supply Chain Disruption to Develop Specialized Logistics Sites

Region 4’s advantageous location positions it to capitalize on global supply chain disruption as companies seek to become provide closer to their customers. The Council should explore projects that could supply a distinctive advantage to the region. The timing may be right to explore the opportunity for a major cold storage facility and to take fuller advantage of the Richmond Marine Terminal.

Grow Capital Jobs

Recommended Strategies for 2022-2024

Workforce/Talent	Focus on the Workforce Pipeline, But Stake Out Locations on the Pipeline Where Grow Capital Jobs Can Be Effective in Expanding High Paying Jobs for a Sustainable and Diverse Workforce
Workforce/Talent	Support Program Models for Upgrading Skills While Maintaining Employment
Workforce/Talent	Develop a Workable Program for Transitioning Military
Workforce/Talent	Assess Previous Projects to Identify Best Practices for Return on Investment and Integrate Future Projects with the Region's Workforce-Related Organizations
Start-up Ecosystem	Apply for and Implement a Regional Entrepreneurial Initiative Award to Fill in Gaps in the Ecosystem
Start-up Ecosystem	Align Start-up Ecosystem Support with Council's Priority Clusters
Start-up Ecosystem	Align Start-up Projects with Innovation-based Larger Firms
Start-up Ecosystem	Include Start-up Space Needs such as Wet Lab Space in Site Development Priorities
Cluster Scale-up	Prioritize the Build Out of the Advanced Pharmaceutical Manufacturing and R&D Cluster
Cluster Scale-up	Partner with Local/Regional Economic Development Organizations to Address Gaps in Priority Clusters
Cluster Scale-up	Examine the Potential of RVA-757 Creating a Global Internet Hub that can Attract Job-Creating Tech Companies to the Region
Cluster Scale-up	Collaborate with the Commonwealth Cyber Initiative in Developing a Regional Cybersecurity Strategy for Research, Business Attraction and Workforce/Talent
Site/Infrastructure	Utilize Site Development Projects to Promote Pharmaceutical Manufacturing
Site/Infrastructure	Identify Priority Sites that can be Elevated to User-Ready Status Expeditiously
Site/Infrastructure	Develop Partnerships to Address Utility/Infrastructure Issues Earlier in the Site Readiness Process and Elevate its Strategic Importance with Utility Companies' Leadership
Site/Infrastructure	Capitalize on Supply Chain Disruption to Develop Specialized Logistics Sites and Further Develop the Richmond Marine Terminal Area

Appendix 1: Locality Specific Data

Employment by Locality, 2016-2019

	Manufacturing	Logistics, Warehousing and Distribution	Information Technology and Communication	Bioscience/ Life Sciences	Total-All Industries
Colonial Heights	-24.3%	-15.9%	-36.7%	-14.3%	-3.2%
Emporia	5.8%	-20.6%	27.6%	4.3%	0.44%
Hopewell	-5.1%	79.3%	-22.1%	3.2%	-0.8%
Petersburg	-10.3%	-9.3%	9.0%	5.4%	1.3%
Richmond	3.2%	4.0%	11.3%	9.2%	5.9%
Charles City County	-42.1%	-11.2%	15.6%	337.0%	5.8%
Chesterfield County	-3.5%	-0.9%	7.7%	6.2%	4.5%
Dinwiddie County	12.8%	14.2%	9.2%	-48.6%	5.3%
Goochland County	18.5%	35.4%	10.3%	1.8%	15.5%
Greensville County	-3.1%	-42.1%	-36.3%	-35.7%	-2.8%
Hanover County	0.2%	76.5%	13.0%	9.1%	9.3%
Henrico County	14.4%	13.8%	8.9%	1.4%	3.0%
New Kent County	-10.0%	-26.5%	-11.9%	9.1%	16.3%
Powhatan County	9.1%	-4.2%	8.3%	8.0%	7.2%
Prince George County	63.2%	-7.4%	-0.3%	17.4%	-0.19%
Surry County	-29.2%	-55.0%	-31.4%	56.1%	-11.5%
Sussex County	-24.3%	12.3%	6.2%	-8.9%	-4.5%

Employment by Locality, 2020Q1-2021Q1

	Manufacturing	Logistics, Warehousing and Distribution	Information Technology and Communication	Bioscience/Life Sciences	Total-All Industries
Colonial Heights	-14.7%	-14.2%	-5.6%	-6.8%	-11.2%
Emporia	-16.1%	46.9%	35.3%	-6.8%	-8.2%
Hopewell	-2.0%	-32.0%	-12.8%	-8.1%	-5.9%
Petersburg	-6.6%	-17.5%	-19.9%	-6.8%	-10.5%
Richmond	-6.0%	-0.3%	-1.6%	-4.1%	-8.4%
Charles City County	1.9%	-6.8%	1.2%	-44.3%	-3.0%
Chesterfield County	-0.1%	11.4%	-5.7%	-7.2%	-5.2%
Dinwiddie County	-2.6%	16.5%	5.2%	-10.4%	0.8%
Goochland County	-14.4%	0.4%	-5.8%	50.3%	1.0%
Greensville County	-0.2%	42.2%	22.9%	-31.4%	-3.3%
Hanover County	-3.3%	28.1%	-0.9%	-7.9%	-7.6%
Henrico County	-8.3%	1.6%	-5.1%	-5.4%	-7.5%
New Kent County	1.5%	-0.2%	15.0%	5.8%	-3.3%
Powhatan County	-12.4%	-13.0%	-0.6%	-19.3%	-2.7%
Prince George County	-23.0%	-5.4%	-12.9%	-1.3%	-4.9%
Surry County	14.8%	55.8%	28.0%	2.0%	-5.5%
Sussex County	-2.7%	-12.3%	17.7%	-14.2%	-5.8%

Wages by Locality, 2016-2019

	Manufacturing	Logistics, Warehousing and Distribution	Information Technology and Communication	Bioscience/ Life Sciences	Total-All Industries
Colonial Heights	-3.3%	-10.1%	-3.6%	20.8%	9.9%
Emporia	18.7%	29.4%	7.4%	-5.8%	7.3%
Hopewell	11.4%	-2.6%	-5.1%	8.8%	5.1%
Petersburg	4.2%	1.7%	1.1%	7.7%	7.1%
Richmond	10.4%	7.7%	8.8%	16.6%	9.7%
Charles City County	28.5%	10.6%	-4.3%	22.0%	15.6%
Chesterfield County	1.4%	16.5%	-3.5%	2.7%	8.8%
Dinwiddie County	9.2%	6.0%	1.3%	11.2%	18.4%
Goochland County	12.5%	16.8%	19.8%	8.0%	16.3%
Greensville County	20.7%	24.1%	13.2%	27.5%	18.9%
Hanover County	14.3%	-19.2%	10.4%	15.8%	8.6%
Henrico County	4.9%	12.3%	9.3%	7.6%	7.9%
New Kent County	15.7%	20.8%	28.7%	15.0%	14.9%
Powhatan County	16.4%	-5.1%	22.5%	38.0%	9.0%
Prince George County	11.9%	10.7%	10.5%	17.8%	9.6%
Surry County	12.8%	-45.4%	-32.7%	-40.7%	0.2%
Sussex County	23.3%	4.3%	-12.4%	8.2%	11.7%

Wages by Locality, 2020Q1 to 2021Q1

	Manufacturing	Logistics, Warehousing and Distribution	Information Technology and Communication	Bioscience/ Life Sciences	Total-All Industries
Colonial Heights	11.2%	10.8%	2.9%	8.2%	10.6%
Emporia	14.0%	-11.2%	2.2%	5.3%	9.8%
Hopewell	3.3%	-11.3%	17.8%	6.5%	9.8%
Petersburg	-3.4%	0.1%	17.6%	5.7%	3.1%
Richmond	2.8%	3.2%	1.4%	3.4%	10.5%
Charles City County	12.8%	3.6%	2.9%	-10.2%	6.7%
Chesterfield County	2.4%	12.3%	-0.3%	2.2%	8.0%
Dinwiddie County	-3.3%	19.9%	10.5%	12.9%	12.9%
Goochland County	-2.7%	-3.9%	2.4%	20.1%	0.2%
Greensville County	2.5%	-4.4%	3.4%	-5.3%	7.6%
Hanover County	5.9%	21.1%	7.9%	1.9%	9.4%
Henrico County	5.9%	-0.8%	1.5%	5.7%	8.2%
New Kent County	12.0%	7.5%	11.1%	29.4%	7.3%
Powhatan County	4.5%	-0.3%	-3.5%	-1.0%	8.2%
Prince George County	-6.5%	13.5%	1.2%	2.4%	6.8%
Surry County	-0.7%	46.8%	31.0%	60.9%	2.0%
Sussex County	1.2%	10.7%	3.7%	32.0%	10.4%

Appendix 2: Traded Bioscience/Life Sciences

The bioscience/life sciences cluster can be separated into traded (export-oriented) sectors and local sectors (primarily serving the local population). Traded sectors are often targeted for economic development as these businesses export goods and services and drive economic growth by bringing money back into the region.¹ Examples of local bioscience/life sciences industries include home health care services, nursing care facilities, medical laboratories, kidney dialysis centers, and hospitals. Traded industries include research and development (R&D) in life sciences; pharmaceutical preparation manufacturing; and medical, dental, and hospital equipment and supplies wholesalers. Virginia Commonwealth University Health blurs these lines, as typically (and in this report) hospital systems are considered local, though research activity can contribute to growing traded industries in the cluster—such as the partnership between VCU’s Medicine for All and pharmaceutical industries.²

Between 2016 and 2019 (prior to the pandemic), employment in the traded cluster grew 2.3% reaching 6,801 workers by the end of 2019. As the pandemic disrupted the global economy in 2020, employment in the traded cluster declined 7.6% down to 6,285 workers. As of the first quarter of 2021, employment in the traded cluster in the region has begun recovering, reaching 6,295 workers. Over the year ending with 2021Q1, several industries have added jobs, including medicinal and botanical manufacturing (+49), surgical appliance and supplies manufacturing (+13), and surgical and medical instrument manufacturing (+10).

	Employment in Bioscience/Life Sciences, GO Virginia Region 4						2016 to 2020	
	2016	2017	2018	2019	2020	2021Q1	%	#
Traded	6,649	6,443	6,529	6,801	6,285	6,195	-5.5%	-364
Local	62,001	63,018	63,449	63,865	61,332	60,705	-1.1%	-669
Total- Bioscience/Life Sciences	68,650	69,462	69,979	70,666	67,617	66,900	-1.5%	-1,033

Source: Chmura’s JobsEQ®

¹ Traded and local clusters are defined based on research from *Delgado, M., M.E. Porter, and S. Stern (2014), "Defining Clusters of Related Industries."* and <https://clustermapping.us/content/cluster-mapping-methodology>

² Source: https://news.vcu.edu/article/VCU_Medicines_for_All_Institute_partners_with_industry_to_secure

The traded bioscience/life sciences cluster has much higher wages than local industries, reflecting higher levels of innovation and productivity. Between 2016 and 2019 (prior to the pandemic), wages in the traded cluster grew 5.4%, reaching an annual average of \$99,825 by the end of 2019. As the pandemic disrupted the global economy in 2020, wages in the traded cluster declined 2.5% to \$97,379. This decline can be attributed to the loss of jobs in high paying industries such as pharmaceutical preparation manufacturing and R&D. As of the first quarter of 2021, the overall annual average wage in the traded cluster is \$96,245.

	Average Annual Wages in Bioscience/Life Sciences, GO Virginia Region 4						2016 to 2020	
	2016	2017	2018	2019	2020	2021Q1	%	#
Traded	\$94,701	\$95,444	\$95,465	\$99,825	\$97,379	\$96,245	2.8%	\$2,678
Local	\$46,259	\$47,652	\$49,230	\$50,818	\$53,648	\$54,903	16.0%	\$7,389
Total- Bioscience/Life Sciences	\$51,340	\$52,530	\$53,914	\$56,140	\$58,100	\$58,997	13.2%	\$6,760

Source: Chmura's JobsEQ®