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2022 Greater Philadelphia Cell and Gene Therapy Update

Prepared for CEO Council for Growth and the University City Science Center

June 2022

Introduction

In 2019, the CEO Council for Growth ("CEO Council"), University City Science Center ("Science Center"), and University City District's West Philadelphia Skills Initiative convened a partnership to leverage their resources and networks on an initiative to support and grow the Greater Philadelphia region's cell and gene therapy sector. The stimulus for this partnership arose from a need, identified by various stakeholders, to understand the growth of and gaps in the cell and gene therapy workforce in Greater Philadelphia. Econsult Solutions, Inc. (ESI) was hired to provide an independent assessment of the future workforce and talent needs of the industry.

Since the release of that report, the cell and gene therapy industry in Greater Philadelphia has continued to grow and develop, even while the COVID-19 pandemic was not only dramatically impacting people's health and welfare, but also the health care industry, global economies, and the nature and makeup of the workforce across all industries. New collaborative workforce development programs have been launched in response to needs identified in the 2019 study.

In early 2022, two of the original partners, the CEO Council and the Science Center, engaged ESI to refresh and update the analysis done in 2019 to assess changes in the industry, and to learn more about the future workforce needs for Greater Philadelphia's growing cell and gene therapy industry.

Following a similar methodological approach as in 2019, ESI used LinkedIn Talent Insights and Burning Glass Labor Insights to determine both the labor market supply and demand, respectively, for the cell and gene therapy sector in Greater Philadelphia. Primary research was also conducted through surveys, interviews, and focus groups consisting of professionals with knowledge of the sectors, including academic researchers, industry and human resources experts, and workforce development organizations. Both quantitative and qualitative data and subsequent analysis informed our understanding of the scope of the sector and identified barriers and opportunities for growth in Greater Philadelphia.

In this updated analysis, ESI's workforce supply and demand analysis looks at over 40 cell and gene therapy (CGT) companies in the Greater Philadelphia region, 15 biopharmaceutical companies (focused on their workforce or job openings for cell and gene therapy-related skills) and 12 contract manufacturing organizations (CMOs). This represents companies that both existed for the 2019 analysis as well as others that are new or expanded since that report was issued. Together with their partners, ESI also conducted a survey of over 30 industry leaders and held three roundtable discussions to inform quantitative findings and analysis. This work was also aided by research being conducted for a parallel study by Drexel University.

The Cell and Gene Therapy Industry in Greater Philadelphia

Cell therapy, gene therapy, and gene editing comprise the next generation of life-enhancing and curative therapies. Briefly, they can be described as innovative approaches to medical research and practice in which cell or gene modifications are used to treat disease. The Greater Philadelphia region, long considered a hub for medical innovation and expertise, is home to some of the global leaders in health care, particularly in cell and gene therapy.

This sector has the potential to dramatically impact the life sciences industry, with much of the research and commercial activity within the cell and gene therapy sector having concentrated in the Greater Philadelphia region over the last 10 years. The first gene therapy approved for a genetic disease by the U.S. Food and Drug Administration (FDA) was developed by researchers at the University of Pennsylvania and the Children's Hospital of Philadelphia (CHOP), while the first FDA-approved cell therapy was developed through collaboration between researchers at the University of Pennsylvania and Novartis.

In the 2019 analysis, ESI constructed four potential scenarios for how the industry could grow and develop in the Greater Philadelphia region. That analysis, based on a construct that pivoted on both the barriers facing the industry and the ability to attract and develop a sufficient pool of talent, suggested that in 2019, the region was an R&D Center on the cusp of becoming a Leading R&D Hub.

In 2022, we once again explored these scenarios. Based on both the growth and development of the industry (see sections 1 and 2) and the opinions expressed by industry leaders in roundtables and through survey responses (see section 3), it appears that the region is now best considered a Leading R&D Hub but moving toward becoming a Commercialization and Manufacturing Hub.

Source: Econsult Solutions, Inc. (2019)

Section 1

Greater Philadelphia Workforce Supply Analysis:

Current Workforce Trends from LinkedIn Talent Insights

Analyzing current workforce supply with LinkedIn Talent Insights

In order to identify changes in workforce trends, ESI leveraged company and talent pool reports from LinkedIn Talent Insights to gauge industry shifts in employment, degree desirability, and professional values. These reports were further utilized to measure fluctuations in regional growth and to determine the growth of skills within the sample regions. More specifically, the company-specific reports were used to gather industry and company-specific microdata while talent pool reports were used for the regional analysis of talent availability in relation to educational attainment, skills, and to determine professional values (LinkedIn profiles used in this analysis included at least one of the following skills: genetics, gene therapy, cell therapy, immunology, cell biology).

The LinkedIn data serves as an industry-wide survey of professionals working for cell and gene therapy (CGT) companies, contract manufacturing organizations (CMOs), and in the cell and gene therapy operations of regional biopharmaceutical companies. With this data, ESI was able to:

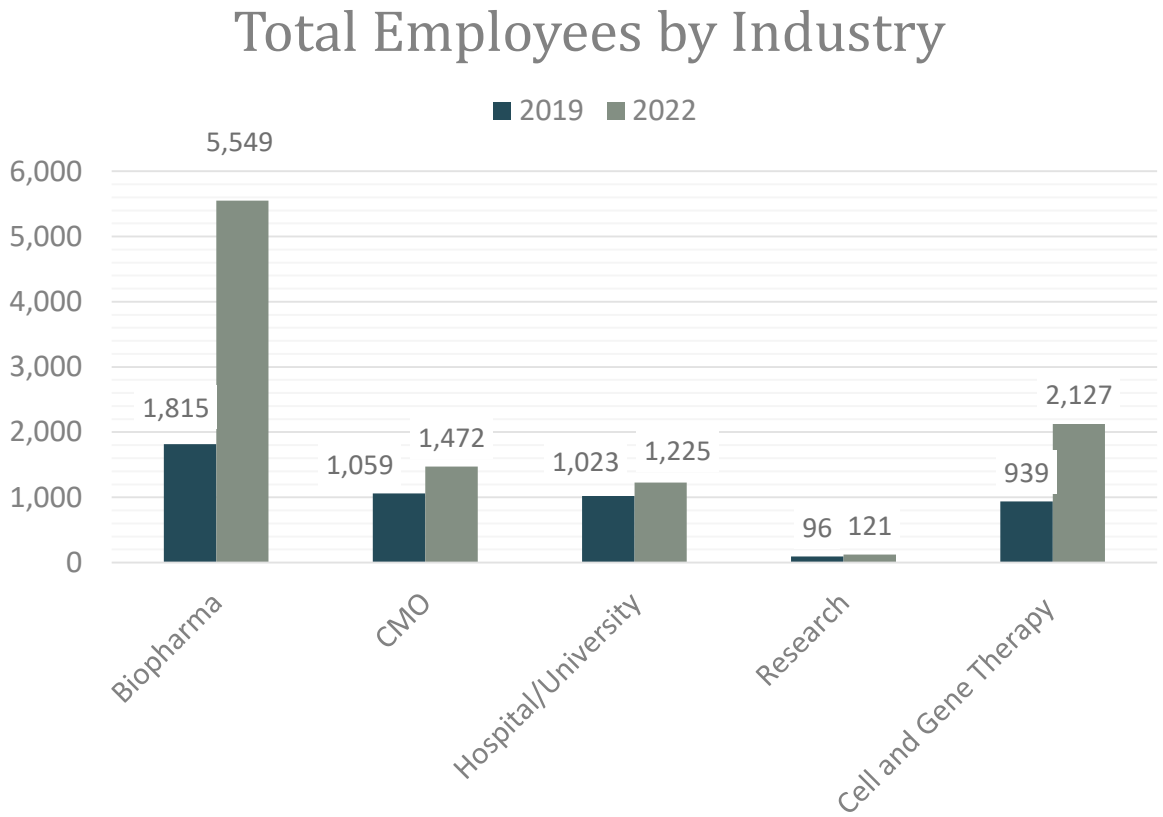
- Aggregate LinkedIn profile information from employees currently working at cell and gene therapy companies, contract manufacturing organizations, or at biopharma companies doing cell and gene therapy work,
- Analyze all regional LinkedIn profiles of individuals who list some level of cell and gene therapy skills, and
- Provide a regional analysis of talent supply characteristics, including moves into and within the marketplace, educational backgrounds, skills, and other characteristics.

ESI also utilized the LinkedIn Talent Insights data to analyze current workforce supply trends in cell and gene therapy within the Greater Philadelphia region, as well as six additional regions known as leaders in the CGT industry (Greater Boston, New York Metro Area, Raleigh-Durham-Chapel Hill Area, San Diego Metropolitan Area, San Francisco Bay Area, and Washington DC-Baltimore Area). This analysis focuses on individuals with skills pertinent to cell and gene therapy such as genetics, gene therapy, cell therapy, immunology, and cell biology. From this, ESI was also able to determine growing skills within the industry inclusive of Greater Philadelphia and comparative regions.

Strong CGT employment growth across region

As measured through LinkedIn Talent Insights analysis of current regional employees, the Greater Philadelphia region has seen strong growth in cell and gene therapy employment.

- Regional employment for cell and gene therapy companies has more than doubled since 2019 (up 127%).
- Employees at contract manufacturing organizations (CMOs) have grown by nearly 40% since 2019.
- The number of employees at regional biopharma companies claiming cell and gene therapy-related skills has grown by over 200%.

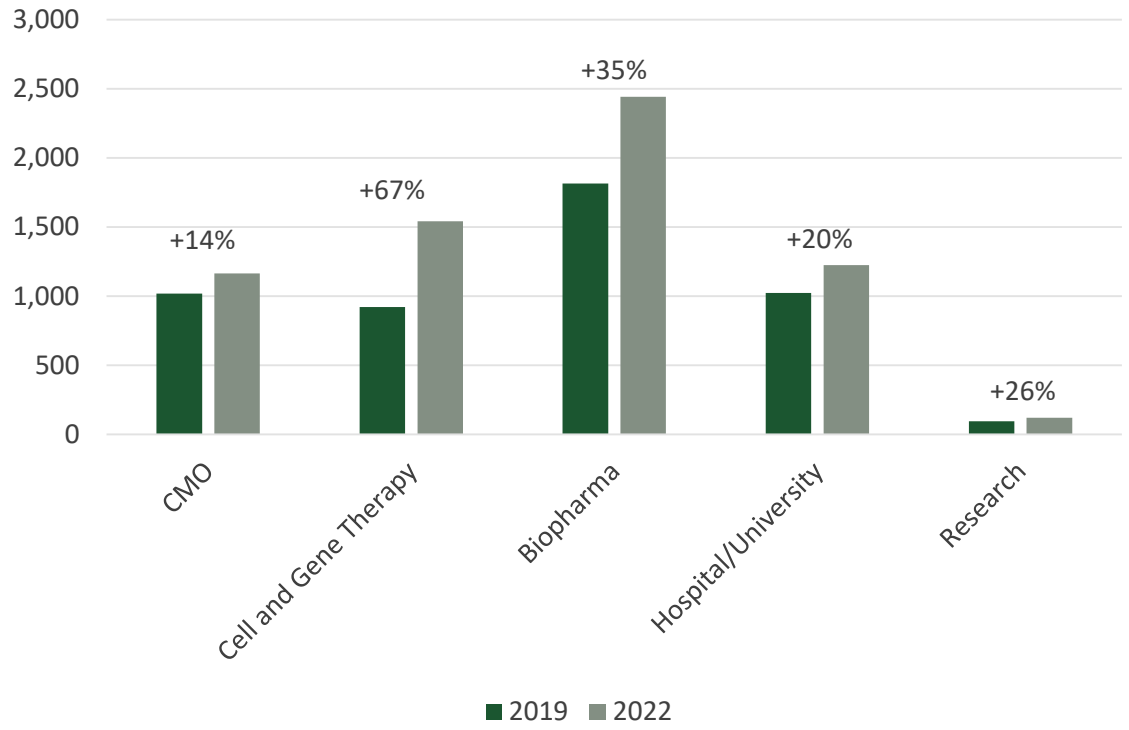


Source: LinkedIn Talent Insights Company Report; CEO Council for Growth; Econsult Solutions, Inc.

Existing company growth has been crucial

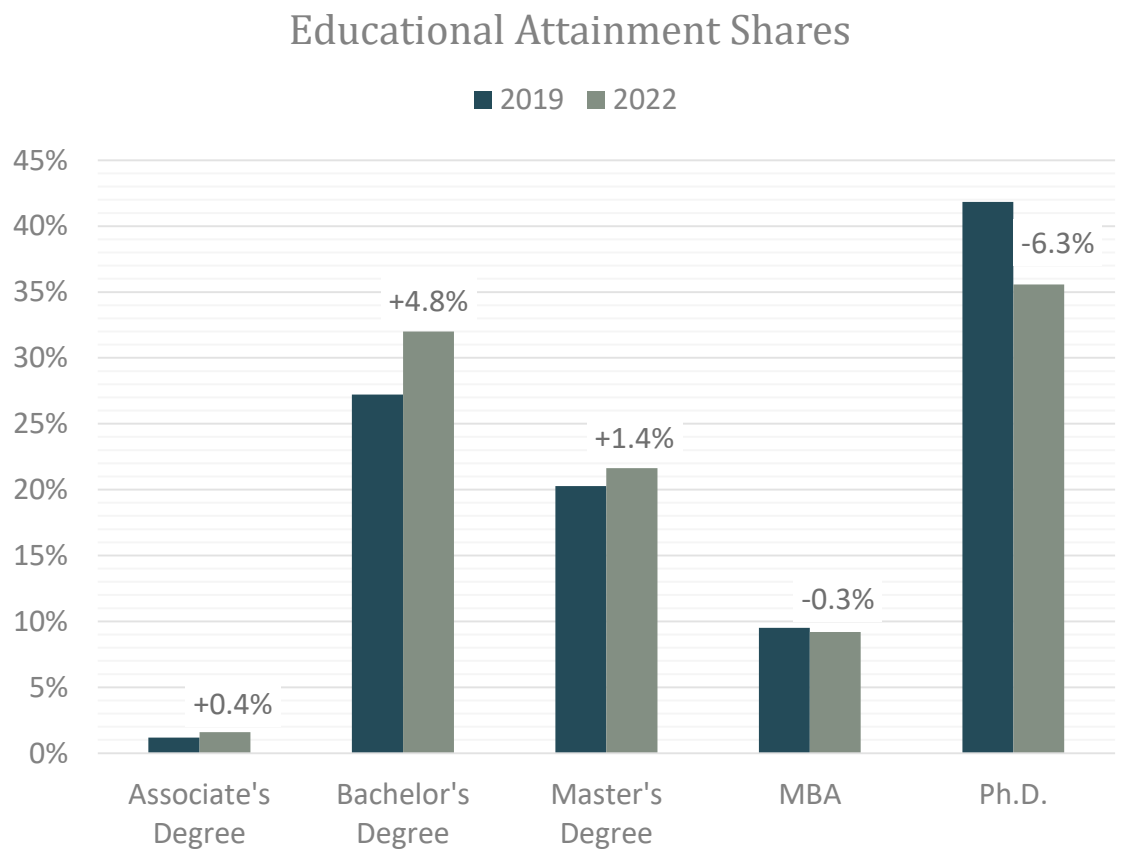
While much of the growth in regional employment since 2019 has come from new companies or divisions focused on CGT, examination of companies that had LinkedIn employment data in both 2019 and 2022 shows strong growth as well, with CGT companies increasing employment by 67% over this time period.

Employment at Select Companies and with Specific Skillsets, 2019 vs 2022



Source: LinkedIn Talent Insights Company Report; CEO Council for Growth; Econsult Solutions, Inc.

Share of employees with master's degrees or lower increased since 2019



Source: LinkedIn Talent Insights Company Reports; Econsult Solutions, Inc.

As the industry has grown, the educational attainment levels within the CGT workforce are shifting.

- Employees with bachelor's degrees make up a larger share of CGT employment in 2022 than in 2019, with the share increasing by nearly 5%.
- As the industry matures, existing companies grow, and more manufacturing of therapies is occurring, the share of employees with advanced degrees has fallen since 2019. The share of employees with a Ph.D. dropped by over 6%, while the share with an MBA remained relatively unchanged.
- The top five educational providers of talent in the Greater Philadelphia region for cell and gene therapy companies are:
  - University of Pennsylvania
  - Temple University
  - Drexel University
  - Thomas Jefferson University
  - University of Delaware

Increase in business-oriented job titles

For those professionals with cell and gene therapy-related skills listed on their profiles, the largest growth in job titles held were among business-oriented job titles, such as QA managers, vice presidents, directors, and program managers.

Alternatively, the job titles that appear among these professionals most commonly are more research-focused, likely concentrated within institutions or reflecting research focus. These titles include scientist, postdoctoral researcher, and professor or assistant professor.

Of all job titles held by those with cell and gene therapy-related skills and who also have a LinkedIn profile, the researcher position was most demanded with 63 job postings from companies within the Greater Philadelphia region that post openings on LinkedIn. In addition, those with the title undergraduate research assistant displayed 25 percent one-year growth, landing it in the top 10 fastest-growing titles on LinkedIn for talent with cell and gene therapy-related skills.

		Growth 2021-2022
1	Quality Assurance Manager	+66.7%
2	Analytical Scientist	+37.5%
3	Senior Director	+35.6%
4	Senior Medical Director	+33.3%
5	Undergraduate Research Assistant	+25.0%
6	Director Biology	+24.4%
7	Process Development Scientist	+24.3%
8	Program Manager	+23.1%
9	Chief Scientific Officer	+22.9%
10	Vice President	+21.8%

Source: LinkedIn Talent Insights Talent Pool Reports; Econsult Solutions, Inc.

Fastest-growing skills within Greater Philadelphia's CGT, CMO and biopharma companies

Within the Greater Philadelphia region, the fastest-growing skills for professionals working or looking for work in the cell and gene therapy sectors are "analytical skills" and "biology," ranked first and second place, respectively.

Compared to the 2019 fastest-growing skills, there is much similarity in terms of the skills recognized, apart from troubleshooting and data analysis which are no longer ranked among the top skills.

New skills that have emerged in the top-five bracket in 2022 are finance and gel electrophoresis. The emergence of the finance skill in particular showcases the expansion of the industry by highlighting the need for talent with more varied skillsets, not exclusive to those pertinent to the life sciences industry, to take on other avenues of company operations.

Top skills, 2019 and 2022

Greater Philadelphia Top 5	2019 Ranking	2022 Ranking
Analytical Skills	4	1
Biology	1	2
Finance	-	3
Real-Time Polymerase Chain Reaction (qPCR)	5	4
Gel Electrophoresis	-	5
Troubleshooting	2	-
Data Analysis	3	-

LinkedIn Talent Insights Talent Pool Reports; Econsult Solutions, Inc.

Top regions seeing steady growth

2020 to 2021 growth in professionals with CGT Skills, Greater Philadelphia vs. Top Regions

	Professionals	Over the year growth
Greater Boston	83,252	+2.4%
New York City Metro Area	81,066	+2.3%
San Francisco Bay Area	78,147	+2.0%
Washington DC-Baltimore Area	44,395	+2.4%
Greater Philadelphia	**36,865**	**+2.0%**
Raleigh-Durham-Chapel Hill Area	25,478	+2.2%
San Diego Metropolitan Area	24,064	+2.2%

LinkedIn Talent Insights Talent Pool Reports; Econsult Solutions, Inc.

The top regions in the U.S. for cell and gene therapy, inclusive of Greater Philadelphia, continue to exhibit steady growth. Although the Greater Philadelphia region was positioned toward the lower end of over-the-year-growth in 2021 when compared to the other sample regions, it is important to note that Greater Philadelphia is keeping pace in terms of producing talent that will continue to propel the CGT sector forward.

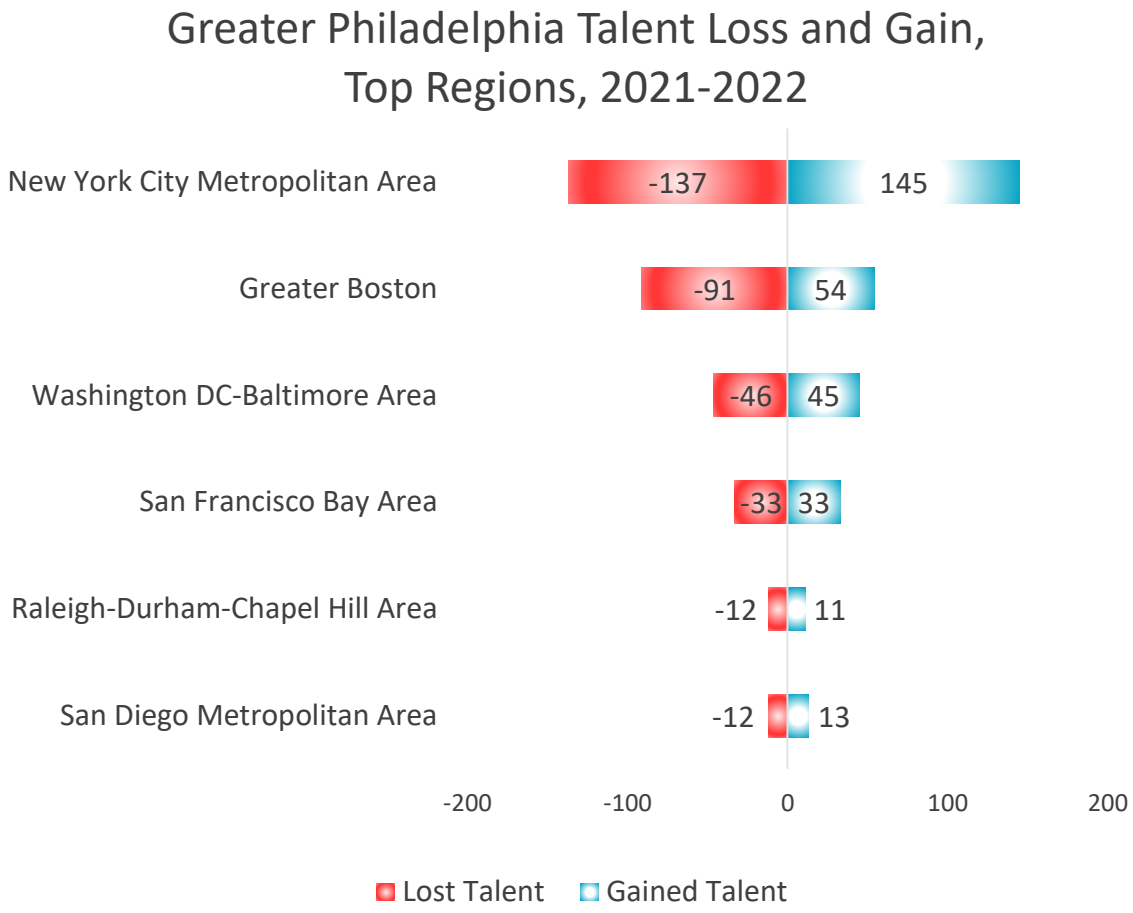
Further, with its agglomeration of high-caliber universities and hospitals, many of which already work in partnership with one another, Greater Philadelphia is poised to continue producing talent to feed industry needs. The region has more professionals within the CGT sector than the San Diego Metro Area and the Raleigh-Durham-Chapel Hill Area, but it will be important to track growth trends in these competitors and potentially new emerging markets.

Recruiting and retaining talent

In addition to the number of professionals present within a region, the movement of talent also plays an important role when measuring the trajectory of a specific industry or sector.

Compared to the other sample regions in this analysis, Greater Philadelphia remained relatively stable in terms of net talent loss and gain. However, there was a slight change in the ratio of talent gained to talent lost in relation to 2019, with the 2019 ratio being 1.03 compared to .91 in 2022, meaning that slightly more talent was lost to top regions from 2021 to 2022, as opposed to 2019 when the region gained slightly more than it lost.

Looking at how Greater Philadelphia is faring versus other top regions, the region remained relatively even in terms of net talent flows with all of the peers except for the Boston region, which continues to be a magnet for talent in the sector. As the industry grows in Greater Philadelphia, it will be important to track these net talent flows as the industry matures and competes on a national level for high-level talent.



Source: LinkedIn Talent Insights Talent Pool Reports; Econsult Solutions, Inc.

Section 2

Greater Philadelphia Workforce Demand:

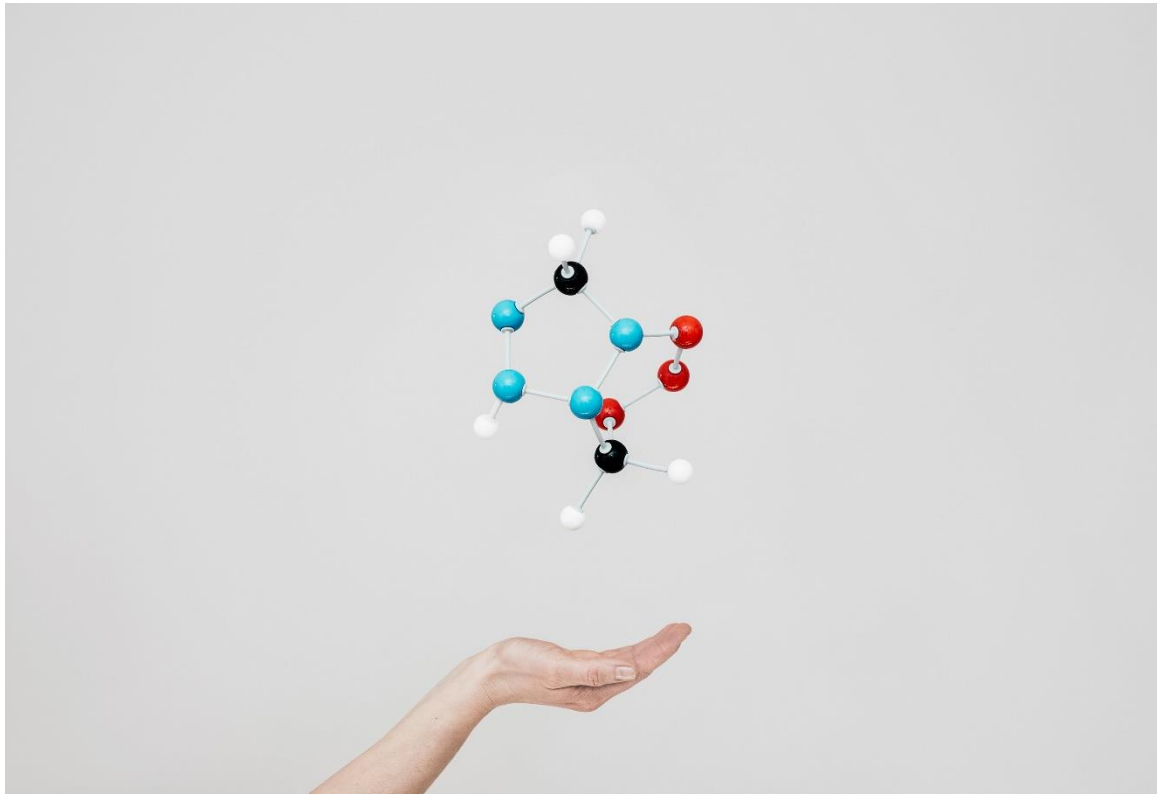
Job Posting Analysis Using Burning Glass

Workforce Demand Analysis – Burning Glass

Like the 2019 study, ESI utilized Burning Glass data to analyze current workforce demand trends in the life sciences sector within the Greater Philadelphia region. With this data, ESI, with the support of the West Philadelphia Skills Initiative:

- Utilized the Burning Glass Technologies database of online job openings to analyze market demand for cell and gene therapy, contract manufacturing, and CGT jobs at biopharma companies.
- Analyzed job skill requirements, educational requirements and other job characteristics for all job postings between 2019 and 2022, and compared that to job postings between 2016 and 2019,

In doing so, ESI leveraged three types of reports containing (1) cell and gene therapy companies' job posts from 2019 throughout 2021, (2) CMO companies' job posts from 2019 throughout 2021, and (3) biopharmaceutical companies' job posts from 2019 throughout 2021. In order to maintain continuity Burning Glass report parameters were set to match those used for the supply-side analysis.



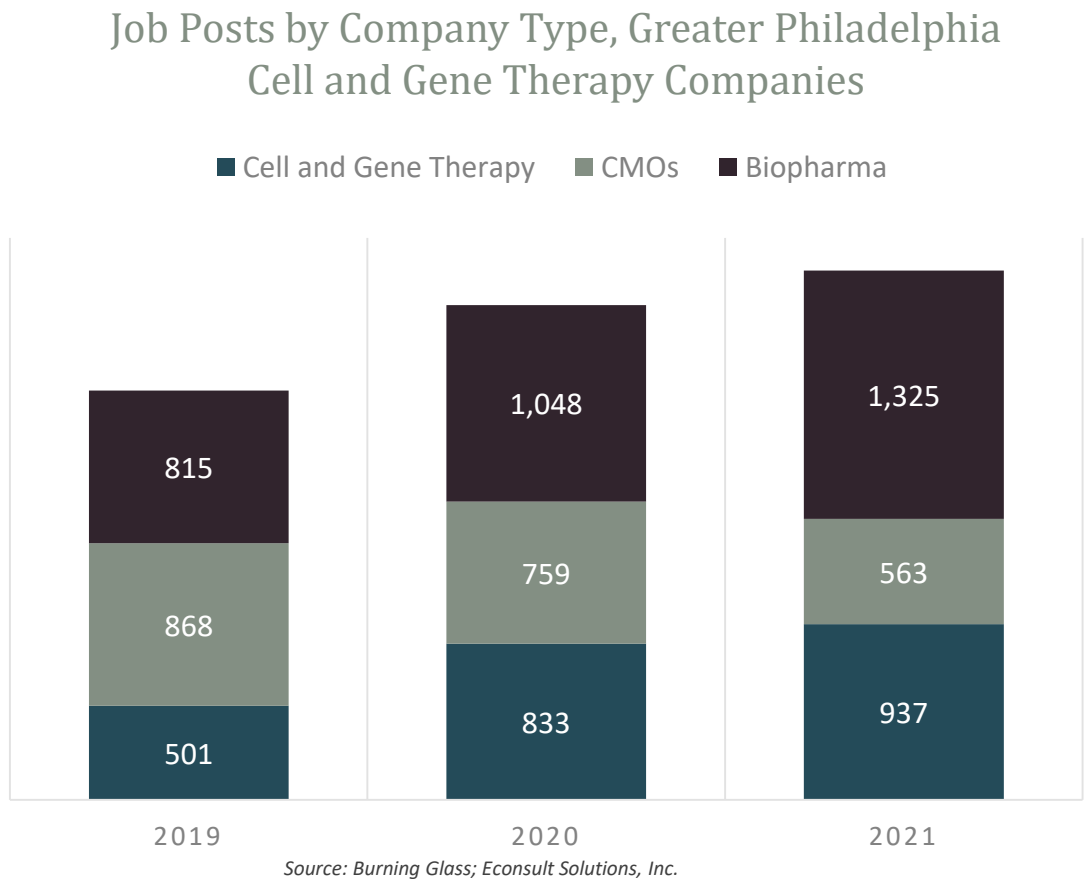
Total job posts increased from 2019 through 2021 for cell and gene therapy and biopharma, decreased for CMOs

From 2019 throughout 2021 the Biopharma industry in the Greater Philadelphia region consistently demanded talent to fill open positions.

Overall, the three sectors posted 2,184 jobs in 2019, 2,640 jobs in 2020, and 2,825 jobs in 2021 – a 29% increase in job postings from 2019 to 2022.

Within the three primary industry sectors, both cell and gene therapy and biopharma companies in the region experienced growth as indicated by a growing need for new talent, while the demand for CMO job postings slowed throughout the same period.

With growing CGT companies like Spark Therapeutics starting to transition to in-house manufacturing, it is possible that CMOs will continue this pattern in the years to come. This industry transition has the potential to bolster the cell and gene therapy and biopharmaceutical industries within the region and create the demand for talent requiring less advanced degrees to fill these new positions as manufacturing centers arise.



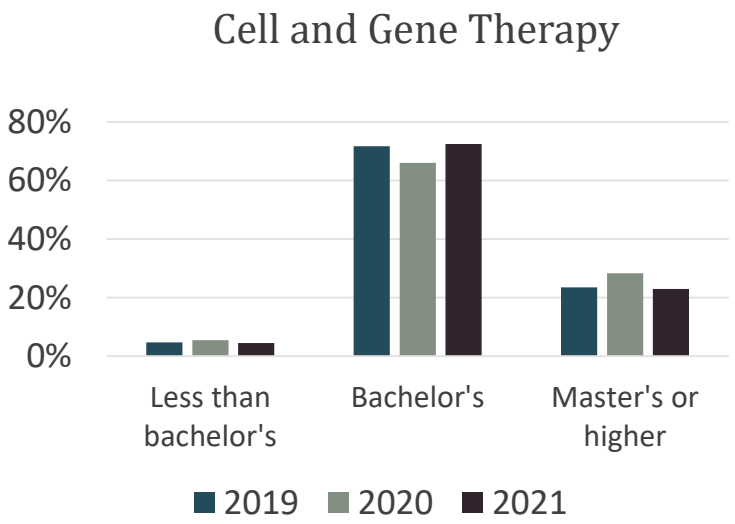
Source: Burning Glass; Econsult Solutions, Inc.

Vast majority of job postings still seek bachelor's degree or higher, but manufacturing may broaden pool of potential applicants

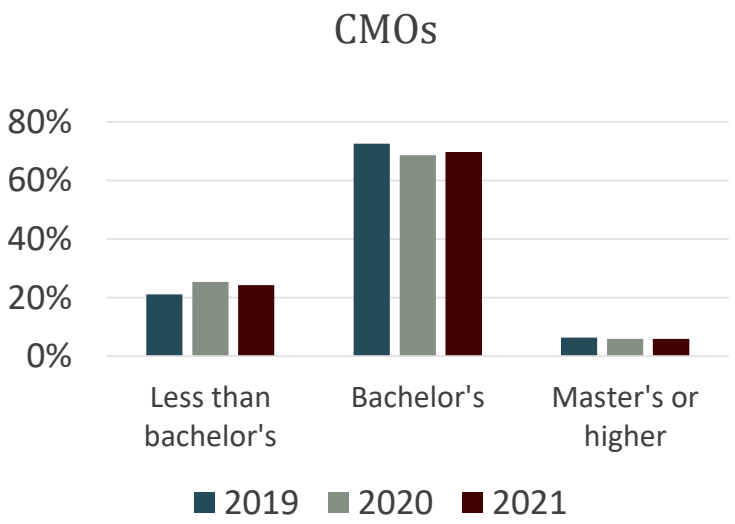
CMOs currently present the largest opportunity for early entry into the life sciences industry with nearly a quarter (24 percent) of job postings requiring less than a bachelor's degree in 2021. Compared to the 2019 talent demand, there was a three percent increase from 2019 to 2021.

Conversely, biopharma and cell and gene therapy industries in the Greater Philadelphia region required more skilled labor when compared to their CMO counterparts. Biopharma demands more talent with specialized degrees, but the demand for such talent has declined by nearly 10 percent since 2019. It should be noted, however, that in response to this shift in demand for talent with specialized degrees the demand for talent with a bachelor's degree increased by eight percent during the same period. Cell and gene therapy companies, on the other hand, have remained relatively constant in their talent needs.

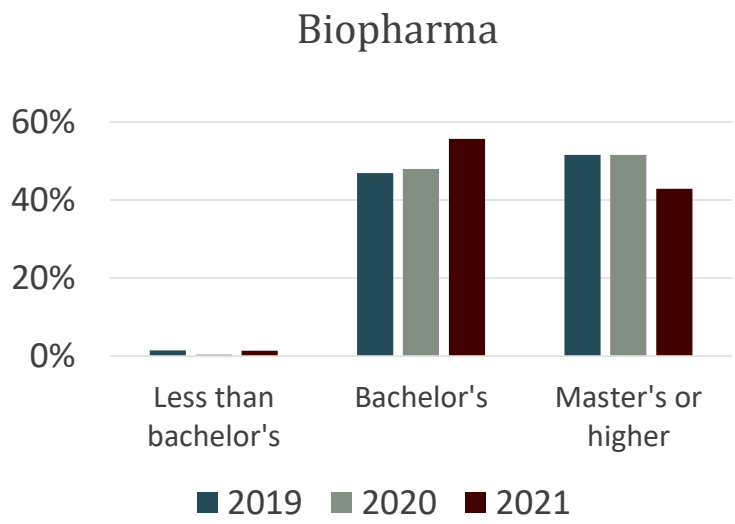
We would expect this to change over time as CGT companies grow and begin to operate their own manufacturing centers, thus changing the degree requirements for key positions and openings.



Source: Burning Glass; Econsult Solutions, Inc.



Source: Burning Glass; Econsult Solutions, Inc.



Source: Burning Glass; Econsult Solutions, Inc.

Top-mentioned programs of study vary by type of company

Top Programs of Study in Job Posts, 2019-2022

	Cell and Gene Therapy	CMOs	Biopharma
1	Biology/Biological Sciences, General	Biology/Biological Sciences, General	Immunology
2	Business Administration And Management, General	Engineering, General	Cell/Cellular And Molecular Biology
3	Engineering, General	Business Administration And Management, General	Molecular Biology
4	Computer Science	Chemistry	Biology/Biological Sciences, General
5	Cell/Cellular And Molecular Biology	Logistics, Materials, And Supply Chain Management	Pharmacy
6	Molecular Biology	Logistics and Materials Management	Business Administration And Management, General
7	Chemistry	Chemical Engineering	Chemistry
8	Immunology	Bioengineering And Biomedical Engineering	Pharmacology
9	Bioengineering And Biomedical Engineering	Immunology	Bioengineering And Biomedical Engineering
10	Biostatistics	Molecular Biology	Virology

Source: Burning Glass; Econsult Solutions, Inc.

In CGT-related job posts, the top-mentioned programs of study vary by company type.

CMO and cell and gene therapy company top skills consisted of biology and biological sciences, while biopharma companies' top skill was immunology.

Interestingly, logistics and materials management appeared in the top 10 lineup for the first time in 2021 (up from 14 in 2020 and 17 in 2019) for CMOs.

Some of the top-ranked programs of interest by cell and gene therapy companies align with the top five skills identified in the LinkedIn supply analysis, including computer science and biostatistics.

Skill cluster demand differs by types of companies

Skill clusters are defined as a grouping of skills, an umbrella term in which a family of skills fall under. For example, the biologics industry knowledge cluster contains skills such as biology, biopharmaceutical industry knowledge, life sciences industry knowledge, and other related skills.

Cell and gene therapy companies saw a significant increase in demand for talent with skills related to the "Biologics and Industry Knowledge" skill cluster, accounting for about 20 percent of all job postings of those mentioned in the top 10 skill clusters for the cell and gene therapy industry. When compared to previous needs identified in the 2019 analysis, the "Biologics Industry Knowledge" skill cluster saw 107 percent growth from 2019 to 2021, with "Genetics" exhibiting the most growth of all skill clusters with a 124 percent increase since 2019.

This analysis also begins to identify the growth of manufacturing processes in CGT companies. As expected, manufacturing skills are at the top of the list for CMOs; in this analysis we are also seeing demand for manufacturing skills in CGT companies. Biopharma companies remain focused on more pure science skills in their job postings.

	Cell and Gene Therapy	CMOs	Biopharma
1	Biologics Industry Knowledge	Manufacturing Processes	Cellular Biology
2	Genetics	Laboratory Research	Drug Development
3	Cellular Biology	Project Management	Genetics
4	Clinical Research	Basic Customer Service	Biology
5	Laboratory Research	Quality Assurance and Control	Clinical Research
6	Manufacturing Processes	Biopharmaceutical Manufacturing	Oncology
7	Drug Development	Cellular Biology	Chemistry
8	Microsoft Office and Productivity Tools	Scheduling	Molecular Biology
9	Molecular Biology	Chemical Analysis	Research Methodology
10	Project Management	Microsoft Office and Productivity Tools	Infectious Diseases

Source: Burning Glass; Econsult Solutions, Inc.

Top-mentioned specialized skills remained largely unchanged from 2019 to 2021, clear demand for manufacturing/lab practices

Specialized Skills required in Job Postings, 2019-2021

	Cell and Gene Therapy	CMOs	Biopharma
1	Biotechnology	Current Good Manufacturing Practices (CGMP)	Immunology
2	Gene Therapy	Good Laboratory Practices (GLP)	Oncology
3	Budgeting	Good Manufacturing Practices (GMP)	Biology
4	Experiments	Project Management	Clinical Development
5	Project Management	Quality Assurance and Control	Gene Therapy
6	Quality Assurance and Control	Batch Records	Experiments
7	Good Manufacturing Practices (GMP)	Scheduling	Budgeting
8	Molecular Biology	Customer Contact	Drug Development
9	Cell Culturing	Good Clinical Laboratory Practice (GCLP) Compliance	Biotechnology
10	Scheduling	Quality Management	Drug Discovery

Source: Burning Glass; Econsult Solutions, Inc.

Diving a layer deeper, specialized skills are defined as a specific skill that falls within a given skill cluster (these skills can also be thought of as "hard skills"). During the period between 2019 and 2021, the life sciences industry's demand in skills slightly pivoted toward those that could be used to curb the acceleration of COVID-19. For instance, "Immunology" and "Drug Development" were both amongst the top 10 demanded skills for biopharmaceutical companies during the period. In addition to this, "Vaccination" as a specialized skill went from zero mentions for cell and gene therapy companies in 2019 and 2020 to being the 15th most mentioned skill in 2021.

In terms of CMOs, the skill "Gene Therapy" fell from being in the top ten in 2019 and 2020 to being 12th in 2021. However, on the other hand, "Current Good Manufacturing Practices" has been the number one most desired skill consistently since 2019. Following this, "Good Laboratory Practices" has been the second most demanded skill consistently since 2019.

Another development recognized in the specialized skills demanded by biopharmaceutical companies was the rise in ranking of the skill "Gene Therapy," which rose from 11th place in 2019 to 5th place in 2021. The skill "Biotechnology" also rose from 15th in 2019 to 9th in 2021. From 2019 to 2021, "Immunology" has been the most demanded skill for biopharmaceutical companies within the Greater Philadelphia region, with "Oncology" ranking second throughout the same period.

Top-mentioned soft skills remained largely unchanged from 2019-2021, but some shifts in CMOs

"Soft" Skills Requirements, Job Postings 2019-2021

	Cell and Gene Therapy	CMOs	Biopharma
1	Communication Skills	Communication Skills	Research
2	Teamwork / Collaboration	Research	Teamwork / Collaboration
3	Research	Teamwork / Collaboration	Communication Skills
4	Problem Solving	Microsoft Excel	Organizational Skills
5	Organizational Skills	Planning	Planning
6	Planning	Troubleshooting	Written Communication
7	Writing	Written Communication	Writing
8	Detail-Oriented	Physical Abilities	Creativity
9	Troubleshooting	Problem Solving	Leadership
10	Verbal / Oral Communication	Organizational Skills	Troubleshooting

Source: Burning Glass; Econsult Solutions, Inc.

As might be expected, there remains a strong emphasis across all three company types for communications, teamwork, and organizational skills.

There are some subtle differences between the companies, however.

- CGT companies have more of an emphasis on verbal/oral communications and planning,
- CMOs have an increased focus (from previous years) on communications and teamwork.
- Biopharma firms put more of an emphasis on creativity.

Top-posted occupational groups vary among company types

Unlike the educational and skills requirements, the top occupations posted were relatively constant across all company types, However, some important variations are present, such as:

- Strong CGT demand for jobs in computer and math occupations, along with a growing demand for business and financial operations (potentially related to scaling of firms).
- CMO demand for healthcare practitioners (likely lab tech-type positions) and production occupations (related to manufacturing functions).
- All three company types showed strong demand for management occupations, potentially linked to the intense competition for experienced talent in this growing and expanding industry.

Cell and Gene Therapy

		% of Postings 2019-2021
1	Computer and mathematical	26%
2	Life, physical, and social science	23%
3	Management	22%
4	Architecture and engineering	7%
5	Business and financial operations	7%

Source: Burning Glass; Econsult Solutions, Inc.

CMOs

		% of Postings 2019-2021
1	Management	26%
2	Life, physical, and social science	24%
3	Healthcare practitioners and technical	9%
4	Production	9%
5	Computer and mathematical	9%

Source: Burning Glass; Econsult Solutions, Inc.

Biopharma

		% of Postings 2019-2021
1	Management	36%
2	Life, physical, and social science	28%
3	Computer and mathematical	13%
4	Architecture and engineering	6%
5	Protective service	5%

Source: Burning Glass; Econsult Solutions, Inc.

Section 3

Industry Perspectives:
Survey and Roundtable Results from Greater Philadelphia's Industry Leaders

Survey and Roundtables Summary Findings

Source: Econsult Solutions, Inc. (2022)

Greater Philadelphia remains Leading R&D Hub, but is seen as moving toward a Commercialization & Manufacturing Hub. Based on a survey of over 30 industry experts and three expert roundtables, local leaders are optimistic about the future, but recognize that key challenges remain to be overcome.

- An inability to find qualified talent could limit growth.
  - Companies are having trouble finding employees at all levels.
  - This could increase the number of people without bachelor's degrees filling more positions, particularly in the growing manufacturing processes.
  - Additional skills training will be needed to meet this demand.
  - There is opportunity to train in good manufacturing practices and key skills.

- Lack of current supply may lead to hiring of employees at higher skill levels who are looking to get into the industry.

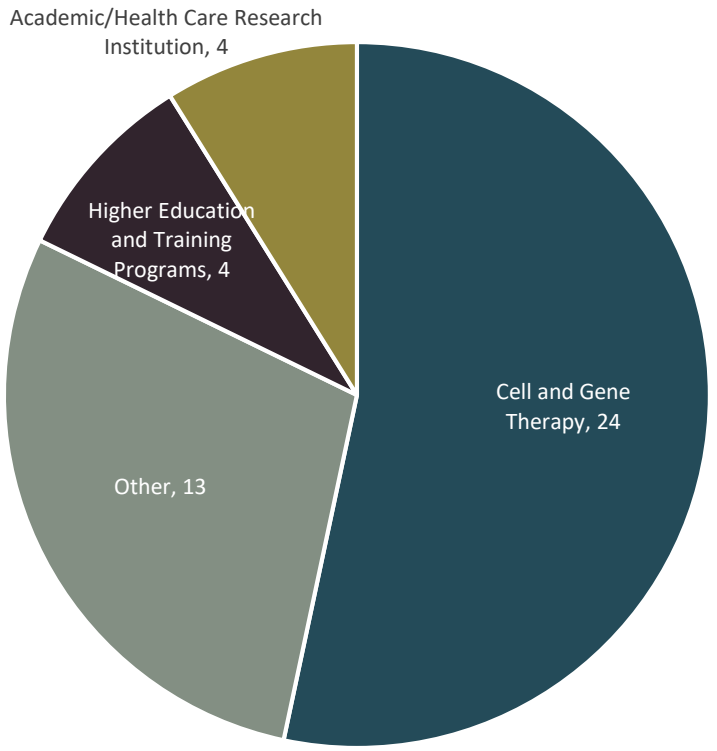
Summary of Survey Responses

- Responses collected December 2021 through January 2022
- Respondents: 39
- Unique organizations: 35

Of the following, which title is most closely aligned with your position?		
Business Owner/CEO/CFO or equivalent	12	31%
Business Employee, other than Owner or C-Suite	8	21%
Research Executive/Manager	6	15%
Human Resources Executive/Manager or equivalent	5	13%
Research Technician	4	10%
Other	3	8%
Academic Program Mgr, Admin, Curriculum Developer, Staff	1	3%

Source: Econsult Solutions, Inc. (2022)

What type of organization do you represent? (Check all that apply)



Source: Econsult Solutions, Inc. (2022)

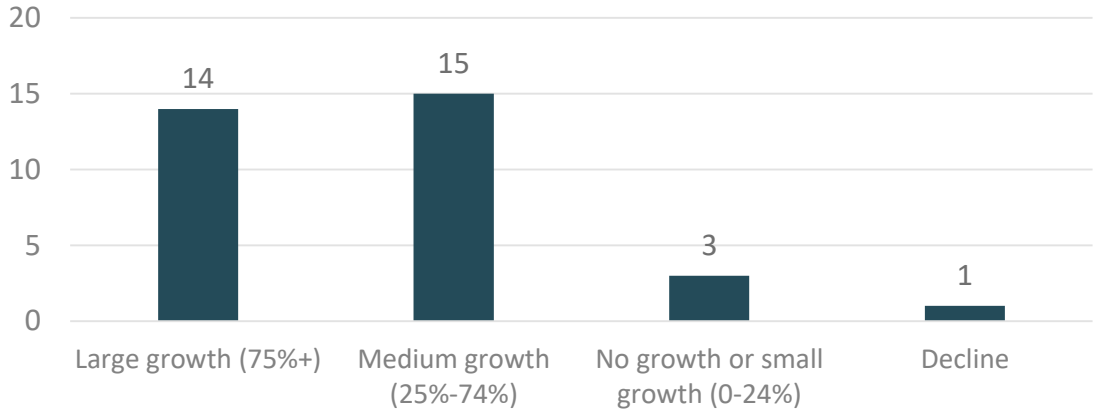
Industry experts optimistic about future

Consistent with findings from the current supply and demand analysis, respondents largely expect strong growth within the cell and gene therapy sector in the Greater Philadelphia region over the next five years. Respondents were split nearly in half between that growth being medium (25-74%) or large (75% or greater).

More than half of the respondents felt that the region will be in *Scenario 3: Major R&D Hub* in the next five years, with about a quarter of respondents answering either *Scenario 4: Manufacturing Hub* or *Scenario 2: Status Quo*. In line with the predictions of respondents, companies within the cell and gene therapy industry are already starting to transition into Scenario 3, including Spark Therapeutics, which established a $575M manufacturing facility in the Greater Philadelphia region in 2021.

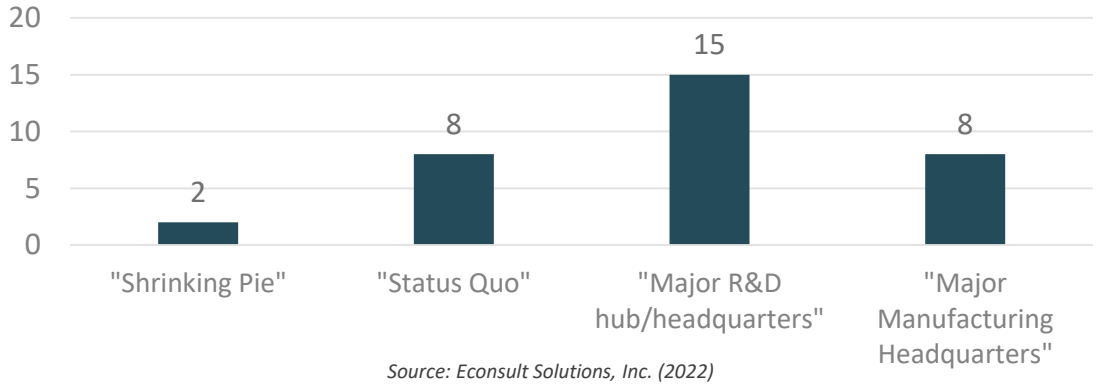
Other factors contributing to the optimistic outlook of the cell and gene therapy and the life sciences sectors are the increases in investment within the region, the mobility of manufacturing talent throughout the region, and other factors specific to Greater Philadelphia. For example, investment has gone up in the region including imported capital and home-grown capital. In addition, the overall national growth in investment doubled while investment in Greater Philadelphia quadrupled between the years 2020 and 2021.

Given your knowledge of the cell and gene therapy sector, what level of growth do you anticipate in the Greater Philadelphia region in the next 5 years? (n=33)



Source: Econsult Solutions, Inc. (2022)

Which scenario do you believe will represent the state of the cell and gene therapy sector for Greater Philadelphia in the next 5 years? (n=33)

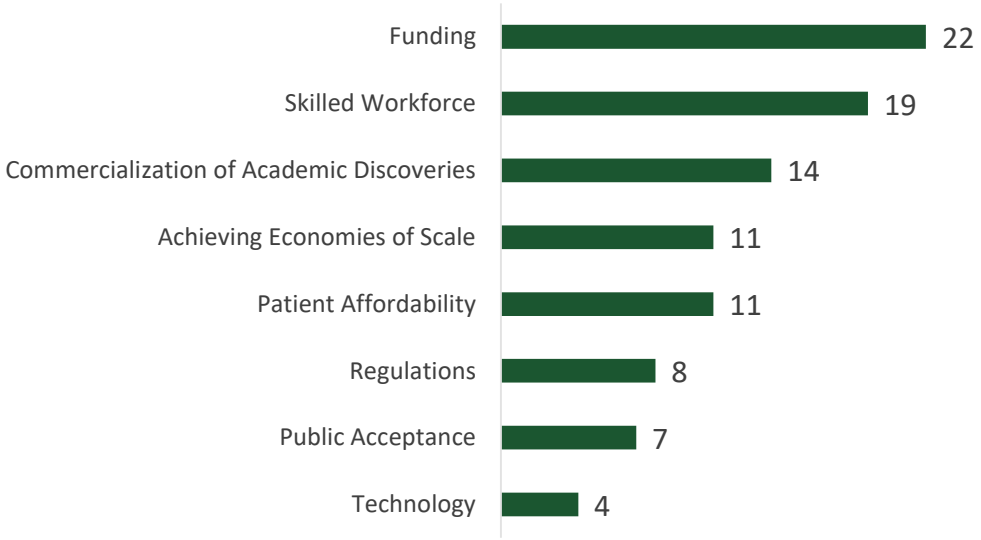


Source: Econsult Solutions, Inc. (2022)

Funding, workforce, commercialization seen as obstacles

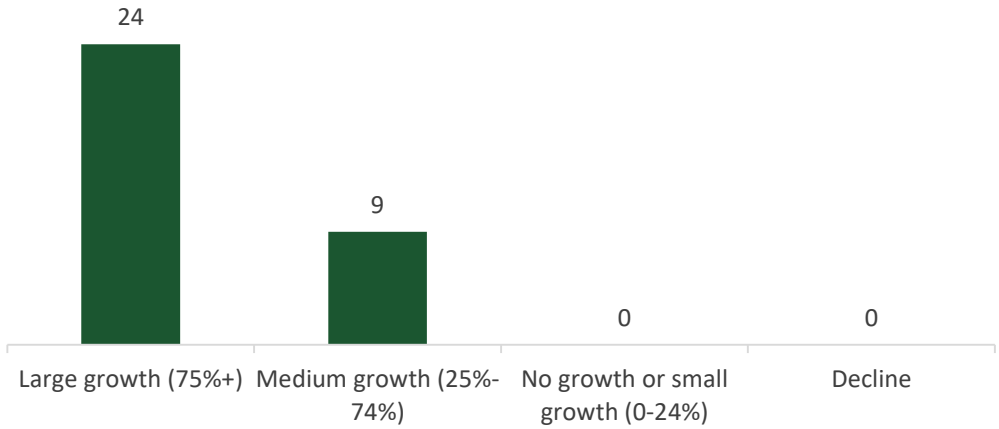
As with any growing industry, the Greater Philadelphia region presents obstacles that are perceived as having the potential to hinder the growth of the sector. When asked to rank the top three obstacles in the region, the obstacles most included in the rankings were funding, skilled workforce, and commercialization of academic discoveries. All responses reflected that, if the obstacles were lifted, the sector would experience medium to large growth over the next five years in the region.

What do you believe are the biggest barriers to growth in the Greater Philadelphia region within the cell and gene therapy sector? (Number of times each barrier appeared in Top 3 ranking) (n=33)



Source: Econsult Solutions, Inc. (2022)

If these barriers to growth were lifted, what level of growth do you anticipate in the Greater Philadelphia region in the next 5 years? (n=33)



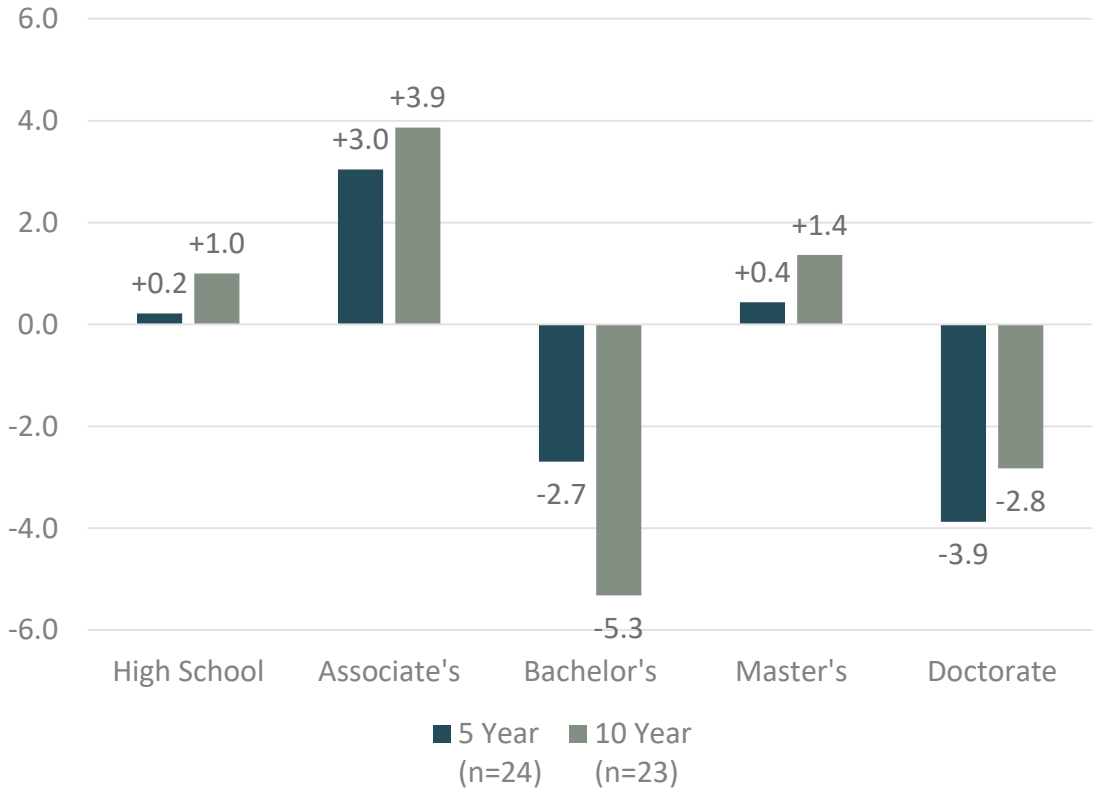
Source: Econsult Solutions, Inc. (2022)

As the industry matures, workforce degree mix expected to broaden

Also consistent with findings in the current supply and demand analysis, survey respondents reported changes in the breakdown of degree types among employees over the next five to 10 years, with a higher share of jobs going to individuals with high school or associate's degrees and a smaller share to those with bachelor's or doctoral degrees.

Roundtable participants mentioned that many of the emerging positions in the industry can be filled by those without a bachelor's degree or more as a credential, but due to a shortage of interested candidates at those levels, the jobs may be filled by candidates with more advanced credentials looking for an entry point into the industry.

What is the approximate breakdown of degree types of your company? How do you believe the breakdown will look in 5 years? In 10 years? (Results shown in average percentage point change)



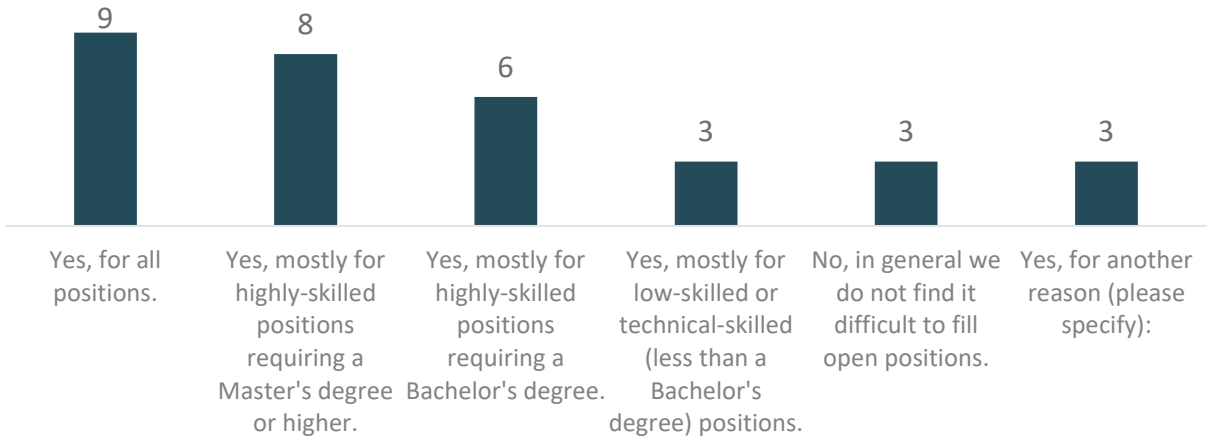
Source: Econsult Solutions, Inc. (2022)

Talent attraction of highly skilled workers remains a challenge

Almost all respondents (29 of 32) cited having difficulty finding candidates for technical positions, with both lack of applicants and skills deficiencies being cited as primary reasons. For technical positions, there remains concern for finding highly skilled applicants with bachelor's and higher credentials, even as we see shifts in the future orientation of the workforces.

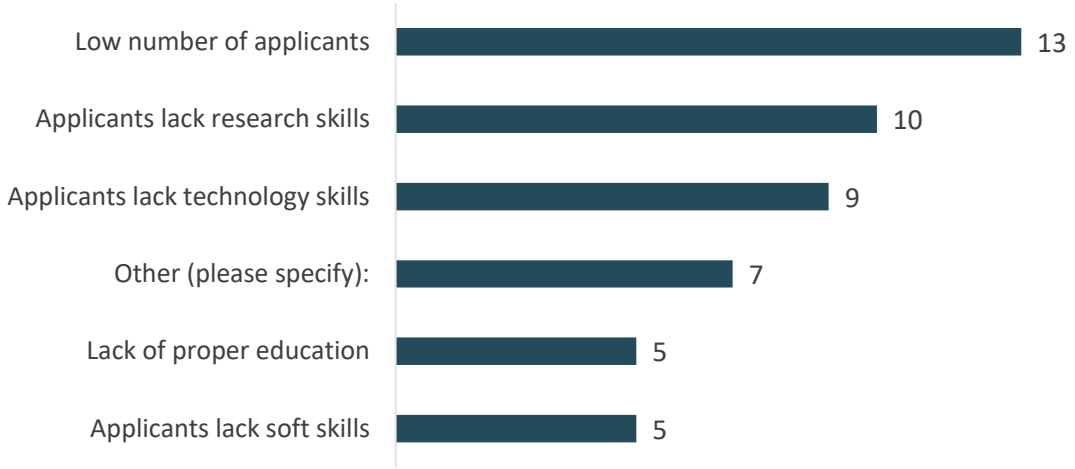
This points to the need to maintain a focus on recruiting top candidates for positions from outside the region, or developing more candidates from regional colleges and universities, as the competition for talent increases. Until now, many of those roles were filled by recruiting from larger pharmaceutical companies, but as those companies ramp up their cell and gene therapy work, there may be less movement from those companies to CGT startups.

Do you currently find it difficult to fill open positions in your company? (n=32)



Source: Econsult Solutions, Inc. (2022)

If yes, what are the primary reasons that make it difficult to fill positions? (Select all that apply) (n=29)



Source: Econsult Solutions, Inc. (2022)

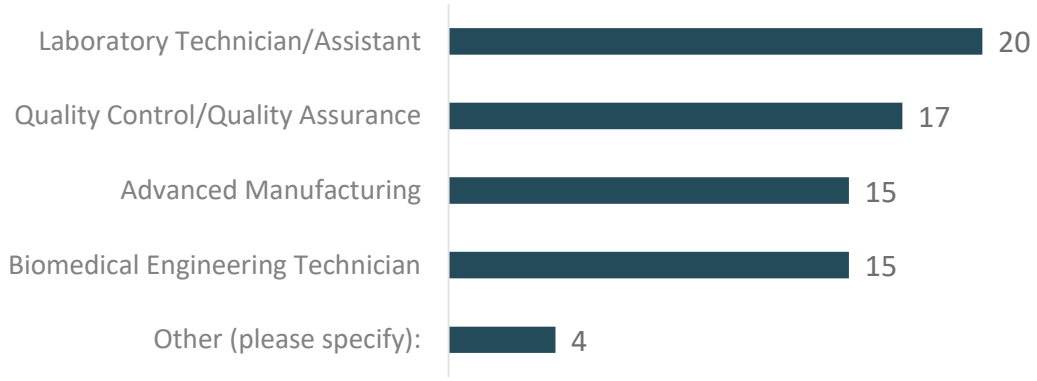
Growth expected in scientific and tech roles not requiring bachelor's degree or more

Respondents also reported that in five years there will be significant need for science and technical positions, but that there are insufficient training programs available for these future roles. The highest value associate degrees/certificates for these positions included:

- Laboratory technician/assistant
- Quality control/quality assurance
- Advanced manufacturing
- Biomedical engineering technician

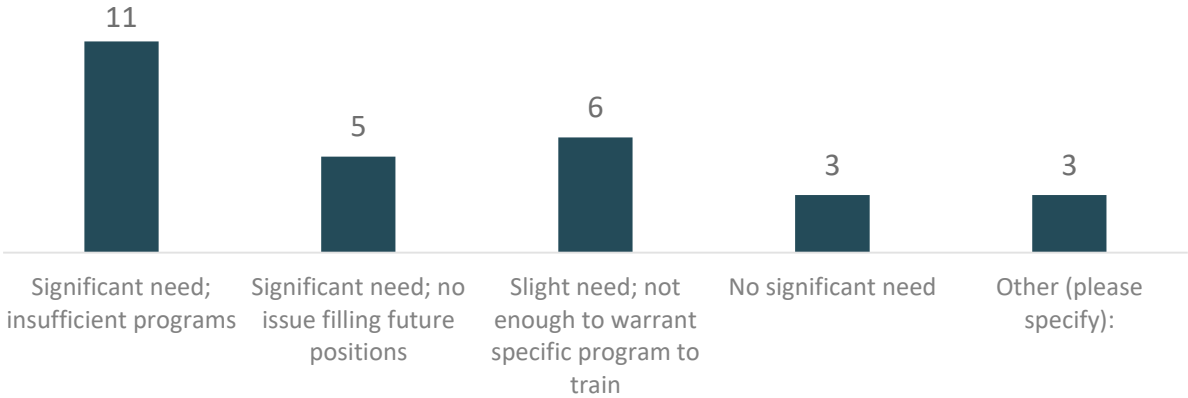
Roundtable participants echoed these findings and mentioned the need to expand collaborative training programs to meet future demand for technical workers without advanced degrees. They cited the efforts launched since 2019 by Wistar, Jefferson and the Science Center.

What type of Associate degrees and/or certificates for science and technical positions would be of most value to your company? (Check all that apply) (n=25)



Source: Econsult Solutions, Inc. (2022)

In 5 years, do you believe there will be a need for Associate-level, Certificate-level, or High School-level degree-holding training programs for science and technical positions in the cell and gene therapy sector? And if yes, to what degree? (n=28)



Source: Econsult Solutions, Inc. (2022)

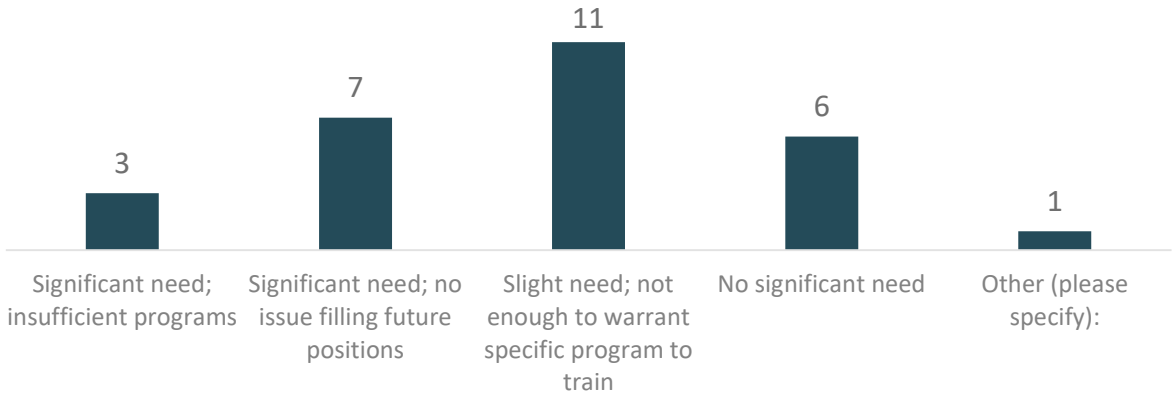
Less need seen for CGT-specific training for business support roles

As companies continue to grow in the sector, they will require additional business support personnel on staff, as well. The top-mentioned business support roles currently within respondents' organizations include:

- Finance/accounting
- IT specialist/systems admin
- Business development, marketing, communications
- Legal/regulatory operations

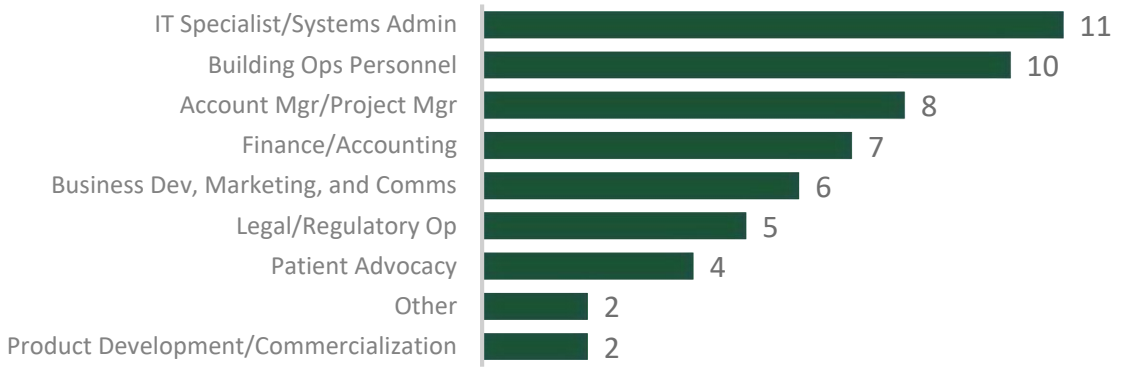
Unlike with science and technical positions, survey and roundtable respondents projected just a slight need for future associate- and certificate-level training programs for business operations personnel but felt that the need would not be enough to warrant specific programs being created. This is likely due to the general nature of training for these roles, from which companies within the sector could recruit employees from all sectors.

In 5 years, do you believe there will be a need for Associate-level, Certificate-level, or High School-level training programs for in-house business support personnel (those with training in law, finance, business development, management, commercialization, marketing or communications, IT, etc.) that specialize in the cell and gene therapy sector? And if yes, to what degree? (n=28)



Source: Econsult Solutions, Inc. (2022)

What type of Associate's degrees and/or certificates in business support functions, with a specialization in cell and gene therapy, would be of most value to your company? (Check all that apply) (n=22)



Source: Econsult Solutions, Inc. (2022)

Section 4

Concluding Thoughts

Where we are today – and what is left to do

Greater Philadelphia's cell and gene therapy sector is growing and maturing.

- Data and industry perspectives point to the region maintaining its position as an R&D hub and increasingly becoming a commercialization and manufacturing center.
- There has been strong growth in existing companies, and we are seeing new entries into the marketplace. The real estate market is booming. More professionals are listing cell and gene therapy skills in their LinkedIn profiles.
- Since the 2019 report, several workforce programs have launched or expanded to provide opportunities for Greater Philadelphia-area residents in this growing field. The Wistar Institute's pioneering apprentice program, Jefferson Institute for Bioprocessing, and the Science Center's BULB (Building an Understanding of Lab Basics) initiative all seek to address expected workforce needs and talent gaps through skills training and certification.
- There is significant economic opportunity for our region, but it is a competitive landscape with top regions growing at the same pace in attracting and retaining skilled talent.

Future growth is likely, but important steps to build future workforce capacity need to be taken.

- The key to future growth will be developing a local workforce, at all levels, that can meet the needs of companies.
- Companies, educators, and training partners must collaborate to build career pathways for non-traditional candidates, particularly in the manufacturing space.
- The creation of new programs that bring together companies and training organizations represents a key opportunity for companies to hire trained talent at scale.

Looking to the future

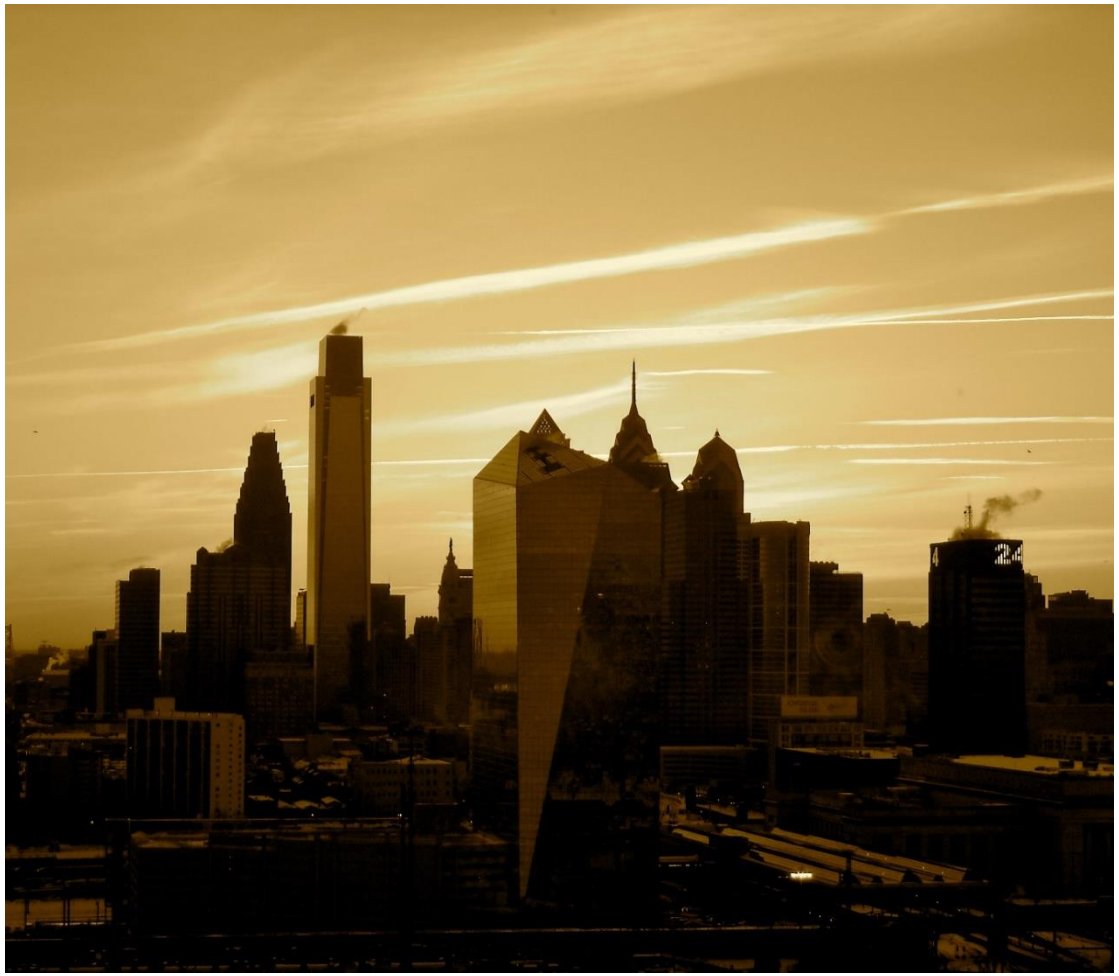
Continued strong employment growth is expected – and is exceeding 2019 expectations

- Employment at cell and gene therapy companies and contract manufacturing organizations grew by 80% from 2019 to 2022, from nearly 2,000 employees to 3,600 employees, as measured by LinkedIn profiles. The number of biopharma employees listing cell and gene therapy-related skills grew by more than 200% from 2019 to 2022.
- Industry experts expect similar levels of growth for the next five years, especially if talent and funding barriers are mitigated.

Leading R&D Hub Scenario

- Greater Philadelphia is likely to maintain its current role as a Leading R&D Hub, based on a continued focus on scientific, laboratory, and analytical roles. It is expected that manufacturing roles will be focused in CMOs and more limited manufacturing employment growth will occur in CGT and biopharma.
- With industry experts projecting employment growth of between 25% and 50% over the next three years, we would expect total employment at CGT companies and CMOs to be between 4,500 and 5,400 employees, with increasing shares of employees not requiring bachelor's degrees.

Looking to the future



Commercialization & Manufacturing Hub Scenario

- Local experts believe we are moving toward the Commercialization & Manufacturing Hub Scenario based on surveys and roundtable feedback, with an accompanying increased need for manufacturing and quality assurance roles.
- If the region can meet this goal, growth of 75% would result in 6,300 jobs at CGT companies and CMOs by 2025, with up to 25% of those jobs being in manufacturing roles requiring fewer educational requirements. This would be similar to the rate of growth seen in the region since 2019, when employment grew from 2,000 to 3,600 employees.
- Lack of available talent could slow movement to this scenario. There has been a lot of growth already, but there are expectations of more growth if funding and talent barriers are mitigated. Companies like Spark Therapeutics and Discovery Labs, as well as contract manufacturers, demonstrate potential for workforce growth. However, if the region doesn't keep up with employment needs at all levels, it may be difficult to reach those expectations.

Keys to Success

- Continuing momentum in research funding and discoveries, leading to new companies and continued expansion of existing companies, will be key to meeting high expectations.
- Building on and expanding collaborative workforce training efforts, to ensure that Greater Philadelphia has talent necessary to meet increased demands for cell and gene therapy manufacturing and development.
- Continuing to promote the region as one of the nation's leading centers for cell and gene therapy, to attract talent and funding the region's growing base of companies.

ESI ECONSULT SOLUTIONS INC.

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1435 Walnut Street, 4th Floor
Philadelphia, PA 19102