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The State of CELL AND GENE THERAPY in the Greater Philadelphia Region

A Comparative Analysis

CEO Council for Growth
September 2022

Greater Philadelphia
The Original Home of Cell and Gene Therapy

Growing the gene and cell therapy industry

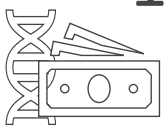
2nd Best regional hub for Cell and Gene Therapy Growth

Over two decades ago, gene therapy research was pioneered in the Greater Philadelphia region. In the last decade, the first FDA approved gene (Luxturna®) and cell (Kymriah®) therapies were developed here. Today, ESI's comparative analysis indicates that the Greater Philadelphia region is ranked 2nd in the country for hubs in the U.S. doing work in the cell and gene therapy (CGT) sectors.

RESEARCH INFRASTRUCTURE

Greater Philadelphia has both Tier I universities and world-renowned research hospitals. Overall, Greater Philadelphia has received at least $1 billion in NIH funding every year for the past five years. In the CGT space, Greater Philadelphia received $317 million in NIH funding since 2018, the most of all regions included in this study.

1st in NIH FUNDING



$317 M

CGT projects since 2018

HUMAN CAPITAL

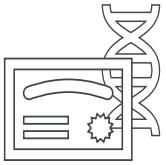
Greater Philadelphia attracts and retains top talent in the CGT sectors. Each year, Greater Philadelphia higher eds typically produce 4,000+ new graduates with science degrees. In 2021, there were more than 15,400 employees in pharmaceutical manufacturing.

15,400+ JOBS in 2021

pharmaceutical manufacturing

INNOVATION OUTPUT

Strong patent and clinical trial activity in Greater Philadelphia include over 300 CGT patents approved over the last decade and approximately 130 clinical trials of novel therapies held.

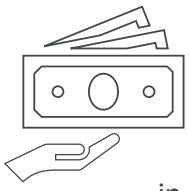


302 since 2012 GENE OR CELL THERAPY PATENTS APPROVED

130 since 2012 GENE OR CELL THERAPY CLINICAL TRIALS

COMMERCIAL ACTIVITY

Greater Philadelphia is the place where CGT was born and is where many growing companies want to locate. New firms to the area include Tevogen Bio, Amicus Therapeutics, Resilience, and Iovance. Existing companies like Adaptimmune, WuXi Advanced Therapies, Castle Creek Biosciences, Spirovant, and SwanBio are expanding their footprint.



$4.2 B VENTURE CAPITAL

in CGT projects since 2018

What Matters in a Business Location

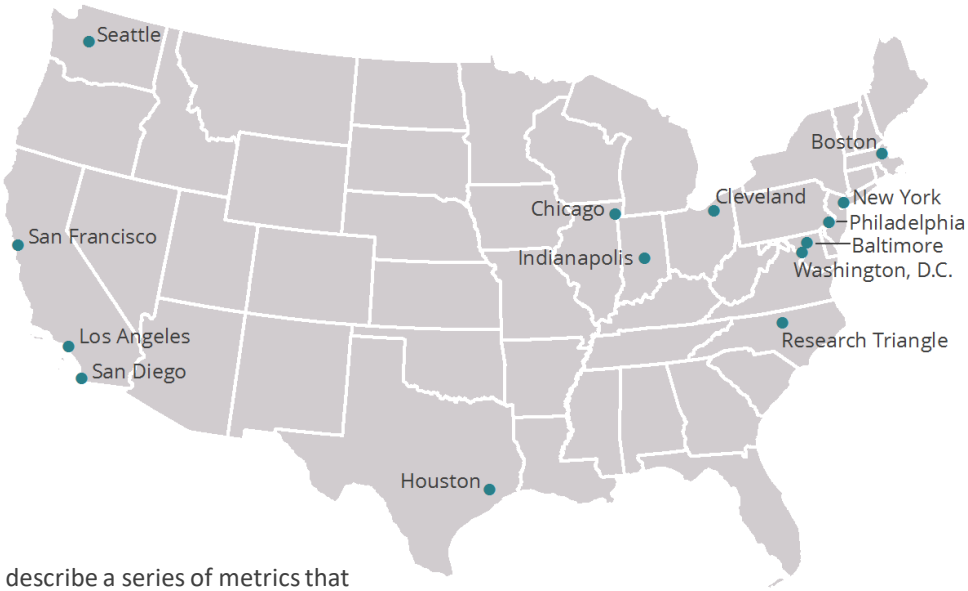
Ranking regions based on characteristics critical to success in cell/gene therapy work

Because research, development, and manufacturing in the CGT sector require concentration of resources, location matters. There are two important location-related innovation characteristics: proximity to research institutions and access to talent. In addition, because the world is not static but is ever-shifting in response to opportunity and perception, reputation and momentum matter.

Comparative Analysis

Keeping in mind the importance of density and concentration of activity, this comparative location analysis identified key metrics to see how different parts of the U.S. fared against each other in these metrics.

Based on initial research of the CGT field and discussions with people knowledgeable about national trends in CGT, fourteen regions were included in this analysis.



We identified five primary categories to describe a series of metrics that signify an attractive location in cell and gene therapy: Research Infrastructure, Human Capital, Innovation Output, Commercial Activity, and Value Proposition. These metrics reflect a range of available data at the city and regional level—some specific to cell and gene therapy work and some more broad in nature—befitting the nascent and inter-disciplinary nature of this work.[1]

[1] Throughout the white paper "cities" represent the municipal census designation. "Regions" are defined as census designated-metropolitan statistical areas unless otherwise specified.

Research Infrastructure
Higher education institutions
Research funding

Human Capital
Graduates
Jobs

Innovation Output
Patents
Clinical trials

Commercial Activity
Venture capital
Real Estate Investment

Value Proposition
Cost of Living
Commercial Life Sciences Rent

> *It's easy to attract talent here because the region offers a diversity of high-quality places to live across the city and suburbs, all at an affordable cost of living*
>
> -Audrey Greenberg, Co-Founder, Center for Breakthrough Medicine

Research Infrastructure

Greater Philadelphia is home to many top-tier institutions and research activity

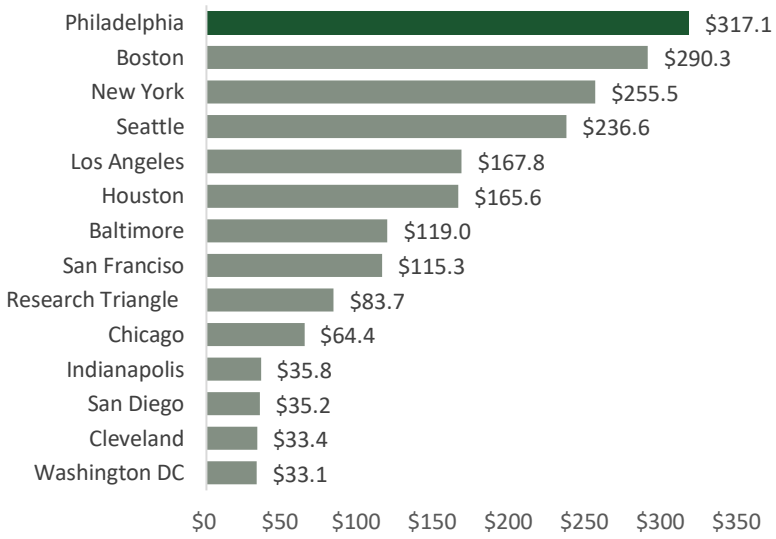
A concentration of research infrastructure is one of the most important resources in creating a biomedical innovation hub, primarily in the form of top-tier research universities, which serve as the magnet for human capital, research grants, and corporate partnerships.

NIH Funding

In the last 5 years, Greater Philadelphia researchers have been awarded at least $1 billion in NIH funding each year. Focusing in more closely on research projects related to cell and gene therapies, more than $317 million in NIH funding has been awarded to Philadelphia investigators during that time period - more funding in this discipline than any other city. Funding for cell and gene therapy comprised of 6 percent of total NIH funding in Philadelphia compared to 0.7 to 5.2 percent in comparison cities.

The volume of research funding is one indicator of the potential pipeline of discoveries and innovations that may be generated from basic academic research in the coming years.

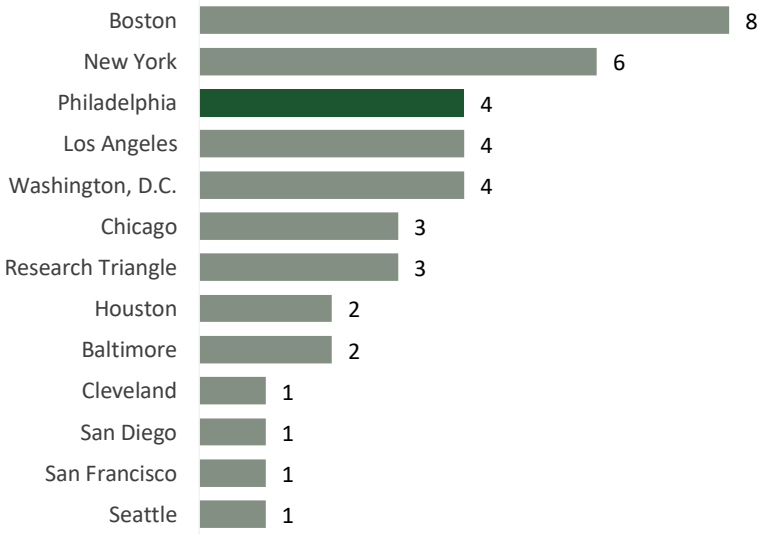
Total funding ($M) for projects in "cell therapy" or "gene therapy" by City (2018 – 2022*)



*Source: National Institutes of Health Reporter *(Through August 2022)*

Colleges and Universities

Number of Tier I research universities by MSA (2021)



Source: The Carnegie Classifications of Institutions of Higher Education (2022)

The Greater Philadelphia region's concentration of higher education institutions is essential to the region's attractiveness for college students, young professionals, and firms seeking talent. Across the region, Greater Philadelphia has:

- Four Tier 1 universities within the region (University of Pennsylvania, Drexel University, Temple University, University of Delaware)
- Three Tier 1 universities within city limits**– more than any other major US city aside from New York.**
- In sum, there are 93 colleges and universities in the Greater Philadelphia region, ahead of other knowledge hubs like Boston, San Francisco, and Washington, D.C.
- A concentration of world-renowned hospitals and research institutions.

Human Capital

Greater Philadelphia boasts a high concentration of talent specific to cell/gene therapy work.

Concentrations of human capital have a force multiplier effect in that the more people you have (1) the more you can produce, (2) the more intense the interactions and therefore innovation are produced, and (3) the more other people want to come work with you.

The number of recent graduates in a region is an indicator of the size of its talent pool as well as the sustainability of firms that rely on a steady source of new talent to remain competitive. The Greater Philadelphia region attracts and retains thousands of graduates each year.

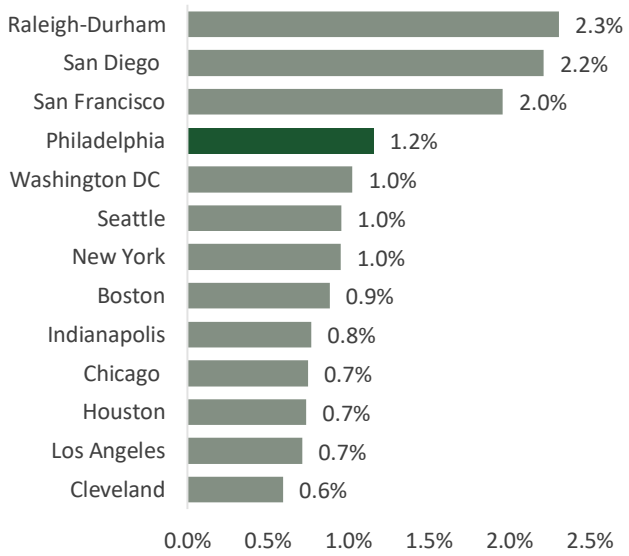
In total, more than 450,000 students attend institutions in the Greater Philadelphia region, and 54% of alumni from regional institutions choose to stay local upon graduation, a retention rate that is 12 percent greater than that of Boston. Philadelphia is also home to seven schools that grant medical degrees, ranking Philadelphia third only to New York and Chicago—much larger cities—in total number of medical degree granting institutions.

The region also boasts a substantial workforce in both R&D and manufacturing and is one of only three regions (with New York and San Francisco) in the top 5 in both categories. **The number of R&D jobs located within the region has increased by 101% in the past five years.**

For the CGT industry specifically, roughly 1.2 percent of new graduates (defined by LinkedIn Data Analytics as a new degree in the past four years) in the Greater Philadelphia region have skills desired by the sector.

Recent Graduates

Percentage of recent grads with CGT skills as a percentage of total recent grads



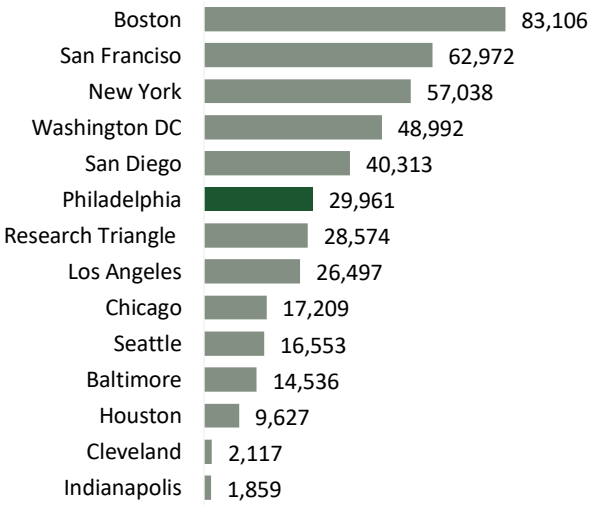
*Recent grads defined as graduates gaining a degree at any level in the past four years

*Source: LinkedIn Data Analytics (2022 *as of August)*

Jobs

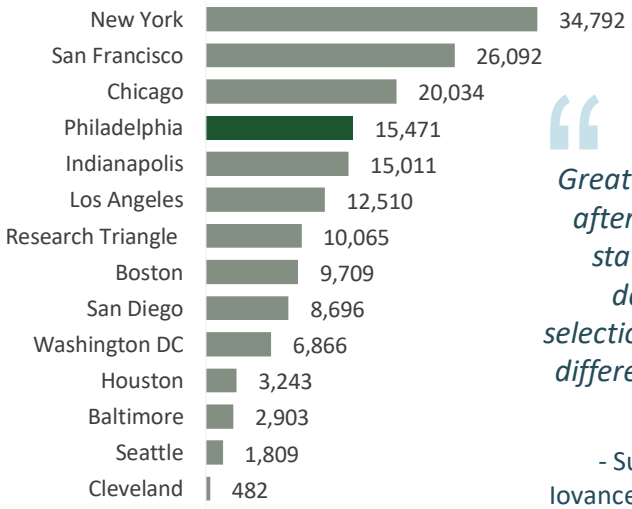
Number of employees by MSA (2021)

Research & development in biotechnology



Source: Bureau of Labor Statistics (2022)

Pharmaceutical manufacturing



Source: Bureau of Labor Statistics (2022)

> *"We decided on Greater Philadelphia after a 15-week, 10 state, 59 location, data-backed site selection process. The differentiating factor is talent.*
>
> - Sumit Verma, SVP, Iovance Biotherapeutics

Innovation Output

Greater Philadelphia produces a large and growing amount of intellectual property in support of cell and gene therapy work.

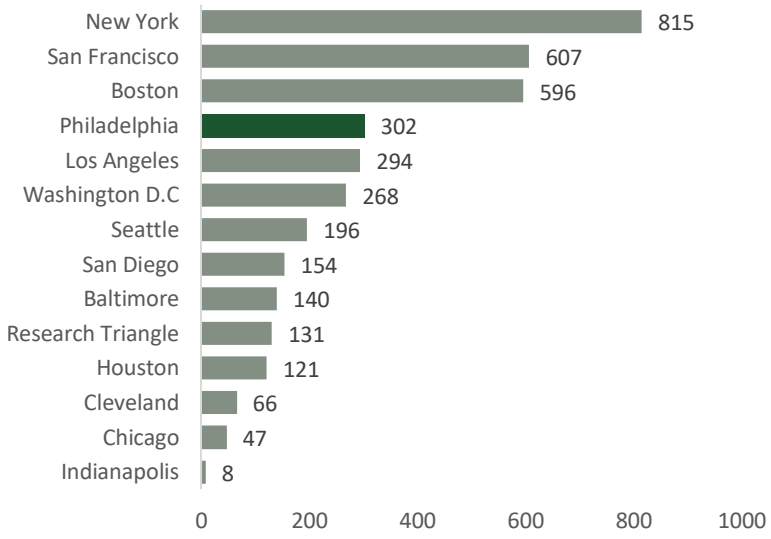
Two important indicators of achievement and growth in the cell and gene therapy sector are innovation and production, measured by the level of patent and clinical trial activity occurring in a certain region.

Patents

Measures of innovation like patents and clinical trials help move CGT products from research to commercialization. A patent is a form of intellectual property granted for an invention. The quantity of patents secured by researchers reflects the rigor and volume of CGT-related research and innovation occurring in a region.

Institutions like Penn and Penn Medicine, CHOP, Thomas Jefferson University, Drexel, and Temple have begun investing in the infrastructure that moves these discoveries from lab to market. From 2012 to 2022, Greater Philadelphia generated 302 gene and cell therapy patents.

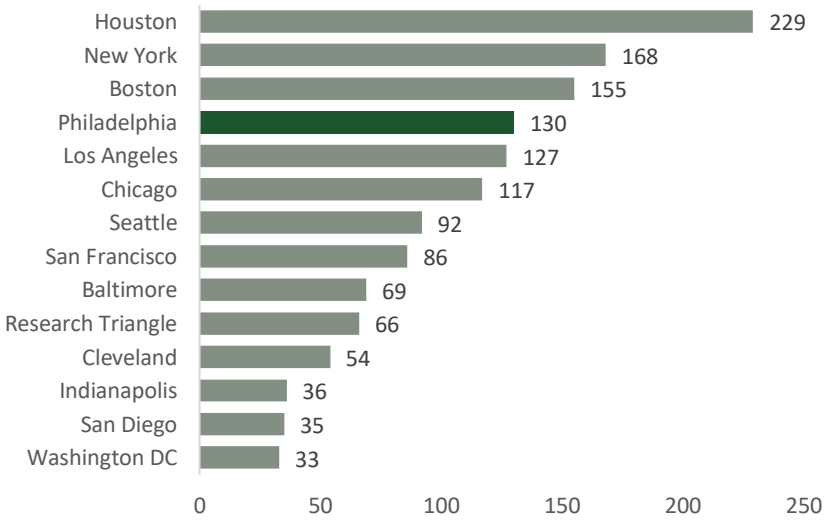
Number of patents in "gene therapy" or "cell therapy" by MSA (2012 – 2021)



Source: United States Patent and Trademark Office (2022)

Clinical Trials

Number of clinical trials in "gene therapy" or "cell therapy" by City (2012 – 2022*)



*Source: US National Library of Medicine *(Through August 2022)*

Clinical trials are research studies conducted to test new treatments for diseases or health conditions. The number of clinical trials in a region indicates the ability of researchers to move their innovative efforts toward a valuable and productive end. Philadelphia had 130 clinical trials from 2012 to 2022, 4th among cities during that time.

Significantly, in each of the last 5 years, the volume of clinical trials related to gene and cell therapy has been in the double digits in Philadelphia.

> *"Greater Philadelphia enables the transition from academia to commercialization amongst all the axes a company needs for that transition.*
>
> -Arun Das, CBO, Cabaletta Bio

Commercial Activity

The investment world is increasingly seeing Greater Philadelphia as a place to invest.

Levels of venture capital and firm creation within a certain area's cell and gene therapy sector indicate a region's ability to connect centers of innovation with anchors of commercial activity. While Greater Philadelphia previously faced challenges in securing levels of investment on par with other CGT hubs, in the past year the region has experienced a significant acceleration of investment in its CGT sector in the form of venture capital, major acquisitions, and firm startups and relocations.

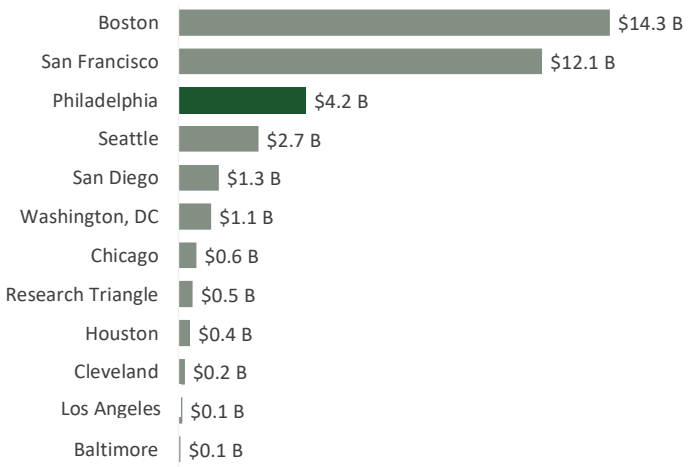
Venture Capital

The high level of venture capital being invested in CGT companies in Greater Philadelphia is an indicator of **growth potential** as perceived by investors. Philadelphia ranks 3rd for venture capital invested in cell and gene therapy from 2018 to 2022, with $4.2 billion invested.

Additionally, total venture capital, not just in CGT, is an indication of overall growth potential, and Philadelphia is seeing significant investments as well as growth. In fact, the level of venture capital overall has been increasing over the last 5 years in the Greater Philadelphia region, hitting a record $8.1 billion in 2021 - up by 299% from 2020. In the first quarter of 2022 alone, venture capital reached $2.1 billion - up by 71% from the fourth quarter in 2021.

Outside of venture capital, CGT companies in the region are raising revenue through a series of valuable IPO offerings. Within the past few years, both Cabaletta's and Passage's IPOS have resulted in combined gross proceeds of over $260 million.

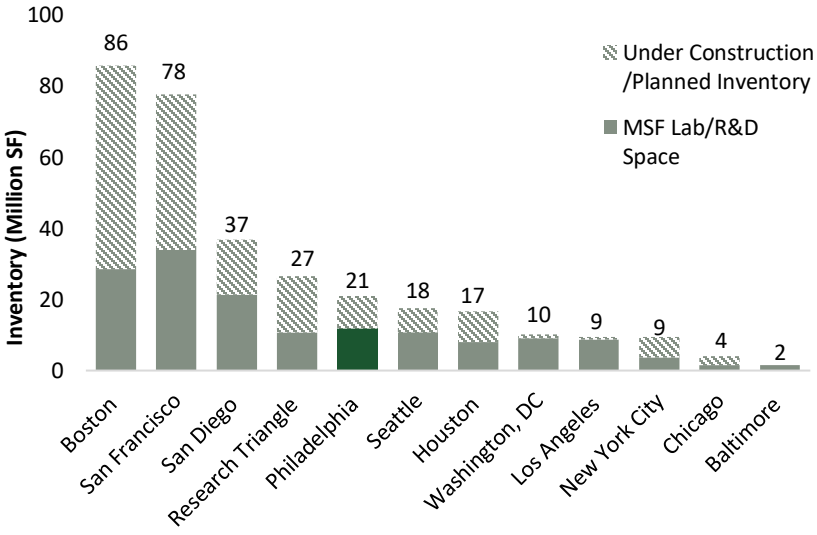
Venture capital invested in CGT companies by city (2018 - 2022)



*Source: DealForma (*Through August 2022)*

Real Estate Investment

Inventory Space by Region (Q2 2022)



Source: CBRE (2022), Newmark (2022), Colliers (2021)

Greater Philadelphia ranks fifth in existing and planned inventory of Lab and R&D Space, with roughly 12 million square feet of existing lab space throughout the metropolitan area. Greater Philadelphia is in the process of adding an additional nine million square feet of additional inventory to the R&D and Lab Space market to support the 10.8 percent enterprise growth within the life sciences sector.

> *"The science has driven the growth. Companies are now intentionally moving to this region.*
>
> - Mahen Gundecha, CBO, Exegenesis Bio

Value Proposition

Greater Philadelphia is increasingly recognized as a great and affordable place to live.

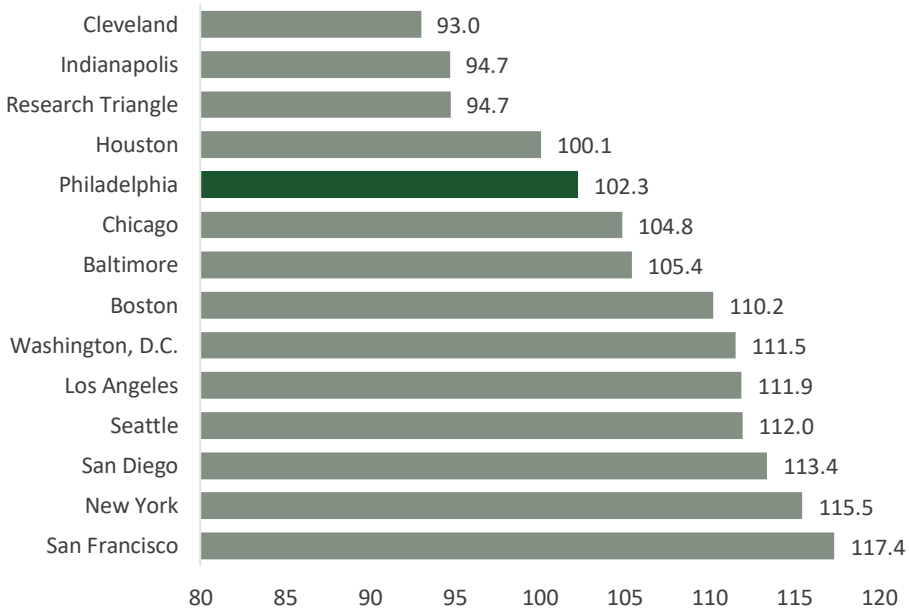
In addition to the research and capital needed to become a world class CGT hub, Greater Philadelphia is an extremely livable region, boasting some of the world's best museums, top notch restaurants, and large open spaces at a comparatively affordable price.

Cost of Living

Compared to its peers, Greater Philadelphia is an affordable place to live. The regional price parity is the regional price level as a percentage of the average price level for the mix of goods and services consumed including goods, housing, utilities, and other services at the national level.

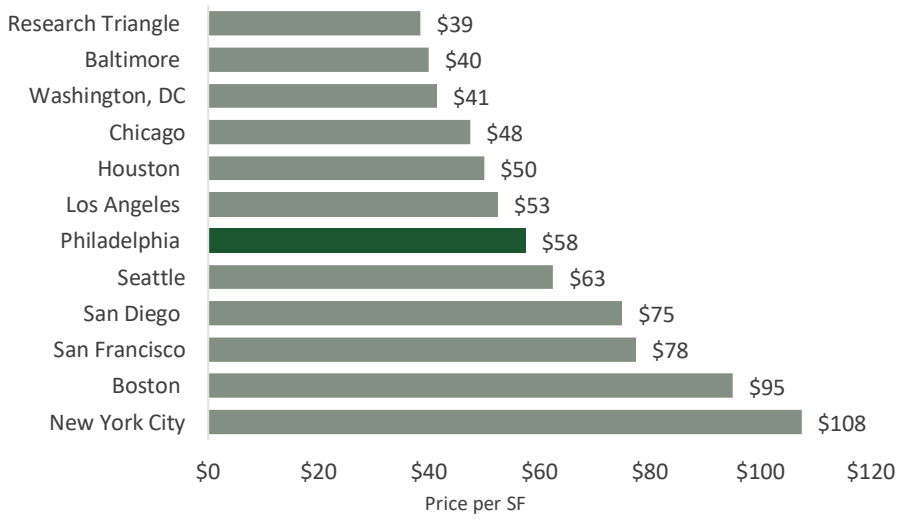
The regional price parity is based on the average price of $100 for goods and services at the national level. This means that for Greater Philadelphia, the cost of goods are 2.25% higher than the national average. However, compared to other metropolitan areas, Greater Philadelphia fairs quite well, only relatively more expensive than Cleveland, Indianapolis, the Research Triangle, and Houston.

Regional Price Parity, 2022



Source: BLS (2022)

Commercial Rents in Life Sciences



Source: CBRE (2022), Newmark (2022)

While the cost of living is an important factor for potential workers in determining where they choose to settle, commercial rents help determine where companies choose to conduct business. The comparative cost of space, coupled with the other benefits of a region, can help draw in or repel companies.

The asking rent per square foot of life sciences R&D space are highest in New York City, consistent with its typically high real estate prices, and Boston, where there are significant concentration of life sciences research activity. Contrastingly, the Research Triangle, another noted life science market, has an asking rent of $39 psf. Greater Philadelphia has the seventh lowest asking rent, at $58 psf.

Aggregate Rankings

Greater Philadelphia consistently ranks near the top of desirable locations for CGT across all metrics.

The metrics from the previous pages analyze Greater Philadelphia's position in the CGT sector against competitor locations as it relates to Research Infrastructure, Human Capital, Innovation Output, Commercial Activity, and Value Proposition. In the aggregate, Greater Philadelphia ranks **2nd** behind only **Boston**.

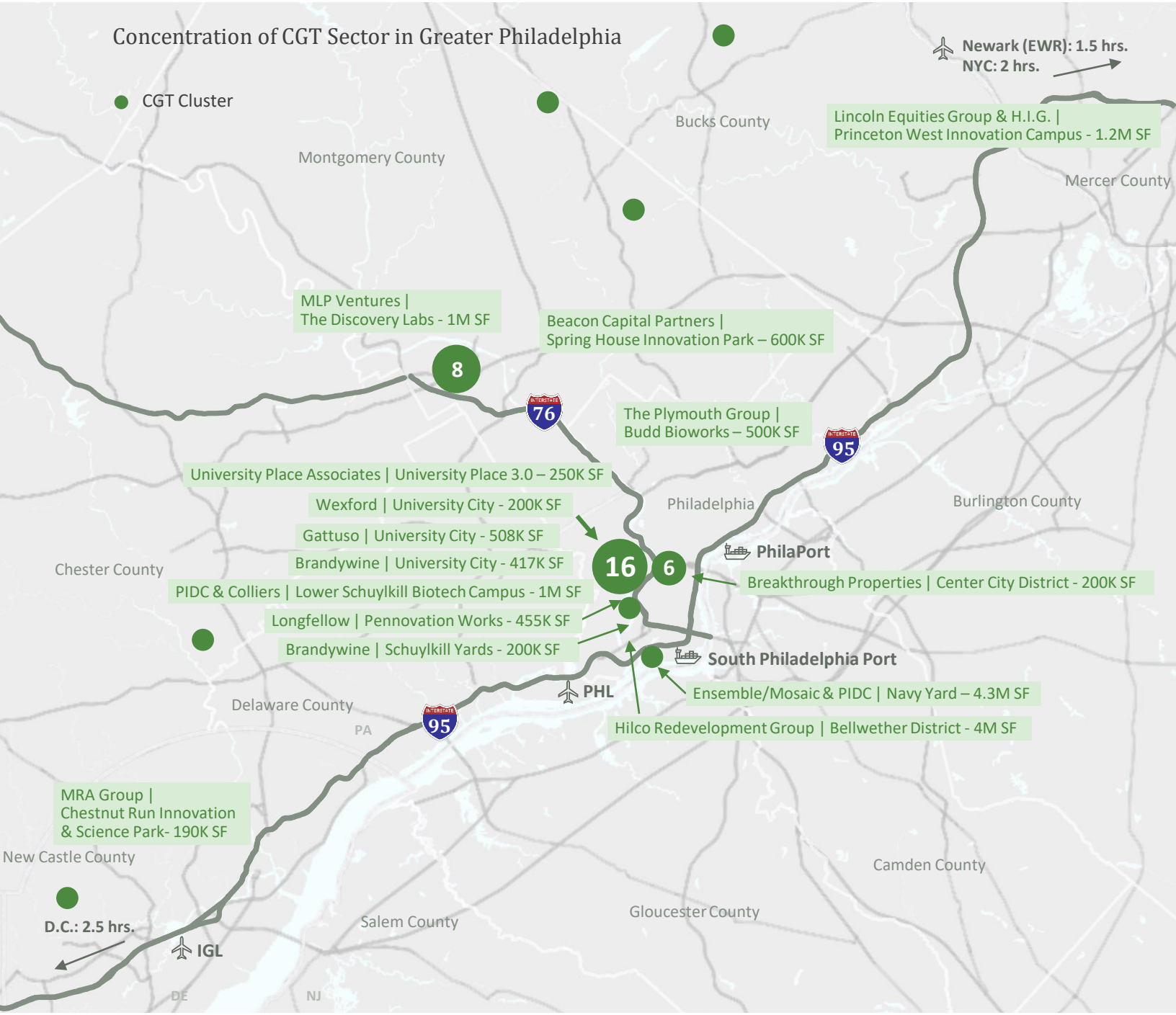
Notably, when comparing Greater Philadelphia to its close competitors—Boston, New York, and San Francisco—Greater Philadelphia fails to gain the number one spot in any single category (although ranks first in NIH funding, a subcategory within Research Infrastructure). However, its value proposition ranks significantly higher than these dense and expensive cities, pushing Greater Philadelphia ahead into the second spot overall. Together, the strength of Greater Philadelphia's cell and gene therapy sector coupled with the livability of the region results in its high ranking.

	Overall Rank	Research Infrastructure	Human Capital*	Innovation Output	Commercial Activity	Value Proposition
Boston	1	1	3	2	1	11
Philadelphia	**2**	**2**	**4**	**3**	**4**	**8**
San Francisco	4	11	1	4	2	13
New York	4	3	2	1	11	14
Los Angeles	5	4	5	4	11	9
Research Triangle	6	7	8	10	6	3
Houston	7	5	12	6	8	5
Seattle	8	5	11	7	5	11
Chicago	9	9	7	9	9	6
Washington DC	10	10	9	10	7	8
San Diego	12	12	6	12	4	12
Baltimore	12	7	13	8	13	5
Indianapolis	13	14	10	14		3
Cleveland	14	13	14	13	11	1

> *You have the talent, innovative thinking, capital investment, and infrastructure here in Philadelphia, all without the high housing costs and dense traffic of Boston.*
>
> - Mahen Gundecha, CBO, Exegenesis Bio

Growth of Cell and Gene Therapy Clusters in Greater Philadelphia

Building on its heritage and long-term commitment to cell and gene therapy research, the Greater Philadelphia Region is taking a leadership position in developing ground-breaking innovations.



A cluster of innovative activity, the Greater Philadelphia region is home to more than 50 CGT firms. The number of CGT firms is projected to continuously grow as additional life sciences space including lab and manufacturing facilities are under construction and planned by many developers. Considerable growth is occurring within the City of Philadelphia: a half million square foot laboratory at Pennovation Works Campus in the city's Gray's Ferry section; and an additional 200,000 square foot lab facility is being completed in Center City. Nearby, a 190,000 square foot Science Park is under way in Wilmington, Delaware, and 1 million square feet of laboratories and manufacturing facilities are being developed in King of Prussia, Pennsylvania.

Spotlight on
Greater Philadelphia CGT Supply Chain Infrastructure

A key ingredient of success in the cell and gene therapy industry is having all the components of the CGT production line in place.

Supply chain and logistics within the CGT industry are complex and challenging. The CGT industry demands the highest degree of precision when transporting material to and from the patient, a product that, in many instances, is individualized with no room for error and no replacement inventory. For this reason, timing, distance, and temperature are critical within every link in the supply chain process for these therapies.

Greater Philadelphia is uniquely positioned on the East Coast to serve the growing biotech industry. PHL is an easily accessible international airport equipped with advanced temperature-controlled shipping technology to serve the growing biotech industry. The region's accessibility is further buoyed by its strategic proximity to several international airports within a three-hour drive: Newark, JFK, LaGuardia, Baltimore/Washington, and Dulles. As an industry with unique products and short lifespans, having several nearby available air transportation options for shipping and logistics considerations is a significant draw.

Greater Philadelphia's air transport infrastructure is poised to expand rapidly in the upcoming years. The Philadelphia International Airport is set to expand its cargo facility by 137 acres. In addition to cargo growth, the Airport is home to a 24,000 square foot refrigerator facility designated for pharmaceutical use, enabling cell and gene therapy companies to ship sensitive materials. This expansion of key cargo and logistics services, as well as the existing cold storage facilities, will help further Greater Philadelphia's status as key cell and gene therapy hub.

Cell and Gene Therapy Production Line

1- Starting material is collected and shipped under ambient and controlled temperature → **2- Apheresis from patient is shipped to manufacturing site** → **3- In case of remote production site, the material is shipped on dry ice**

4- The finished product is shipped to a storage/distribution site on dry shipper → **5- The finished product is shipped to the clinical site for patient administration**

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