



United States | 2021

Research

2021 Life Sciences Real Estate Outlook

The innovation engine is shifting into high gear

Welcome

to our 2021 Life Sciences Outlook

The life sciences industry continues to scale on the heels of a global health crisis, driven by investor confidence in the sector's promise to save lives and by the industry's rapid advancement of new innovations. Collaboration between researchers, scientists and companies across platforms is more important than ever, and cluster markets with all the right ecosystem components are taking the lion's share of tenant demand, new development and investor interest.

For years now, the life sciences industry has been investing in lab space and lab R&D, and new capital players continue to enter the space. Not only is venture capital fueling new company formation faster than ever before, new real estate capital players are battling for the best-located assets or development sites in hopes of capturing the wave. However, there's not been similar investment in the development of biomanufacturing space, and that will be the next challenge as companies continue to scale, and as clinical trials grow at a faster pace than ever before.

For years, the major clusters of Boston, the San Francisco Bay Area and San Diego have led the way

for the industry, and for the associated lab real estate market. Close behind, there is a yeasty second tier that includes Raleigh-Durham, New York-New Jersey, Greater DC Mid-Atlantic, Los Angeles, Denver-Boulder and several others. Communities that have great research capabilities, access to capital, workforce training, PhDs, respect for science in the workforce and lower costs are now more competitive. Coupled with broader migration trends happening in the United States, these new upstart locations have become very attractive, and frankly, in high demand for some developers, tenants and landlords.

Some of the hurdles and barriers of getting from early-stage translational research to commercialization of a product are real estate related issues, and they can be sources of significant cost, lack of efficiency and lack of coordination. In the end, for life sciences, location continues to matter most. Now, more than ever, firms are seeking deep insight into geographies to weigh cost, rental price, access to venture capital, access to skilled labor, intellectual capital, support services and political predictability in making location and growth decisions.



Travis McCready
Executive Director
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The life sciences industry was thrust into the spotlight amid the COVID-19 pandemic, viewed as a hopeful solution to the crisis, and as an attractive pursuit for venture capitalists and real estate investors.

But momentum had been building for years, proven by the rapid development of life-saving vaccines within a year of the onset of the pandemic. The sector is attracting real estate capital from around the globe, and most investors are targeting legacy markets where industry clusters are strongest and where a density of lab properties already exist. But, strong buyer competition in key clusters, coupled with emerging growth in secondary markets, is driving investment and development activity beyond the traditional geographies.

This year's report aims to identify the fundamental industry trends driving demand for lab space now and into the future. The key components that define a world-class life sciences cluster are found only in a few geographies, but with new investors and new companies entering the field, doors of opportunity are emerging outside the traditional hubs.



Our major report themes

1.

What's driving growth and how much further can it go?

Industry growth and productivity are being driven by the adoption of new technologies and rapid advancements in innovation.

2.

How much longer can tenant demand keep at its current pace?

Core cluster markets are generating outsized demand, but competition and industry evolution are opening new markets of opportunity.

3.

What are investors doing to meet the swell of demand and will there be enough supply to support this growth?

Supply pipelines are growing with development and conversion activity, and new capital players are driving competition in key cluster markets.

2021 cluster rankings

We've reinvented our approach to our annual life sciences cluster ranking, employing a new methodology that scores the **key components** that define the industry and predict its growth.

Not all markets can reach the bar set high by Boston, but this year we've benchmarked market opportunity relative to talent, industry depth, innovation and lab real estate dynamics to provide a more robust market comparison. Indexed to 100, market scores indicate how far above or below "average" each market ranks.

Rank	Cluster	Cluster score
1	Greater Boston	149.81
2	San Francisco Bay Area	132.54
3	San Diego	119.81
4	Raleigh-Durham	119.71
5	New York-New Jersey	109.61
6	Greater DC Mid-Atlantic	107.58
7	Los Angeles	104.41
8	Denver-Boulder	104.36
9	Philadelphia	104.29
10	Seattle-Bellevue	102.14

Rank	Talent score	Talent rank	Industry score	Industry rank	Innovation score	Innovation rank	Lab real estate score	Lab real estate rank
1	145.29	1	138.06	1	145.83	2	160.93	1
2	118.53	4	137.50	2	151.80	1	126.67	2
3	120.04	3	123.39	3	115.69	4	121.04	3
4	131.55	2	120.27	5	110.19	7	117.82	4
5	111.87	8	116.40	6	115.79	3	100.69	7
6	116.01	5	113.11	7	96.62	20	107.01	5
7	114.21	7	109.67	10	104.64	8	95.00	11
8	115.92	6	109.81	9	99.37	14	97.33	8
9	107.45	11	108.74	11	103.36	9	100.80	6
10	103.81	14	97.85	18	110.26	6	97.00	9

A market with a total score over 100 has the right components to cultivate a strong life sciences cluster. Only a handful of markets can compete with Boston, the indisputable center of the life sciences world. Scoring the individual components—talent, industry depth, innovation and lab real estate dynamics—can highlight markets poised to capture greater industry momentum, even if they don't score highly across the board. As key clusters become too challenging for occupier growth, or too competitive for real estate investors, the questions becomes, "where next?"

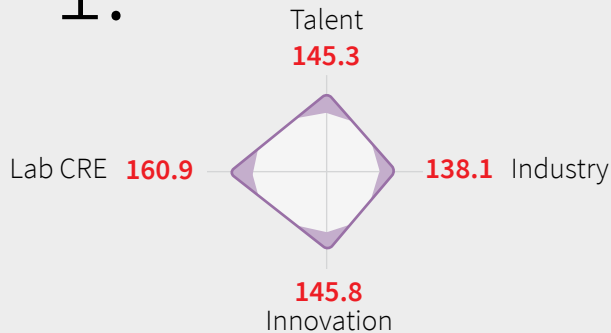
The top three clusters are unchanged from the previous year, despite our new approach, but Raleigh-Durham moved up one position. Raleigh-Durham's legacy of strong research institutions, competitive talent pipeline, existing industry depth and viable commercial lab market can support greater industry expansion.

The Greater New York-New Jersey cluster is another top market, but here the talent pool is not quite as deep, although it's quite broad given its scale. Innovation is the driver here, capturing the third-largest volume of venture capital dollars among all markets in the U.S. The Greater DC-Mid-Atlantic cluster is less successful in attracting start-up capital, but depth of talent, a semi-mature lab real estate market, and breadth of institutional research in the region all support further development of its life sciences ecosystem.

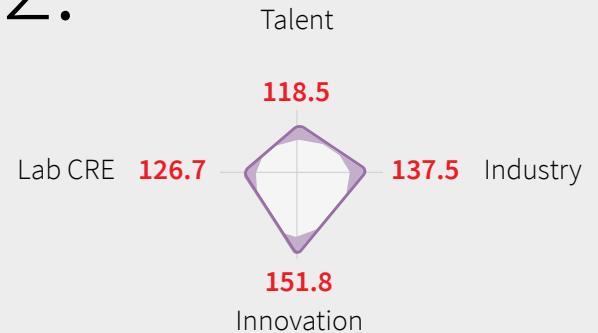
Los Angeles has the advantage of proximity to San Diego and the San Francisco Bay Area, the second and third-ranked clusters. What Los Angeles lacks in a centralized cluster, it makes up for with talent, innovation and institutional presence. Los Angeles has an opportunity to capture some of the overflow demand from its northern and southern neighbors. Denver-Boulder, Philadelphia and Seattle-Bellevue round out the top 10; all score relatively well across the components, with room to grow.

2021 top 5 cluster markets

1. Greater Boston | 149.8



2. Greater SF Bay Area | 132.5



3. San Diego | 119.8



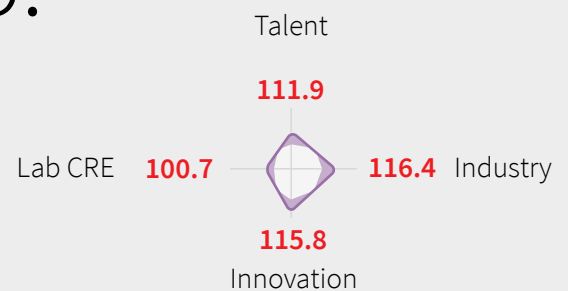
4. Raleigh-Durham | 119.7



>> We examined 46 markets in the U.S. and Canada but reveal only the top 10 in this report because the scores drop precipitously outside these 10.

Our assessment underscored just how mature a market like Boston is relative to the rest and just how important the clustering effect is for company and investor success. Look for a deeper dive into our methodology and approach at the end of this report.

5. New York-New Jersey | 109.6



1.

What's driving growth and how much further can it go?

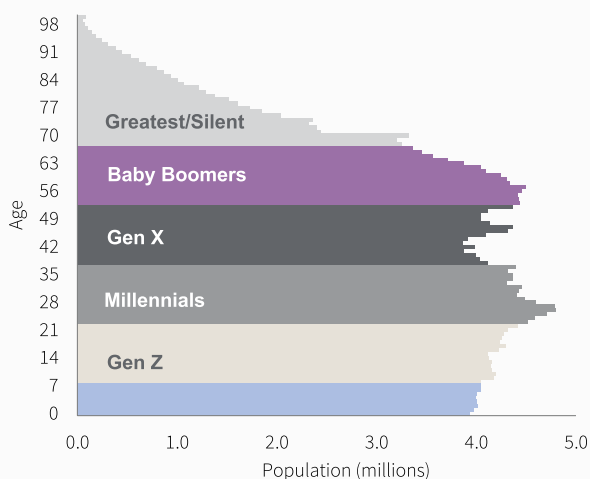
Industry growth and productivity are being driven by the adoption of new technologies and rapid advancements in innovation.

Consumer demand

Human health and consumer demand for therapeutics will continue to drive growth in the life sciences industry, and the rapid pace of technological adoption will ensure this continues for the foreseeable future. Medical advancements have increased our lifespans, sustaining a greater demand for consistent care and specialized care.

People aged 55 and older comprise more than half of all healthcare expenditures in the U.S. yet make up only 29% of the population. The demographic groups that follow are even larger, so even if population growth was slower this decade than it has been in 90 years, the demographic equation driving healthcare demand is tuned for rapid growth.

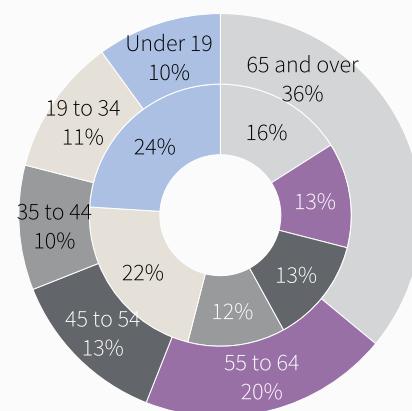
U.S. population by age



Population vs. healthcare expenditures

Outer ring represents share of **healthcare expenditures** paid by age cohort

Inner ring represents share of **population** by age cohort



Sources: JLL, U.S. Census Bureau, Kaiser Family Foundation analysis of Medical Expenditure Panel Survey

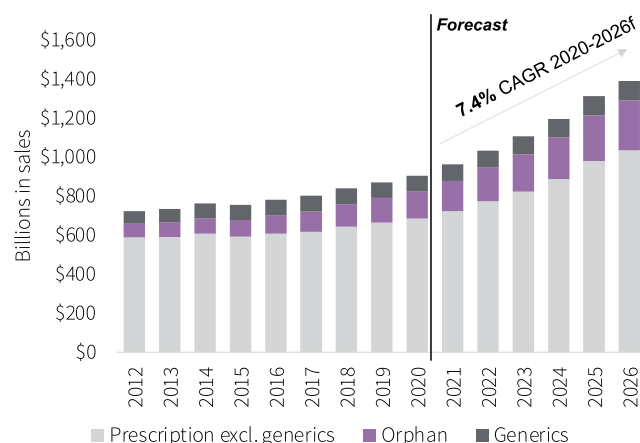
Currently, there are several thousand known diseases in the world but therapies are only available for approximately 500.¹ Consequently, demographics and consumer demand for healthcare will remain the fundamental drivers for life sciences product research and development—we all want to live longer, healthier lives.

Worldwide pharmaceutical sales are predicted to escalate at a compound annual rate of 7.4%

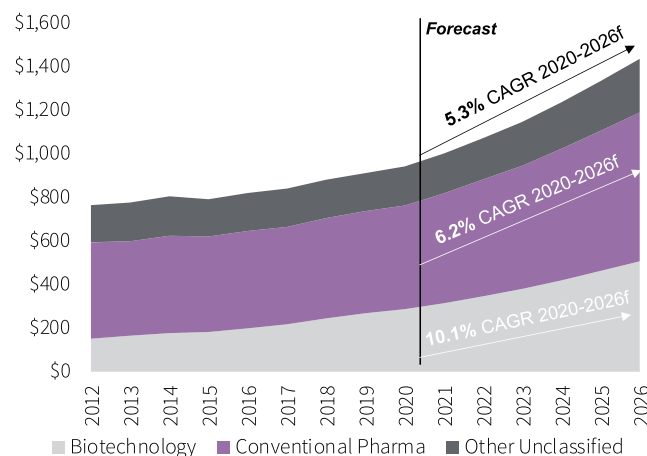
through 2026, to nearly \$1.4 trillion in sales. This is a significant increase in the next six years compared with the previous six when sales grew at a compound annual rate of just 2.9%. Growth is largely expected from accelerated sales of biotechnology-driven therapeutics, growing at a compound annual rate of 10.1% through 2026, reflecting the growing share of biologics that have been made possible through advances in the industry.

¹“We generally say: Several thousand diseases affect humans of which only about 500 have any U.S. Food and Drug Administration-approved treatment,” said Cindy McConnell, a spokeswoman at NIH’s National Center for Advancing Translational Sciences (NCATS); www.washingtonpost.com/news/fact-checker/wp/2016/11/17/are-there-really-10000-diseases-and-500-cures/.

Robust growth forecast for brand-name pharma industry



Worldwide pharma sales by technology type



Source: EvaluatePharma, 2020

Technological advancements

We're only at the beginning of what's possible in drug discovery and delivery through greater adoption of technology. Scientists today have more tools at their disposal to find, test and target molecules. This is enabling more-efficient research and development efforts and driving a need for more specialized talent and space. Small molecule therapies have been the dominant modality, but **biologics** (large molecules) are taking a greater share each year, thanks to new technologies driving more productive research efforts.

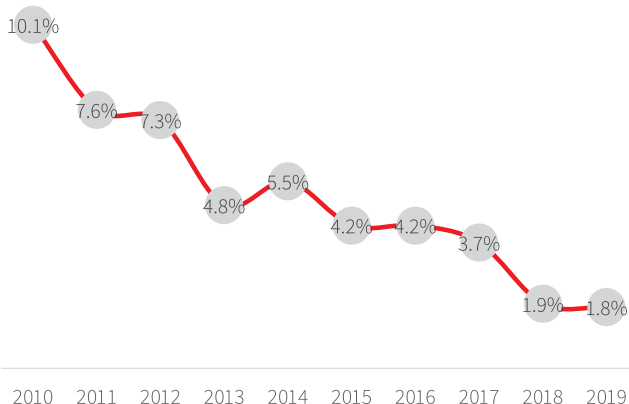
Pharma companies are **focused on new modalities** in part to hedge against patent expirations, which lead to revenue loss. The worldwide risk to market revenues due to patent expirations is currently 1.2%, according to EvaluatePharma, down from a recent high of 7.2% in 2012. Small molecule drug compounds made up 67.0% of the late-stage drug pipeline in 2010 but account for just 49.5% of the late-stage drug pipeline in 2021, and the shift will continue as new discoveries are made.

Artificial intelligence (AI) methods are now critical in the R&D process and throughout the drug

development pipeline. Implementation of AI technology can accelerate productivity in drug discovery, clinical trials, testing of existing drugs for new uses and aggregation of data at scale. The human genome contains millions of data points that can unlock biomarkers of opportunity for new therapeutics much faster than ever before, thanks to new software techniques. The "omics" field of study (genomics, transcriptomics, proteomics) is seeing tremendous growth within the industry. These technological advancements are precisely why several COVID-19 vaccines were developed in record time.

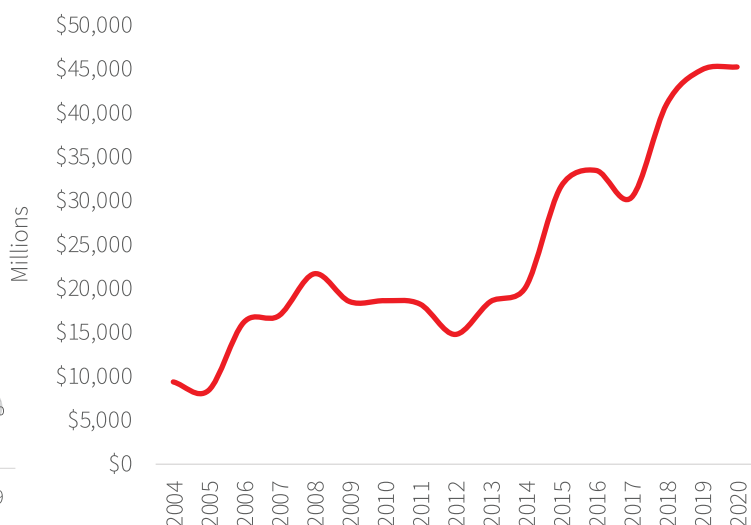
Established biopharma companies are increasingly investing in AI-focused start-ups, and this field will continue to be a primary driver of the life sciences innovation engine. Large-cap pharma companies have continued to see declining rates of return on R&D investments over time, but with partnerships between large-cap pharma and biotechnology start-ups growing steady every year, the development of new therapeutics will continue to scale.

IRR of internal R&D spend Top 12 large-cap pharma companies



Sources: IBIS World, Deloitte, JLL Research

Value of partnerships & licensing agreements | U.S.



Why do modalities matter? Accelerated advancements in drug discovery and delivery will fuel industry growth and demand for lab space.

We're at the forefront of rapid change concerning modalities² of drug discovery and delivery. Drugs in development today are more likely to be "living"—the result of bio engineered or modified proteins, antibodies, or other large molecules targeted to specific mechanisms of action in the human body. Or, as with the promise of cell and gene therapy, certain modifications of our own bodies will become the 'drug' itself. New modalities and technologies will fuel ever evolving infrastructure and real estate requirements.

Wave 1: 1900s

Launch of aspirin

Scientists know about chemical structures but are unsure of their modality.

Wave 2: 1970s

Rational drug design

Specific compounds aimed at molecular targets, allowing drug makers to understand what they were making but also how it worked.

Wave 3: 1980s

Biotechnology revolution

Sequencing the human genome allowed use of recombinant DNA technology, enabling scientists to design medicines based on the proteins and other large molecules that govern biology.

Wave 4: 2021+

Convergence (now)

Technology enables more rapid discovery of molecules and proteins by which to create compounds and test efficacy of new biological targets. Scientists are focused on diseases that were once deemed "uncurable."

Glossary of terms

Modality: the key (a drug) that unlocks a target molecule

Drug discovery: research that aims to find new modalities

Therapeutics: drugs that are developed through this research

Small molecules and biologics: modalities by which drugs are delivered

² Amgen: www.amgenscience.com/features/a-sea-change-in-drug-design

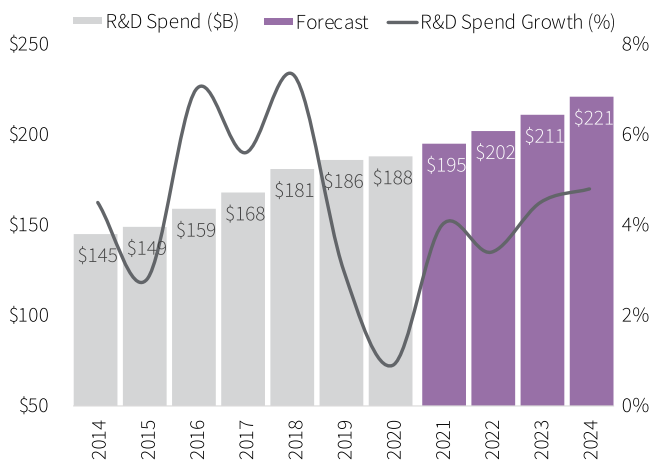


Regulatory environment

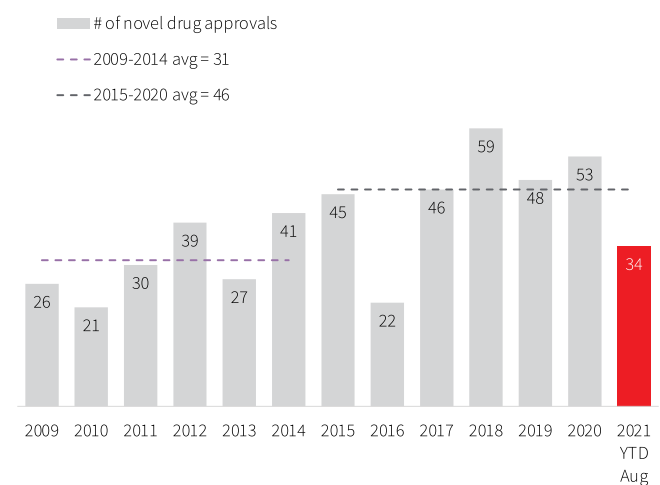
While industries such as technology and finance must adhere to certain regulatory guidelines related to antitrust laws, financial disclosures or monopolies, regulatory guidelines enforced by the Food and Drug Administration (FDA) can have far more impactful consequences for the life sciences sector. The FDA, seeking to ensure the health and safety of its constituents, must balance the need for enhanced healthcare with the checks and balances of a governing agency. Therefore, it's important to understand how the FDA is working to improve the clinical trial process, develop new tools to enable product development and, ultimately, evolve the approval process for greater speed to market.

R&D spend is a significant up-front cost that doesn't always guarantee a viable commercial product. According to an MIT study examining the global drug pipeline from 2000 to 2015, the overall success rate of a phase 1 clinical trial drug moving through to final approval was 13.8%. Once a drug reaches phase 3, the success rate increases to 59.0%. With 910 drugs currently in U.S. phase 3 clinical trials as of August 2021, an estimated 536 new therapies could be introduced over the next several years (median phase 3 trial duration is 3.8 years).

Life sciences R&D spend and forecast



FDA novel drug approvals



Sources: EvaluatePharma, 2020; FDA Center for Drug Evaluation and Research (CDER). This dataset does not contain vaccines, allergenic products, blood and blood products, plasma derivatives, cellular and gene therapy products or other products approved by the CDER.

The FDA's primary mission of protecting public health inherently includes the advancement of products that can save lives. FDA approval of novel drugs accelerated in the last six years relative to earlier in the decade, and this slow rise is expected to increase as the FDA maintains focus on advancing science and productivity.

Notably, in 2021 a new leader was appointed to the FDA's Center for Drug Evaluation and Research (CDER), the main governing body of the commercial drug pipeline. The implications of this change will undoubtedly drive changes within the agency. Below are just some of the FDA's key focus areas that will help drive greater productivity, unlocking growth within the life sciences industry.

Focus area	Strategic research initiative
Individualized therapies and precision medicine	<p>Precision (personalized) medicine tailors disease prevention and treatment for the differences in peoples' genes, environments and lifestyles. The goal is to match the right treatments to the right patients at the right time.</p> <ul style="list-style-type: none"> • The FDA is exploring new technologies (omics) to advance major breakthroughs in thinking about diagnosis, prognosis and treatment of disease. • The FDA created precisionFDA, a cloud-based community research and development portal that engages users across the world to share data and tools to test, pilot and validate bioinformatics.
Complex innovation trial design	<p>In response to the quickly changing drug development landscape, the FDA is concentrating efforts to advance Complex Innovative Trial Designs (CIDs).</p> <ul style="list-style-type: none"> • The goal is to maximize clinical trial efficiency while using scientifically sound methods to determine the optimal design for the question and population of interest. • CID has design elements and/or analysis approaches that generally require computer simulations to determine the statistical properties of the trial, maximizing analytical capabilities.
Product development tools	<p>FDA-endorsed product development tools facilitate the industry's ability to harness innovative science and technology to reduce the time, complexity or cost of developing FDA-regulated products.</p> <ul style="list-style-type: none"> • Biomarker identification and data management tools promote consistent use of biomarker terms and concepts, thereby advancing the science. • Model-informed drug development (MIDD) can drive efficiency in clinical trial designs, predict outcomes, optimize dosing or therapeutic individualization, predict product safety and evaluate potential adverse-event mechanisms.

2.

How much longer can tenant demand sustain its current pace?

Core cluster markets are generating outsized demand, but competition and industry evolution are opening new markets of opportunity.

The process for conducting research and scientific development is inherently fixed to the physical assets in which these activities take place. However, the physical lab is only as good as the ecosystem that enables it, and without the right infrastructure, life sciences companies are unable to grow and succeed.

Fundamentally, all life sciences markets are anchored by a **research institution**, which could be a university specializing in the field or an institute that is mission-driven to solve critical health needs. These institutions not only help to drive science forward, but they also generate the **talent** who will do so.

Talent-rich institutions alone are not the singular driver of growth. **Capital** is essential to the

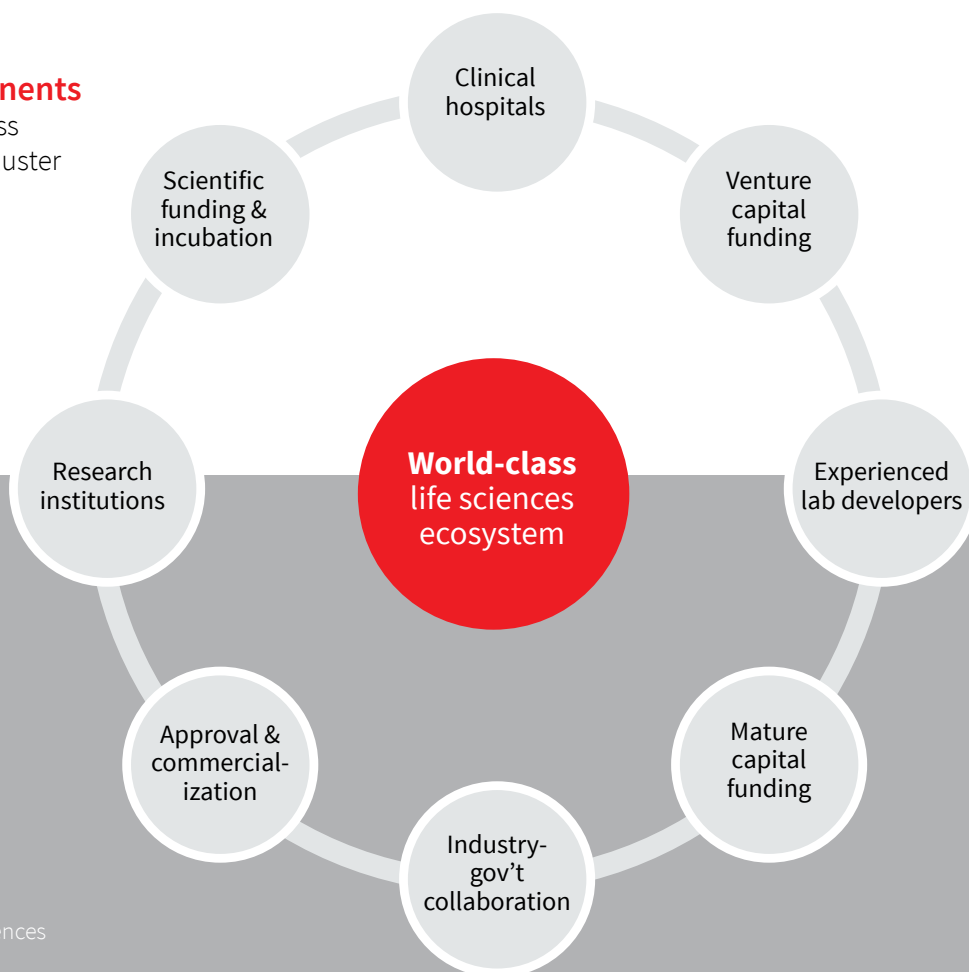
speculative nature of R&D, without which there would simply be no industry. This injection of funding is deployed through government agencies, venture and private equity and public markets.

No life sciences ecosystem can operate at its highest level without **skilled industry** partners, which include public-sector support, regulatory experience and experienced real estate developers and project managers that can deliver the physical assets required.

The following sections highlight just how significant a role the entire ecosystem plays in the sector and how that ultimately impacts the commercial lab market.

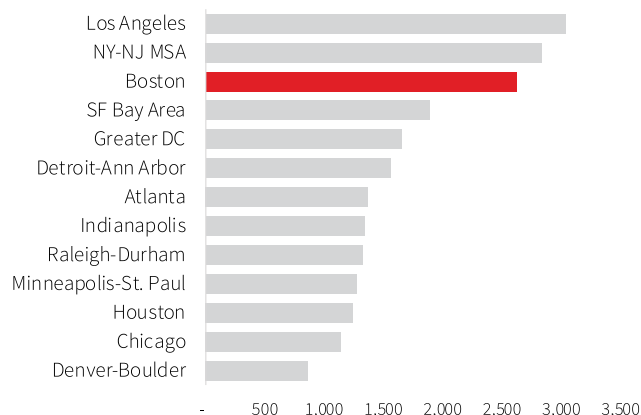
Key components

of a world-class
life sciences cluster

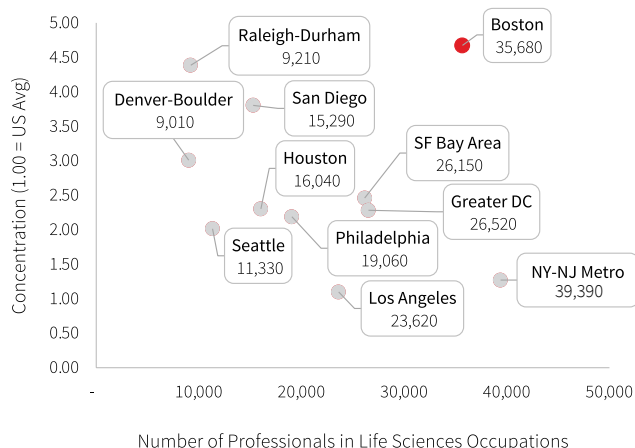


Access to talent is a primary concern for growing companies

Life Sciences PhDs earned each year, MSA level, 5-yr. avg.



Concentration of life sciences professionals in major markets, 2020



Sources: National Science Foundation, BLS

Talent matters

Like the well-publicized ongoing war for tech talent, growth and innovation in the life sciences sector are driven by specialized talent that exists in finite numbers. Therefore, location is a critical site-selection consideration, and it's not enough to have many talented professionals. It's important to have depth and density of talent as well. The clustering effect is more acute in life sciences than in perhaps only a handful of other industries.

The deepest and most concentrated cluster markets are tied to a strong research institution with a legacy of study in the field. Los Angeles and New York

have world-renowned institutions engaged in the advancement of life sciences research, but scale alone is not a guarantee of a good talent cluster. Boston ranks third in PhDs earned but has the most-concentrated life sciences talent pool in the country—4.67 times more concentrated than the U.S. overall.

Unlike the tech industry, life sciences talent is even more specialized and is not ubiquitous within all industries and pervasive across all geographies. Nearly every mature company today employs a chief technology or chief innovation officer. Few companies outside of the life sciences industry have a chief scientist or chief medical officer.

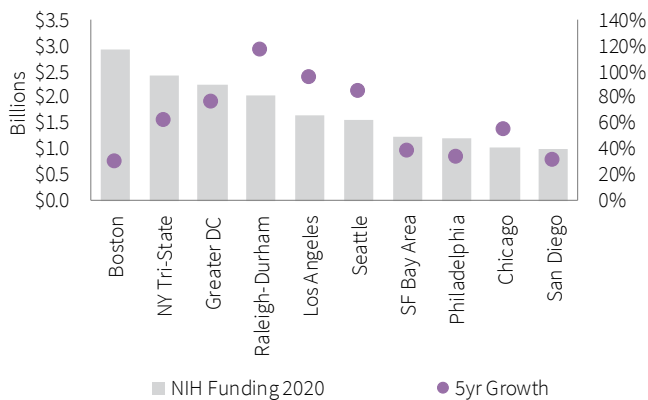


NIH and venture capital funding

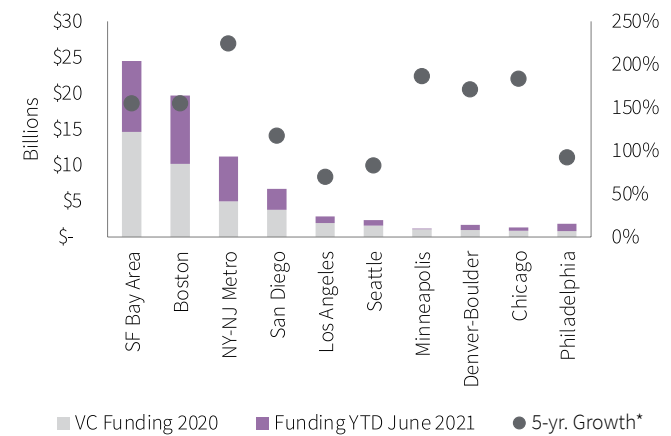
National Institutes of Health (NIH) funding is a critical stream of capital that supports research to drive the industry forward and is highly concentrated in Boston, accounting for one-quarter of all grant dollars among the top 10 recipient geographies and about 10% of all NIH funding in the U.S. overall. Funding has accelerated fastest in Raleigh-Durham, a rapidly rising market that's anchored by legacy research institutions and a culture of innovation.

Adding fuel to the innovation fire is the flow of venture capital dollars, which truly drives company formation and demand for lab space. A steady flow of graduate talent is important for a life sciences ecosystem, but not all new start-ups are formed adjacent to one's alma mater. To build upon an idea, scale is important. Access to established industry partners and depth of talent are critical to company formation. Venture capital dollars are fueling new start-up activity, and the top cluster markets captured the lion's share this year.

2020 top NIH funding awarded and 5-yr. growth



Life sciences VC funding 2020-21 and 5-yr. growth



Sources: NIH, Crunchbase

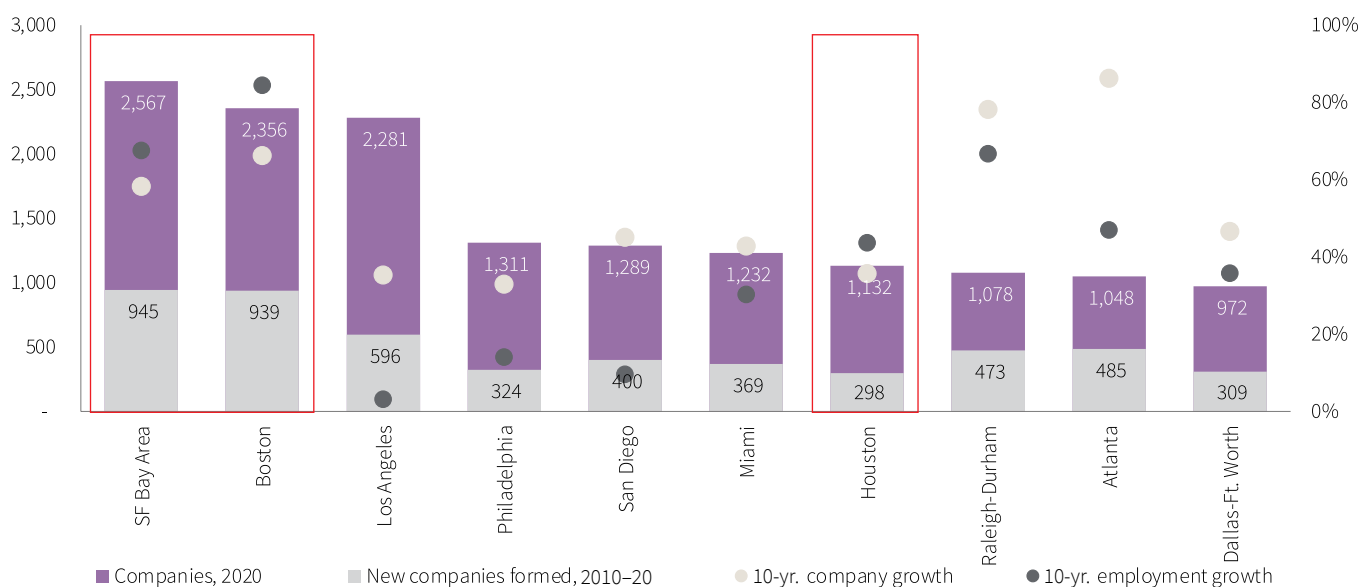
*Growth based on 5-year rolling average funding by market, 2020 vs. 2015

Mature life sciences markets continue to see steady company formation, driven by new startup activity. The pace of employment growth has slowed relative to company formation in the Bay Area and in Boston, both the largest and most mature markets, indicating that more growth is occurring within companies of scale. But start-up activity is still more robust in these

two clusters than anywhere else, with formation of nearly 1,000 companies each over the last decade. Both markets also recorded the largest gain in research-focused life sciences employment during the period, underscoring the importance of both depth and scale in location choice.

Signs of industry maturation and institutional depth appear in markets where job growth exceeds company formation

Fastest-growing markets, life sciences research-focused company formation 2010-20



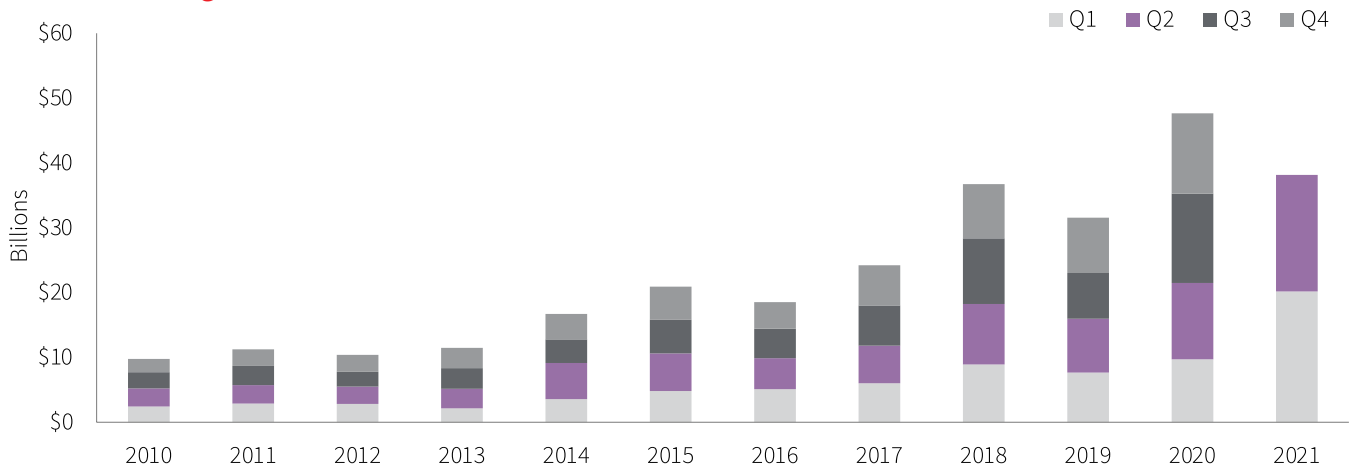
*Growth based on 5-year rolling average funding by market, 2020 vs. 2015
Sources: BLS, EMSI

Record levels of investment flowing into both established and mature markets across the country have been a key driver of demand for lab space. In the first half of 2021, life sciences companies raised over \$38 billion, an increase of 77% from the first half of 2020 and well over the 10-year average of 18% annual growth. While venture capital funding has grown across the U.S. and Canada, it remains highly concentrated in major cluster markets. In 2020, 70% of all life sciences funding was captured by just four markets: the San Francisco Bay Area, Boston, New York-New Jersey and San Diego. This concentration increased from 63% in 2015, with the San Francisco Bay Area and San Diego realizing the largest gains.



Life sciences venture capital funding is on pace for another record year

Total VC funding in life sciences



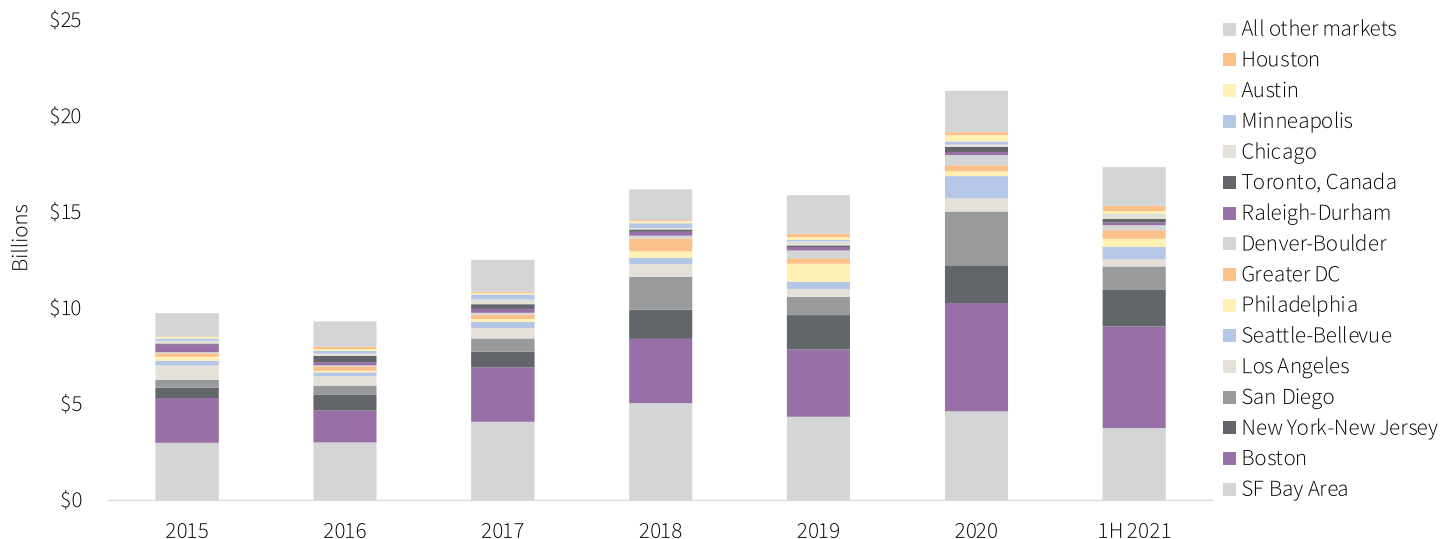
Source: Crunchbase

The onset of the last decade (the years between 2010 and 2013) saw major changes in venture capital trends, including a decrease in overall funding volume and number of deals as well as a move toward larger and later-stage funding rounds. Since then, funding activity has shifted in the opposite direction. The average number of recipients increased by 51% since

2014 and early-stage funding, at \$17 billion for the first half of 2021, is on pace to have its best year ever. This record investment in early-stage deals indicates emboldened investor optimism in life sciences and is expected to remain abundantly healthy in the near term.

Early stage funding reached \$17B by the first half of 2021, set to outpace previous records

Early-stage VC funding by market, 2015–20



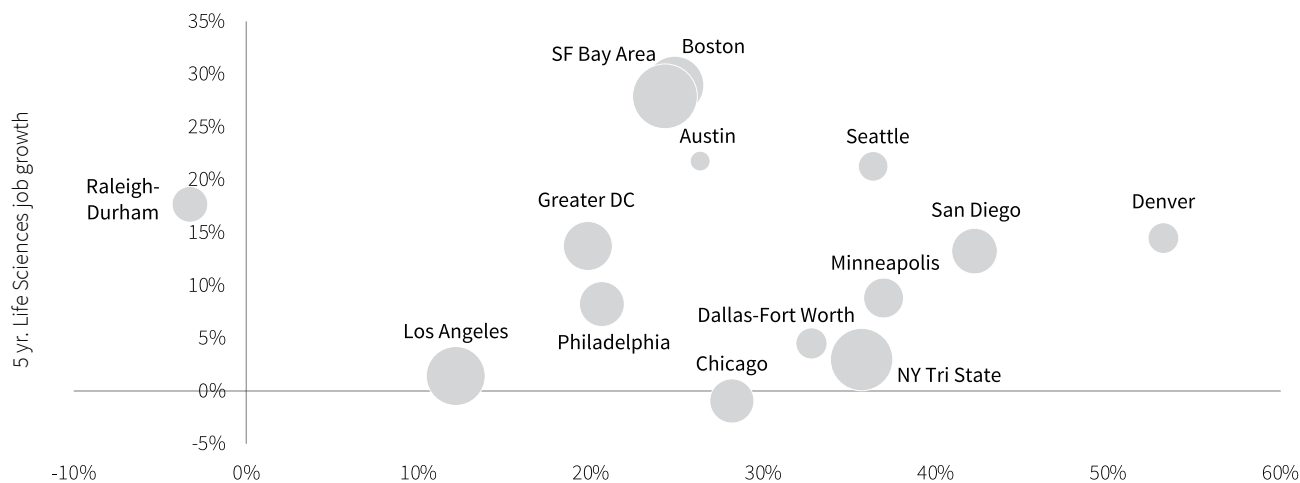
Source: Crunchbase

The life sciences sector has made steady job gains over the last decade and currently employs over 2 million people in the U.S. Like leasing activity, employment increases also tend to “follow the money.” Between 2015 and 2020, established markets like Boston and the San Francisco Bay Area realized

the largest employment increases in concert with record growth in venture capital funding. Funding will fuel employment momentum in new markets as start-ups build teams, and growth will be especially pronounced in markets with strong preexisting life sciences clusters.

Large established markets continue to capture the most venture capital funding

Life sciences VC investments vs. life sciences jobs, by top market [Size of bubble = 2020 total employment in sector]



Sources: Crunchbase, Emsi

5 yr. rolling average growth - VC funding

Venture capital investment is one of the strongest leading indicators of commercial lab demand; in top cluster markets like Boston and the San Francisco Bay Area, a **capital event typically leads to a lease transaction within six to nine months, on average.**

Leasing activity in lab space was up 22% in the aggregate in major markets compared with five years ago, but compared to other commercial property types, it is still a niche sector. Developers must be willing to take on some speculative risk to capture this demand as tenants need to be able to see it to lease it.

Public market activity

With a perception of being relatively insulated or benefiting from shifts driven by the pandemic, the industry has seen considerable investment via public markets in the past 18 months. Building

the intense pursuit of COVID-19 vaccines and therapeutics accelerated investor interest in the sector more broadly. IPO activity surged in 2020, with 71 biotechnology companies raising \$14.8 billion through initial public offerings, far surpassing 2019's 44 public offerings totaling \$4.7 billion. The first half of 2021 saw continued momentum, with \$8.8 billion generated by 49 public offerings as of the end of June and \$14.1 billion in funding year-to-date through secondary offerings, surpassing 2020 totals.

While the NASDAQ Biotech Index outperformed the S&P 500 from March 2020 to March 2021, growing 110.4% compared to 75.8%, the S&P 500 has outperformed biotech since then, growing 13.9% compared to 4.1%, as capital has rotated back into some of the sectors that had fallen out of favor during the pandemic.



3.

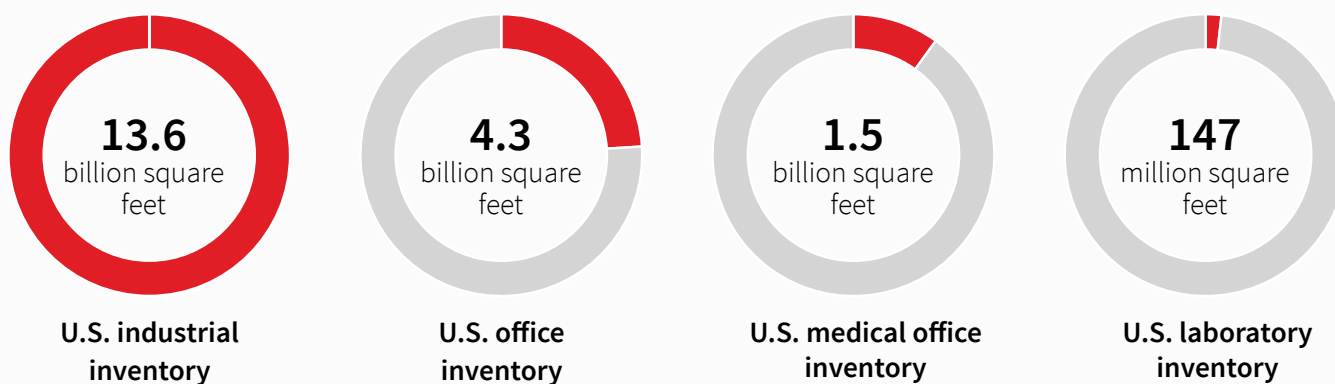
What are investors doing to meet the swell of demand and will there be enough supply to support this growth?

Supply pipelines are growing with development and conversion activity, and new capital players are driving competition in key cluster markets.

Commercial lab space is relatively scarce and is one of the smallest asset classes in the U.S. Totalling nearly 150 million square feet, the investor-owned commercial lab market is equivalent in size to the investor-owned downtown Chicago office market.

But it's highly concentrated in Boston, the San Francisco Bay Area, San Diego and Raleigh-Durham. This clustering effect is reflective of the markets' life sciences ecosystem infrastructure, often irreplaceable and many years in the making.

Sizing the life sciences opportunity



>> Compared to other property sectors, lab is still very much niche in scale

Many markets across the map experienced accelerated leasing activity in the first and second quarter, reducing lab availability to all-time lows. In the three core life sciences markets—Boston, San Francisco Bay Area and San Diego—second-quarter leasing activity was equivalent to 13%, 16% and 23% of inventory, respectively.

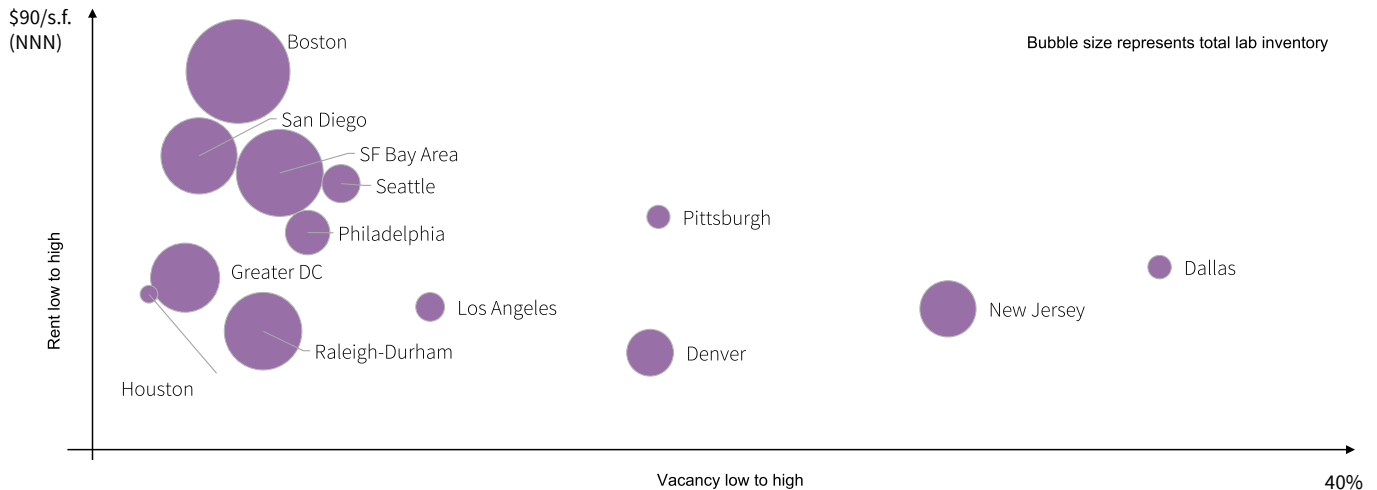
In Boston, 85% of available space is tied to new projects. While tenant demand exceeded 7.0 million s.f. as of midyear 2021, the market has just 6.5 million s.f. available, resulting in market gridlock and slower leasing activity. San Diego, on the other hand, has realized record leasing activity in its life sciences

cluster this year. Leasing volume throughout the first half of 2021 increased by 102% from the first half of 2020 and is 133% higher than the trailing five-year average. In the San Francisco Bay Area, year-to-date leasing activity in 2021 is over 1.9 million s.f. while lab vacancy remains below 5%.

The vibrancy in the life sciences sector will continue to push demand to new heights in the top clusters, but **scarcity and competition will drive overflow demand to adjacent markets**, especially those where the talent and availability of lab product can support company expansion.

The largest lab markets have the most limited amount of space, and tenants are still willing to pay a premium

Lab asking rents (NNN) and vacancy rates as of Q2 2021



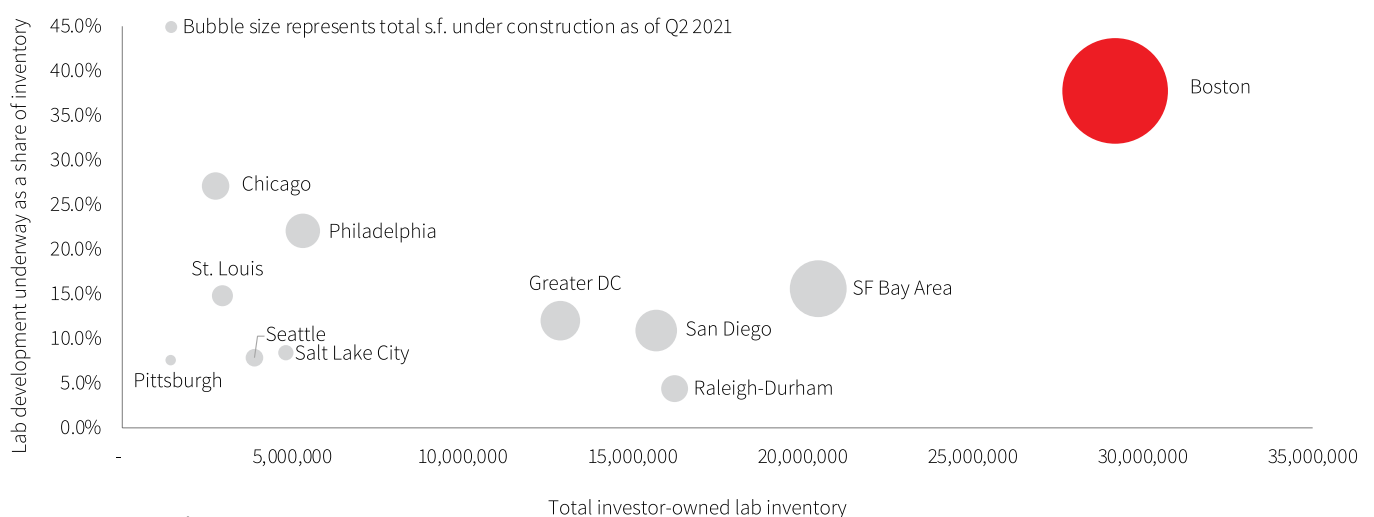
With long-term employment increases, industry and demographic shifts, record funding, tight vacancies, and rising rents, **all signs indicate a potentially undersupplied commercial lab market.** There is roughly 21.6 million s.f. of lab space under construction in the U.S. as of Q2 2021, 75% of which is concentrated in the three clusters. With 11 million s.f. of lab space under construction, or 38% of its current investor-owned inventory, Boston is the leading development market. Nearly all the space expected to

deliver in 2021 has been preleased, and the 8 million s.f. expected to deliver in 2022 is nearly half preleased.

San Francisco and San Diego are also experiencing a surge in development at 8.5% and 10.9%, respectively, of existing investor-owned inventory. A few other markets are also seeing robust activity: 1.4 million square feet of development activity in Greater DC accounts for 11.1% of the market's existing inventory; Philadelphia has less than 1 million square feet under way, or 14.1% of existing market inventory.

Development activity currently under way totals more than 20 million s.f., nearly half of which is concentrated in Boston

Lab development under way as share of existing lab inventory



Source: JLL Research

Investors and developers are seeking new avenues to create supply. Conversions can be a viable option if the base building has a floorplate between 30,000 and 60,000 s.f., clear height of at least 12 feet, increased electrical service and dedicated freight loading,

among other factors. Investors and developers considering this option will need to invest \$135 to \$400 per square foot depending on geography and scope of conversion required.

Anatomy of a life sciences building



Screened service areas



Expanded loading
for secure truck delivery



Intricate below-slab plumbing areas



Increased floor loads



16-foot minimum floor-to-floor heights



Interstitial space
above ceiling for mechanical systems



Utility yard or roof space



Increased MEP in slab



Additional freight elevator



Increased HVAC package in warm shell



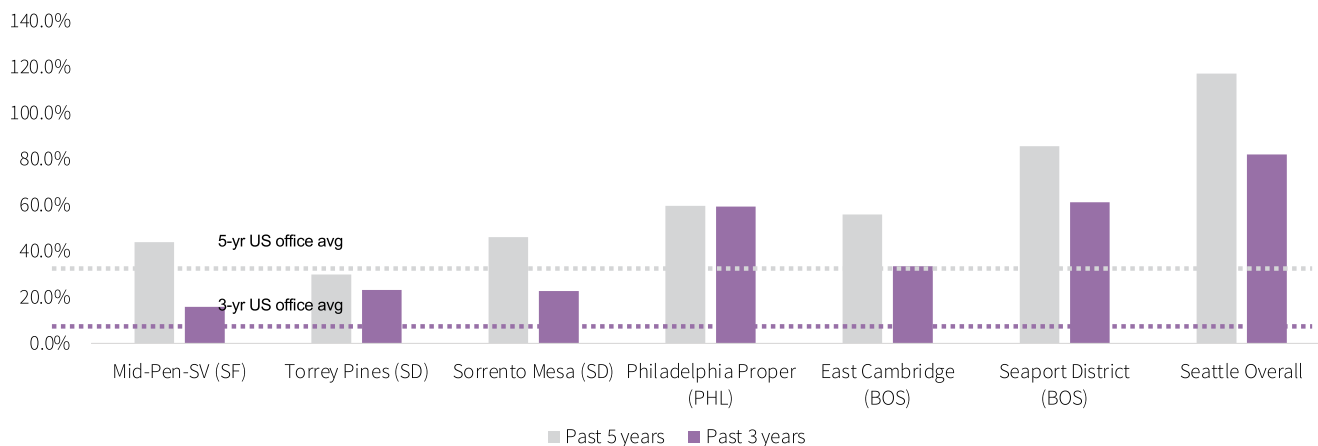
Backup generator space

Rental rate performance is driving excitement among investors and developers. Relative to the traditional office sector, lab properties have generated greater rental growth, a trend that's accelerated in the last three years. While cost is always an important consideration for tenants in all industries, life sciences

companies value other factors like talent, location, proximity to partners, and ability to grow as higher priorities. The scarcity of space drives competition among tenants, especially in key clusters where company formation has the greatest momentum.

Established life sciences markets have outperformed the office market, averaging 63% rent growth over the past five years

Historical rent growth



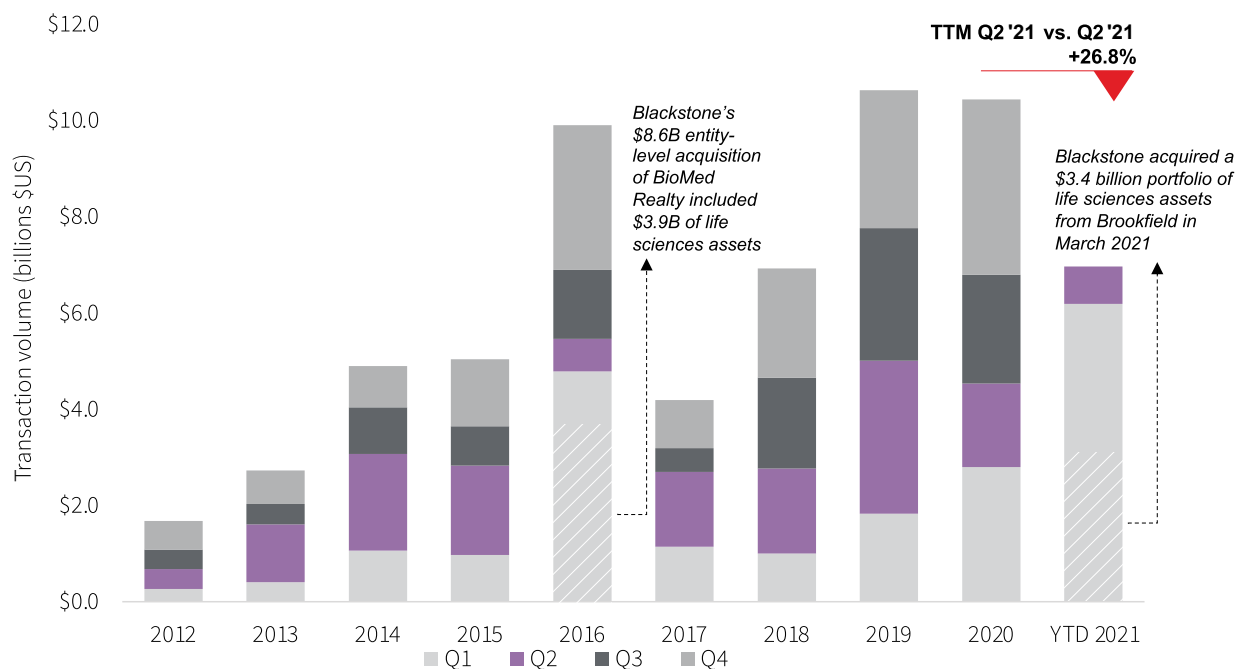
New capital players driving competition and supply shifts

In 2016, Blackstone made a high-profile expansion into the life sciences landscape with its \$8.6 billion entity-level acquisition of BioMed Realty. This move awakened many institutional real estate investors to the asset class and drove a wave of new entrants in the following years. The inflow of capital fueling growth in the life sciences sector amid the COVID-19 pandemic has driven additional interest

from institutional real estate investors through 2021, causing pricing and transaction activity to grow considerably. Lab investment volume in the U.S. totaled \$12.9 billion in the 12-month period ending in Q2 2021, representing 26.8% growth over the previous 12 months and driving record pricing across many established markets.

New capital sources and large transactions drive accelerated life sciences transaction volume

Historic life sciences transaction volume



Sources: JLL Research, Real Capital Analytics (Transactions larger than \$5.0M)

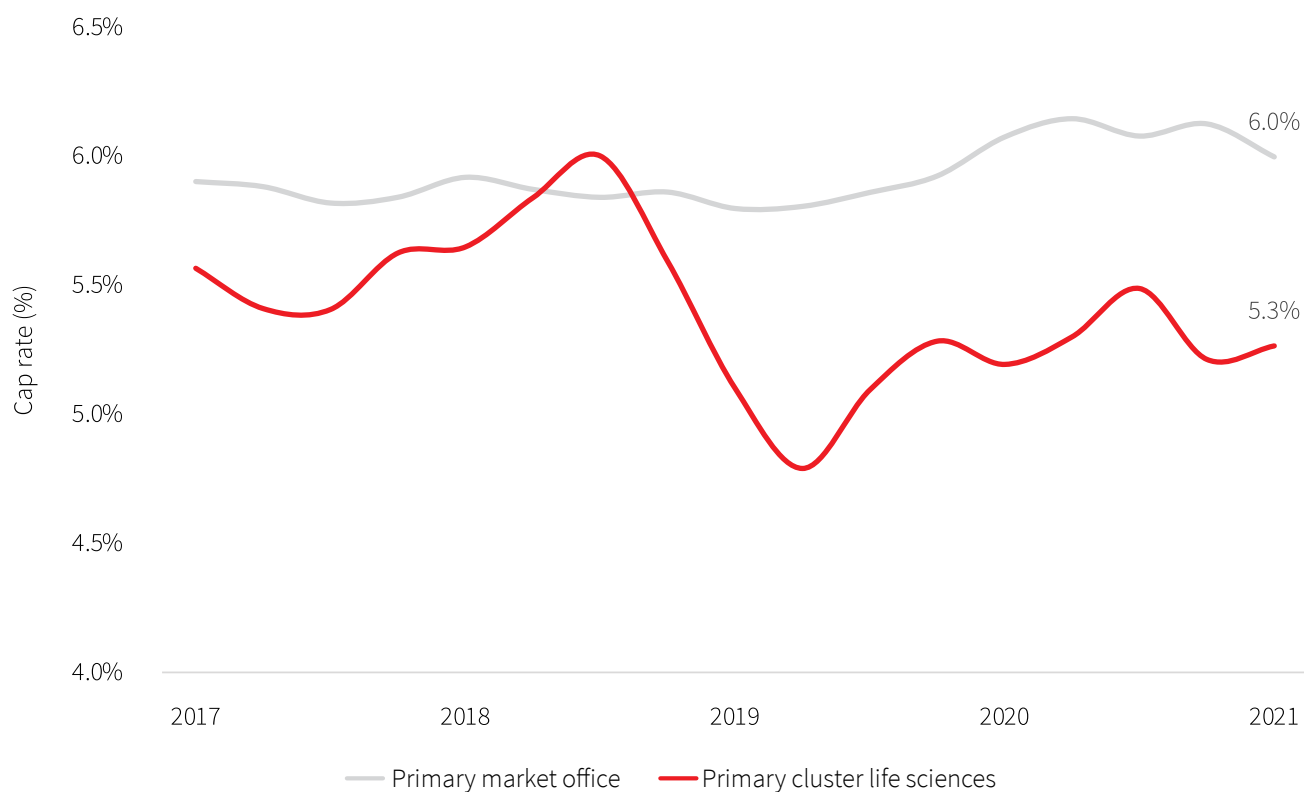


The first quarter of 2021 was the largest quarter on record for life sciences real estate investment. In another high-profile acquisition, Blackstone acquired a \$3.4 billion northeast portfolio of life sciences assets from Brookfield in March, while single-asset investment volume reached record

levels, driving total transaction volume to \$6.2 billion. The significant appetite for life sciences product has driven record pricing across several markets, with Boston and Raleigh-Durham lab product generating a roughly 100 basis point cap rate premium to traditional office in recent quarters.

Outsized demand coupled with limited stabilized supply on the market drive premium pricing for life sciences

Life sciences yields compressing relative to traditional office



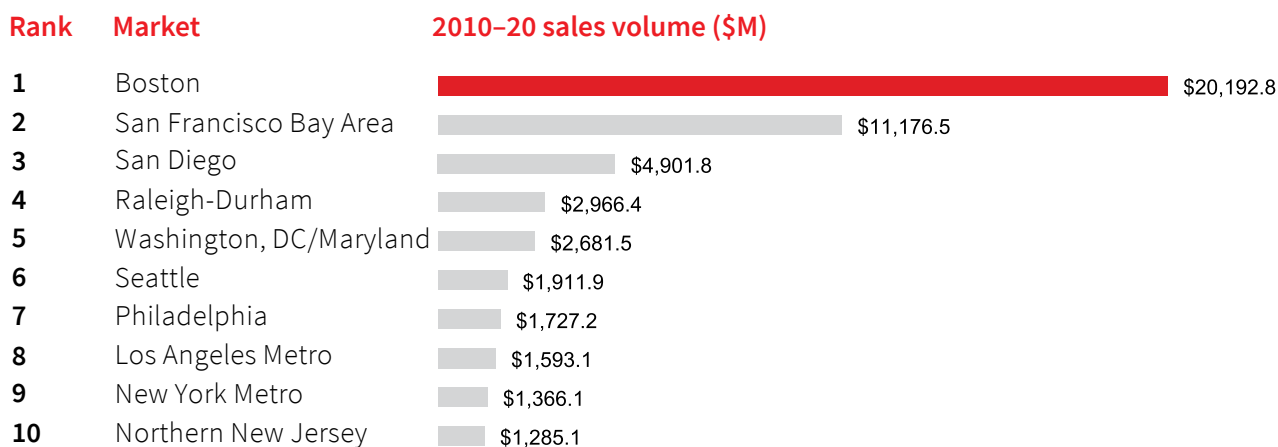
Sources: JLL Research, Real Capital Analytics (Transactions larger than \$5.0M)



Ownership composition remains highly concentrated among the most established life sciences owner-operators, and stabilized product rarely comes to market. As a result, scarcity and barriers to entry are high. Nevertheless, 70% of transaction volume in the past cycle took place in the top five markets,

a direct correlation to their combined share of lab product. Increasingly, investors have been gaining exposure to life sciences through creative strategies that include office-to-lab conversions in urban cores as well as entry into emerging life sciences markets.

Life sciences investment landscape remains hyper-concentrated in primary clusters



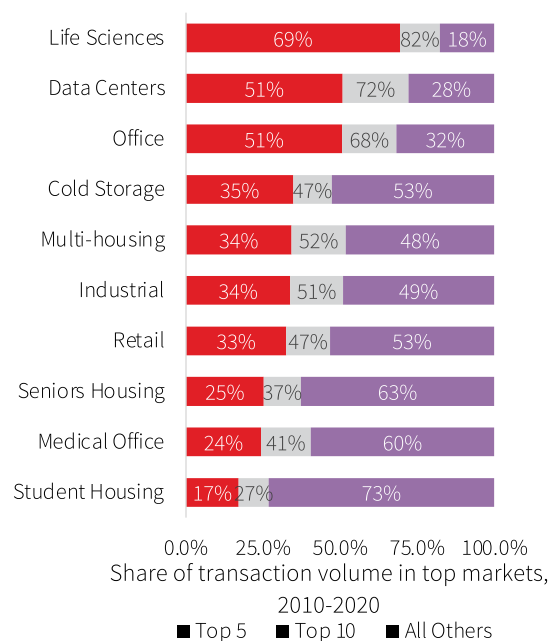
Sources: JLL Research, Real Capital Analytics (Transactions larger than \$5.0M)

Note: San Francisco Bay Area inclusive of San Francisco, Oakland and Silicon Valley; Los Angeles Metro inclusive of Los Angeles and Orange County; New York Metro inclusive of New York City, Long Island, Westchester County and Fairfield County; Miami / South Florida inclusive of Miami, Fort Lauderdale and West Palm Beach

Investors are increasingly evaluating entry into smaller or tertiary markets, where barriers to entry are lower. Transactions in secondary life sciences geographies tend to be smaller in scale and the buyer pools are somewhat less competitive. While these opportunities can enable smaller capital players to enter the space, the importance of a multifaceted life sciences ecosystem to drive lab demand cannot be understated. Investors must consider institutional presence, depth of existing industry talent, and partnership opportunities with experienced operators to drive success.

New developments and conversion activities have attracted a significant share of capital in the last two years. Top owners have a reluctance to sell product, resulting in limited acquisition opportunities for stabilized assets. For assets that have suitable physical features and a favorable tenant roster, conversions can be an effective way of capitalizing on current demand and can deliver to market more quickly than entitled land sites. Despite the desire for speed to market, the appetite for new development is so strong that some investors are acquiring office assets in key clusters with several years of remaining lease term, aiming to convert to lab use when those leases expire despite the lengthy time horizon until delivery.

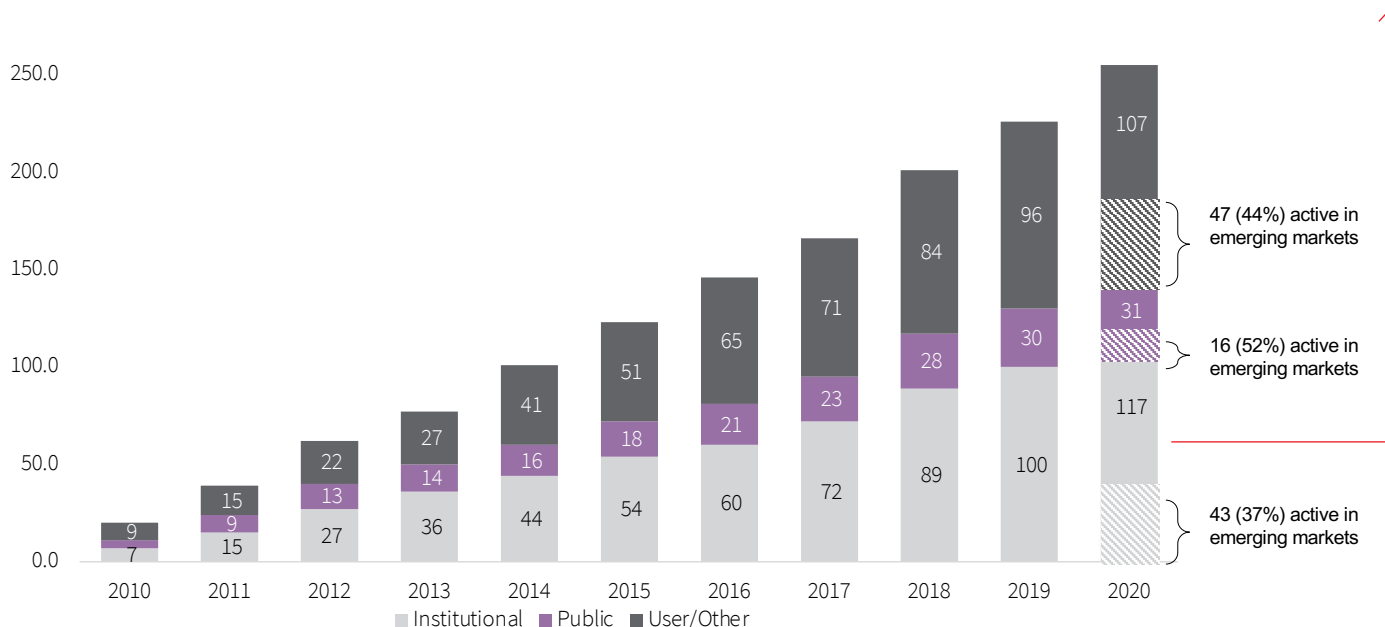
Life sciences has the most concentrated investment landscape geographically



Despite rapidly expanding capital landscape, life sciences remains a niche asset class for institutional investors

U.S. active life sciences buyers

1,111 active institutional investors in office, industrial and flex nationally
(11% active in life sciences)



Sources: JLL Research, RCA

Life sciences assets have performed exceptionally well in the last 18 months, but improved performance across office-using sectors, and an expectation of more meaningful return-to-office plans in 2022, could result in a coming slowdown in investor momentum. Nonetheless, prospects for industry growth and expansion are highly positive, and the next major

scientific breakthrough or industry innovation could catalyze another wave of momentum for life sciences real estate investment. Meaningful returns in this cycle will bolster investor interest in the longer term, but the scale of opportunity will remain limited relative to other asset classes.

Feature:

GMP manufacturing dynamics and post-pandemic considerations

Although many of the headlines over the past 18 months have been focused on the rapid growth in demand for life sciences laboratory space, a related segment of the industry and ecosystem is now attracting the interest of investors and developers alike: biomanufacturing.

As the industry expands, there are now more life sciences companies maturing and achieving pre-clinical and clinical trial milestones. These milestones require companies to develop their small-batch therapeutic production capacity to make further progress toward approvals and, ultimately, revenue generation. Additionally, many already successful companies are capitalizing at higher levels through both public and private markets as a rush of funding flows into this sector, making it possible for companies to expand their operations.

As a result, GMP or CGMP (otherwise known as Good Manufacturing Practices or Current Good Manufacturing Practices) manufacturing spaces have begun to attract the attention of real estate investors who are seeking an allocation to the life sciences

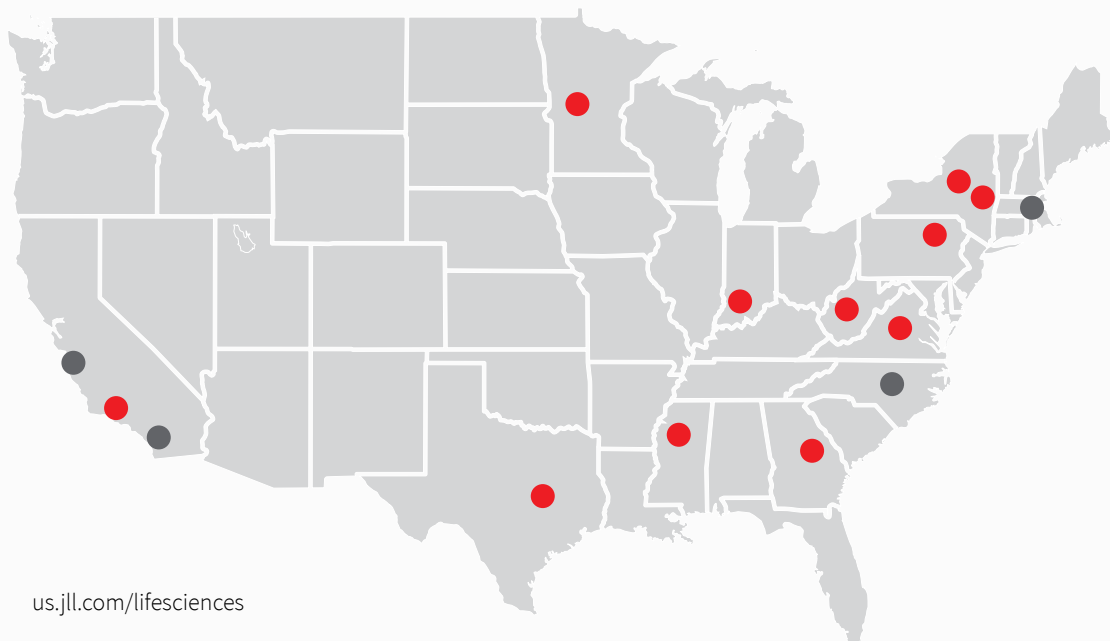
industry. In simple terms, Good Manufacturing Practices are the guidelines established by the FDA as requirements that must be applied to the pharmaceutical manufacturing process. These guidelines are critical to the efficacy and approval stages for novel therapeutics, and they dictate the type of physical manufacturing space that life sciences companies must have.

Within the life sciences real estate industry, GMP manufacturing locations are often divided into two distinct categories, which we refer to as Tier 1 and Tier 2 GMP markets.

Tier 1 GMP markets are defined as large-scale manufacturing hubs that are commonly recognized by their strong manufacturing infrastructure and talent base, as well as their lower costs of operations and real estate. In such locations, production is often focused on over-the-counter and FDA-approved products that are manufactured in large quantities (typically 5,000+ liters per batch). Facilities in Tier 1 locations frequently range from 250,000 to 1 million square feet in size.

Tier 1 & Tier 2 markets

● Tier 1 markets ● Tier 2 markets



us.jll.com/lifesciences

- 100% owner-occupied
- Location is based on local incentives
- Typical size is between 250,000 and 1,000,000+ SF
- 5,000 liters per batch

- Mostly leased space
- Location is based on R&D talent
- Typical size is between 50,000 and 150,000+ SF
- 1,000 liters per batch

Tier 2 GMP markets, conversely, are more closely associated with the leading R&D hubs—a critical distinction between Tier 1 and Tier 2 markets. GMP facilities in these markets cater to pre-clinical dosing and single product manufacturing that are located near laboratories so that the manufacturing process can be closely monitored and controlled. The success of Tier 2 GMP facilities is most often dependent on their proximity to therapeutic development labs and their access to the skilled talent required to monitor and adjust the production process as needed during clinical trials.

With a total investor-owned laboratory inventory across the United States of approximately 150 million square feet (about the size of downtown Chicago's

office market), it should come as no surprise that investor-owned GMP manufacturing inventory is even smaller in composition. Additionally, small-format GMP space is often commingled with traditional lab buildings, making market segmentation more challenging. However, demand is fast propelling it into its own distinct life sciences category for investment and development. In research conducted by JLL in Boston, life sciences companies generally sought GMP space between three and seven years after company formation. With venture capital funding and new company formation rising rapidly, it's reasonable to expect GMP demand to continue its upward trajectory in the coming years and even spur speculative GMP development in the future.

Beyond the differences between R&D and non-R&D GMP markets, there are several other factors that are important for investors to understand. Below are additional trends and drivers impacting the GMP market today:

- 1. Contract manufacturing:** Contract manufacturing organizations (CMOs) play a significant role in the production of drugs and therapeutics. According to GlobalData, there are more than 900 FDA-approved contract manufacturing locations in the United States. However, only 16% of those 900 CMOs maintain more than one facility, which highlights both low barriers to entry in the industry and the potential for future consolidation of operations. Additionally, nearly 50% of manufacturing capacity is focused on marketed drugs versus clinical or pre-clinical pipelines, which make up less than 5% of current manufacturing capacity. While this makes sense relative to the size and scale of the juggernaut that is the traditional pharmaceutical industry, it underscores the need for additional pilot manufacturing facilities that support the rapidly growing life sciences sector.
- 2. Reshoring:** Across the manufacturing sector generally, a pandemic-driven interest in reshoring has emerged as a potential solution for minimizing supply-chain disruptions. In the life sciences sector, reshoring is being considered for direct manufacturing as well as for access to active pharmaceutical ingredients (APIs). While this has more direct implications for the production of FDA-approved and marketed pharmaceutical products that are manufactured in Tier 1 GMP markets, it reinforces the importance of proximity to main laboratories and R&D hubs in the location strategies of Tier 2 GMP facilities. It also confirms that this segment of GMP manufacturing may not be ideal for future off-shoring.
- 3. Talent constraints:** While the global pandemic placed a significant spotlight on the life sciences sector and elevated its importance in our economy, combatting the pandemic has led to talent shortages and capacity constraints in the pharmaceutical manufacturing sector because of the production of COVID-19 tests, PPE, and now vaccines. Further emphasis should be placed on increasing the labor pool of manufacturing and quality control talent needed to grow this sector through various public and private partnerships.

4. Speed to market: Rapid life sciences growth in recent years has had a multifaceted impact on the development cycle. With capital flowing into life sciences companies at unprecedented levels, the real estate needs for emerging life sciences companies can only be characterized as urgent. As a result, development in top R&D hubs is predominantly speculative. Combined with tenant urgency, this imbalance has given rise to significant conversion activity. While the primary focus has been on office-to-lab conversions, GMP developers are beginning to evaluate vacant or obsolete big-box and department stores (in addition to flex R&D

product), where clear heights and structure are conducive to more industrial-centric GMP space.

Real estate investors seeking opportunities in the manufacturing segment of the life sciences industry must determine whether their interests and expertise are more tailored to Tier 1 or Tier 2 locations. They must further evaluate the external factors within each tier, from labor constraints to the supply pipeline. The opportunities within the space are significant and growing, but proper investment requires careful analysis and subject matter expertise.



Summary and outlook

The life sciences industry has been building momentum for decades, but high barriers to entry are challenging both investors and occupiers. Investors entering the market are unable to easily penetrate the top cluster markets, where industry depth mitigates risk. Occupiers, just the same, are having trouble securing space quickly enough in top clusters, where start-up momentum will only drive additional scarcity. Secondary markets are gaining more traction, but the life sciences ecosystem is critical to success—whether you're an investor or an occupier looking to grow.

Like the technology boom that grew out of Silicon Valley over the last 20 years, the life sciences industry is on a trajectory of similar expansion. The nuance of activity that drives demand for lab space may be a governing factor in how quickly and how far this industry can scale in the medium term. Technology-enabled changes in the life sciences industry will drive more activity outside of specialized wet lab space in the future, as digital adoption drives productivity and enables new ways to conduct research. Markets that have the right mix of industry fundamentals will be better positioned to capture this growth.

1. What's driving growth and how much further can it go?

Technology and productivity gains in R&D efforts and, at the most basic level, our human desire to live long lives, will drive the industry forward. Yes, it will certainly last—we don't know all that's possible in scientific development, but the runway is long. However, don't count all future demand to target lab space specifically. Other related product types will also benefit from life sciences industry growth, namely GMP manufacturing and healthcare real estate.

2. How much longer can tenant demand sustain its current pace?

Tenant demand will continue to grow if funding sources continue to flow, talent continues to grow, and commercial lab supply is available to lease. But nothing goes up forever. Core clusters will be immovable from their dominant positions for the foreseeable future, much like Silicon Valley is the undebatable center of tech. There will be a slow evolution of growth in secondary life sciences clusters, but markets with the key ecosystem components in place will capture the most meaningful activity.

3. What are investors doing to meet the swell of demand and will there be enough supply to support this growth?

It's nearly impossible to quantify precisely how much lab space will be needed in the next five years, but suffice to say there is not enough in the top three cluster markets, and scarcity is building in the rest of the top 10 clusters. Conversion activity seems to be the most-attainable solution for developers and owners. New investors in the space are seeking capital partners and joint ventures to stake their claim. All this activity should bolster supply as demand continues to swell with industry expansion.

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Appendix

Life sciences cluster market results in more detail

Our life sciences cluster ranking intends to answer the question: Which markets are best positioned to capture and enable life sciences industry growth, specifically as it relates to the investor-owned lab real estate market? It is designed to provide a concise and robust market score summarizing how a given cluster performs across a range of fundamental components, specific to lab demand.

Our model included data for 18 variables across 46 markets in the U.S. and Canada scaled relative to market size in an effort to normalize the results. The score informs a market's position relative to the mean, with Boston raising the bar very high for the rest of the top ten markets. The scoring is standardized to 100 so

that any score above 100 is that much “above average.” The variables are grouped into four components: talent, industry depth, innovation, and lab real estate dynamics. Each variable is weighted individually within its component group and the overall ranking score is calculated as a weighted average of the four groups. Our model enables individual component ranks, highlighting markets where certain ecosystem components are stronger than others.

These four groups can inform investor or occupier strategy when cross comparing markets, providing a comprehensive summary of a market's strengths and weaknesses (and how they compare to other markets') with greater precision.

Variable group	Weights	Data source
Talent	25%	
Number of students enrolled in life sciences graduate studies, 5-yr. total		National Science Foundation
Number of life sciences PhDs earned, 5-yr. total		National Science Foundation
Concentration of life sciences occupations relative to U.S., 2021		BLS OEWS
Industry concentration	15%	
Life sciences research employment, 2021		BLS
Life sciences research employment per capita, 2021		BLS
Total life sciences employment, 2021		BLS
Total life sciences employment per capita, 2021		BLS
Concentration of life sciences establishments relative to U.S., 2021		BLS
Innovation investment	25%	
Life sciences venture capital investment, 2017–21 YTD		Crunchbase
Life sciences venture capital funding growth, 2017–21 YTD		Crunchbase
NIH Funding, 2020		NIH
R&D investment as share of GDP, 2020		National Science Foundation
Lab real estate fundamentals	30%	
Life sciences real estate investment volume, 2015–20		JLL
Investor-owned lab inventory, total s.f., Q2 2021		JLL
Investor-owned lab inventory, total s.f. per square mile, Q2 2021		JLL
Owner-occupied inventory total s.f., Q2 2021 (estimates)		JLL
Investor-owned lab inventory under const. or redevelopment, Q2 2021		JLL

Note: Individual group weights total 100% within each group and impact the market's group rank. The four group scores are then weighted and scored together for the total market ranking score.



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