

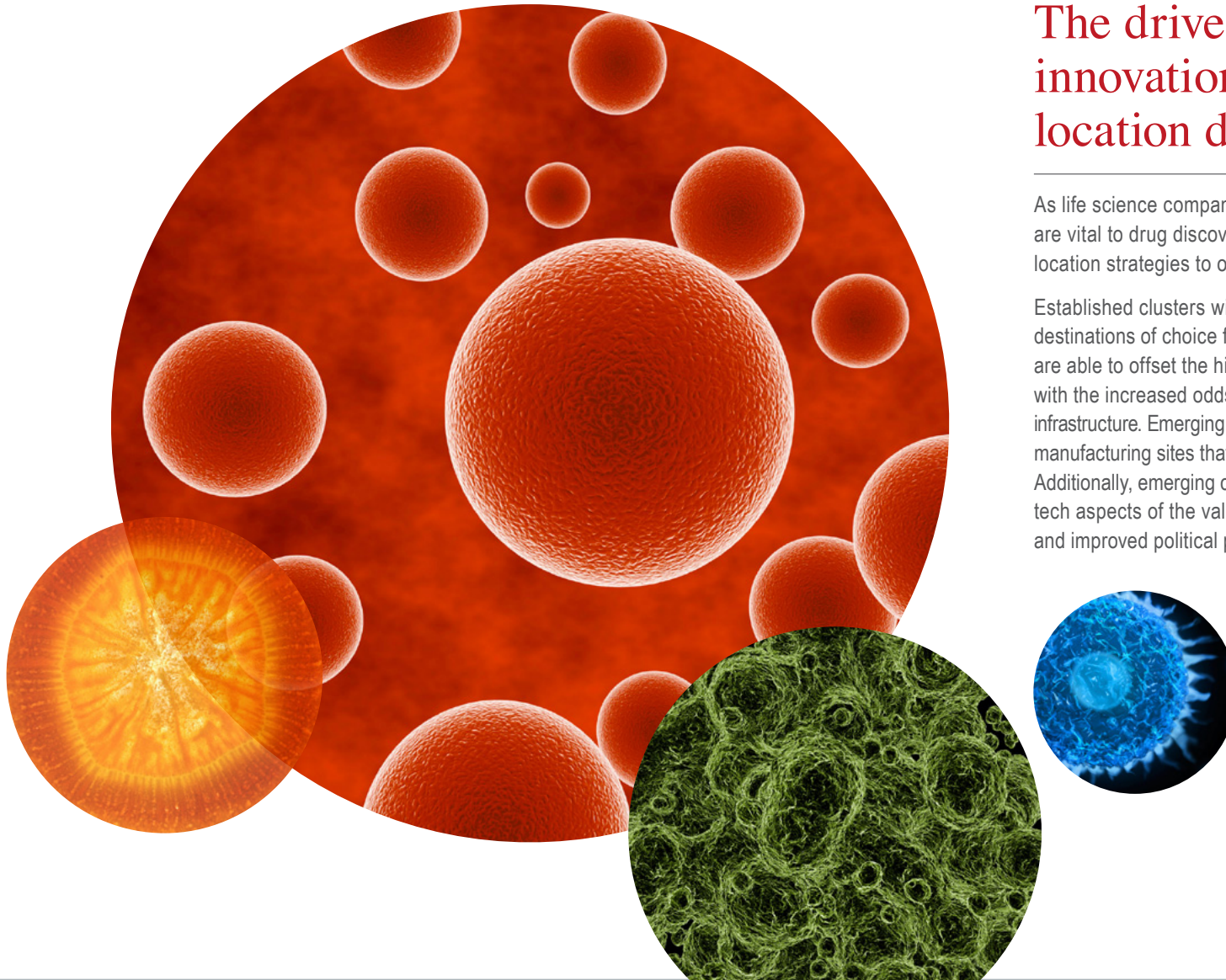
# Life sciences cluster report

Global. 2011

## The drive for discovery and innovation is shifting how location decisions are made

As life science companies determine which aspects of the business are vital to drug discovery and innovation, they are bifurcating their location strategies to optimize the cost versus output equation.

Established clusters within the United States and Europe remain destinations of choice for core aspects of drug discovery. Companies are able to offset the high costs of operating in established clusters with the increased odds of innovation due to deep, rich talent pools and infrastructure. Emerging global clusters, however, offer cost-advantageous manufacturing sites that provide both revenue and margin opportunities. Additionally, emerging clusters are becoming more competitive in high-tech aspects of the value chain, due to significant capital investments and improved political policies.



Jones Lang LaSalle

# Life sciences cluster report

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# A message from Bill Barrett

*Complex macro and micro factors have forced the life sciences industry to re-examine traditional business models and location strategies.*



**William Barrett**  
Executive Managing Director, Life Sciences

Impacts of the global economic recession, increased competition, pricing pressure, depleted new-product pipelines and heightened regulatory processes all strain profitability and influence the industry's facility and location decisions. They produce an environment of change and the opportunity that comes with it for all market clusters.

As life sciences companies seek to balance their operations among the three global regions of the Americas, Europe/Middle East/Africa (EMEA) and Asia Pacific, and they have to evaluate the financial equation surrounding innovation and production. By honing in on the efficiency of R&D and manufacturing models and determining what aspects of drug discovery are core and essential to a product's lifeline and which are not, companies can use this knowledge to influence their location decisions.

As we'll see in this report, expansion into emerging clusters around the globe is at the forefront of most companies' location strategies due to market share opportunities and favorable cost structures for manufacturing and other operations. Not to be discounted, however, are the plans to remain in critical established clusters where deep and mature talent pools increase innovation efficiency.

## *Focus of the report*

Given the importance of location, we thought it critical to examine industry-relevant global markets on a variety of data points that historically define a life sciences "cluster":

- Educated workforce
- Venture and investment capital
- Centers of excellence and innovation
- Industry-friendly political structures
- Institutions of higher learning
- Target economic development incentives
- Patent protection
- Other associations and supporting infrastructure

Although cluster infrastructure is not the only determinant of a city or country's viability as an industry hub, we think it serves as a good measuring stick and baseline point of comparison.

While we maintain a broad view of the life sciences industry, considering various sub-sectors such as pharmaceuticals, biotechnology, medical device technology, agricultural biotechnology and biofuels, the two most important sub-sectors for investment are pharmaceuticals and biotechnology. Consequently, we focus more of our attention on those two sub-sectors.

William Barrett leads the Life Sciences business at Jones Lang LaSalle. A seasoned veteran and leader in the pharmaceutical industry, Mr. Barrett is widely known as an expert in streamlining and transforming complex technical operations and for providing clients with overall global real estate and integrated facility management solutions.

Prior to his tenure at Jones Lang LaSalle, Mr. Barrett served over two decades with Pfizer, Inc., and its legacy companies, directing operations; research and development manufacturing operations around the world.

Mr. Barrett holds a Bachelors of Science in Chemistry from the University of Oklahoma and a JD from the John Marshall Law School. He is a member of the Illinois and Federal Bar Associations.

By Matt Jackson & Shannon Curley

# The drug and pharmaceuticals global direct investment landscape

*A focus on key areas with the greatest growth potential.*

The location footprint for drug and pharmaceutical companies has been under ongoing transformation for an extended period. In response to seismic shifts within the industry, companies have been on a journey to realign the enterprise operating footprint with the new realities for *a*) how revenue will be generated, and *b*) margin preserved. Combined with a heightened focus on improved asset efficiency and more effective research and development, these factors have led to a shift in how enterprises configure operations around the world. This structural shift is closely tied to expectations about how the industry will create shareholder value and reflects the need to rebalance the portfolio of assets among regions of the world.

Some countries have emerged during the last decade as major recipients of foreign direct investment (FDI), while in others, the industry talks of rationalization or consolidation. For investors, it is important to understand trends that affect the industry and how they transform facility planning and foreign direct investment in the drug and pharmaceutical sector.

## *Focus of the discussion*

The life sciences industry is commonly characterized as containing four major segments, including, *a*) agricultural feedstock and chemicals, *b*) drugs and pharmaceuticals, *c*) medical devices and equipment, and *d*) research, testing and laboratories. Within each segment, there are discrete sub-segments that span 27 industry classification codes. For purposes of this discussion, we will focus primarily on the drug and pharmaceuticals industry segment because of its size, its position with investor and the significant changes that companies have faced in recent years.

## *Drivers of operating footprint transformation*

Like all systemic changes in business, the core driver for a new location footprint for drug and pharmaceuticals is the ongoing search for ways to create increased shareholder value. The network of locations have been reconfigured to place greater emphasis on locations with the best potential for revenue growth, improved operating margins, improved return on installed assets, changes in technology and production lines, and investor expectations. This has led to a shift in facility configuration and adaptations leading to improved competitiveness.

## *About the authors*



Matt Jackson serves as Jones Lang LaSalle's Strategic Consulting lead to the life sciences industry. He specializes in business configuration and cross border location strategy services and has worked for many leading companies in the life sciences industry.



Shannon Curley is a member of Jones Lang LaSalle's Strategic Consulting group and specializes in foreign direct investment strategy, cross border investment and business configuration.

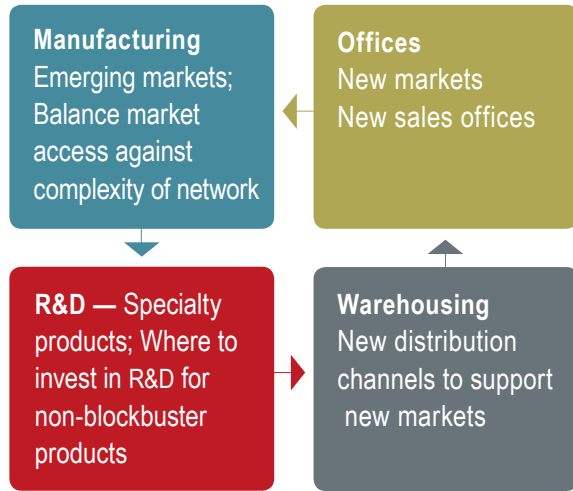
**Revenue growth**

To increase revenue, the industry has shifted its focus to regions and countries with the greatest growth potential. Less emphasis will be placed on sales in North America and Europe—which today represent about 70 percent of industry revenue—and more emphasis will be placed on areas likely

to experience double-digit revenue growth, such as Asia, Africa and Latin America.

Growth in all three areas will result from increased health-care spending, demographic trends and shifting disease patterns. As a consequence, drug and pharmaceutical companies have rebalanced manufacturing, distribution, sales, and to some extent R&D operations among regions. Investments in Asia, in particular, have been significant. (Reference, figure 1)

**Figure 1**  
Revenue model impact on the location footprint



**Operating margin**

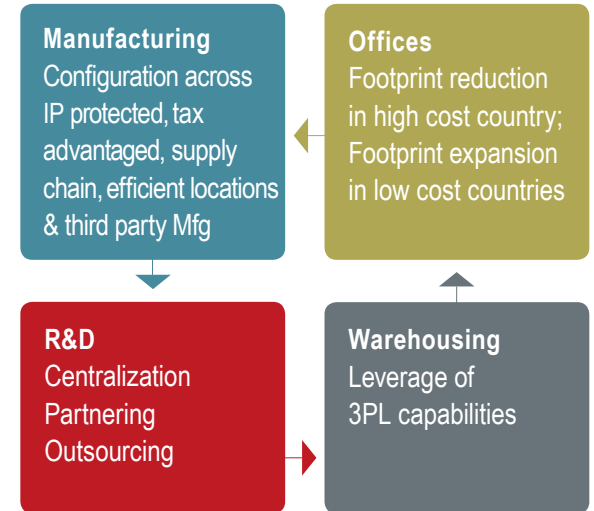
Drug and pharmaceutical facility locations and configurations have been altered as companies seek to improve or maintain operating margins (and net after tax profit) during a period characterized by patent expirations and an onslaught of generic drug alternatives. Notably, companies have invested in a number of low-cost platforms in efforts to preserve operating margins. An illustration of such a shift is the 80 percent share of global active pharmaceutical ingredient (API) now manufactured in India and China.

Companies in the sector are also reevaluating their businesses to identify core processes that must remain under their direct control, and non-core processes that can be performed by others. As a consequence, there is new emphasis on the use of third parties to reduce costs and improve margins across functional areas of the business in R&D, manufacturing,

distribution and general and administrative processes. For functions that remain under direct control, companies seek alternative operating platforms to lower structural costs attributable to location. Many companies have migrated non-core activities and/or low margin products away from legacy Western European and North American locations to lower-cost destinations around the world (in particular India and China). Others have shifted to lower cost regions with shared services in support of the finance, tax, HR, IT, procurement and customer service organizations. While some companies in the industry have been slow to adopt shared service models, many companies now use low-cost locations to help support the business in high-cost countries.

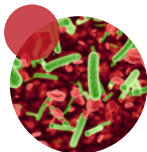
Another approach has been to seek locations with a favorable tax structure. More companies seek locations in the attractive tax environments of Ireland and Singapore, for example, and there has been a corresponding move to divest assets in areas with poor or declining tax advantages. One example is Puerto Rico where there has been a significant decline in inward investment since 2007 as the tax benefits sunset for pioneer investors. It is fair to say that tax incentives were a powerful tool to develop the sector in countries where, a decade ago, the industry was embryonic. (Reference, figure 2)

**Figure 2**  
Operating margin impact on the location footprint

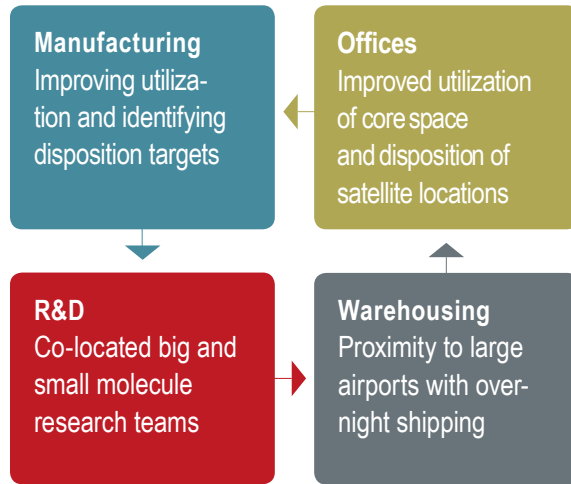


**Asset efficiency**

A turbulent decade has also led to more focus on asset efficiency, in particular for manufacturing and research and development operations. Whereas in a period of economic growth the industry was highly incented to install excess capacity to ensure there were no constraints to revenue growth, the economic downturn



**Figure 3**  
Asset efficiency impact on location footprint



resulted in a notable decline in capacity requirements and entire buildings becoming idle. From a manufacturing perspective, the drop in throughput requirement, shift of production capacity to emerging markets and the decline in the number of doses patients require per day all reduced capacity utilization at many plants. This is not easy to resolve, partly because of the unique nature of drug and pharmaceutical manufacturing facilities and technologies, and partly

because of the need to separate entities and manufacturing technologies within a country to reduce legal risk. Many companies have been forced to dispose of under-utilized manufacturing operations at a fraction of replacement cost. In contrast, in emerging markets with significant growth potential, there is evidence that companies are rethinking the use of third-party manufacturers to improve asset utilization and bring more capacity under the direct control of the company.

Research and Development is the other area of focus for asset efficiency. R&D portfolios have been consolidated, and in high-cost countries, more work has been reallocated to research hubs. Investments have been made in existing world-class locations, while satellite locations have been divested. At the same time, more R&D facilities have been established in low-cost countries such as India, China and Singapore, permitting overall cost reductions, or larger research headcounts at an equivalent cost. (Reference, figure 3)

### **Direct investment landscape**

Data compiled for this report demonstrates the extent of the shift in foreign direct investment (FDI) to include not only the United States and Western Europe, but also low-cost markets such as India and China. For this report, foreign direct investment data was analyzed for the period from 2003 to 2010, with a view of activity before and after the global economic downturn.

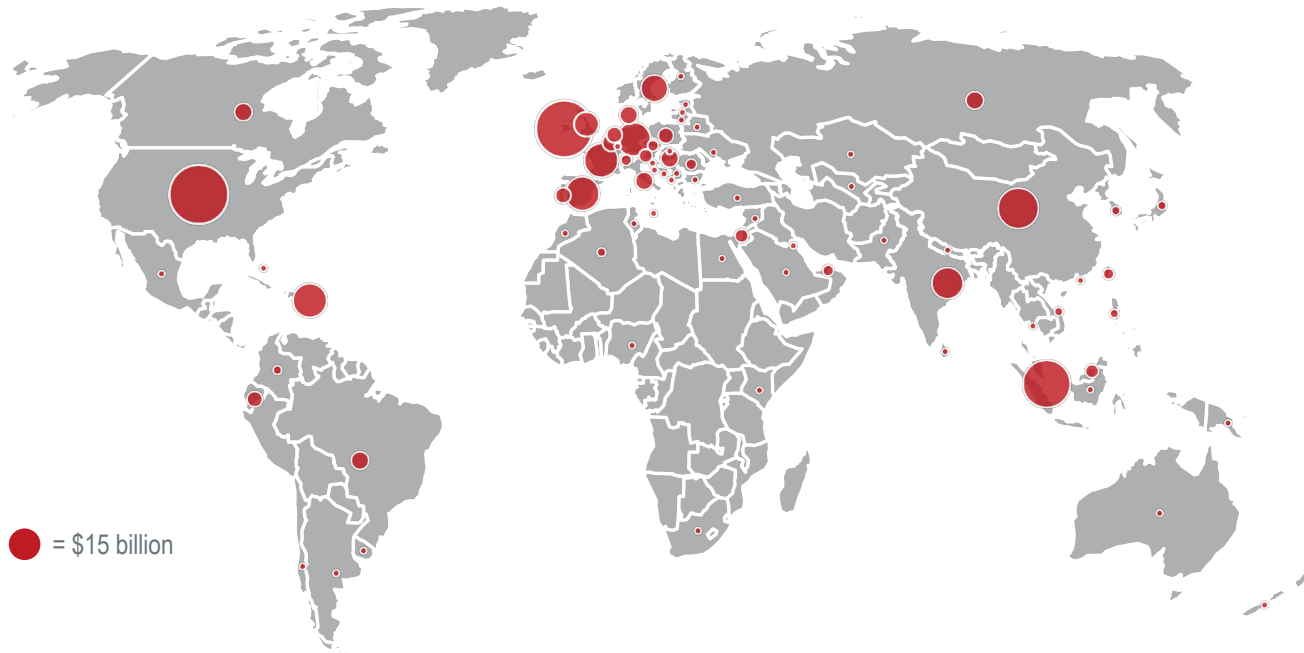
#### **The global view**

Figures 4 and 5 provide an overview of the global investment landscape, comparing pre-downturn (2003–2006) with (roughly) post-downturn (2007–2010) investments. The United States, with the world's largest economy remains the number one country for attracting investment. While many of the largest drug and pharmaceutical companies have disposed of assets in the United States to diversify into the world's emerging markets, the available assets have been acquired by other United States companies, or European, Japanese and Taiwanese investors, among others. The result was that the United States received close to 20 percent of all global investment between 2003 and 2010. (Reference, figure 4 & 5)

Other countries representing a significant percentage of overall global investment included Ireland, China and Singapore, each individually attracting seven to nine percent of all global direct investment. Project experience suggests that China's emergence as a leading destination for FDI is due to both the revenue and operating margin opportunities there. Ireland and Singapore are sought-after locations because of their tax advantages. Ireland maintains a 12 percent flat corporate income tax rate, and Singapore offers a very desirable income tax-based incentive program that can reduce the rate to zero for a period of 10 years or longer for select investments.

The next group of top performers, with FDI of less than five percent of all global investment, includes India and Germany, with other locations of relevance including France, Spain, Puerto Rico (although declining) and Italy. The prominence of Ireland, Singapore and Puerto Rico in the top 10 list for both time periods is a clear indicator that tax-based incentives are a highly effective way to attract investment.





**Figure 4**  
Drug and pharmaceutical inward direct investment flow by country  
2003–2006

**Top 10 receiving countries**

- (in billions)
- United States** \$38.7
  - Ireland** \$37.1
  - Singapore** \$27.6
  - China** \$19.7
  - Germany** \$14.8
  - Spain** \$14.8
  - France** \$14.2
  - Puerto Rico** \$14.1
  - India** \$12.2
  - Sweden** \$8.6



**Figure 5**  
Drug and pharmaceutical inward direct investment flow by country  
2007–2010

**Top 10 receiving countries**

- (in billions)
- United States** \$73.3
  - China** \$29.8
  - Singapore** \$17.7
  - India** \$16.8
  - Ireland** \$16.0
  - Italy** \$13.1
  - Germany** \$11.9
  - Switzerland** \$11.1
  - Canada** \$9.9
  - Brazil** \$8.9

All monetary values in United States dollars

Source: FDI Intelligence from Financial Times Ltd, JLL analysis

In the period immediately following the global economic downturn (2007 to 2010), a noteworthy point is the significance of investment in Asia, where China, Singapore, and India are ranked second, third and fourth on a global basis. Only the United States received more inward investment. Switzerland, Canada and Brazil climbed into the top 10 global destinations for direct investment for the period. Also of note was the declining level of investment in Ireland, Puerto Rico, France and Spain, with the latter three falling out of the top 10 list during the period.

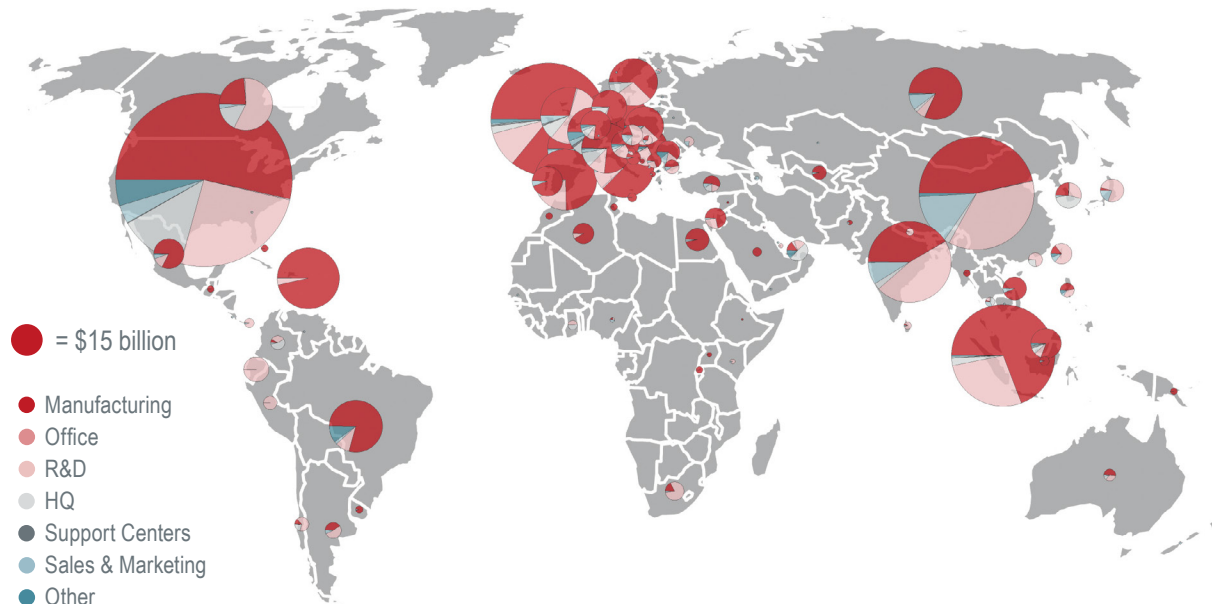
Manufacturing represents the most significant portion of direct investment flows. Manufacturing investment is also distributed to a larger degree than R&D, the other capital-intensive activity. The R&D investment landscape is significantly more concentrated in a few countries, with the United States, China, India, Singapore, Ireland, Canada and the United Kingdom representing the vast proportion of global activity. (Reference, figure 6)

**Regional patterns**

**The Americas**

The United States was the leading destination for direct investment in the Americas (also globally), receiving more than \$38 billion<sup>1</sup> in inward investment between 2003 and 2006 (13 times the global average for the period), and an even larger \$73 billion between 2007 and 2010 (a figure 22 times the global average). The growth in the level of investment was 91 percent between 2003 and 2006, and a slower but still impressive (given the existing level of investment) 34 percent between 2007 and 2010. A somewhat unique characteristic of investment in the United States was the sizable levels of investment across the functional spectrum, with manufacturing representing only 54 percent of the total. Approximately 25 percent of the investment in the United States was in R&D, which translates to a notably large absolute figure given the total size of inward investment between 2003 and 2010.

**Figure 6**  
Composition of drug and pharmaceutical direct investment by country  
2003–2011



Puerto Rico took second place in inward direct investment levels. Between 2003 and 2006, Puerto Rico received just over \$14 billion in direct investment, a figure almost five times the global average. The growth between 2003 and 2006 was 68 percent. During the 2007–2010 period, investments dropped significantly, to just over \$3.5 billion, the net result of lower inward investment and also divestiture activities by legacy drug and pharmaceutical companies. Manufacturing constituted 97 percent of all investment in Puerto Rico. Although Puerto Rico is trying to organize around R&D and advance its value proposition, the data suggests it has not yet been successful.

1. All monetary values in United States dollars

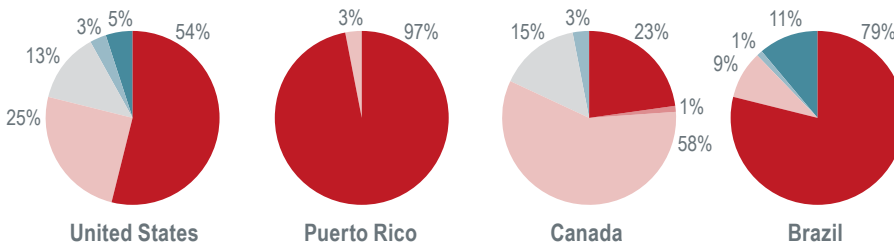
Source: FDI Intelligence from Financial Times Ltd, JLL analysis



**Figure 7**  
Composition of drug and pharmaceutical inward investment in the Americas

**Dominant Recipients**

Country	Total Investment (in millions)		LQ (world average = 1)		Growth (average annual)	
	2003–2006	2007–2010	2003–2006	2007–2010	2003–2006	2007–2010
United States	38,669	73,322	13.04	22.51	91%	34%
Puerto Rico	14,068	3,630	4.70	1.12	68%	-18%
Canada	4,052	9,850	1.33	2.82	33%	143%
Brazil	4,504	8,865	1.42	2.76	-72%	4,659%



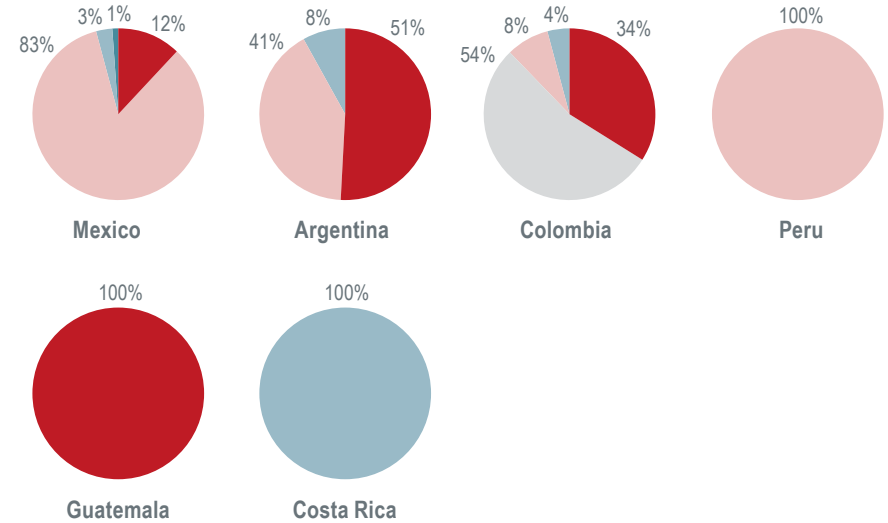
- Manufacturing
- Office
- R&D
- HQ
- Support Centers
- Sales & Marketing
- Other

Canada was the next largest recipient of inward investment over the period, receiving just under \$14 billion in direct investment between 2003 and 2010. Like the United States, Canada received more inward investment between 2007 and 2010 and in the prior period (close to 3 times the global average). Like the United States, Canada was a beneficiary of a large percent of R&D investment. While lower than the United States in total dollars, R&D represented a very large 58 percent of total inward investment.

Brazil rounded out the top four countries in the Americas with inward investment levels just slightly lower than Canada. Similar to Canada, Brazil received a notably larger amount of investment between 2007 and 2010 compared to the prior period. The more than \$8 billion in inward investment between 2007 and 2010 represented roughly 2.75 times the global

**Up & Coming Recipients**

Country	Total Investment (in millions)		LQ (world average = 1)		Growth (average annual)	
	2003–2006	2007–2010	2003–2006	2007–2010	2003–2006	2007–2010
Mexico	542	4,687	0.21	1.53	75%	101%
Argentina	308	1,488	0.12	0.49	751%	554%
Colombia	1,046	435	0.36	0.14	306%	160%
Peru	0	1,152	0.00	0.38	66%	38%
Guatemala	0	402	0.00	0.15	25%	14%
Costa Rica	0	28	0.00	0.01	0%	0%



average. Like Puerto Rico, a significant percentage of Brazil's inward activity was for manufacturing, possibly a direct outcome of its mandatory market presence policy.

Investment levels decline significantly for the remaining countries in the region, with only Mexico achieving investment levels above the global average (for the period between 2007 and 2010). (Reference, figure 7)

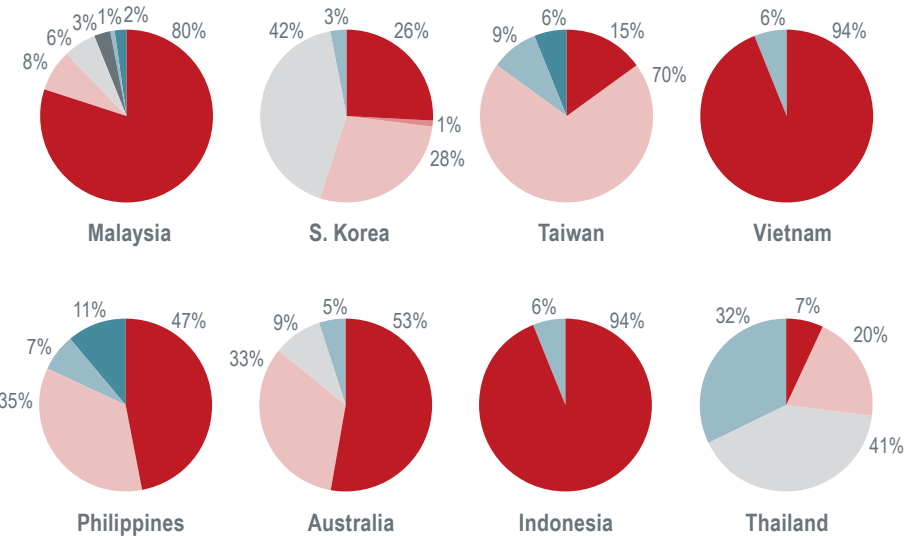
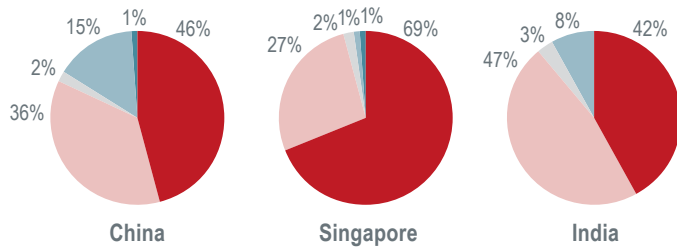
**Figure 8**  
Composition of drug and pharmaceutical inward investment in Asia Pacific

**Dominant Recipients**

Country	Total Investment (in millions)		LQ (world average = 1)		Growth (average annual)	
	2003-2006	2007-2010	2003-2006	2007-2010	2003-2006	2007-2010
China	19,709	29,831	6.87	9.66	77%	14%
Singapore	27,540	17,738	9.53	5.59	24%	-5%
India	12,166	16,814	4.46	5.61	109%	-3%

**Up & Coming Recipients**

Country	Total Investment (in millions)		LQ (world average = 1)		Growth (average annual)	
	2003-2006	2007-2010	2003-2006	2007-2010	2003-2006	2007-2010
Malaysia	1,995	2,776	0.69	1.06	66%	1190%
S. Korea	742	2,884	.025	0.82	-16%	239%
Taiwan	1,274	1,437	0.42	0.44	-69%	7630%
Vietnam	867	656	0.28	0.22	146%	45%
Philippines	799	528	0.26	0.19	-84%	556%
Australia	298	534	0.09	0.20	-33%	25%
Indonesia	268	515	0.10	0.16	-33%	175%
Thailand	223	410	0.08	0.14	4%	336%



- Manufacturing
- Office
- R&D
- HQ
- Support Centers
- Sales & Marketing
- Other

**Asia Pacific**

Like the Americas, inward investment in Asia between 2003 and 2010 was concentrated in a few countries, with FDI in China, Singapore and India exploding onto the global landscape. Investment in other countries in the region was significantly lower, with only Malaysia, South Korea and Taiwan really seeing any activity of note.

China, from 2003 to 2010, saw increasing levels of investment. Between 2003 and 2006, inward flows amounted to just under \$20 billion a figure approximately seven times the global average, and just under \$30 billion from 2007 and 2010, a figure just over 9.5 times the global average. The growth in inward investment for the 2003 to 2006 period was a solid 77 percent, but slowed between 2007 and 2010 to 14 percent. Just over 36 percent of investment in China was for research and development, a figure second only to India.

Between 2003 and 2006, Singapore received more than \$27 billion in inward flows (approximately 9.5 times the global average), and between 2007 and 2010, just under \$18 billion

(approximately 5.5 times the global average). A large percentage of investments in Singapore were in manufacturing, likely the direct result of its extremely positive tax incentives, but 27 percent of sector investments in Singapore were in R&D operations, an illustration of the success it is seeing in its push for R&D investment.

India ranked third for inward direct investment flows. Between 2003 and 2006, just over \$12 billion was invested (a figure approximately five times the global average) and between 2007 and 2010, just under \$17 billion was invested (a figure presenting more than 5.5 times the global average). India's growth over the first period was more than 100 percent, yet like other countries impacted by the global economic recession, India saw a decline in year-to-year investment levels between 2007 and 2010. Some 47 percent of investment in India went for R&D, one of the best research investment performances by any of the top FDI nations.

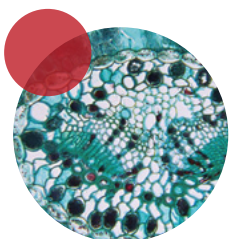
Investment levels declined significantly outside of the top three Asian countries. Even while some of the countries put up very sizable percentage growth figures, the absolute dollar value of the inward flows was a fraction of the top three countries.

*(Reference, figure 8)*

### Europe, Middle East and Africa (EMEA)

Ten countries in the EMEA region received significant investments in the drug and pharmaceutical sector. EMEA countries also generally received a larger percentage of R&D investment than those of countries in other regions.

Ireland was the largest recipient of inward direct investment in the region, receiving more than \$50 billion from 2003 to 2010. From 2003 to 2006, Ireland received just over \$37 billion in inward flows (approximately 14 times the global average), and between 2007 and 2010, just under \$16 billion (approximately 5



times the global average). Direct investment in manufacturing facilities represented close to 90 percent of all investment in the country, probably because of related tax incentives.

Germany was the second largest recipient in the region with more than \$25 billion in inward investment between 2003 and 2010. Like Ireland, Germany also received more investment between 2003 and 2006 than between 2007 and 2010, but when viewed from a global perspective, Germany received just over five times the global average between 2003 and 2006 and just under four times the global average between 2007 and 2010. Most investment in Germany was in the manufacturing sector.

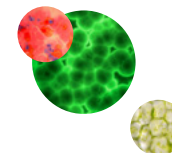
France was third in the region for inward investment flows, receiving just under \$23 billion between 2003 and 2010. Between 2003 and 2006, France received just over \$14 billion in inward investment, a figure just over five times the global average, and approximately \$8.5 billion between 2007 and 2010, a figure 2.75 times the global average. R&D investment represented just over 30 percent of total investment in France.

Spain and Italy rounded out the top five destinations for direct investment in Europe. Spain received a significant amount of inward investment between 2003 and 2006, but slowed notably after 2006. Italy was the opposite.

Other countries of significance in EMEA included the United Kingdom, Russia, Belgium, Switzerland and Sweden. While seeing lower levels of investment than the top five, each still received notable investment at levels generally above the global average. Of this group of countries, at more than 30 percent, the United Kingdom, Belgium and Sweden all stood out in terms of the total investment represented by R&D.

As a general rule, investment in the Middle East and Africa remains very low relative to other countries in the region.

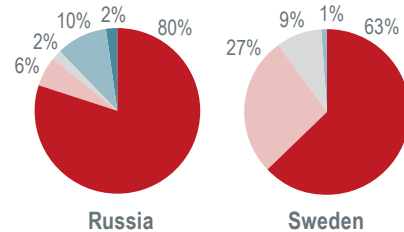
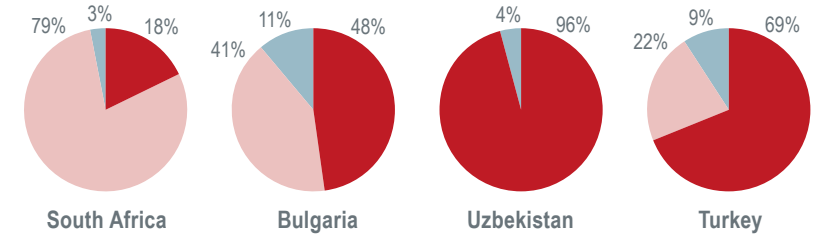
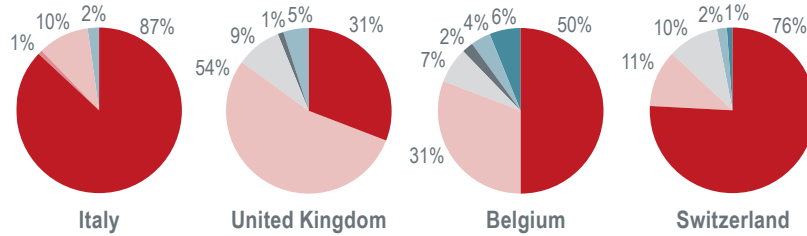
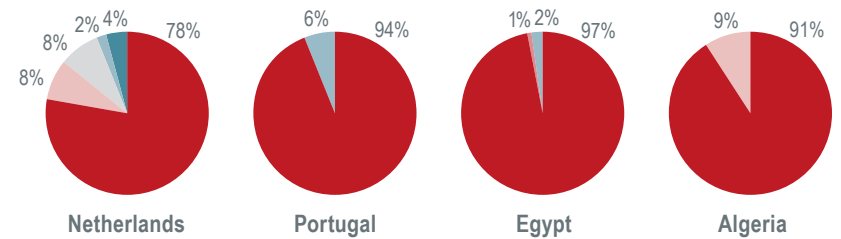
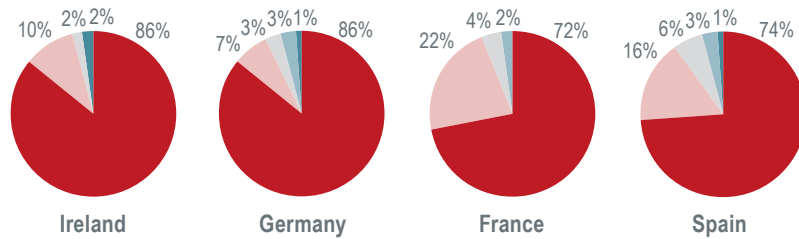
*(Reference, figure 9)*



**Figure 9**  
Composition of drug and pharmaceutical inward investment in Europe, Middle East and Africa

Country	Total Investment (in millions)		LQ (world average = 1)		Growth (average annual)	
	2003-2006	2007-2010	2003-2006	2007-2010	2003-2006	2007-2010
	Ireland	37,065	15,982	13.8	4.96	60%
Germany	14,848	11,909	5.15	3.93	-40%	31%
France	14,231	8,510	5.28	2.75	45%	-19%
Spain	14,807	3,900	5.34	1.16	-12%	-47%
Italy	4,180	13,109	1.49	3.67	119%	314%
United Kingdom	7,454	7,349	2.6	2.34	30%	6%
Belgium	4,605	8,257	1.75	2.68	326%	78%
Switzerland	1,569	11,103	0.54	3.77	18%	147%
Russia	3,895	8,664	1.38	2.94	27%	63%
Sweden	8,557	3,238	3	1.04	116%	116%

Country	Total Investment (in millions)		LQ (world average = 1)		Growth (average annual)	
	2003-2006	2007-2010	2003-2006	2007-2010	2003-2006	2007-2010
	Netherlands	2,937	1,930	0.94	0.64	-59%
Portugal	3,045	1,799	1.20	0.60	-15%	94%
Egypt	458	2,499	0.18	0.74	-9%	1256%
Algeria	822	1,900	0.29	0.69	-61%	85%
South Africa	303	1,903	0.12	0.7	4%	589%
Bulgaria	389	1,009	0.15	0.32	33%	445%
Uzbekistan	21	1,320	0.01	0.45	33%	400%
Turkey	388	891	0.15	0.34	0%	185%



- Manufacturing
- Office
- R&D
- HQ
- Support Centers
- Sales & Marketing
- Other

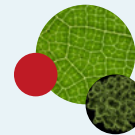
## Conclusion

As we emerge from a period of notable turbulence in the drug and pharmaceuticals sector, investment patterns would seem to illustrate how companies are now thinking about their global operating configuration and where new investments are likely to be made.

Asia is clearly an area of focus, particularly India and China. The scale and breadth of investment over the last decade in India and China suggests companies are looking to these countries as both revenue and margin opportunities, and as a destination for both manufacturing and R&D activities. Both have gained notable ground on the legacy Western European and North American locations over the last decade. Singapore is also a success story in Asia because of its targeted incentives and infrastructure development. The data also suggest that while companies are testing the value propositions of other countries in the region, only Malaysia, South Korea and Taiwan have emerged as locations of interest to the industry.

In the Americas, the United States is likely to continue to attract investment capital. Canada is emerging as a R&D location and Brazil for manufacturing. The data also suggests that Puerto Rico, the second largest investment destination in the region, struggles to retain a viable value proposition to companies with incentives that have, or are about to, end. Outside of these countries, only Mexico, Argentina, Colombia and Peru are being tested as platforms for either manufacturing or R&D, but all are far behind the others in investment activity.

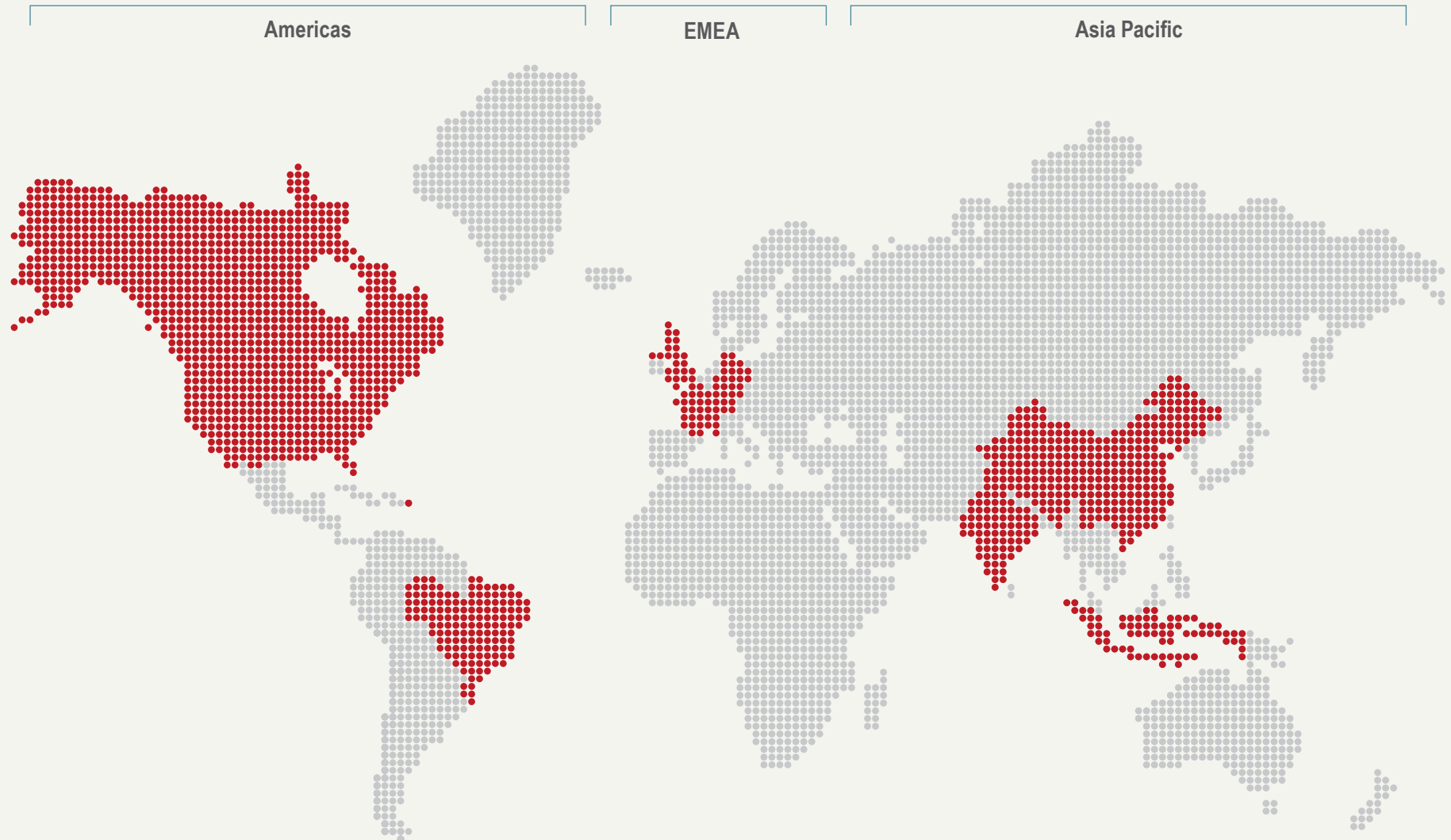
A number of the higher cost locations in EMEA are starting to see the balance of investment shift away from manufacturing to R&D. The United Kingdom is clearly such a location. France, Belgium and Sweden would also appear to be heading in this direction. The data also suggests that a broad number of European locations will continue see healthy levels of inward investment. Investment levels in the Middle East and Africa are however, nominal compared with Europe, and the data suggest the industry has not yet turned to either region as a platform for operating margin improvement or revenue growth.



*The scale and breadth of investment over the last decade in India and China suggests companies are looking to these countries as both revenue and margin opportunities, and as a destination for both manufacturing and R&D activities.*

# Global clusters

*A review of established and emerging clusters within the three global regions of the Americas, EMEA and Asia Pacific.*



United States, Canada, Brazil and Puerto Rico

# Americas

*In this section we will review established and emerging clusters within the United States, Canada and Latin America.*

Within the United States, life science-focused clusters are at various stages in their evolution. While coastal hubs in the Northeast and California represent cornerstone locales and will forever play an important role as the headquarters cities for many of the industry's largest players, other markets are steadily emerging as locations of interest.

Canadian submarkets largely mirror those of emerging clusters within the United States due to comparable tenants, types of facilities and product types, while clusters in Latin America are more geared towards agricultural biotech and pharmaceutical manufacturing.

## United States

### Established

Bay Area  
Boston  
Los Angeles  
New York/New Jersey  
Philadelphia  
Raleigh-Durham  
San Diego  
Seattle  
Washington DC/Suburban MD

### Emerging

Atlanta  
Chicago  
Denver  
Florida  
Houston  
Indianapolis  
Minneapolis

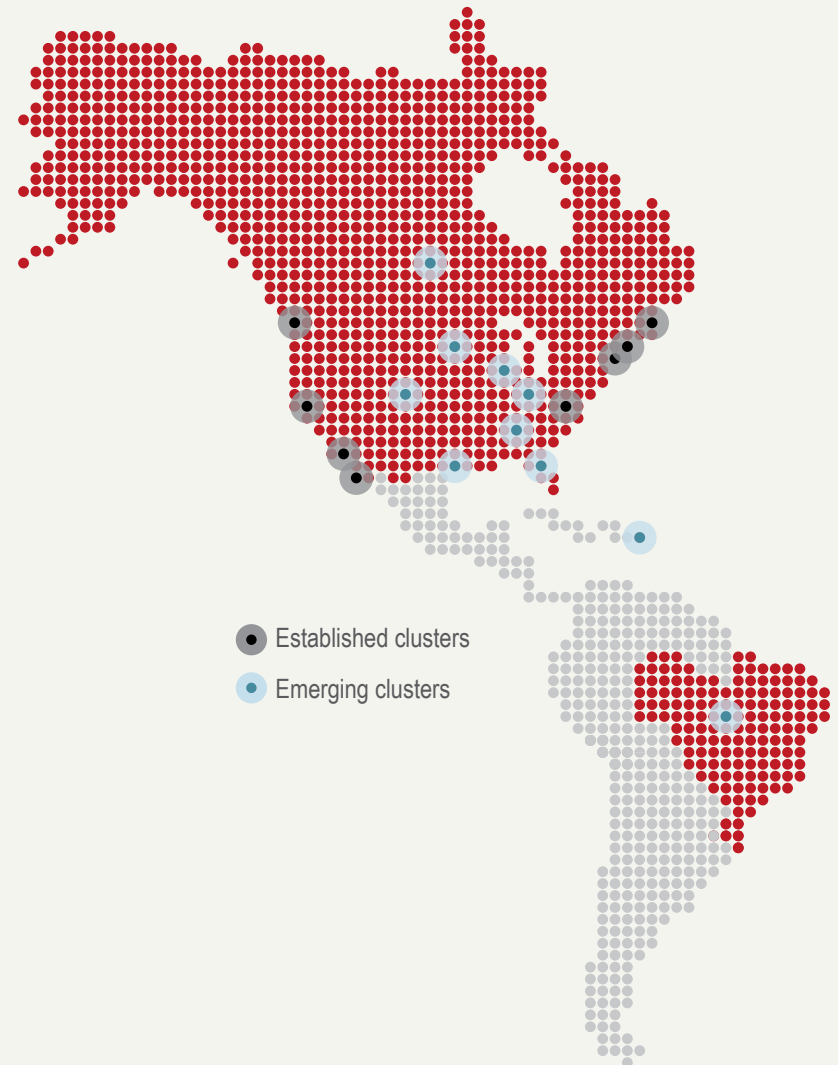
## Emerging

### Canada

### Brazil

### Puerto Rico

- Established clusters
- Emerging clusters



## United States

# Cluster methodology

The determination of United States life science clusters as “established” or “emerging” was formed through an analysis of both quantitative and qualitative data. Data points reflecting key components of cluster development were gathered for each of the 16 clusters. Results were ranked with a score of “1” being most favorable

to the industry and a score of “16” being least favorable. Each cluster’s scores for the six data points were amalgamated to form a composite score. These scores were ranked and taken into consideration along with market intelligence to determine categorization.

Cluster	High tech research & hospital/medical employment (as percent of total employment) <sup>1</sup>		Science & engineering graduate students (per 1,000 individuals aged 25-34) <sup>2</sup>		NIH funding <sup>3</sup>		Venture capital funding <sup>4</sup>		R&D spend as % of GDP <sup>5</sup>		Academic and research institute facilities (in thousands of SF) <sup>6</sup>		Composite score	Ranking
	%	Score	#	Score	\$	Score	\$	Score	%	Score	SF	Score		
Boston	16.2%	1	28.7	1	\$2,235,904,192	1	\$1,142,101,500	2	7.0%	1	5,997	1	7	1
New York / New Jersey	13.2%	5	15.0 <sup>7</sup>	4	\$1,639,384,464	2	\$306,152,900	4	4.2% <sup>8</sup>	7	5,965	2	24	2
Bay Area	13.5%	4	12.9	8	\$1,234,346,373	3	\$1,825,487,700	1	4.3%	4	4,120	5	25	3
Los Angeles	11.6%	13	12.9	8	\$1,001,160,022	5	\$250,165,900	6	4.3%	4	4,000	6	42	4
Washington DC / Suburban MD	11.7%	12	15.8	3	\$1,011,379,315	4	\$172,822,000	11	5.0% <sup>9</sup>	2	3,307	10	42	5
Philadelphia	14.8%	2	14.2	6	\$785,214,411	9	\$266,927,700	5	2.5%	10	2,953	12	44	6
San Diego	11.9%	11	12.9	8	\$823,714,571	6	\$560,717,300	3	4.3%	4	2,821	14	46	7
Minneapolis	13.6%	3	18.6	2	\$289,110,813	15	\$131,354,100	12	3.0%	8	3,530	9	49	8
Raleigh-Durham	12.9%	7	10.8	12	\$806,677,028	7	\$198,596,500	9	2.4%	11	4,299	4	50	9
Seattle	12.5%	8	7.1	16	\$805,613,160	8	\$201,399,800	8	4.9%	3	3,668	8	51	10
Chicago	12.3%	9	14.3	5	\$633,240,757	10	\$175,537,400	10	2.3%	13	3,246	11	58	11
Denver	11.6%	13	13.4	7	\$305,872,896	14	\$76,727,900	13	2.9%	9	1,664	15	71	12
Houston	10.2%	15	10.0	13	\$509,192,059	11	\$218,318,000	7	1.6%	14	2,920	13	73	13
Florida	12.1%	10	9.1	14	\$356,630,211	12	\$15,225,100	15	1.0%	16	3,779	7	74	14
Atlanta	9.8%	16	8.3	15	\$343,352,066	13	\$71,225,000	14	1.1%	15	4,474	3	76	15
Indianapolis	13.0%	6	11.5	11	\$126,527,940	16	\$4,356,000	16	2.4%	11	1,353	16	76	16

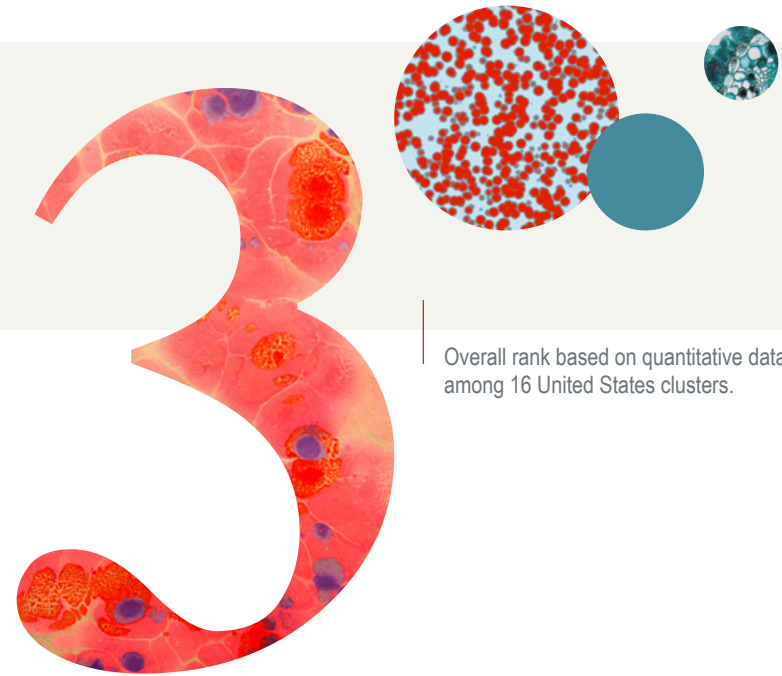
## Footnotes:

1. DemographicsNow/Business-Industry Report, by select Metro CBSAs, 2010
2. National Science Foundation/Division of Science Resources Statistics/SEI State Data Tool, 2011
3. National Institute of Health/Awards by Location, by select congressional districts, FY 2010
4. PricewaterhouseCoopers/MoneyTree Report, Biotechnology & Medical Devices and Equipment Industry Reports, 2010
5. National Science Foundation/Division of Science Resources Statistics, Survey of State R&D Expenditures, FY 2007
6. National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities, FY 2009
7. Average of NJ (18.2) and NY (11.3)
8. Utilized NJ R&D % as most of this type of activity done in the state of New Jersey
9. Weighted average of MD (5.34%) and DC (4.17%)

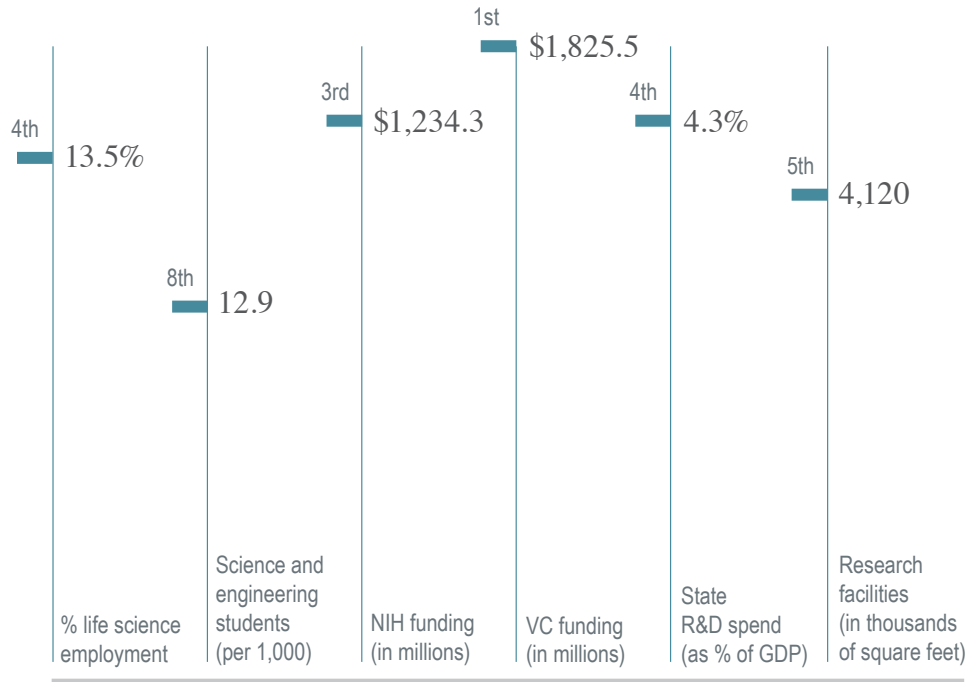


Established cluster

# Bay Area



Overall rank based on quantitative data, among 16 United States clusters.



Rank in relation to 16 United States clusters

*Proximate to several world-renowned university research institutions and an impressive roster of tenants, the San Francisco Bay Area continues to reign as one of the premier locales for biotech and other life sciences companies.*

## Overview

The Bay Area cluster is made up of the three submarkets of San Francisco's Mission Bay/China Basin, South San Francisco and East Bay.

During the last decade, San Francisco's Mission Bay/China Basin submarket has undergone a significant transformation as one of the city's highest priority redevelopment areas. With the University of California at San Francisco anchoring the submarket with a world-renowned research facility and planned hospital, the area quickly generated demand among biotech and pharmaceutical companies. In 2010, Alexandria Real Estate

## — Bay Area

Equities opened the doors to its most recent development, 455 Mission Bay Boulevard in San Francisco, and welcomed Nektar Therapeutics and Bayer Pharmaceuticals to San Francisco. They occupy 105,000 and 50,000 square feet, respectively. In 2011, Alexandria purchased 409–499 Illinois, a two-building life sciences asset 50 percent occupied by Fibrogen.

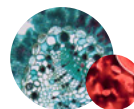
South San Francisco contains the highest concentration of life sciences companies in San Mateo County and brightest talent pool in Northern California. The restoration of venture capital confidence has resulted in increased demand for space and expansion, spurring some hiring. The life sciences industry in South San Francisco remained resilient throughout 2010 despite heavy losses in employment in the tech industry, and was able to bounce back by the beginning of 2011. Top companies in South San Francisco include Amgen, Elan, Onyx Pharmaceuticals, Takeda Pharmaceuticals, among others. Swiss drug maker Genentech alone currently occupies approximately 5 million square feet in the area. Although there was much speculation as to the state of the South San Francisco submarket when the company was acquired by Roche in 2008, Genentech has expanded through recent construction of a new office building on their campus.

The East Bay's life sciences market is generally clustered in Richmond, Fremont, Newark, Berkeley, and Emeryville, and contains approximately 4.6 million square feet of inventory within office, flex and lab space. In 2009, Bayer's efforts to enlarge the Oakland Enterprise Zone to include Berkeley and Emeryville were paramount to retaining life sciences companies in the region, and should foster future growth in the industry. Significant life science companies include Abgenix, Novartis, Bayer HealthCare, and WaferGen Biosystems.

### *Industry framework*

#### **Intellectual capacity**

San Francisco's location, impressive business center and world renowned cultural attractions make the city one of the most attractive places to live in the United States. Both the Mid-Peninsula and Silicon Valley have been at the forefront of innovation and advancement in technology, attracting talent from all around the world. Major corporations such as Genentech continually support academic programs at local universities through grants, scholarships, and internship programs. Specific areas within Palo Alto are dedicated solely to research and development companies to encourage students to work locally once they graduate. The East Bay shares this talent pool, and University of California at Berkeley similarly draws students from around the world to its biology and chemistry programs.



*South San Francisco contains the highest concentration of life sciences companies in San Mateo County and brightest talent pool in Northern California. The restoration of venture capital confidence has resulted in increased demand for space and expansion, spurring some hiring.*

## Bay Area

### Innovation capital

For more than 30 years, the University of California at San Francisco (UCSF), Stanford University, and the University of California (UC) at Berkeley have actively partnered with health-care, biotechnology, and pharmaceuticals experts to develop some of the most cutting-edge advances in medicine. Several large centers of excellence are hosted by the area universities, such as UC Berkeley's Cancer Research Laboratory and Stanford's Genome Technology Center.

### Fiscal & political resources

In 1998, the City of San Francisco adopted the Mission Bay Redevelopment plan in an effort to transform the former rail and shipyard into a world class neighborhood and business center. With the development of UCSF's research campus in 2003, Mission Bay/China Basin became a highly coveted market for the biotech and pharmaceutical sectors, attracting tenants and developers to the area. In addition to UCSF, Alexandria Real Estate Equities, a premier life sciences developer, has made significant investments in the area.

The Oakland Enterprise Zone was developed by the California State Legislature in 1993 to stimulate business growth in the East Bay. Businesses located within the zone, which includes Berkeley and Emeryville, are entitled to a variety of tax incentives that promote hiring. Bayer is one of the largest biotech companies located within this enterprise zone and was a major force in expanding the zone in 2009, a move that ensured the retention of thousands of biotech jobs in the region.

San Francisco's Mission Bay community is today at the center of the biotechnology revolution. To support expansion of this flourishing industry and the creation of new jobs, the City of San Francisco offers a payroll tax exclusion for up to 7.5 years to San Francisco-based businesses engaged in biotechnology pursuits.



### Outlook

Recent transactions in the Mission Bay/China basin submarket that include new tenants, and the future development plans of UCSF and Salesforce.com, have provided a renewed surge of excitement for the area. Looking ahead, San Francisco can expect the transformation of Mission Bay to be one of its greatest success stories.

In the Mid-Peninsula, given the moderate leasing activity within the life sciences sector, new development has remained at standstill since 2008. Alexandria continues to be one of the major players in life science product with proposed development of 800,000 square feet in the South San Francisco submarket. In total, there are 6.4 million square feet of speculative space. However, without any genuine interest from a major company looking for at least 250,000 square feet, no progress is expected.

The future of the East Bay life science industry looks bright. The Lawrence Livermore National Laboratory, run by UC Berkeley, wants to expand in the East Bay by 45 acres and has narrowed the search to six sites. One of the sites, a former naval base in Alameda, is offered for free, indicative of the community's desire to foster life sciences research and development growth.

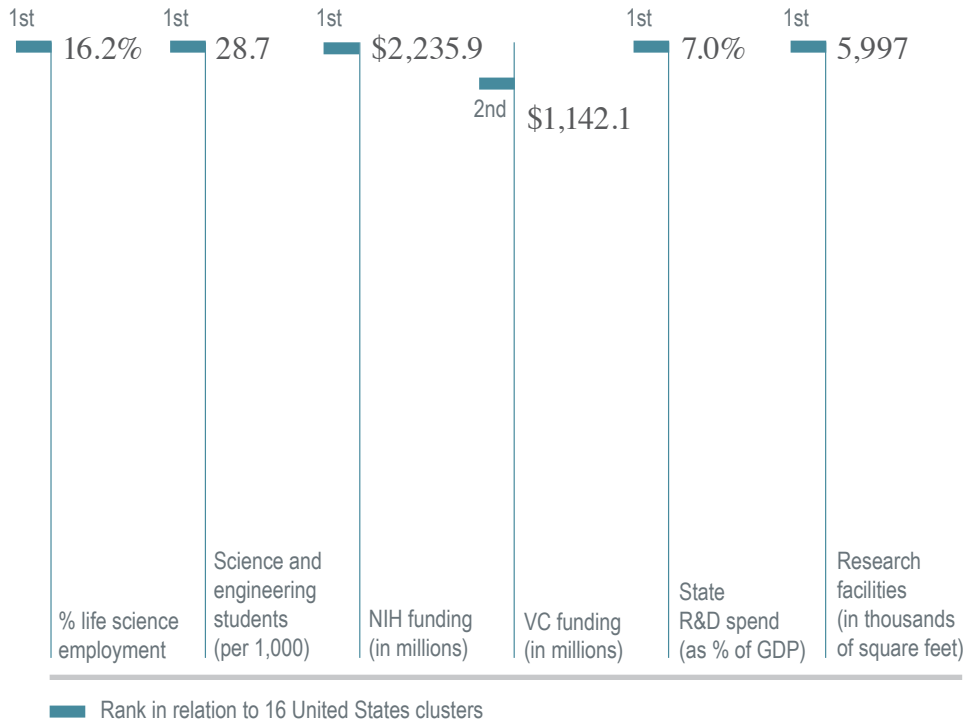
*Looking ahead, San Francisco can expect the transformation of Mission Bay to be one of its greatest success stories.*

Established cluster

# Boston



Overall rank based on quantitative data, among 16 United States clusters.



*The Greater Boston area is home to major academic institutions and centers of life sciences excellence, all located within minutes of each other to create a global hub.*

### Overview

The Greater Boston area is a leading global industry cluster that supports all aspects of the life sciences industry including biotechnology, pharmaceuticals, medical devices, diagnostics and bioinformatics. Because of the industry's mature critical mass in the area, new companies and venture capital investments are common.

The cluster has a large life sciences industry focus and includes geographic submarkets that are both established and emerging. The Cambridge submarket is the core of the Massachusetts life sciences industry. Many start-ups begin here and grow until they are acquired or relocate as they outgrow space options.

## **Boston**

Others, however, choose to keep their headquarters and maintain operations in Cambridge as they see the value of co-locating with many other life science companies and prominent academic and research institutions. The most current and prominent example of this is Biogen IDEC's plans to relocate its headquarters back to Cambridge after only a short period in the suburban submarket of Weston. The company plans to occupy two new buildings in East Cambridge, totaling more than 497,000 square feet of office and lab space. Biogen's return will kick-start the development of top-class lab space in the Cambridge area. Biogen leaves the Route 128 submarket, which is home to notable life science tenants such as Genzyme, AstraZeneca, and UMass Medical Center. Despite Biogen's departure, the area will remain relatively stable with a new generation of companies available to backfill varying space options.

More emerging submarkets exist in Boston and Northwest of the city. Boston's Longwood Medical Area is hot spot for life sciences research organizations, and is home to renowned institutions such as Harvard Medical School, Brigham & Women's Hospital, Dana-Farber Cancer Institute, and Merck. The South Boston Waterfront, or Fan Pier, is a more recent development and is beginning to attract life sciences institutions. This year, Vertex Pharmaceuticals announced that it will relocate from Cambridge into 1.1 million square feet of office and lab space at the Fan Pier development. This is the largest private development project in Boston's history. As Vertex expands in Boston, other tenants are looking to the suburbs for more economic options. Many life science tenants seek space in the Northwest submarket in such towns as Lexington and Bedford. The Massachusetts Biotechnology Council rates these towns as Platinum BioReady Communities; in other words, these areas are highly supportive of the biotech industry due to expedited permitting and zoning polices. Notable tenants here include Millipore and Shire.

### **Industry framework**

#### **Intellectual capacity**

Because the industry is mature in Massachusetts, the labor pool is diverse and no longer merely consolidated to the twenty-somethings living in downtown Cambridge. The Boston MSA features more than 85,000 high tech research employees and more than 340,000 hospital and medical employees with job growth that continues to trend upwards and outpace other life sciences clusters. The area enjoys seven times the number of workers in biotech R&D than the national average.

#### **Innovation capital**

Massachusetts receives 13 percent of all National Institutes of Health (NIH) funding and historically has trailed only California (the location of three of the country's largest life sciences clusters) as a recipient. Massachusetts is home to five of the top eight NIH-funded hospitals in the United States, and includes Massachusetts General Hospital, Brigham & Women's Hospital, Dana-Farber Cancer Institute, Beth Israel Hospital, and Children's Hospital, each global leaders in biotechnology research. The top five NIH-funded universities (Harvard, University of Massachusetts, Boston University, MIT, and Tufts) anchor this cluster and offer advanced degrees in biosciences, fuel employment in the industry, and add great depth to the development of innovative products.



*The Cambridge submarket is the core of the Massachusetts life sciences industry. Many start-ups begin here and grow until they are acquired or relocate as they outgrow space options.*

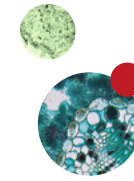
# Boston

## Fiscal & political resources

The State of Massachusetts provides significant tax incentives and other offerings to support the growth of the life sciences industry. The Massachusetts Life Sciences Center (MLSC) is an agency of the Commonwealth of Massachusetts and was designed to administer the state's 10-year, \$1 billion life science initiative to support the life sciences cluster through job growth, economic development, and commercialization of treatments and cures.

The initiative includes the following programs:

- Life Sciences Center Research Matching Grant Program: Matches funding for academic institutions
- Internship Challenge Program: Funds interns working at life science companies
- Accelerator Program: Provides capital for early-stage biotech companies
- SBMG Program: Matches funds for federal small business grants
- Tax Incentive Program: Creates incentives for companies to locate and expand in Massachusetts Corporate Consortium Program/Works to attract funds from both the private and non-profit sectors



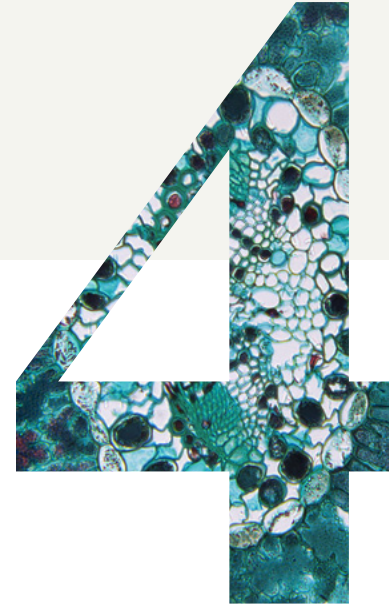
## Outlook

The area's life sciences sector is well positioned in comparison to its peers. It will continue to fuel employment and attract both companies and investors to the area. As the market continues to tighten, there will be additional demand for top-grade laboratory space. As the rents increase in Cambridge, price-conscious life sciences tenants may look to South Boston or the suburbs for more economic options. However, in all areas, developers and owners stress the importance of flexibility of space. As the sociology of drug discovery continues to change, so does the need to design laboratory space to reflect and support collaboration and access to information. This emerging trend will strongly affect the way developers build space or rehab second-generation facilities in Cambridge, Boston, and suburbs.

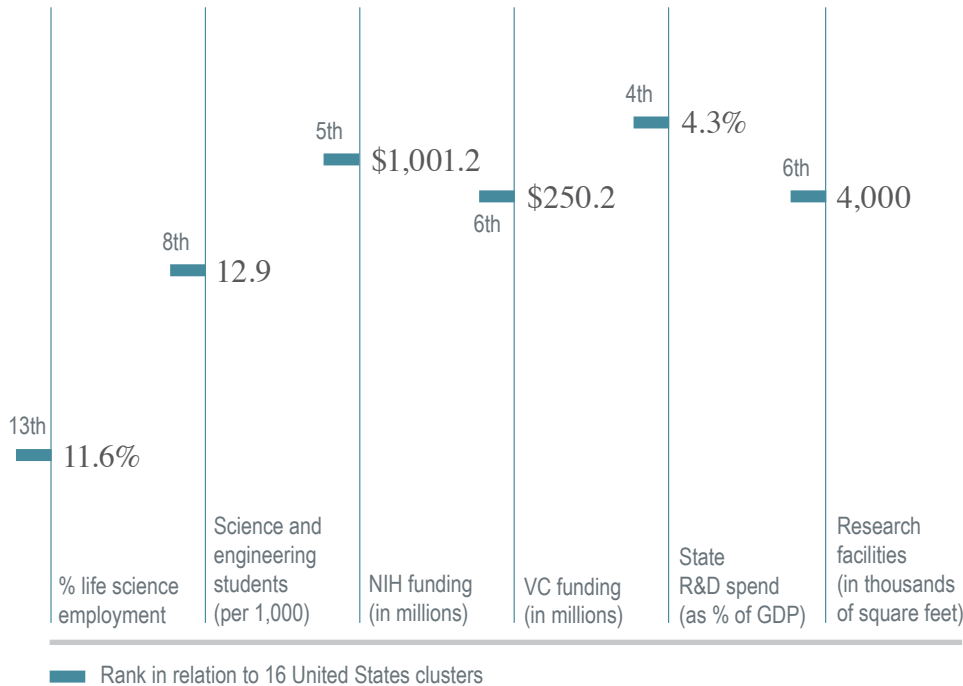
*The area's life sciences sector is well positioned in comparison to its peers. It will continue to fuel employment and attract both companies and investors to the area.*

Established cluster

# Los Angeles



Overall rank based on quantitative data, among 16 United States clusters.



*The region's vast number of hospitals, universities and research facilities and its large college-educated population should help propel Los Angeles' growing biotechnology sector to complement its mature medical device presence.*

### Overview

The Los Angeles life sciences market covers approximately six million square feet spread across Los Angeles, Ventura and Orange Counties. Leasing activity among all three neighboring counties tends to be driven by smaller requirements in the private sector, typically from start-ups which have outgrown their initial premises. Public university research institutes have also driven space demand through late 2011 and represent larger requirements than the private sector.

# — Los Angeles

Within Los Angeles County, industry clusters can be grouped into five major submarkets: West Los Angeles, South Bay, Los Angeles North, San Gabriel Valley, and the Santa Clarita Valley. Each submarket varies significantly based on the composition of university and research facilities and life sciences companies operating in these submarkets. The five major submarkets are comprised of a variety of industry players in the medical device and biotechnology sectors, including Medtronic and Abraxis Bioscience, a subsidiary of Celgene.

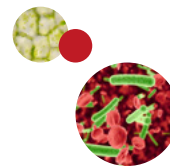
Two of the region's leading biotechnology companies are located in close proximity to each other in Ventura County. Amgen, headquartered in Thousand Oaks, operates from a sprawling, six-million-square-foot campus, and neighbor Baxter International operates facilities in Thousand Oaks, nearby Westlake Village, and other sites in Irvine and Los Angeles.

Within Orange County, several large pharmaceutical and medical device/technology companies are spread throughout the region including Allergan, Beckman Coulter, Peregrine Pharmaceuticals, Edward Life Sciences and Advanced Medical Optics.

## ***Industry framework***

### **Intellectual capacity**

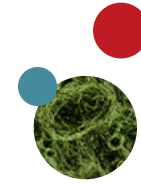
Bolstered by world-class academic institutions and research facilities, Los Angeles maintains a highly educated workforce, often attracting global talent to the area. The region is home to some of the nation's top schools, including the University of California, Los Angeles (UCLA) and University of Southern California's schools of medicine, as well as several nationally recognized universities offering life sciences doctoral programs. Los Angeles has more than 45 health and biomedical sciences associations, education and research institutions. Nearly 7,000 professionals in the greater Los Angeles area work in life sciences related fields.



*Leasing activity among all three neighboring counties tends to be driven by smaller requirements in the private sector, typically from start-ups which have outgrown their initial premises.*



# Los Angeles



## Innovation capital

The area's three leading universities—UCLA, University of Southern California and UC Irvine—feature centers of excellence that deliver cutting-edge research and innovations.

UCLA is home to the David Geffen School of Medicine, which consistently ranks among the top 10 schools in the United States, along with its School of Nursing, School of Dentistry, and School of Public Health. The University of Southern California's Health Sciences campus is a major center for basic and clinical biomedical research; the USC Keck School of Medicine annually receives more than \$275 million sponsored program awards. UC Irvine's Medical Center continues to be ranked as one of the top hospitals in the nation and spends nearly \$60 million annually to fund ground-breaking research in the areas of neurodegenerative diseases, cancer and stem cell therapy.

## Fiscal & political resources

The area is largely supported by the efforts and programs of the Southern California Biomedical Council, which helps to create public-private partnerships to tackle industry needs in the areas of capital-sourcing, public policy advocacy and links to nearby university and research centers.

The Stem-Cell Bond Initiative, passed in 2004, provides research grants to California universities. The initiative authorized the sale of general obligation bonds to allocate \$3 billion over a period of 10 years to stem cell research and research facilities.

*Near-term lab space demands are expected to be sparse and come largely from large universities and research centers.*

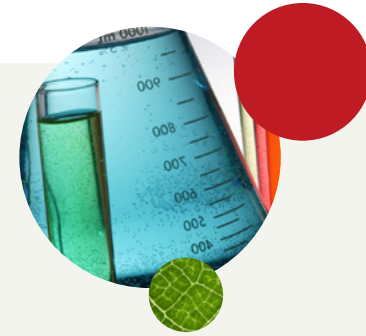
Within Ventura County, the Economic Development Collaborative, with funding provided by the U.S. Economic Development Administration, created a new Business Loan Fund for entities located within the county. Companies in the county's six identified core growth business clusters (agriculture, high technology/communications, biomedical, plastics, environmental, and metals/machinery) that can demonstrate a need to hire a high percentage of dislocated defense-related workers may apply for a loan.

## Outlook

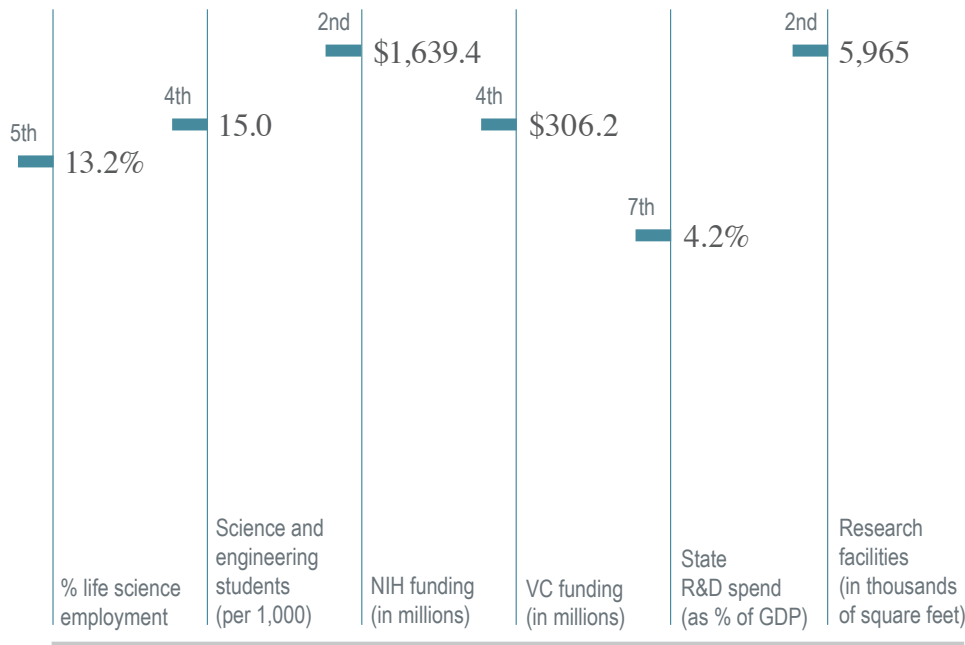
State government deficits may impact future public research funding in California, but no major existing programs had been reduced as of the 2011 fourth quarter. Near-term lab space demands are expected to be sparse and come largely from large universities and research centers. The development pipeline is extremely light with no large projects expected to be completed through late 2012.

Established cluster

# New York / New Jersey



Overall rank based on quantitative data, among 16 United States clusters.



Rank in relation to 16 United States clusters

*The New York/New Jersey area boasts the highest concentration of college graduates in the nation and the world's largest concentration of academic institutions—a source of significant discovery and the first adopters of new products.*

## Overview

The New York/New Jersey life sciences market consists of the five boroughs of New York City, Westchester county and Northern and Central New Jersey.

In New Jersey, the life sciences sector is a major driving factor in the state's economy with many of the pharma-giants owning or leasing large amounts of space in the state. Some of the well-known names include; Pfizer, Merck, Johnson & Johnson, Imclone, Bayer, Celgene, and Novo Nordisk. Much of the related leasing activity in recent years has occurred within Somerset, Morris, and Mercer counties, including seven leases

## *New York/New Jersey*

in excess of 100,000 square feet since the start of 2010. Most recently, Novo Nordisk leased the entire building at 800 Scudders Mill Road in Plainsboro. The company will occupy the building in 2013 upon completion of the \$215 million redevelopment of the 770,000-square-foot office building in the Princeton Forrestal Center, initially leasing 500,000 square feet with the option to take the remaining space at any time. Novo Nordisk's initial lease at the new address will expand its presence in the Princeton submarket by 150,000 square feet and marks the largest expansion by a pharmaceutical company in the Garden State in recent years. Year-to-date, pharmaceutical companies have accounted for almost one third of New Jersey's office leasing activity. However most larger leases have consisted of companies renewing in place or consolidating due to mergers and acquisitions.

Meanwhile, in New York City, Pfizer recently disposed of more than 660,000 square feet of its space at 685 Third Avenue. They sold the property to TIAA-CREF last year for \$190 million as they cut or relocated more than 1,000 jobs. While New York City and Westchester don't house as many life sciences firms as New Jersey, there are some noteworthy tenants who call the area home, including Pfizer, Progenics, Regeneron Pharmaceuticals, and Bristol Myers Squibb.

Within Westchester County, two major construction projects were underway in the 2011 fourth quarter. New York Medical College began a \$12.6 million redevelopment project of a vacant building into a biotechnology center, which could create as many as 215 jobs. Fareri Associates plans to build a \$500 million, two-million-square-foot park for biotech and medical tenants and a children's health education center adjacent to the New York Medical College project.

### *Industry framework*

#### **Intellectual capacity**

The New York/New Jersey cluster supports almost 400,000 jobs in the life sciences industry with over 95,000 workers directly employed in high tech applications. Life sciences companies have an abundance of highly educated workers to choose from. The area has a large concentration of colleges and universities, many of which offer undergraduate and post-graduate programs in a variety of life sciences-related fields.

#### **Innovation capital**

There are numerous centers of excellence located within New York and New Jersey, such as the Cancer Institute of New Jersey and Montefiore Medical Center in New York City. The centers support high technology ventures through a collaborative approach among the states, academia, private venture capital companies, and other private and public sector parties. Established to encourage rapid commercialization of scientific breakthroughs, the centers specialize in nanoelectronics, bioinformatics, photonics, environmental systems, wireless applications and information technology.

In New York City, the city's first major bioscience office park, The Alexandria Center for Life Science, was completed in 2010 and provides laboratory and office space for companies such as Imclone, Abbott Laboratories, Novartis, and Celgene.



*Year-to-date, pharmaceutical companies have accounted for almost one third of New Jersey's office leasing activity. However most larger leases have consisted of companies renewing in place or consolidating due to mergers and acquisitions.*

## *New York/New Jersey*



### **Fiscal & political resources**

New York and New Jersey have worked aggressively to retain and lure large biotechnology and life sciences industry leaders to the area.

#### *New Jersey*

- The Edison Innovation Centers of Excellence Federal Matching Program: Seeks to build research excellence at New Jersey's universities and research institutions to benefit the technology economy. Funds will be provided to match federal grants for research centers of excellence in the state's priority technology areas.
- The Technology Business Tax Certificate Transfer Program: Enables approved, unprofitable technology and biotechnology businesses to sell their unused Net Operating Loss Carryover (NOL) and unused Research and Development Tax Credits (R&D Tax Credits) to unaffiliated, profitable corporate taxpayers in the State of New Jersey for at least 80 percent of the value of the tax benefits.

#### *New York*

- New York State Qualified Emerging Technology Company Credit (QETC): Provides early-stage technology companies, including biotechnology, with a capital infusion of up to \$1 million.
- Empire Zone Program: Provides New York State tax credits and tax exemptions to manufacturing and biotech companies located in an Empire Zone. Recipients must have growing employment and invest in real estate and equipment. New York City's primary biotech real estate, the East River Science Park (ERSP) and the Brooklyn Army Terminal (BAT), are located within the Empire Zones.

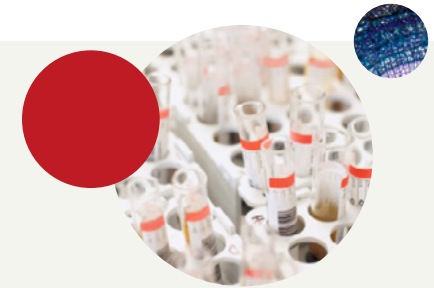
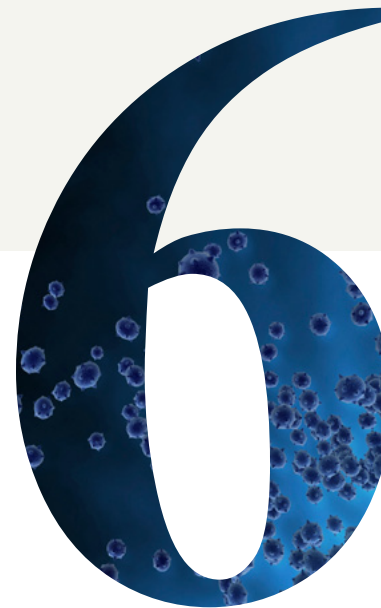
- New York City Biotech Tax Credit: Helps small biotech companies to accelerate commercialization by providing a refundable tax credit for facilities, operations, and training.
- Hudson Valley Economic Development Corporation & Westchester County Economic Development's NY BioHud Valley Campaign: Encourage investment and development in pharmaceutical and biotechnology projects since their inception in 2010. Recent efforts to expand and enhance Westchester's life sciences market range from intellectual development endeavors to leasing activity and construction projects.

### ***Outlook***

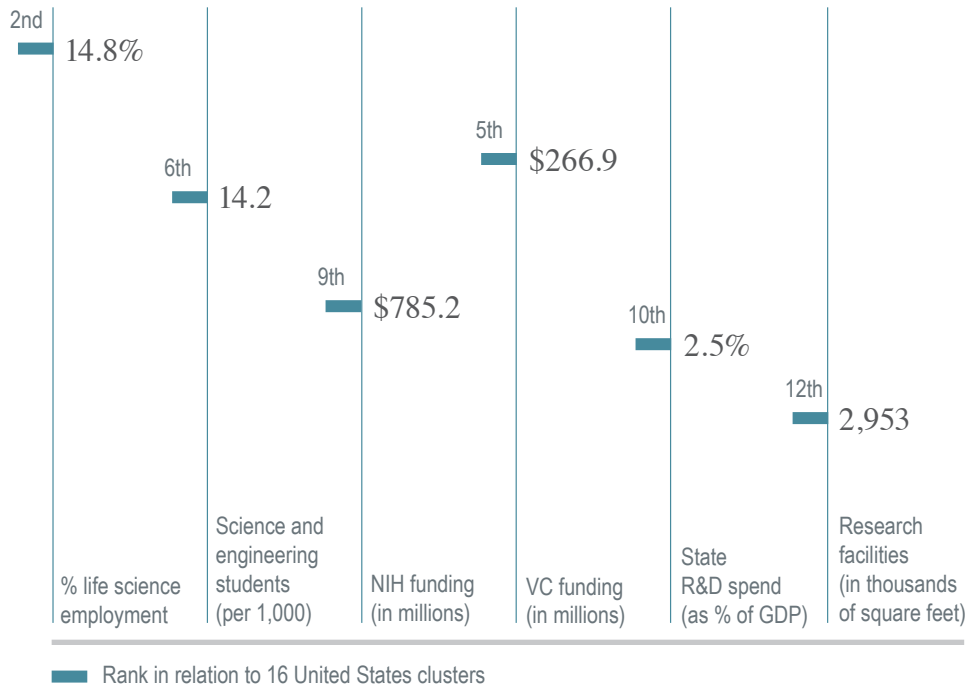
The immediate future for the life sciences industry is bright in the New York/New Jersey area with only a handful of tenants' leases expiring within the next couple of years. Many of the large pharmaceutical companies that have been looking for new addresses will remain in the local area. With the majority of the consolidations now passed, and the economy slowly growing, some companies should begin to add jobs into 2013.

Established cluster

# Philadelphia



Overall rank based on quantitative data, among 16 United States clusters.



*The region's vast array of leading universities and research institutes have led to a collaborative environment and nearly \$4 billion of venture capital funding during the last 10 years.*

### Overview

Philadelphia's large concentration of leading academic institutions and pharmaceutical companies has created a central life sciences hub in the Mid-Atlantic region. With close proximity to New York's financial markets and Washington D.C., the Philadelphia metropolitan Area is home to more than 1,200 companies, ranging from the industry's largest multinational companies, including AmerisourceBergen, AstraZeneca and Shire Pharmaceuticals, to the fastest growing firms such as Cephalon, NuPathe and Tengion.

Philadelphia's laboratory market has both an urban and suburban presence. Located due west of the Central Business

## — Philadelphia

District, University City plays host to The Science Center, one of the largest urban research parks in the United States. The Science Center is strategically located proximate to several major universities and research institutions including The Children's Hospital of Philadelphia, Drexel University, the University of Pennsylvania, University of the Sciences in Philadelphia and The Wistar Institute. Serving as an incubator for many of the region's growing companies and research efforts, University City's Science Center has led to more than 40,000 jobs in the region and \$64.5 million for the city and state in tax revenue.

The Philadelphia Navy Yard, a 1,200 acre, dynamic waterfront development, offers the Philadelphia region a unique and centrally located environment with more than 115 companies and 8,000 employees. The Navy Yard is a business incubator for both life sciences and technology firms. Since 2005, the Navy Yard has helped more than 100 entrepreneurs, attracted seven start-up technology companies, and advanced major Penn State University research programs and commercialization initiatives.

While lab presence is spread throughout the Pennsylvania suburban markets, the largest concentration is in the suburbs along the Route 202 Corridor that extends from King of Prussia/Wayne to Malvern/Exton. The area is home to several of the region's largest pharmaceutical firms, including Amerisource-Bergen, Auxilium Pharmaceuticals and Endo Pharmaceuticals, as well as small biotech companies which have opted to co-locate for synergistic purposes. At year-end 2011, Endo Pharmaceuticals and Shire Pharmaceuticals are looking to build-to-suit options for 300,000–500,000 square foot facilities rather than renewing or relocating to second generation lab space, illustrating a current trend in the market.

Large companies have continued to increase their commitment to Philadelphia's life sciences hub. In the first quarter of 2011,

GlaxoSmithKline (GSK) announced plans for its \$81 million, 205,000-square-foot headquarters in The Navy Yard. As a result, GSK will be leaving the CBD's Market Street West for the build-to-suit project with Liberty Property Trust. Teva announced plans to locate its new distribution center in Northeast Philadelphia, a \$300 million dollar project, and West Pharmaceutical Services' is constructing its new headquarters at Eagleview Corporate Center in Exton. The build-to-suit facility will consist of 130,000 square feet of office space and approximately 41,000 square feet of lab space.

### *Industry framework*

#### **Intellectual capacity**

With 100 colleges and universities and 25 medical schools, Philadelphia's institutions have fed the region's 432,000 jobs and \$20.2 billion in earnings within the biotechnology and healthcare sectors, accounting for 26.5 percent of the regional workforce and nearly 15.0 percent of Philadelphia's economic activity, respectively.

Philadelphia hosts some of the nation's largest and oldest academic clusters, including Pennsylvania Hospital, America's first hospital, and the University of Pennsylvania School of Medicine, the country's first medical school and teaching hospital. The nearby presence of Princeton University, Jefferson Medical College, and Temple University further strengthens the area's rich talent pool.



*While lab presence is spread throughout the Pennsylvania suburban markets, the largest concentration is in the suburbs along the Route 202 Corridor that extends from King of Prussia/Wayne to Malvern/Exton.*



# Philadelphia

## Innovation capital

With grants, university investments and venture capital funding, a number of collaborative efforts between the public and private sectors have driven the development of world-class science innovation centers in the area, such as the Wistar Institute, the Greater Philadelphia Bioinformatics Alliance and the Franhofer USA Center for Molecular Biotechnology.

Established by the state of Pennsylvania to stimulate growth through innovation, Ben Franklin Technology Partners provides risk capital and commercialization products to early stage companies, supporting the development of centers of excellence in the region. As a result of its efforts, companies such as Yaupon Therapeutics and Protez Pharmaceuticals, which was acquired by Novartis for \$400 million in 2008, have achieved commercial success.

## Fiscal & political resources

The Philadelphia region has a robust collection of incentives that attract life sciences companies and promote growth. Emerging companies are drawn by a supportive environment and the myriad of tax incentives, favorable policies and grants.

- Keystone Innovation Zones (KIZ): These state-created areas offer tax credits of up to \$100,000 to companies based on revenue growth.
- KIZs in Chester County, The Navy Yard, and University City provide services, facilities, or funding to growing life sciences companies.
- University City's KIZ has attracted more than \$100 million in venture capital, private equity, and grants for companies through universities and community partnerships.
- Keystone Opportunity Improvement Zones (KOIZ) New, growing businesses located in these regions may receive situation-specific packages of tax reductions, exemptions, abatements, and credits. Additionally, state and local sales and use tax exemptions may apply.

- The Navy Yard KOIZ provides tax savings for companies, typically ranging between \$10 and \$20 per square foot annually.
- Workforce Development: The Collegiate Consortium for Workforce and Economic Development assists life science businesses with customized workforce training, retention, and skill development programs.
- Industry-Focused Landlords: Large landlords, such as Liberty Property Trust, offer competitive incentive packages to attract life sciences tenants. In collaboration with the PIDC, Liberty attracted Iroko Pharmaceuticals to One Crescent Drive, a LEED Platinum building in its Navy Yard Corporate Center.

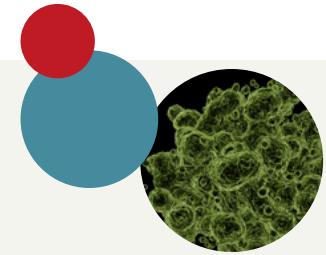
## Outlook

Recent acquisitions and consolidations by large companies could negatively impact employment and absorption in Philadelphia's leasing market. With Johnson & Johnson's \$21.3 billion acquisition of Synthes, Teva's \$6.8 billion acquisition of Cephalon, and Stryker's \$316 million acquisition of Orthovita, office and flex market vacancies could increase. Continued acquisitions of local companies such as Cubist Pharmaceuticals may additionally bring second generation specialized lab space to the market in 2012. In the CBD, the announcement of GSK's new headquarters will significantly impact Philadelphia's office market in 2013, leaving nearly 825,000 square feet of space.

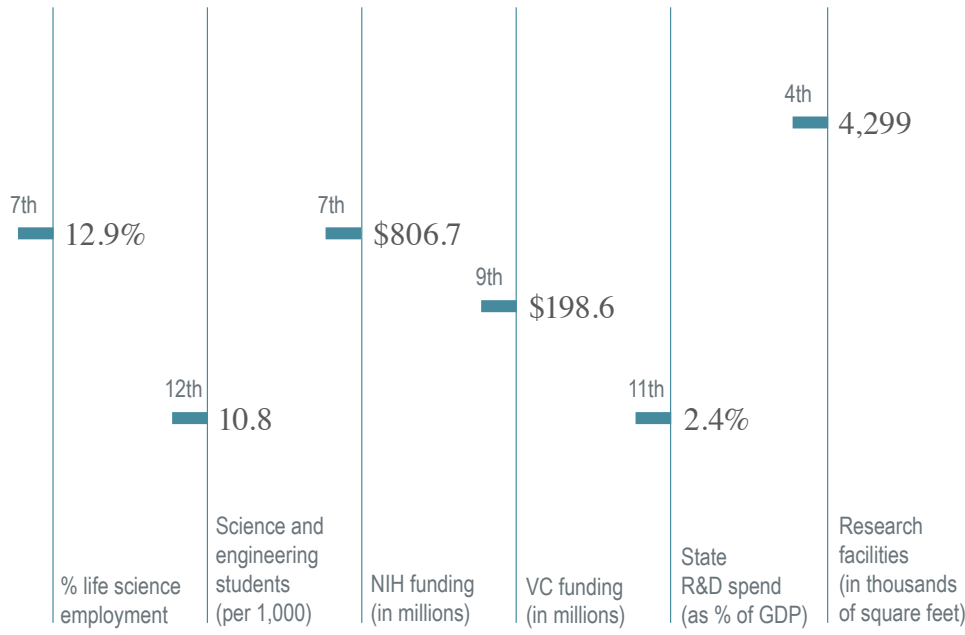
Despite industry shifts by large life sciences companies, the region's innovation hubs and academic institutions will continue to move the industry forward. With local, growing life sciences companies such as Neuronetics as well as international life sciences consulting firm The Triana Group locating in Philadelphia, the sector will continue to be important to the local economy.

Established cluster

# Raleigh Durham



Overall rank based on quantitative data, among 16 United States clusters.



Rank in relation to 16 United States clusters

*Home to one of the largest research parks and the nation's highest concentration of contract research organizations, the Raleigh-Durham market has deep and mature innovation capabilities.*

### Overview

The Raleigh-Durham life sciences cluster is familiarly called the Research Triangle Region due to the geographic nexus of the area's three leading research institutions — Duke University, North Carolina State University and the University of North Carolina Chapel Hill. Squarely in the center of the region is Research Triangle Park (RTP), a 7,000-acre center of research created by the state to help coalesce R&D talent to the region. The broader area includes 13 counties anchored by the cities of Raleigh, Cary, Durham and Chapel Hill.

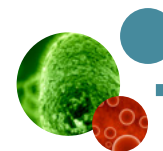


## *Raleigh Durham*

The Raleigh-Durham life sciences market is fairly inelastic. Very few lab spaces are available for lease, particularly in the range where most users fall, 5,000 to 15,000 square feet. Conversely, several very large R&D facilities remain on the market, such as Wyeth's 108,000-square-foot facility that was vacated in 2010. There is little demand for a contiguous space of that size.

Some of the industry's largest players are situated in the Research Triangle Region and have fueled much of the activity in the marketplace. Merck is adding to its current footprint of roughly 600,000 square feet with a 200,000-square-foot manufacturing facility at its Varicella Bulk Facility. Merck is also building a 42,500-square-foot lab. In May 2011, the Hamner Institutes for Health Science announced plans to add six buildings to its current site in RTP, bringing its total footprint in the park to one million square feet by 2020. Hamner now has a 116,000-square-foot building and plans to begin the project with a 165,000-square foot building estimated to cost \$68.2 million.

Alexandria Real Estate announced plans to develop a \$13.5 million, 50,000-square-foot ag-tech center in Durham. The campus will feature 18,000 square feet of greenhouse space and is expected to be online by summer 2012.



### *Industry framework*

#### **Intellectual capacity**

The three research universities offer a variety of biomedical engineering degrees and professional science masters programs. The region is known for its highly educated workforce with more than 53 percent of the workforce holding a bachelor's degree or higher. However the region does fall behind other established clusters when looking at science and engineering graduates only. More than 500 life sciences companies are located in North Carolina, with the greatest concentration occurring within the Raleigh-Durham region.

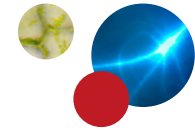
#### **Innovation capital**

Home to the nation's largest concentration of contract research organizations (CROs) and more than \$2 billion in annual research and development expenditures, the Research Triangle region is a global leader in innovation infrastructure. Research Triangle Park is the area's biggest innovation hub. The park offers five incubators and business accelerators to help support start-up companies. More than half of the park's 170 companies employ fewer than 10 people.

Additional centers of excellence and research facilities are anchored at area universities, such as Duke's Center for Biomolecular and Tissue Engineering (CBTE) and UNC Chapel Hill's Institute for Advanced Materials, Nanoscience, and Technology, among others.

*The Raleigh-Durham life sciences cluster is familiarly called the Research Triangle Region due to the geographic nexus of the area's three leading research institutions—Duke University, North Carolina State University and the University of North Carolina Chapel Hill.*

# Raleigh Durham



## Fiscal & political resources

The Research Triangle Region is home to multiple established organizations and leaders who, with area companies and universities, help move companies towards commercialization. These include:

- The North Carolina Biotechnology Center, a private, non-profit organization dedicated to biotechnology development. Through workforce development, and links among academic, business and civic leaders and funding programs, such as its Center for Innovation (COI) grant, the Biotechnology Center supports the commercialization of innovations.
- North Carolina Biosciences Organization (NCBIO) represents the interests of more than 150 companies in state and federal legislative and regulatory affairs.
- Biofuels Center of North Carolina works to expand production of liquid fuels.
- North Carolina Center for Innovation of Nanobiotechnology and Center of Innovation for Nanobiotechnology (COIN) are not-for-profit organizations that connect public and private resources and increase commercialization of nanobiotechnologies.
- Research Triangle Regional Partnership (RTRP) coordinates economic development for the region.

The state in 2004 created the One North Carolina Fund. It offers financial assistance to recruit and expand business in knowledge-driven industries. Additionally, several locally focused venture capital groups support the industry. These include Calvert BioCapital, Pappas Ventures, Golden Pine Ventures, Hatteras Venture Partners and Intersouth Partners, among others.

## Outlook

Overall the Research Triangle Region is expected to remain fairly stable during the coming quarters with fluctuations of expansions and contractions among the area's many tenants. The development of the Alexandria's ag-tech campus should bolster that sector. The region is already home to four of the top five ag tech companies including Syngenta, Bayer CropScience, BASF, and Monsanto.

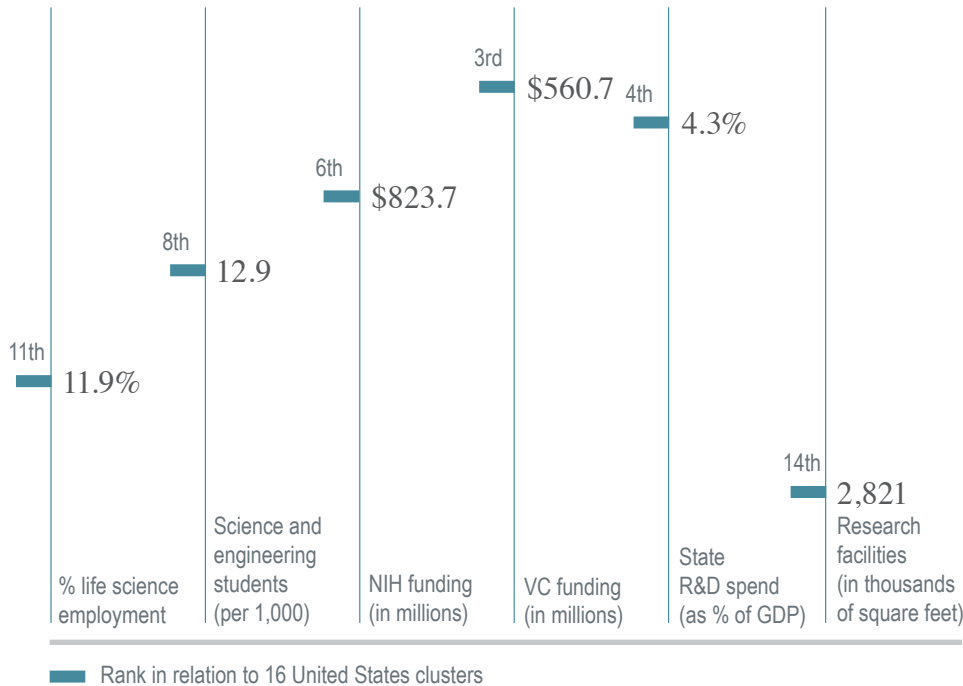
As a mature, established cluster, the Raleigh-Durham area has the necessary infrastructure in place to support the life sciences industry. From a pure numbers standpoint, the region ranks behind other established clusters in the area of science and engineering graduates and R&D capital as a percent of state GDP. However, given the deep rooted presence of top industry companies, a favorable living environment that attracts out-of-state professionals and ample public/private interest groups in the area, the market has more than enough resources to sustain and grow the needs of the industry.

Established cluster

# San Diego



Overall rank based on quantitative data, among 16 United States clusters.



*World-class research institutions and the highest per-capita concentration of holders of Ph.D. degrees define the character of San Diego's life sciences cluster.*

### Overview

The San Diego region is one of the largest life sciences clusters in the United States, anchored by prominent non-profit medical research institutions and R&D-oriented private companies such as The Scripps Research Institute, Sanford-Burnham Medical Research Institute, Synthetic Genomics, Pacira Pharmaceuticals and Althea Technologies.

At third quarter 2011, the majority of deals were being inked for spaces below 20,000 square feet, speaking to San Diego's heavy concentration of incubator and start-up companies. The labor markets and availability of capital—indicators that point to the continuance of today's increase in leasing activity—are strong and forecasted to end the year on a positive note.

## — San Diego

Rents have bottomed and started to recover in select submarkets and size ranges. This trend is expected to continue into 2012 and beyond as vacancies tighten, thanks in part to a lack of new development.

San Diego's leading life sciences submarket, Torrey Pines, is home to the region's largest concentration of lab space with 5.3 million square feet of lab space. Of this total, more than half—or 2.9 million square feet—is owner-user space owned by Big Pharma and research institutes such as The Scripps Research Institute, the Sanford-Burnham Institute, Pfizer and the Salk Institute.

Torrey Pines has begun to experience a resurgence of activity among users that need more than 25,000 square feet of space. Companies are more amenable to the higher rents demanded by Torrey Pines owners as VC funding and overall market conditions within the more established biotech firms have improved. Verenum signed a lease for 59,000 square feet in Torrey Pines, the largest new deal the submarket has seen in over two years.

The UTC/Eastgate submarket, like Torrey Pines, is comprised of mature, publicly traded corporate tenants with late-stage product development. This submarket, which offers the most direct competition to Torrey Pines, has just over two million square feet of lab space and is located in San Diego's "Golden Triangle", offering an unbeatable amenity base. UTC, which has struggled with a high availability rate is anticipated to tighten. Celgene and Optimer are in negotiations to lease 175,000 square feet of space within the submarket.

Sorrento Mesa, which contains four million square feet of lab space, caters to San Diego's early and mid-tier biotech companies. Some of the largest lab tenants in the area include Gen-Probe, Vical, Arena Pharmaceuticals, Quidel, Nuvasive and Pharmatek Laboratories. Class A laboratory space in

Sorrento Mesa is almost fully leased. Landlords, in turn, are beginning to re-position older/distressed assets in Sorrento Mesa and Sorrento Valley to cater to tenants' demands for higher-quality space.

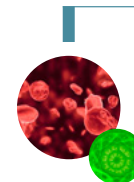
Sorrento Valley was developed as an ancillary submarket to Torrey Pines and continues to attract and retain many start-up biotech operations. With a base of older R&D buildings that have been converted to lab space, this submarket provides an economical alternative for early-stage companies. In 2011, Sorrento Valley experienced a surge in leasing activity by startup companies in the 1,000 to 3,000 square foot range.

### *Industry framework*

#### **Intellectual capacity**

The emergence of the life science industry in San Diego dates to the 1960s, when the Torrey Pines Mesa was designated as an area for "scientific research and development activities," limiting manufacturing to "prototype fabrication and/or production of products requiring advanced technology and skills directly related to research and development activities on the premises."

Since that time, San Diego has continued to capitalize on its favorable collection of factors, including relationships with some of the nation's top scientific research institutions, access to venture capital and government funding, a concentration of suitable lab and R&D facilities, and, perhaps most important, a community and climate that attracts the best talent in the world. More than 25,000 professionals live in the San Diego region.



## San Diego

### Innovation capital

The Scripps Research Institute, the Salk Institute, the Sanford-Burnham Medical Research Institute, and other outstanding regional universities—including three that offer life sciences doctorate programs—are centrally located within the regional life science cluster and provide much of the area's Innovation capital. As the life sciences network has grown, so too have grown the presence of venture capitalists, recruitment/technology staffing firms and patent attorneys, all intimately familiar with the needs of the life sciences industry.

### Fiscal & political resources

Despite the comparably high cost to do business in California, companies are still flocking to “Americas Finest City.” Although many of the business incentives offered by local government lie outside of the traditional life sciences submarkets, the real incentive for companies is not derived from these sources, but rather come from within the industry. Access to talent, investment capital, the research institutes, and an ever-growing group of industry-leading enterprises all make San Diego extremely attractive to life sciences companies.

The federal government supports the San Diego region through generous National Institutes of Health (NIH) grants, which are deployed to all stages of research and development. NIH grants in 2010 totaled nearly \$1.2 billion, a 28 percent increase from the previous year and a 70 percent increase from 2008.

Although the investment sales market for biopharma-focused real estate cooled in 2011, it was red-hot in 2010 when the three major landlords—Biomed Realty, Alexandria Real Estate and HCP—increased their ownership by more than 1.2 million square feet. Together they now account for almost 50 percent

of San Diego's life sciences property ownership. After the surge of investment activity in 2010, acquisition activity among those top firms is anticipated to continue into 2012. Both private owners and owner/users are anticipated to continue disposing of their real estate. Look for these owners to begin to push rates as the market continues to improve, the development pipeline remains closed, and their percentage of the competitive inventory grows.

### Outlook

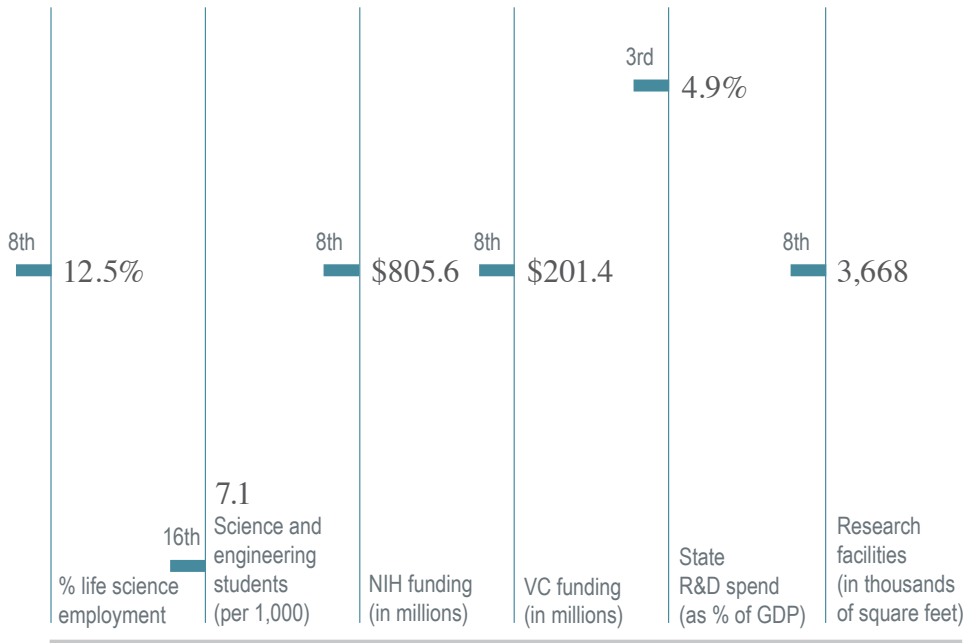
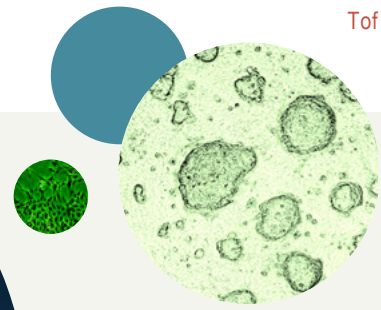
Thanks to ongoing investment in biopharma companies, the number of established and emerging businesses is growing, as evidenced by the average increase of the number of start-ups and the deployment of capital—both from government grants and venture-based groups. Mergers and acquisitions are expected to increase in 2012.

With more than one million square feet of tenants in the market for space (of which 414,000 square feet will be positive net absorption once the deals are signed), look for this industry sector to have a continued positive effect on the local commercial real estate environment. No speculative development is currently under way; new construction will be build-to-suit.

*With more than one million square feet of tenants in the market for space (of which 414,000 square feet will be positive net absorption once the deals are signed), look for this industry sector to have a continued positive effect on the local commercial real estate environment.*

Established cluster

# Seattle



Rank in relation to 16 United States clusters

Overall rank based on quantitative data, among 16 United States clusters.



*One of the distinguishing features of the Seattle-area life sciences market is that very little manufacturing is done in the region. Nearly all life sciences industry activities are based on research and development.*

### Overview

Overall, there are nearly five million square feet of life sciences facilities within the Seattle metro area. The two main hubs within the area are Bothell, located 20 miles northeast of the Seattle CBD, and the submarkets of the Seattle CBD, Lake Union, First Hill, and Queen Anne/Interbay, all located within the Seattle city limits. Most of the lab space within Seattle consists of newer, Class A facilities, although in some cases complete renovations of older structures have taken place. For example, the Lake Union steam plant renovated by Zymogenetics, now a wholly owned subsidiary of Bristol Meyers Squibb. Bothell offers more of a suburban campus environment, typically consisting of concrete tilt up buildings finished with lab space.

## Seattle

Typically, life sciences tenants in this market consist of research and development organizations, primarily focused on drug development. At present, there is no large scale manufacturing, although there are several smaller, medical device makers. Most companies are usually in the early stages of drug development and are rarely profitable. Those that are successful are frequently acquired by Big Pharma. Examples include Zymogenetics (acquired by Bristol Myers Squibb), Immunex (acquired by Amgen), Corixa (acquired by GSK), Icos (acquired by Eli Lilly), and Corus (acquired by Gilead).

Most of the recent development or redevelopment of commercial real estate for life sciences use have taken place in the Lake Union submarket. Since 2007, more than 670,000 square feet of space has been placed into service for life sciences use. Examples include redevelopment of the former Washington Natural Gas buildings for the University of Washington (284,000 square feet), construction of the 96,000-square-foot Fairview Research Center occupied by Nanostring Technologies and Novo Nordisk, and Alexandria Real Estate's development 199 E Blaine Street for Gilead. In addition, Fred Hutchinson Cancer Research Center purchased 1100 Eastlake, originally developed for offices, and will convert the building to owner-occupied life sciences space.

An elevated vacancy rate in Bothell has reduced development work there. The most recent project was BioMed Realty's conversion of a 20-year old office building into life sciences space in 2008.

As in many markets, Alexandria Real Estate Equities and BioMed Realty Trust are major players in Seattle area life sciences properties in most submarkets, but there are several other prominent ownership entities as well. In Bothell, life sciences owners include Arden Realty, Bentall-Kennedy, TIAA-CREF, and regional and local players such as Schnitzer West and Washington Capital Management.

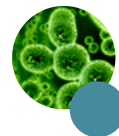
In the Lake Union submarket, prominent life sciences developers and owners include Vulcan Real Estate, Schnitzer West, Touchstone, Capstone, Washington Holdings, and Erlandson Development Group, and EOP.

### *Industry framework*

#### **Intellectual capacity**

Industry employment includes 19,000 people engaged in some form of research & development, with an additional 191,000 people employed in hospitals and the medical field.

University programs provide additional employment and education for future life sciences employees. The University of Washington (UW) located in Seattle is the leading educational institution in the region supporting life sciences, with additional educational programs provided by Washington State University, Western Washington University and Eastern Washington University.



*Typically, life sciences tenants in this market consist of research & development organizations, primarily focused on drug development.*

## Seattle

### Innovation capital

The University of Washington is one of the nation's leading research institutions, receiving more research dollars from the National Institutes of Health than any other public university in the United States. UW Medicine has major academic and service affiliations with Seattle Children's Hospital, Fred Hutchinson Cancer Research Center and Cardinal Health in an innovative public-private collaboration designed to advance the use of molecular imaging in clinical investigations and trials.

The four primary academic institutions lead the state in funding for R&D expenditures led by the University of Washington, in conjunction with centers of excellence like the Institute for Systems Biology, Pacific Northwest Research Institute and Seattle Cancer Care Alliance.

### Fiscal & political resources

Washington State has a "high tech" B&O tax credit which includes biotechnology R&D. The credit is allowed for eligible expenditures on R&D in excess of 0.92 percent of a company's taxable income, with the maximum amount of the credit at \$2 million annually. In 2009, the last year for which statistics are available, 484 companies took advantage of the credit for a total of \$23.8 million in credits claimed. Of that total, 78 companies claimed \$2.46 million in the biotechnology.

In addition, Washington offers a sales/use tax deferral/exemption for investments in biotechnology manufacturing, although it is not widely used.



### Outlook

The life sciences industry is likely to continue as one of the drivers of Seattle area real estate, particularly in the Lake Union submarket and, potentially, in Bothell.

Limited speculative construction is likely to occur around Lake Union.

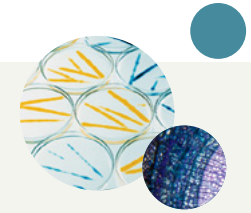
This is due both to cost and the effects of the recent downturn. The most probable developments in the near term would be BioMed's 110,000-square-foot Fairview Research Center II or Alexander Real Estate Equities' (AREE) 165,000-square-foot Eastlake project. Both projects are located near to the Fred Hutchinson Cancer Research Center and University of Washington research facilities. The Bothell market is less likely to see near-term development due to ample existing space is available.

*The most probable developments in the near term would be BioMed's 110,000-square-foot Fairview Research Center II or Alexander Real Estate Equities' (AREE) 165,000-square-foot Eastlake project.*

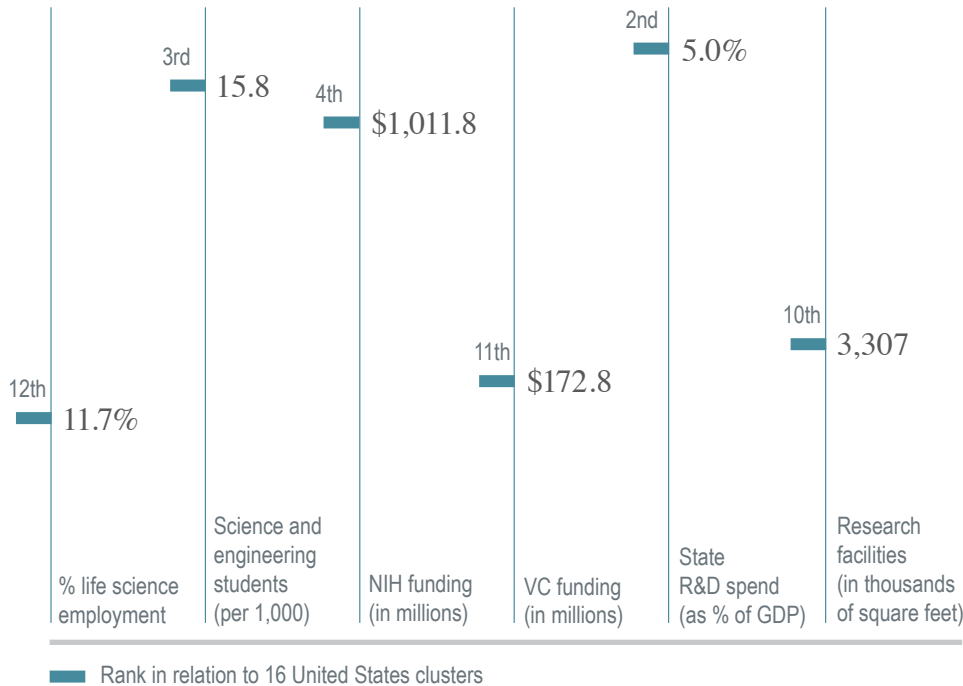


Established cluster

# Washington DC / Suburban Maryland



Overall rank based on quantitative data, among 16 United States clusters.



*Fiscal and human capital support generated through close ties with government agencies and world-renowned academic research centers, such as Johns Hopkins University, sustain the Washington DC/Suburban Maryland cluster as a vital region for the industry.*

## Overview

The Washington DC/Suburban Maryland life sciences market has benefited tremendously from the area's large federal government presence. Government agencies such as the National Institutes of Health (NIH), and the Food and Drug Administration (FDA) have provided contracts for private sector companies as well as a critical mass of scientists who have gone on to start or staff many of the region's private bio-life companies.

# Washington DC / Suburban Maryland

Aside from its federal backbone, the market boasts a significant inventory of existing lab space which originated primarily from a decision by Alexandria Real Estate to invest in speculative space. The growth that rewarded Alexandria came largely from research into the human genome. The companies that led the region's development into a cluster included Human Genome Sciences, MedImmune, and Qiagen, all with strong ties to the federal government and an affinity for public-private research partnerships.

The life sciences are largely clustered among suburban Montgomery County, particularly along the I-270 corridor, known locally as "DNA alley." Within the I-270 corridor, a heavy concentration of bio-life companies is found in the Shady Grove micromarket. The J. Craig Venter Institute and Johns Hopkins (satellite campus) are both located there. Federal government facilities are found to the south in the Twinbrook, White Flint, and North Bethesda submarkets. The major landlords are Alexandria Real Estate and BioMed Realty Trust. BioMed has recently started buying product in the market, including the notable sale-leaseback of the J. Craig Venter Institute campus. BioMed also recently began speculative construction of more than 100,000 square feet in the Shady Grove submarket.

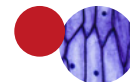
## **Industry framework**

### **Intellectual capacity**

The Washington DC/Suburban Maryland cluster is distinctive in that it sources the vast majority of its intellectual resources from the federal government. The presence of groups such as the NIH, FDA and other agencies leads to a critical mass of top scientists who are hired by private sector companies, many of which were created by former federal employees. The region also benefits from proximity to a plethora of large educational institutions including Johns Hopkins, the University of Maryland, George Washington University, Georgetown University, George Mason University, and Catholic University.

### **Innovation capital**

Johns Hopkins University is particularly active in the cluster's development, helping to connect public and private ventures. The university is also influential through its real estate assets. As a large land-owner at the center of the dense bio-life submarket of Shady Grove, the university has influenced formation of companies by providing economical incubation space that includes federal and private sector access. Non-profits are also innovative. One notable example is Aeras; funded by the Gates Foundation, this group develops sustainable and affordable tuberculosis vaccines. Another prominent nonprofit example is the J. Craig Venter Institute, a conglomerate of research groups that is one of the leading innovators in genomic research.



*The Washington DC/Suburban Maryland life sciences market has benefited tremendously from the area's large federal government presence.*

# Washington DC / Suburban Maryland

## Fiscal & political resources

Several statewide programs and initiatives geared towards R&D, financial and employment support have helped to support growth in the region. Most originate with the Maryland Department of Business and Economic Development, assisted by development and advocacy efforts from organizations such as MdBio, a division of the Tech Council of Maryland.

- Research and Development Tax Credit: Provides tax credits to businesses with qualified R&D expenses
- Biotechnology Investment Tax Credit: Income tax credits to individuals or entities that invest \$25,000 or more in a qualified Maryland biotechnology company
- Cellulosic Ethanol Technology R&D Tax Credit: Issues state income tax credits for businesses that incur R&D expenses related to cellulosic ethanol technology
- Economic Development Fund Grant/Loan Program: Funds private employers who retain and create jobs in Montgomery County, especially high technology and manufacturing
- Maryland Economic Adjustment Fund: Offers financial assistance to businesses with modernized manufacturing or that develop commercial applications for technology.
- Maryland Venture Fund: Provides direct investments in technology and life science companies and indirect investments in venture capital funds
- TEDCO Working Capital Loan Fund: Provides loans to early stage technology-oriented companies located in the State of Maryland



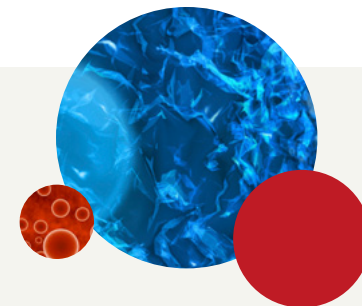
## Outlook

Although it is an established cluster, the Washington DC/Suburban Maryland life sciences industry is in an adolescent period. A wave of early startups has given way to mid-stage companies ripe for acquisition by major pharmaceutical companies. This market includes two of the hottest life science companies anywhere in the nation—Human Genome Sciences and MedImmune. In addition, the cluster is also home to Qiagen, Charles River Labs, SAIC, and the Henry M. Jackson Foundation—all established players. No large-scale developments are planned. While a climate of steady growth is likely, much of that growth can be accommodated by companies on or in their owned campuses and buildings.

*A wave of early startups has given way to mid-stage companies ripe for acquisition by major pharmaceutical companies.*

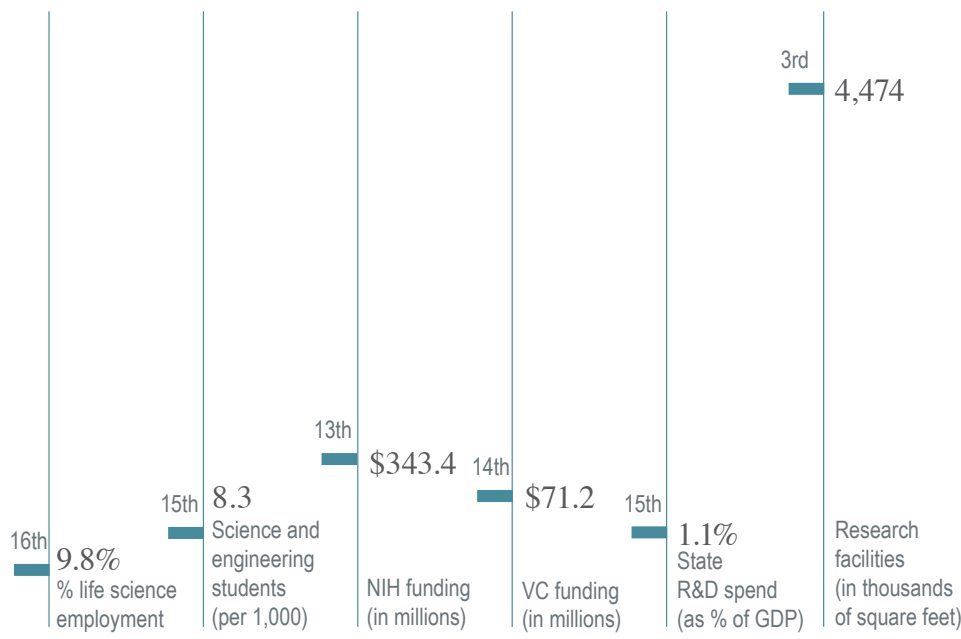
Emerging cluster

# Atlanta



# 15

Overall rank based on quantitative data, among 16 United States clusters.



Rank in relation to 16 United States clusters

*Atlanta's growing bioscience community is centered around several academic research facilities and is bolstered by strong state economic incentives and the area's prominent make-up of closely-related health information technology companies.*

### Overview

Headquartered in Atlanta are large-scale health organizations like the Centers for Disease Control and Prevention, the American Cancer Society and Arthritis Foundation, among others. Their presence, along with first-rate research universities and a pro-business climate, encourage life sciences industry growth in Atlanta. Top employers include CIBA Vision Corp., Quest Diagnostics, UCB Inc., Covidien and the Centers for Disease Control and Prevention, which alone employs nearly 7,000 personnel.

## Atlanta

In a 2009 study by Georgia Bio and the Selig Center for Economic Growth, life sciences companies and life sciences-focused university research was found to account for more than 62,000 jobs throughout the state with an economic impact of \$17.3 billion. Additionally, the bioscience industry grew more rapidly than any other sector in the state from the years 2001 to 2007. Civic leaders and institutions alike have planned accordingly. Recently, the Morehouse School of Medicine announced a \$165 million expansion that will double the number of students in graduate-level biomedical science programs, while Georgia Health Sciences University has planned a new campus in Atlanta.

The city is also fast emerging as a center for healthcare information technology, with four of the top 25 HCI-100 companies headquartered in Atlanta. Many segments of the bioscience and health IT communities are symbiotic, and both sectors should benefit from proximity to one another as these industries grow.

### *Industry framework*

#### **Intellectual capacity**

There are eight academic institutions in the area that offer a range of life sciences-related degrees. Many of these schools benefit from the Georgia Research Alliance, an independent non-profit entity that facilitates research among industry and academic entities. Since 1990, a multitude of renowned scientists have been recruited to Atlanta through its Eminent Scholars program. Nearly 18,000 Georgians are employed in life sciences, with most of those jobs concentrated in Atlanta.

#### **Innovation capital**

The Georgia Institute of Technology and Emory University provide a joint biomedical engineering degree program that is ranked second in the nation and has become a model for successful and innovative research collaboration. Both schools anchor several centers of excellence including the Biomedical Technology Research Center and the Center for Behavioral Neuroscience. Along with Children's Healthcare of Atlanta, those same schools recently launched a first-of-its-kind research center that links healthcare to engineering and is devoted to pediatric nanomedicine.

#### **Fiscal & political resources**

Georgia has embraced the life sciences industry because of its ongoing and positive economic impact. Multiple programs encourage growth. Atlanta and the state share a business-friendly reputation. Life sciences companies have access to tax credits, sales tax exemptions, job training, cash grants, and property tax relief.

Specifically targeted to the industry are services provided by the Georgia Bioscience Commercialization Center, a resource hub to assist entrepreneurs from bench to market. The Georgia Research Alliance launches companies around laboratory discoveries at partner universities through its VentureLab



## Atlanta

program. There is also the Georgia Medical Center Authority, which was established to advance the life sciences industry through research, development and manufacturing facilities and programs.

Specific available funding includes:

- Georgia Research Alliance Venture Fund: Private investment fund established to provide investment capital to companies that participate in the Georgia Research Alliance's VentureLab commercialization program
- Georgia Tech Edison Fund: Provides seed funding for early-stage biotechnology companies that have a close association with the school
- Georgia Tech Seed Capital Fund: Invests in Georgia-based entrepreneurial businesses pursuing innovation in bioscience and advanced technology
- Georgia Centers of Innovation Research and Commercialization Grant Program: Direct assistance that includes access to world-class research, product commercialization, state-of-the-art incubator space, connections to industry expertise
- Georgia Medical Center Authority: Issues up to \$300 million in negotiable revenue bonds

### Outlook

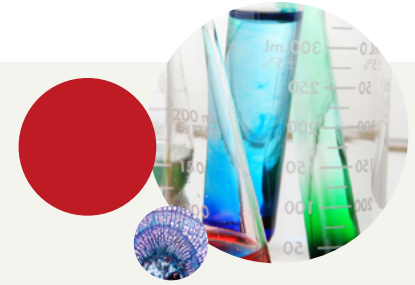
The life sciences sector is likely to continue to expand in Atlanta. The city's concentration of research universities, IT backbone, superior transportation infrastructure and national health organization presence first catalyzed the industry's growth in Atlanta, and economic development initiatives that have followed should help to sustain it. However, Atlanta competes directly for regional tenants with the Raleigh-Durham market, where a thriving life sciences cluster is established around Research Triangle Park. Luring relocations is often a battle of economic incentives and both metro areas tend to be similarly aggressive.



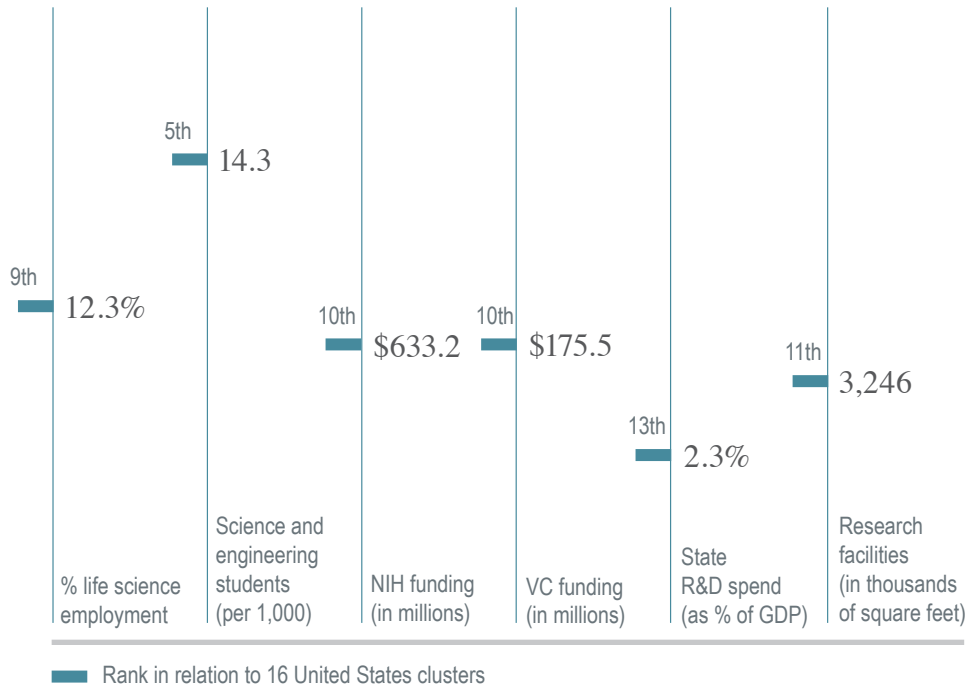
*The city's concentration of research universities, IT backbone, superior transportation infrastructure and national health organization presence first catalyzed the industry's growth in Atlanta, and economic development initiatives that have followed should help to sustain it.*

Emerging cluster

# Chicago



Overall rank based on quantitative data, among 16 United States clusters.



*As a national leader in research and general manufacturing, the Chicago area is primed to expand its life sciences presence.*

### Overview

Since the opening in 1946 of Argonne National Laboratory, the first national science and engineering research laboratory, the Chicago area has developed a reputation as a hub for research and innovation.

Headquartered in the Chicago area are large life sciences companies including Abbott Laboratories, Astellas, Baxter, Hospira, Takeda, and Walgreens. These companies, and many smaller life sciences firms, are located in the north suburban submarket.

Evidence of commitments by companies to the Chicago market includes recent build-to-suit headquarters' for both Astellas and Takeda Pharmaceuticals as well as a recent significant transaction by Sysmex. In 2007, Takeda completed its new

# Chicago

three-building, 630,000-square-foot world headquarters on 70 acres purchased from Baxter. Astellas has announced plans to follow suit and will deliver its new 445,000-square-foot headquarters in 2012. Sysmex also executed two recent deals for its world headquarters, opting to lease 160,000 square feet of office and 146,000 square feet of industrial space in Lincolnshire. Further fueling activity was the September 2011 memorandum for collaboration between the Illinois Science and Technology Coalition, iBio and China's Shanghai Bio Pharmaceuticals Association.

Also underway, the Illinois Science + Technology Park in Skokie will be a 23-acre campus providing laboratory, office and conference space for life science-focused companies. Currently under construction by Forest City's Science + Technology Group, the site will eventually offer up to two million square feet of advanced facilities (660,000 square feet are immediately available).

## *Industry framework*

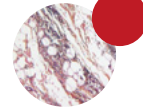
### **Intellectual capacity**

The area benefits from a large hospital system and life sciences-related employment of nearly 530,000 individuals, most of whom work in hospital or medical-related professions.

The metropolitan area is home to several leading universities and institutions. These include Northwestern University, the University of Chicago, the Illinois Institute of Technology (IIT), and the University of Illinois at Chicago (UIC). The area also attracts graduates from other schools in the state, such as the University of Illinois at Urbana-Champaign and Southern Illinois University School of Medicine.

### **Innovation capital**

The area's universities are among the factors that identify Chicago as a life sciences cluster. Research is a heavy point



*Headquartered in the Chicago area are large life sciences companies including Abbott Laboratories, Astellas, Baxter, Hospira, Takeda, and Walgreens*

of emphasis at area centers like the International Institute of Nanotechnology at Northwestern, the Center for Pharmaceutical Biotechnology at the University of Chicago and the Medical Imaging Research Center at IIT.

The Illinois Medical District was created in 1941. Since then the area has become rich with hospitals, medical centers and research facilities including the biotech incubator, Chicago Technology Park. The 56-acre park features a 56,000-square-foot research center for emerging ventures and roughly 118,000 square feet of graduate and other facilities to accommodate more established companies.

### **Fiscal & political resources**

Founded in 2000, the Illinois Biotechnology Industry Organization, or iBIO, facilitates relations between public, private and academic sectors and advocates for favorable public policy for the industry. Its PROPEL program, launched in 2007, is specifically focused on increasing the number of life sciences start-ups in Illinois by providing entrepreneurs with access to funding, coaching and technical expertise.

Additionally, in 2010, efforts led by iBIO resulted in the state passage of the Angel Investment Tax Credit program. The measure grants investment tax credits to early-stage VC or Angel investors, capped at \$10 million.

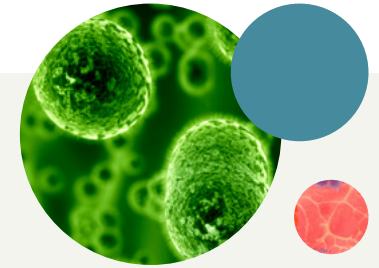
### **Outlook**

Although the State of Illinois is home to some of the top research universities and institutions in the United States, the area struggles to translate its innovation into start-ups, and further, to retain them in the state. Historically, the Chicago region has been challenged by the loss of its research graduates to coastal cities but has reversed this trend slightly during the past 36–48 months; more programming, expertise and fiscal attention will help the area overcome this hurdle and move the Chicago area into an established cluster.



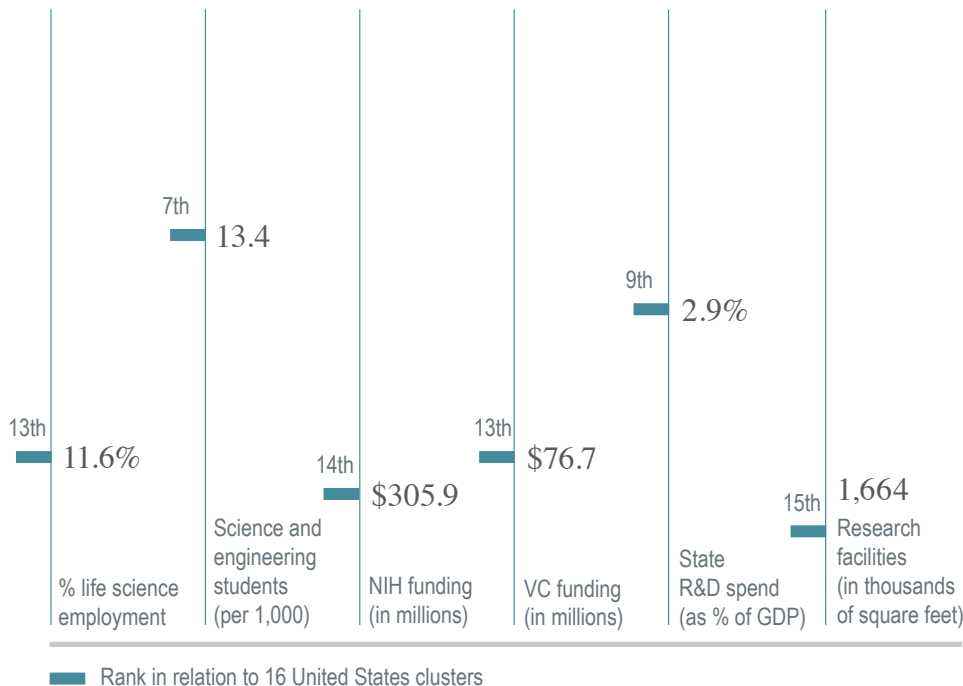
Emerging cluster

# Denver



# 12

Overall rank based on quantitative data, among 16 United States clusters.



*After several years of stagnation, Denver area bioscience companies are benefiting from renewed interest from investors and partners.*

### Overview

While industry activity is spread throughout the entire metro Denver area, the Northwest submarket, encompassing the cities of Broomfield, Boulder, Louisville and Longmont, is the most prominent and home to nearly 100 life sciences companies. The submarket is predominantly made up by smaller companies. Although many closed their doors during the recession, a few local players are succeeding. Somalogic, miRagen and Biodesix are all recent recipients of cash infusions, and are poised to begin hiring additional workforce. With close access to the University of Colorado's research and laboratories and a growing critical mass of industry-related companies, the Northwest submarket will continue to lead life sciences activity in the Denver market.



## — Denver

The Northwest submarket lacks any current development projects, however, the Fitzsimons Life Science District along with the Anschutz Medical Campus in Aurora, Southeast of downtown Denver, are among the largest life sciences developments in the country. Start-up companies and fully-developed companies alike are accommodated and have access to research, resources and facilities.

### *Industry framework*

#### **Intellectual capacity**

High-tech research and hospital/medical industries employ nearly 188,000 people employed in the Denver area. Ten higher education institutions operate life sciences programs and research resources. Among them are Colorado State University, the University of Colorado at Boulder and the Colorado School of Mines. The largest research facility in Colorado is the Fitzsimons Life Science District in Aurora. With swift growth in the industry over the past few years, Fitzsimons has created a central hub for research dedicated to life sciences, healthcare and education.

The state is home to nearly 400 companies in the bio-related fields of medical devices, pharmaceuticals, agricultural and traditional biotechnology including the likes of Allos Therapeutics, Amgen, Array, Sandoz, Somalogic and Roche.

#### **Innovation capital**

The University of Colorado offers the Colorado Initiative in Molecular Biotechnology, which cultivates research and development in life sciences. The initiative was established to attract exceptional students to integrate research and teaching in biotechnology development. The university's medical school also offers a new stem cell research center made possible by a \$6 million grant from the Charles C. and June S. Gates Family Fund.

#### **Fiscal & political resources**

The Colorado BioScience Association works to further Metro Denver and Colorado's life sciences community. Aiding this effort are Colorado programs such as grants, sales tax exemptions, and support for start-up companies.

The state has five venture firms predominantly or solely focused on funding local life sciences companies as well as several other programs and grants available:

- Bioscience Discovery Evaluation Grant Program: Aims to foster growth of the state's bioscience industry by expanding bioscience research and accelerating development of new products and services. Program funding is disbursed through proof-of-concept grants, Early-State Bioscience Company grants, and research institution grants for infrastructure development.
- Biotechnology Sales and Use Tax Refund: Refunds are available for state sales and use taxes paid on the sale, storage, use, or consumption of tangible personal property to be used in Colorado directly and predominantly in research and development of biotechnology.
- Bioscience and Life Science Fund: A 5-year, \$31.5 million grant from the state of Colorado aids start up companies and research institutions in Colorado.

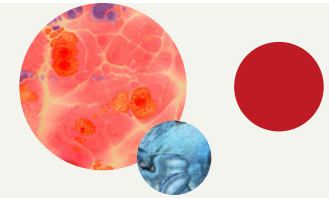
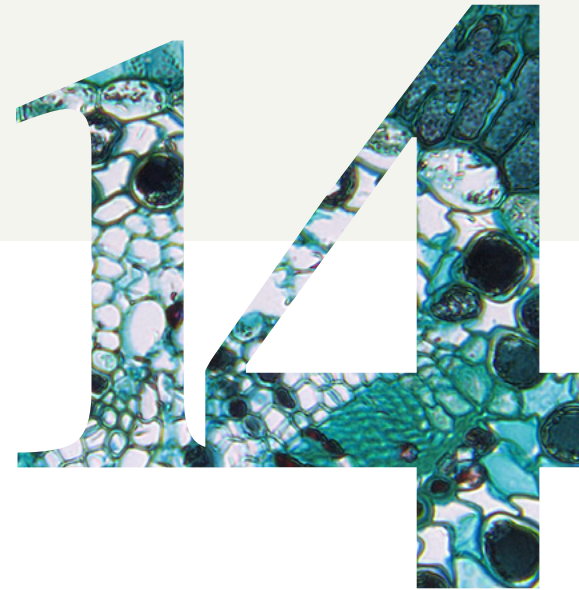
### *Outlook*

Denver's life sciences industry is trending positively. Budding start-ups have the intellectual and innovation resources needed to develop into successful and solid companies, while established companies enjoy access to resources with the presence of the Fitzsimons Life Science District and the Anschutz Medical Campus. However, it is evident that the market requires investors and landlords who specialize in the development of research facilities. Many current facilities have been retrofitted, and having these types of facilities readily available will support forward momentum in Colorado.

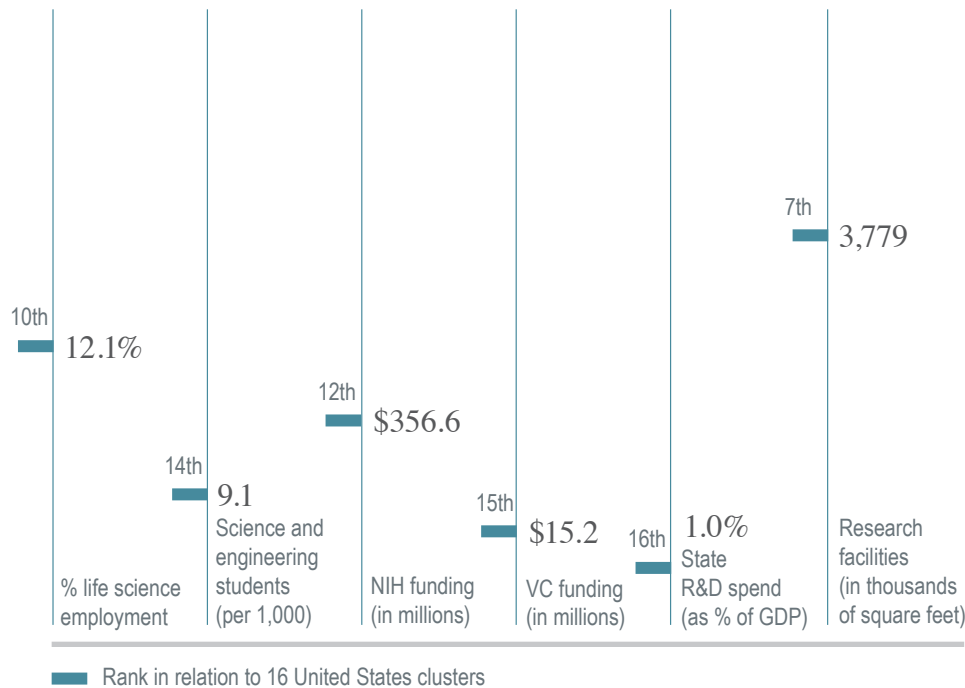
*The Northwest submarket, encompassing the cities of Broomfield, Boulder, Louisville and Longmont, is the most prominent and home to nearly 100 life sciences companies*

Emerging cluster

# Florida



Overall rank based on quantitative data, among 16 United States clusters.



*Florida's commitment to an expanded bioscience community is evident through the many development projects, incubation centers and academic programs in the central and southern regions.*

### Overview

Central Florida, consisting of metro Orlando, Tampa Bay area and Gainesville, and South Florida, consisting of Miami, Fort Lauderdale, Boca Raton, Jupiter and Port St. Lucie, are regional hubs for the industry.

In Central Florida, a major bright spot in the life sciences is the development of the Lake Nona Medical City. Under construction by the Tavistock Group, the master-planned community will span more than 7,000 acres. Some tenants of the Medical City include the University of Central Florida College of Medicine, the Sanford-Burnham Medical Research Institute at Lake Nona, the Orlando VA Medical Center, Nemours Children's Hospital, MD Anderson Cancer

## — Florida

Center, and the University of Florida Research and Academic Center. Sanford-Burnham was an early partner of the Lake Nona Medical City and occupies a 175,000-square-foot, state-of-the-art facility. The Orlando VA Medical Hospital, expected to open in 2012, will be a 134-bed hospital. Moreover, it will be the home to a new 35,000-square-foot training facility for a new medical simulation system called the Simulated Learning Enhancement and Advance Research Network.

Construction is also under way on the University of South Florida's Center for Advanced Medical Learning and Simulation (CAMLS) in the Tampa Central Business District. When completed, CAMLS will be a state-of-the-art, 90,000-square-foot medical conference facility. CAMLS will feature a 30,000-square-foot training center for USF Health's Graduate Biomedical Degree program, a 2,000-square-foot auditorium, a 6,000-square-foot laboratory, and a 10,000 square-foot Virtual Hospital.

In South Florida, the new science and technology park at the University of Miami is helping to shape a strong innovation community. The University of Miami Life Science & Technology Park's (UMLSTP) master plan includes up to five buildings totaling between 1.6 million and 2 million square feet of retail, lab and office space. Building One was recently completed and is 60 percent leased. Highlights from its tenant roster include medical device companies DayaMed and Emunamedica, Spanish technology company Andago, Community Blood Centers of South Florida lab facility, clinical research firm Advanced Pharma CR, and the UM Tissue Bank. Developed by Wexford Equities, the 252,000-square-foot facility includes both wet and dry lab space, in addition to office and retail. Building Two, also to be developed by Wexford, is in final design as a 12-story building that will also include a hotel and conference facility in addition to the research, office, clinical and retail space. Building Three is in the planning stage.

Outside of development projects, life sciences companies are expanding in both regions. In Central Florida, Nephron Pharmaceuticals, currently based in Orlando, plans to build a new 531,000-square-foot facility, add 100 new, high-wage employees with expansion estimated at a total of \$100 million. Nephron has narrowed its site selection options to Orlando and Murray, Kentucky.

In South Florida, Teva Pharmaceuticals maintains a significant presence in Miami through its \$7.6 billion purchase of Ivax. The Miami connection was reinforced in 2010, when Ivax founder Dr. Phillip Frost, was named Teva's chairman. Residing in Miami, Dr. Frost has built a significant biotechnology portfolio that includes NYSE-listed Opko Health. Also in 2010, BD Bioscience opened a 90,000-square-foot facility in Miami to produce cell culture media and in early 2011, HeartWare, a medical device manufacturer with its operating and manufacturing activities based in Florida, opened a new 131,000-square-foot facility. With recent news of high survival rates in recent trials for its miniaturized ventricular assist devices, the potential exists for additional growth over the near term.



*The University of Miami Life Science & Technology Park's (UMLSTP) master plan includes up to five buildings totaling between 1.6 million and 2 million square feet of retail, lab and office space.*

# Florida



## Industry framework

### Intellectual capacity

On the research side, Central and South Florida are home to nearly 43,000 high tech research employees and several large academic institutions including The University of Florida, University of Central Florida (UCF), University of South Florida (USF), The University of Miami (UM), Florida International University (FIU) and Florida Atlantic University. These universities provide incubator programs to support life sciences technology growth.

As a popular retirement destination, Florida is also a large healthcare market. Medical device and other life sciences companies actively establish relationships with hospitals and medical facilities throughout the area.

### Innovation capital

The Central Florida region benefits from seven life sciences-related centers of excellence and a number of incubators that help start-ups, including the UCF Business Incubators and USF's Tampa Bay Technology Incubator. Of particular note is the University of Florida's Sid Martin Biotechnology Incubator, which provides wet labs, small and large animal research facilities, common equipment labs, fermenters, greenhouses and other facilities and utilities needed by budding research companies.

In the South Florida region, the University of Miami Life Science and Technology Park includes a 25,000-square-foot Innovation Center with pre-built and furnished wet and dry labs, office suites, and shared equipment. The University of Miami also has developed its nationally recognized Launch Pad program that offers one-on-one facilitation to help students and alumni develop their ideas into a company and offers business plan evaluation, strategy and basic business guidance.

FIU's Applied Research Center is a university-wide stand-alone facility intended to foster multi-disciplinary research collaboration between research units. Scripps Florida houses five academic departments of its parent, the Scripps Research Institute, in addition to the Translational Research Institute. Additionally, the South Florida region is home to the Vaccine and Gene Therapy Institute, the Torrey Pines Institute for Molecular Studies in Port St. Lucie and the Max Planck Florida Institute, currently under construction at Florida Atlantic University's McArthur Campus.

### Fiscal & political resources

BioFlorida, the state's bioscience industry association, represents companies and research centers to help facilitate innovation, foster collaboration and create a business-friendly environment for life sciences companies.

Several local programs and measures have been developed to further foster industry growth, such as grant funding for high tech businesses and industry tax exemptions, quick response training grants and Enterprise Zone sales tax credits, offered throughout Orlando, Tampa and Miami.

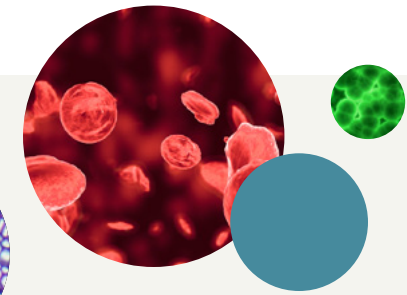
### Outlook

The Central and South Florida development projects will have a tremendous impact over the next 10 years on the region's life sciences community. These and related projects are expected to create more than 6,000 jobs and add significantly to the local economy. Expansions such as these significantly enhance the area's medical and research community, increases in direct funding will further support this active market and cement Florida's viability as a life sciences cluster.

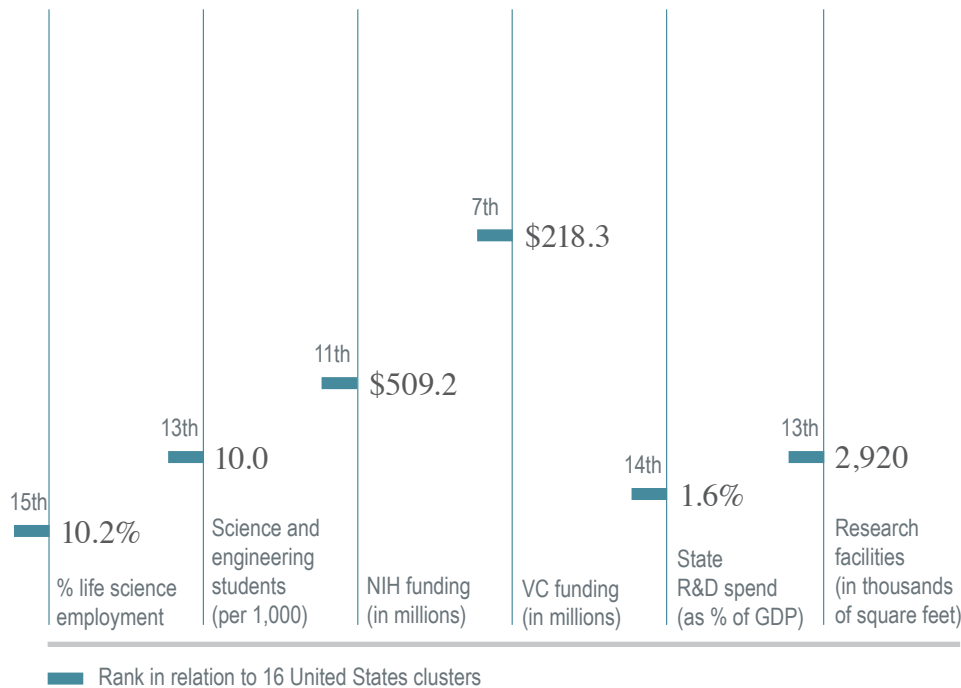
*The Central and South Florida development projects will have a tremendous impact over the next 10 years on the region's life sciences community.*

Emerging cluster

# Houston



Overall rank based on quantitative data, among 16 United States clusters.



*Houston's rich research resources and life sciences community are strongly rooted in the infrastructure provided by the Texas Medical Center.*

### Overview

Houston's emerging life sciences cluster revolves around innovation at the Texas Medical Center (TMC) located just outside of the Houston central business district. TMC has planned more than \$7 billion in capital projects through 2014.

Current activity around the TMC has been dominated by two developments in the 100-acre University of Texas Research Park. The first is GE Healthcare's \$55 million joint development of the Center for Advanced Diagnostic Imaging at the University of Texas Research Park. The center conducts imaging research and encourages commercialization of new medical technologies. Additionally, MD Anderson's new 85,000-square-foot, \$125 million Proton Therapy Center offers state-of-the-art radiation therapy to cancer patients.

# Houston

## *Industry framework*

### **Intellectual capacity**

With more than 42 colleges, universities and other degree-granting institutions, Houston benefits from an extensive pool of academic talent and resources. Top schools such as Baylor University, Rice University, the University of St. Thomas and the University of Houston all fuel local innovation. According to 2009 rankings by the National Science Foundation (NSF), the State of Texas held the first, second and third rankings for number of doctorates conferred in agricultural sciences, natural resources, health sciences and life sciences and biological/biomedical Sciences.

Houston has more than 275,000 employees in the high tech research and hospital and medical fields, more than 75 hospitals and clinics and representation from some large companies such as Alcon, Bruker, Bayer, US Oncology and Sigma Life Science.

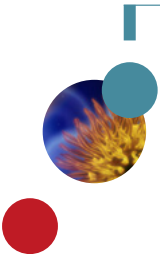
### **Innovation capital**

Located in Houston, the Texas Medical Center is the world's largest research and applied medical center, featuring a network of 49 leading non-profit and government institutions, including 13 hospitals and annually conducts more than \$1.2 billion in research.

The Richard E. Smalley Institute for Nanotechnology at Rice University provides the infrastructure, community and leadership necessary to promote nanotechnology research. Also at Rice University, the Rice Alliance for Technology and Entrepreneurship supports entrepreneurs and early-stage technology ventures with education, collaboration and research assistance. Additionally, the University of Houston Center for Life Sciences Technology serves the region as an impartial academic and research organization designed to facilitate the education and training of people to work in life sciences research and biotechnology organizations of the region and state.

### **Fiscal & political resources**

In 2003, the state of Texas authorized the \$295 million Texas Enterprise Fund (TEF). As of December 2010, \$77 of the \$97 million awarded went to life sciences companies in Houston, with an estimated employment impact of more than 7,200 jobs. More recently, the state of Texas approved a \$3 billion cancer research institute, which will distribute up to \$300 million in annual research funds over the next decade.



*According to 2009 rankings by the National Science Foundation (NSF), the State of Texas held the first, second and third rankings for number of doctorates conferred in agricultural sciences, natural resources, health sciences and life sciences and biological/biomedical Sciences.*

# Houston

BioHouston, a non-profit organization founded by area research institutions, works for partnerships with the business community to commercialize research among the area's centers of excellence.

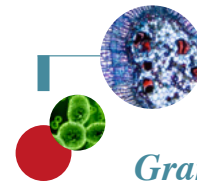
Specific available funding includes:

- Texas Emerging Technology Fund, which helps expedite development and commercialization of new technologies and recruits the best available research talent in the world
- Gulf Coast RCIC, processor of applications for Commercial Awards from the Texas Emerging Technology Fund
- BioHouston has established a match-making program to introduce emerging Texas life science companies to local and national venture capital firms and established life sciences companies
- Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) offers advice and information on applying, as well as a visual step-by-step overview for small business applicants.
- Various support networks for emerging companies include the Houston Angel Network, Rice Alliance for Technology and Entrepreneurship and the Texas Coalition for Capital

## Outlook

The city of Houston, with assistance from state government, has made great strides in recent years to promote and bolster the city's research institutions. Grant programs, industry-minded organizations and steady venture capital funding have helped the Texas Medical Center and its affiliates to develop a deep research capacity.

Outside of the institutions, companies, and facilities associated with TMC, however, Houston currently lacks the established commercialization infrastructure needed to move innovation out of the laboratory. Its geographic separation from mature coastal life sciences clusters is a challenge for the region as is the competition it faces from surrounding Texas cities.

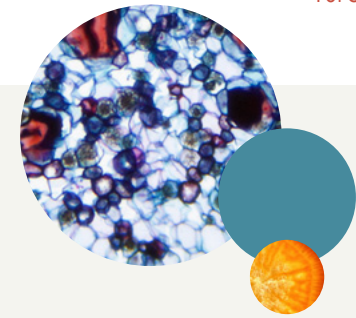


*Grant programs, industry-minded organizations and steady venture capital funding have helped the Texas Medical Center and its affiliates to develop a deep research capacity.*

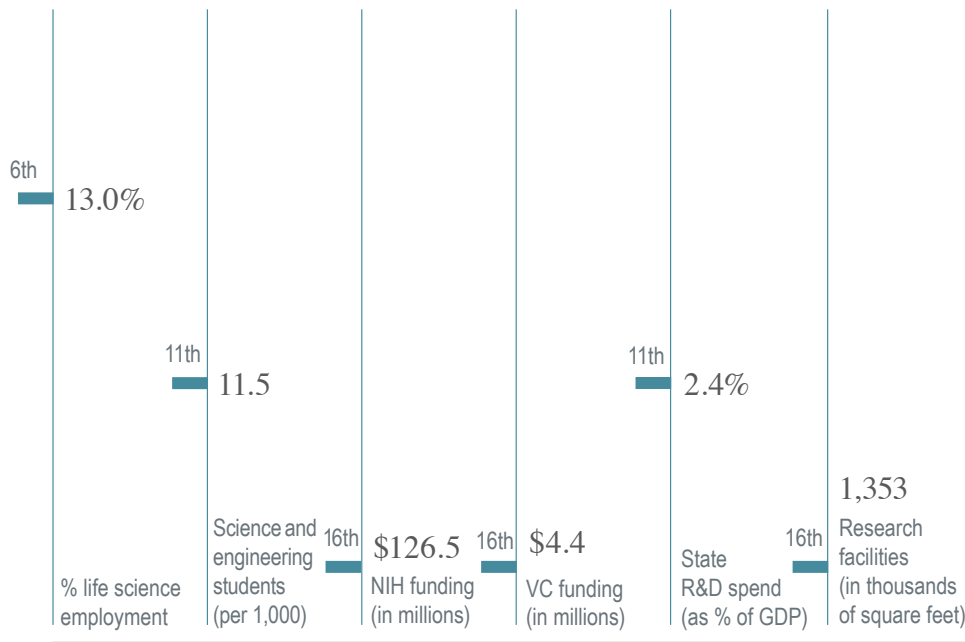


Emerging cluster

# Indianapolis



Overall rank based on quantitative data, among 16 United States clusters.



Rank in relation to 16 United States clusters

*The city of Indianapolis and surrounding areas have made enhancements to the cluster’s emerging life sciences sector a priority via development project funding, grant programs and aggressive business-friendly incentives to improve its viability in the global marketplace.*

## Overview

Indianapolis’s life sciences community has grown dramatically during the past decade, thanks in large part to the collaborative efforts of the state government, industry-focused organizations, area universities and leading area employers.

Eli Lilly, one of the industry’s largest pharmaceutical makers, is based in Indianapolis, and several of the largest medical device manufacturers, including Zimmer, Biomet and DuPuy Orthopedics, are headquartered in northern Indiana. Also in the area is medical manufacturer Cook Incorporated of Bloomington near Indiana

## — Indianapolis

University's main campus. Roughly 18 percent of the state's economic output is tied to life sciences, with more than \$13 billion in economic activity generated from central Indiana, where Indianapolis is located.

Eli Lilly owns and/or occupies more than 10 million square feet of office, lab and industrial space throughout metro Indianapolis, including a 120-acre campus downtown. In mid-2011, the company announced plans to enhance its downtown campus, adding green spaces, connections to bike/walking trails and other projects to improve accessibility. This is in addition to the \$155 million, mixed-use-development project 'North of South' currently underway by Eli Lilly and local developer Buckingham Cos. to replace more than 10 acres of Lilly parking lots with a hotel, YMCA branch and apartments. The company hopes the redevelopment project will not only enhance downtown Indianapolis, but also serve as a recruiting tool for young talent interested in living in a vibrant downtown setting.

In June 2011, a master plan was announced for up to one million square feet of development and redevelopment north of the IUPUI campus. Develop Indy, a public and privately funded economic development group, in collaboration with the City of Indianapolis, named the project '16 Tech', and plan to turn the area into a work, live and play district for biotechnology, research and other high-tech companies.

### **Industry framework**

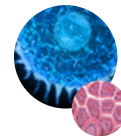
#### **Intellectual capacity**

The metro area is home to several large universities including Indiana University, Indiana University-Purdue University Indianapolis (IUPUI), the IU School of Medicine and Purdue University. The IU School of Medicine is the second largest-medical school in the United States and was designated by the National Institute of Health as a Clinical and Translational Sciences Institute for Translational Research. Purdue offers several top engineering programs and its School of Pharmacy is the second-largest in the county.

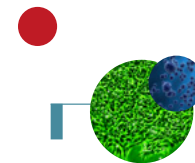
The state of Indiana is home to more than 800 life science-related businesses, with the largest representation in medical devices and pharmaceuticals.

#### **Innovation capital**

Regional universities are home to several centers of excellence including the Indiana University (IU) Medical Center, the IU Simon Cancer Center and the Alfred Mann Institute for Biomedical Development.



*Eli Lilly, one of the industry's largest pharmaceutical makers, is based in Indianapolis, and several of the largest medical device manufacturers, including Zimmer, Biomet and DuPuy Orthopedics, are headquartered in northern Indiana.*



## Indianapolis

In addition, several incubator programs have been established, to use university and private sector relationships to accelerate the growth of emerging companies. These include:

- Purdue Research Park of Indianapolis, now under development. The 1,500-acre project will provide state-of-the-art facilities and business accelerator resources to support emerging companies.
- Indiana University's Emerging Technology Center is an incubator for emerging life science, biotechnology and bioinformatics companies by promoting university-industry partnerships.

### Fiscal & political resources

Among U.S. life sciences clusters profiled, Indianapolis receives the lowest amount of National Institutes of Health (NIH) funding and had the lowest amount of venture capital funding in 2010. Because of this, local government and organizations have tried to improve the area's structure of financial incentives and programs.

BioCrossroads is the most notable public-private partnership and, to date, it has raised more than \$250 million in funds for life science initiatives managed through three separate funds. The Indiana Future Fund and the INext Fund were established as venture capital umbrella groups, while the Indiana Seed Fund provides capital to newly forming companies.

Statewide, life science companies made nearly \$1.8 billion in capital investments from 2005 to 2010. One of Indianapolis's largest companies, Eli Lilly, also makes philanthropic grants to area research universities and institutes.

The state of Indiana is extremely business-friendly, with no inventory or gross receipts taxes and a flat, low corporate adjusted gross income tax based on in-state sales only. Indiana is one of only a few states that has not enacted general tax increases in recent years. Several other programs or incentives have been created to benefit the industry. These include:

- The Venture Capital Investment tax credit
- Indiana 21st Century Research and Technology Fund, with financial support to entrepreneurial ventures focused on the commercialization of innovative technologies
- Patent Income Tax Exemption, which exempts taxpayers from certain income related to utility and plant patents
- Research and Development Tax Credit for increases in the increase of Indiana R&D
- Research and Development Sales Tax Exemption, which exempts a business from 100 percent of the sales tax on R&D equipment

### Outlook

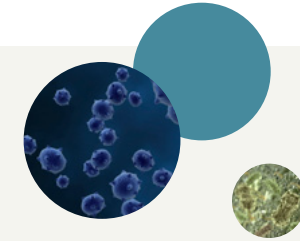
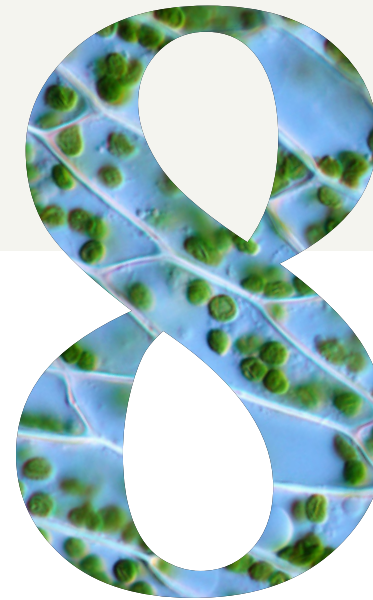
While Indianapolis's life sciences industry has made great strides in recent years, the area needs to further solidify relationships between university programs and established companies in the industry. As the emerging cluster's companies continue to innovate and advance their offerings, they will need a highly educated workforce with specialized graduate degrees to staff future companies. Development projects like North of South and 16 Tech are expected to attract emerging companies to the area; proximity to universities, research centers and established companies like Eli Lilly should bolster budding ventures.

Additionally, the area will need to keep venture capital and grant programs active. Given the area's NIH and venture capital shortcomings, local government and organizations will need to develop ways to fill this gap and fund early stage innovation.

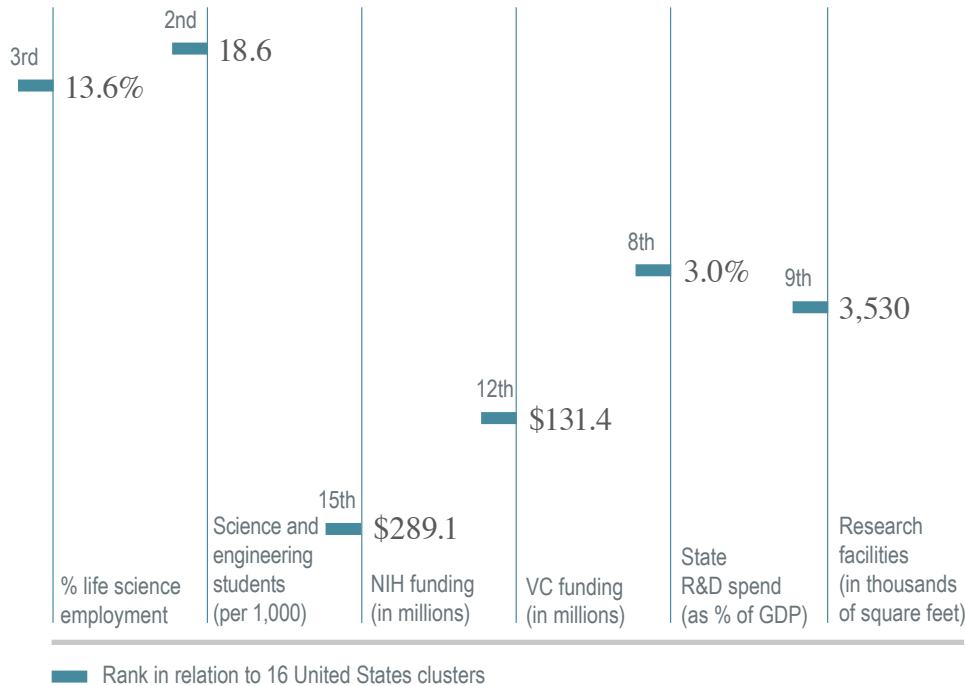
*Development projects like North of South and 16 Tech are expected to attract emerging companies to the area.*

Emerging cluster

# Minneapolis



Overall rank based on quantitative data, among 16 United States clusters.



*Despite a lack of innovation-friendly incentives and programs, Minneapolis’s deep intellectual resources prime the region for growth and development.*

### Overview

Minnesota’s economy is about 24 percent more dependent on the life sciences than the national average. Ventures in the area compete in a variety of industry sectors such as medical devices, biopharmaceuticals, animal health, agricultural biotechnology and biofuels. Over the past five years, Minnesota has outpaced the nation in the growth of its biobusiness technology industry. The workforce has increased by 20 percent with growth led by the medical devices sub-sector.

Success in life sciences is anchored in the state’s agricultural and medical technology industries, but is made possible by the strength of its high-technology industries. In partnership with government and academia, these segments of the state’s industrial sector

# — Minneapolis

historically have worked together to create an economic environment that has positioned Minnesota as one of the top emerging life sciences clusters. The Twin Cities currently employs about 28,000 workers in medical technology and is home to med-tech giants such as Medtronic Inc. St. Jude Medical Inc. and 3M Healthcare, among others.

## *Industry framework*

### **Intellectual capacity**

Solid funding in education and infrastructure has contributed to high-quality life sciences jobs in Minnesota. Among the 16 United States markets examined in this report, Minneapolis scored second in the number of science and engineering graduate students and third for the percent of high tech research and medical/hospital-related employment.

### **Innovation capital**

The University of Minnesota, one of the top public research institutions in the country, has made a significant investment scientific research through its Biomedical Discovery District. The district is a cluster of five state-of-the-art research facilities. Within the Biomedical Discovery District, nearly 1,000 people, including 165 faculty researchers, work in 700,000 square feet of flexible research space to find new cures, treatments, and preventions.

Outside of the University of Minnesota, the Twin Cities has no significant research parks or R&D centers of excellence, nor are there any development plans in the near future. Non-profit organizations and public committees, such as the Minnesota Science and Technology Economic development Project Committee, have supported development through enhanced incentive programs.

### **Fiscal & political resources**

Minnesota adopted an expanded R&D tax credit in early 2010. It includes:

- 10 percent refundable credit for first \$2 million spent on qualified R&D expenditures
- 2.5 percent for all qualified expenditures over \$2 million
- Expansion of qualifying companies to include S corporations, partnerships, and individuals
- Refundable: if the amount of tax credits qualified for exceed a company's Minnesota tax liability, the balance will be paid as a tax refund

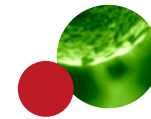
The improved R&D tax credit will support further growth of research and development in Minnesota by encouraging expansion of existing companies and location/relocation of R&D facilities from companies based elsewhere.

Unlike many states, Minnesota has no incentives for angel investors and no state funds for seed, early stage or gap funding.

## *Outlook*

The life sciences industry in Minnesota seeks to reprioritize funding, partnerships and political support. Unlike nearly 30 other states, Minnesota has not developed, funded, or implemented a major, comprehensive science and technology initiative to support recruitment and retention of top talent, develop and maintain infrastructure, encourage research, and attract external financing critical to Minnesota's competitive position in the growing knowledge-based economy.

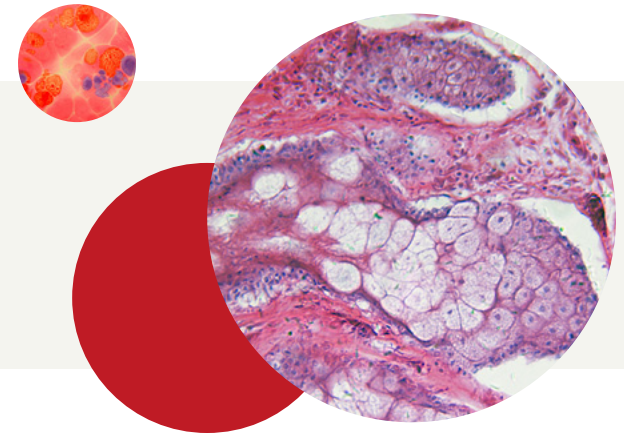
To counter this reality, both public and private parties are taking action. Minnesota's two largest non-profit organizations representing the life science industry, LifeScience Alley and The BioBusiness Alliance of Minnesota, have announced a strategic affiliation to strengthen the state's economy and leadership in the life sciences.



*The Twin Cities currently employs about 28,000 workers in medical technology and is home to med-tech giants such as Medtronic Inc. St. Jude Medical Inc. and 3M Healthcare, among others.*

Emerging cluster

# Canada



1.9%

R&D expenditure  
(% of GDP, 2007)

4,260

Researchers in  
R&D (per million  
people, 2006)

18.0%

High technology  
exports (% overall  
exports, 2009)

10.9%

Total health  
expenditure  
(% of GDP, 2009)

11

World economic  
forum's innovation  
rank (out of 142)

*Strong flows of intellectual and Innovation capital drive development of Canada's life sciences industry. Increased financial resources are needed to commercialize the nation's biotech research.*

## Overview

Canada's life sciences-related research and development expenditures accounted for roughly 1.95 percent of GDP nationally in 2009 and are currently valued at over C\$80 billion (\$81 billion)<sup>1</sup>. Realizing the growing industry's potential impact on the Canadian economy, incentives and grants are being built-in at the federal, provincial and local levels to ensure that life sciences industry has a significant chance of flourishing.

Nearly all members of Big Pharma have Canadian operations and/or partnerships with local companies and represent some of the nation's largest spenders on life science R&D. These include Pfizer, GlaxoSmithKline, Merck, Novartis, Sanofi and AstraZeneca. Also ranking high among the nation's R&D-

spenders are several regionally headquartered companies such as Apotex, Neurochem and Biovail, which recently merged with fellow-national Valeant Pharmaceuticals. Other large Canadian companies include Nordion, Paladin Labs, Atrium and Theratechnologies.

The current Canadian landscape has given rise to growing research communities with universities, research parks and incubation centers driving much of the development of the biotech and life sciences sectors. Although activity is spread throughout the nation, clusters are forming around areas where these key resources are already in place, namely within major cities in the provinces of Ontario, Quebec and British Columbia.

# — Canada

## ***Industry framework***

### **Intellectual capacity**

Research and development-related employment reached nearly 160,000 people in 2008, including professionals, technicians and support staff. Upwards of 5,200 life sciences-related companies are located throughout the country, including roughly 600 biotech development companies, 200 biotech supplier and engineering providers, 100 medical technology companies and 200 public sector biotechnology organizations.

Research facilities at the country's top universities play an integral role in the industry. These include McMaster University, the University of Ottawa, and the University of Toronto in Ontario; Université Laval and McGill University in Québec; the University of Alberta and the University of British Columbia.

### **Innovation capital**

Since 1989, the Networks of Centres of Excellence (NCE) has helped mobilize and engage some of the best academic research talent in Canada while supporting partnerships from the private sector, the three tiers of government and non-profit groups. Support from granting agencies, such as the Natural Sciences and Engineering Council, the Canadian Institutes of Health Research and the Social Sciences and Humanities Research Council, is a central component of the NCE's efforts. Much of the research conducted in the life sciences industry is driven by Canadian universities in collaboration with the NCE. Combined, there have been more than 36,000 skilled personnel trained and more than 100 spin-off companies created since the partnership's inception.

Some prominent centres of excellence in Canada include Centre for Commercialization of Regenerative Medicine in Toronto, Ontario, the Centre for Drug Research and Development in Vancouver, British Columbia and the Institute for Research in Immunology and Cancer— Commercialization of Research in Montreal, Quebec.

### **Fiscal & political resources**

Canada offers federal tax credits for Scientific Research and Experimental Development (SR&ED) expenses. The credits vary depending on R&D spending totals, with C\$3 million (\$3.05 million)<sup>1</sup> as the threshold. Additional sums are available for small Canadian-controlled private companies. British Columbia, Ontario and Quebec offer additional credits of varying sizes, again determined by the type and size of corporation.



***Ranking high among the nation's R&D-spenders are several regionally headquartered companies such as Apotex, Neurochem and Biovail, which recently merged with fellow-national Valeant Pharmaceuticals.***

## Canada

Ontario provides additional incentives, including:

- Ontario Business Research Institute Refundable Tax Credit, which provides up to C\$4 million (\$4.07 million)<sup>1</sup> for pre-clinical research
- The Next Generation of Jobs Fund, which grants a maximum of 15 percent of a company's R&D budget for those that invest a minimum of C\$25 million (\$25.5 million)<sup>1</sup> or create at least 100 jobs
- Ontario Venture Capital Fund, with C\$160 million (\$163 million)<sup>1</sup> in capital and a planned expansion to C\$270 million (\$275 million)<sup>1</sup>
- The Ontario Innovation Development Fund, offering grants of up to C\$4 million (\$4.07 million)<sup>1</sup> per company over a two-year period to certain early stage companies

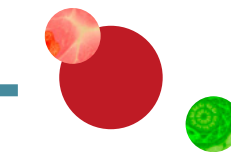
Further, the Canadian Biotechnology Strategy (CBS), launched in 1998, is the federal government's biotechnology plan. More than C\$65 million (\$66 million)<sup>1</sup> per year is spent on projects and includes The Canadian Biotechnology Strategy Fund, the Canadian Regulatory System for Biotechnology and the intramural Genomics Research and Development Program.

### Outlook

Investment capital will be the biggest hurdle for Canada's emerging life sciences sector. The recession reduced spending in the sector and although venture capital returned in 2011, remains in short supply. The recent announcement that the expansion of MaRS (research incubator) Phase II has resumed suggests that there is demand for such facilities.

Partnership and venture capital from foreign investors will be an important component of Canada's future life sciences growth. This will require a more investment-friendly tax environment to encourage additional foreign participation.

1. Six month average conversion rate of C\$0.98 per US dollar, as of October 2011.



*Partnership and venture capital from foreign investors will be an important component of Canada's future life sciences growth.*



Emerging cluster

# Brazil



1.1%

R&D expenditure  
(% of GDP, 2007)

657

Researchers in  
R&D (per million  
people, 2007)

14.0%

High technology  
exports (% overall  
exports, 2009)

9.0%

Total health  
expenditure  
(% of GDP, 2009)

44

World economic  
forum's innovation  
rank (out of 142)

*The Brazilian government hopes to grow its innovation capabilities in agricultural and human-use biotechnologies, leveraging current representation in manufacturing aspects of the industry.*

## Overview

Brazil has enjoyed one of the fastest growing economies over the past few decades and could continue its upward momentum as a leading South American economy. Advancements to its national healthcare system and national interest in the life sciences will funnel economic growth to the industry.

Brazilian-national companies continue to attract interest from foreign investors and players, predominantly in the manufacturing aspect of the value chain. Most recently, the Pall Corporation announced an agreement to acquire its Brazilian distribution partner, Engefiltro. Earlier this year, Amgen purchased the Brazilian pharmaceutical firm Bergamo and re-acquired several products from Hypermarchas for distribution in the Brazilian market.

Brazil has welcomed advancements in clinical trials, generics, agricultural biotech and biofuels. During the past few years, large industry players such as Sanofi, Pfizer, Valeant and Watson pharmaceuticals each made acquisitions or partnership deals with Brazilian generic-makers. Brazil is also a leading producer of genetically modified crops and draws upon renewable sources to meet its energy needs thanks to its strong agrarian roots. As the world's largest producer of sugarcane (used to make ethanol), the country will continue to play an important role in biofuels.

# Brazil

## Industry framework

### Intellectual capacity

The University of São Paulo and the State University of Campinas host a majority of the country's research and related degree programs. Although these universities are not world class, they are working to enhance their programs with the help of many government-funded incentive programs. Brazil is home to 90 biotech companies.

On the production end, Brazil is challenged by a relatively weak labor quality. The workforce is largely unskilled for life sciences purposes particularly in the areas of quality assurance, production and logistics. Only one technical school, the Institute of Science, Technology and Industrial Quality (ICTQ), has programs to meet the technical needs of the industry.

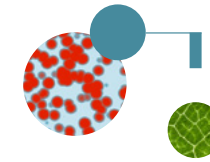
### Innovation capital

The Butantan Institute, affiliated with the São Paulo State Secretary of Health, is a research development and training center and is the largest producer of immunobiologics and biopharmaceuticals in Latin America.

In March 2011, the São Paulo state government announced plans for the country's first plasma fractionation plant. Located within the Butantan Institute, the plant is being built to respond to World Health Organization (WHO) standards that call on every country to have production facilities for blood by-products and vaccines. The São Paulo government enlisted the advisory services of GE Healthcare and expects the plant to be operational by mid-2012, with product commercialization to begin in 2013.

### Fiscal & political resources

Over the past two decades, the Brazilian government has encouraged development of the nation's innovation industries.



*Brazil invests roughly one percent of its GDP on research and development with plans to increase such investments to 1.5 percent.*

With the passage of the intellectual property laws in 1996, patents on pharmaceutical products were granted for the first time, marking a major turning point. Since that time, the government has added protections for innovation.

- The Innovation Law of 2004 offers incentives for developing partnerships between private companies, research institutions and universities, incentives for universities and research institutions to participate in innovation, and incentives to promote innovation within private institutions.
- The Law of Goods offers private sector incentives to invest in R&D.
- The government's industrial policy prioritizes the development of domestically owned private pharmaceutical manufacturers. Most notably, the Profarma-Innovation program, operated by the government's development bank, Banco Nacional de Desenvolvimento Econômico e Social (BNDES), is investing about R\$2.5 billion (\$1.5 billion)<sup>1</sup> in the industry through 2012.

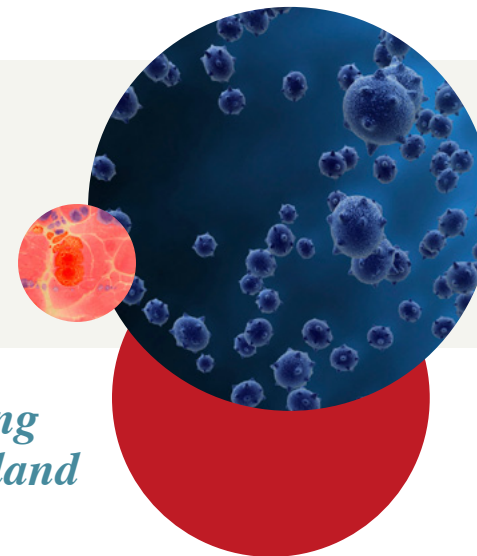
Brazil invests roughly one percent of its GDP on research and development with plans to increase such investments to 1.5 percent. More than half of the R&D spending is publicly funded; many of the aforementioned efforts aim to increase private sector investment in the industry.

## Outlook

Perhaps one of the biggest challenges for Brazil's future as a biotechnology hub is the inability to bring to market its discoveries. Although life science and healthcare disciplines account for more than 25 percent of the research conducted at Brazilian universities, they represent 3.2 percent of patent registrations in the country, according to a study by Prospectiva Consultoria. Lack of seasoned industry professionals and R&D facilities combined with leery foreign and domestic investors will continue to challenge Brazil's development of a high-tech hub.

1. Six month average conversion of R\$1.64 per US dollar as of October 2011.

# *Puerto Rico*



*Over the past five decades, many of the industry's leading players have moved manufacturing operations to the island to take advantage of incentives and reduced taxes.*

## **Overview**

The Commonwealth of Puerto Rico has deep-seated roots in pharmaceutical and medical device manufacturing. Puerto Rico is home to more than 140 FDA, EMA and MHLW-approved pharmaceutical and device plants and produces products for distribution in the United States, European Union and Japan.

Puerto Rico enjoys representation from some the industry's largest companies, including Eli Lilly, Merck, Pfizer, Johnson & Johnson, Novartis, GlaxoSmithKline, Bristol Myers Squibb, Abbott Laboratories and AstraZeneca. Big Pharma's presence is rooted in the offshore manufacturing sites established since the 1960s. Investment since that time has been focus on modernization, with a few high-tech labs and R&D facilities.

At mid-year 2011, Monsanto announced plans to construct a 20,000-square-foot R&D lab to replace temporary facilities with permanent ones in the southern town of Juana Diaz. The expansion is valued at \$4.3 million and is expected to create nearly 50 jobs. In June 2011, Legacy Pharmaceuticals announced a \$34 million expansion project over the next five years at its Humacao complex, adding 300 jobs. Legacy will receive more than \$1.5 million in job-creation incentives from the Puerto Rico Industrial Development Company (PRIDCO).

Additionally, Merck, Sharp & Dohme, the British-based subsidiary of Merck & Co., announced a \$65 million investment plan at its Barceloneta site. The company will build a new plant and employ an additional 200 people.

## **Industry framework**

### **Innovation capacity**

The primary academic research institution is the University of Puerto Rico (UPR), which features multiple locations throughout the island including the UPR Medical Sciences Campus in San Juan. Other academic institutions include the Ponce School of Medicine and the San Juan Bautista School of Medicine.

### **Innovation capital**

One of the largest groups working to develop the island's capabilities is the Puerto Rico Science, Technology and Research Trust. Beyond its efforts to build the territory's talent pool and transfer technology from the workbench to the marketplace, the trust's flagship initiative is its San Juan Knowledge Corridor. The planned 2,000-acre "science city" will encompass a mix of educational, commercial, laboratory and residential space. The campus will connect to existing

## *Puerto Rico*

infrastructure at UPR's Rio Piedras Campus, Medical Sciences campus and the future UPR/MD Anderson Comprehensive Cancer Center and Molecular Sciences Complex, in addition to 11 area hospitals.

Also working in close collaboration with the Science, Technology and Research Trust is the Puerto Rico Industrial Development Company (PRIDCO) and the Pharmaceutical Industry Association of Puerto Rico (PIA PR).

### **Fiscal & political resources**

Puerto Rico's life sciences industry began as a destination of choice for offshore manufacturing due to low local corporate income taxes (no higher than seven percent) and no U.S. federal income tax.

Other financial incentives include a 200 percent tax credit for R&D and job training costs, accelerated depreciation for investment in buildings, machinery and equipment and tax credits and deductions applicable for 10 to 25 years, depending on eligibility. Puerto Rico also boasts a foreign trade zone status, which means raw materials, components and finished goods may be stored and transported tax free, U.S. duties are deferred and no U.S. duties and Puerto Rico excise tax payments on products exported to foreign markets.

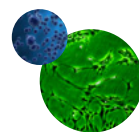
In October 2010, a four percent tax was introduced under Law 154, impacting all offshore companies with manufacturing operations in Puerto Rico. Although the measure received heavy criticism from the industry at the outset, the new law seems to be benefiting U.S. pharma companies. In March 2011, the Internal Revenue Service announced that U.S.-based parent companies with Puerto Rican manufacturing operating that are subject to Law 154 may claim a federal tax credit against the levy. The lack of industry involvement during the legislative process has been called into question and such lack of transparency may discourage drug makers from expanding operations on the island.

As a United States territory, Puerto Rico benefits from national funding programs and grants. In 2010, the National Institutes of Health granted \$59 million to the Commonwealth of Puerto Rico. Although this amount was well below other emerging life science markets in the United States, it does represent an important funding source for the island and its research institutions. Additionally, its territory status means operations on the island benefit from the same intellectual property protection and FDA rules as on the mainland.

### ***Outlook***

In recent years, the local government has become more interested in life sciences innovation and R&D. However, Puerto Rico faces an uphill battle. The advantage once held by lower-cost operations is being challenged by developing countries throughout Asia and other parts of Latin America, while on the R&D front it competes with other emerging markets in the United States. The island is not as well positioned for successful innovation as most U.S. markets.

Despite Puerto Rico's line-up of top industry names, facilities on the island receive a disproportionate amount of warnings and citations from the FDA when compared to other facilities in the United States. A University of Ohio report in September 2011 found that quality issues are more likely to occur at offshore sites, citing challenges in the transfer of knowledge and language and cultural barriers as the reasons.



*The Commonwealth of Puerto Rico has deep-seated roots in pharmaceutical and medical device manufacturing.*

France, Germany, Switzerland and United Kingdom

# EMEA

*In this section we review established clusters in Europe that are home to a range of pharmaceutical, biotechnology and medical device companies.*



A rich mixture of factors, including high-quality infrastructure, stability, a history of innovation, ease of doing business and some of the world's best educational establishments, continue to attract investment in the region.

Like the United States and other mature life science markets, Europe is increasingly facing challenges to its primacy from emerging markets across the globe. But despite the challenges and changing geographic scope of global life science companies, major established European clusters are sure to remain critical for the industry going forward.

## Established

**France**

**Germany**

**Switzerland**

**United Kingdom**

Established cluster

# France



2.0%

R&D expenditure  
(% of GDP, 2007)

3,496

Researchers in  
R&D (per million  
people, 2007)

23.0%

High technology  
exports (% overall  
exports, 2009)

11.7%

Total health  
expenditure  
(% of GDP, 2009)

17

World economic  
forum's innovation  
rank (out of 142)

*France is one of the leaders in the life sciences industry, thanks in large part to the size of its market. It is first in Europe in terms of medicine production by volume and among the main global pharmaceutical exporters.*

## Overview

France's life sciences industry produces yearly revenue of about €47 billion (\$66.5 billion)<sup>1</sup> and reinvests more than €1 billion (\$1.4 billion)<sup>1</sup> each year. The country is acknowledged for the quality of its research and for its history of therapeutic innovation and it benefits from the best health system in the world, according to the OECD.

The French landscape is clearly dominated by the Paris region due to its strategic location and its high education level, important concentration of prestigious hospitals and high-tech research. Consequently, Paris and its closest suburbs host most of the largest pharmaceutical headquarters. Even though there are no easily identifiable submarket clusters,

it is nonetheless possible to spot some higher concentrations of laboratories in the first western inner suburb which include Roche, Ipsen and Pierre Fabre at Boulogne, Servier at Suresnes, Bayer Schering at Puteaux, AstraZeneca, Bristol-Meyers Squibb (BMS) at Rueil Malmaison, and to a lesser extent in the south outer suburb.

The ambitious plan for "Grand Paris", a major urban planning project to reinforce the position of Paris as a leading city on the international scene, also involves a dedicated cluster located in the Villejuif/Evry submarket. This cluster will specialize in healthcare and life sciences, capitalizing on high-level research institutes specializing in a variety of treatment arenas.

# France

Pharmaceutical production is spread among several big urban areas, essentially in the Paris region, the centre of France (Centre) and the south east (Rhône-Alpes).

The life sciences market in France, like many mature life sciences markets globally, is in the midst of significant change. Restructuring of operations, consolidation, mergers and acquisitions are all impacting the overall shape and geography of the sector, leading many industry participants to challenge and re-think the way they structure and coordinate their different activities.

There is a clear trend towards outsourcing, especially of pharmaceutical production, to better focus on the most strategic activities. An important concern of life science companies is cost reduction via the rationalization of the real estate portfolio. Many larger groups are looking at multi-site consolidation options and lease renegotiation.

Business rationalization is also having a clear impact on space utilization and translates directly into real estate strategies. A move away from working in cellular offices has been evident, with several companies now introducing more open plan designs for headquarters. Many industry participants have also increased densities and have restructured portfolios as part of wider rationalization. Sanofi, Merck and Roche provide good recent examples of this trend of restructuring and rationalization.

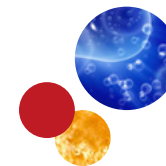
To optimize resources, sale-lease back operations have also been favored. Merck and BMS are two recent examples of companies that have chosen this route to raise capital and increase occupational flexibility.

## Industry framework

### Intellectual capacity & innovation capital

The biopharmaceutical sector in France involves more than 104,000 employees. Education is also an important asset, with more than 18,000 new highly qualified graduates produced by the French higher education system each year.

The sector benefits from significant investment, with about €4.9 billion (\$6.9 billion)<sup>1</sup> spent annually on R&D, according to 2008 figures. The biotech network is especially dynamic in France, with strong leaders operating in niche markets and growing on the international scene including BioAlliance, Nicox and ExoHit.



*The French landscape is clearly dominated by the Paris region due to its strategic location and its high education level, important concentration of prestigious hospitals and high-tech research.*

## France

Several dedicated research centres focused on high-tech biology or new therapies have been created both within Paris, and throughout France, these include:

- Lyonbiopôle, Rhône-Alpes. Dedicated to infectious pathologies, vaccines and nano-biotechnologies
- Medicen Paris Région, Ile-de-France. Dedicated to infectious pathologies, central nervous system, cancer.
- Alsace BioValley, Alsace. Dedicated to therapeutic innovations.
- Nutrition Santé Longévité, Nord Pas de Calais. Specialized in the impact of nutrition on health.
- Cancer Bio Santé, Midi-Pyrénées. Dedicated to research on the cancer and innovative therapeutics.
- EuroBioMed, Provence-Alpes-Cote-d'Azur et Languedoc Roussillon. Focusing on rare diseases.
- Atlantic Biothérapie, Pays de la Loire. Specialized in cellular and tissue engineering and immunotherapy.

### Fiscal & political resources

The life sciences industry in France benefits from a significant commitment from the French government. The strategic council for the health industries, chaired by the President, includes government agencies and industry leaders to establish specific measures such as tax credits for research, more efficient clinical testing, or budgets that include funds to assist biotech companies.

Industry growth is also based on strong partnerships with the public sector, enjoyed by a full range of market participants, from big international companies to smaller businesses, start-ups and academic research laboratories.

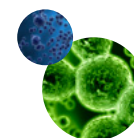
### Outlook

The French life sciences industry remains one of the largest in Europe. It has won and maintained its leading position in pharmaceutical production for 15 years. Like other mature markets in Europe, this record is now challenged by regional and global competitors.

The life sciences sector is mature, with traditional pharmaceutical companies facing growing competition from generic drugs, which are actively encouraged by health care cost reduction efforts. Vigilance from local and international health authorities continues to impact the number of new products, and a growing pressure on costs, in the context of the economic crisis, is reducing the resources available for investment in healthcare.

However, the outlook for the life sciences sector within France remains solid. Strong existing clusters, a deep presence from established international life science companies, renowned centres of research and a favorable incentive program for new investment from the French government will continue to support growth in the sector.

1. Six month average conversion rate of €0.71 per US dollar, as of October 2011.

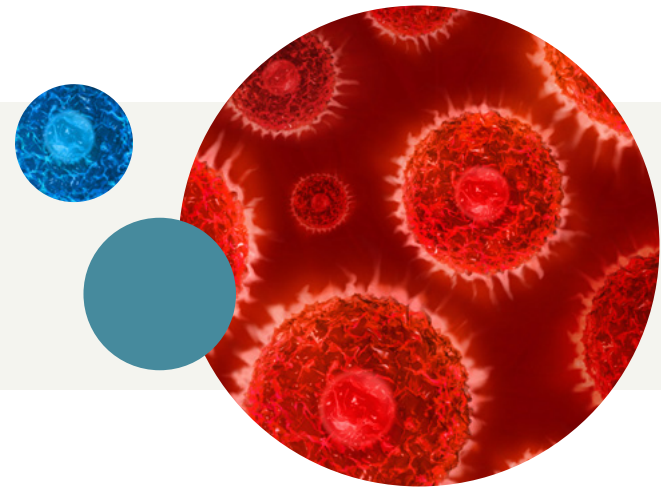


*The life sciences sector is mature, with traditional pharmaceutical companies facing growing competition from generic drugs, which are actively encouraged by health care cost reduction efforts.*



Established cluster

# Germany



2.5%

R&D expenditure  
(% of GDP, 2007)

3,532

Researchers in  
R&D (per million  
people, 2007)

16.0%

High technology  
exports (% overall  
exports, 2009)

11.3%

Total health  
expenditure  
(% of GDP, 2009)

7

World economic  
forum's innovation  
rank (out of 142)

*Germany's increasing consumer demand as a result of healthcare reform and a government push for high-tech industry growth will support activity in the country in the near-term.*

## Overview

The life science sector in Germany continues to grow in importance and is one the largest in Europe. The German pharmaceutical sector's export ratio grew from 36 percent in 1995 to more than 50 percent in 2009, and rising life expectancy and increasing health awareness in the country with Europe's largest population (82 million) also drives consumer demand. Germany is the fifth largest location for dedicated biotechnology companies within the OECD.

Even during the economic crisis, the life sciences industry in Germany showed resilience. In 2009, the pharmaceutical sector grew by 5 percent, while the broader manufacturing industry saw a decline by 18 percent. This stability was also reflected in employment statistics, which fell by less than 1 percent in 2010.

However, investment spending by research-based pharmaceutical companies fell by 14 percent in 2010.

The life sciences industry has a number of industry-relevant clusters across Germany, the largest of which are located around Munich, Berlin, the Rhine Neckar triangle and Ruhr area. One of Europe's most important biotech clusters, the BioRegion Ulm, comprises 60 biotechnological, pharmaceutical and medical-technology companies, while the Munich Biotech Cluster is made up of more than 200 companies, employing some 16,000 people.

Half of Germany's newly formed companies in 2010 were located in the Munich area, in the Federal State of Bavaria. Various chemical parks in Germany also provide specific

## Germany

location advantages to companies and investors, and the logistics infrastructure, often combining various transport modes in one location, ensures Germany's international connectivity.

### *Industry framework*

#### **Intellectual capacity**

The pharmaceutical industry employs around 126,000 people and is growing. In addition to global companies such as Merck KGaA and Boehringer Ingelheim, Germany supports a large number of smaller life sciences companies. About 92 percent of pharmaceutical manufacturing companies in Germany employ fewer than 500 people. In the commercial biotechnology sector, the number of employees grew by three percent to 32,500 in 2010. Germany ranks first in Europe for production of chemicals and biopharmaceuticals.

#### **Financial & political resources**

The life sciences industry is considered the leading sector for innovation in Germany. €1.2 billion (\$1.7 billion)<sup>1</sup> were given in grants from 2006–2009 for innovations in biotechnology, pharmaceuticals and medical technology as part of the federal government's "High Tech Strategy"<sup>2</sup>, and federal grants of more than €5.5 billion (\$7.8 billion)<sup>3</sup> have been dedicated to the health care sector's research during the period ending in 2016. Only the United States exceeds this volume of support. In terms of intellectual property protection and planning and operating security, Germany is one of the best locations globally, according to the World Economic Forum. The industry also benefits from a number of renowned universities and research institutes, including the Max Planck Society and the Leibniz Association. Life sciences and biomedical engineering programs are offered by more than 60 national universities.



*The life sciences industry has a number of industry-relevant clusters across Germany, the largest of which are located around Munich, Berlin, the Rhine Neckar triangle and Ruhr area.*

Healthcare reform in Germany is also likely to boost areas of the life sciences industry. Generic drugs and health management are two areas that will be promoted in the course of healthcare reform that became effective in 2011. Special provision is also being made for the pharmaceutical and biotechnology industries.

The National Research Strategy BioEconomy 2030 and the Health Research Framework Programme, both of which were implemented by the German federal government in 2010, provide further political support for the industry. Funding of about €8 billion (\$11.3 billion)<sup>3</sup> is available for allocation over the next years as part of this programme.

### *Outlook*

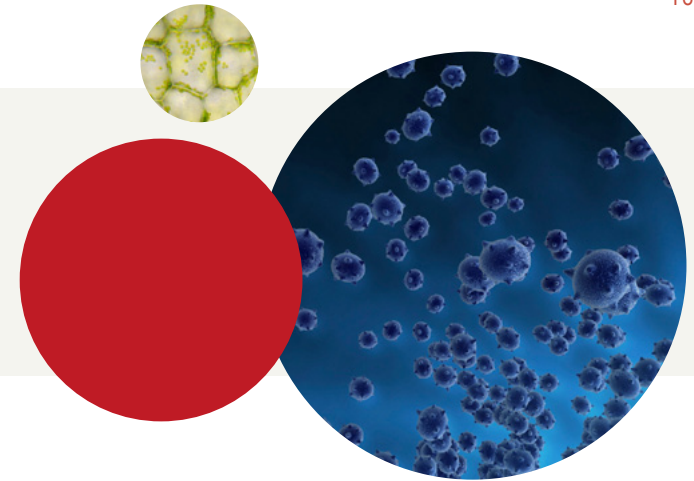
Similar to fellow Western European markets active in life science, Germany will continue to be subject to global competition as the life sciences sector restructures its operations and real estate portfolio to fit the new realities of emerging markets in Asia and Latin America. In the short term, economic uncertainty and Eurozone concerns will also dominate news flow.

However Germany remains one of the most important markets for life sciences in Europe, and a productivity rate 10 percent above the average of Europe's 15 core economies makes Germany one of the more attractive business locations in Europe. Additional positive factors include the positive R&D environment and partnerships with universities and research centres.

1. Six month average conversion rate of €0.71 per US dollar, as of October 2011.
2. The Government's "High Tech Strategy aims at reaching the Lisbon/ Barcelona objectives of the EU, that is to increase R&D expenditures to at least 3 percent of the GDP until 2010. This aim has not yet been achieved.
3. See footnote 1.

Established cluster

# Switzerland



2.9%

R&D expenditure  
(% of GDP, 2004)

3,436

Researchers in  
R&D (per million  
people, 2003)

25.0%

High technology  
exports (% overall  
exports, 2009)

11.3%

Total health  
expenditure  
(% of GDP, 2009)

1

World economic  
forum's innovation  
rank (out of 142)

*Academic excellence, high-profile education programs and the high quality of life render Switzerland not only very competitive in the global market for life sciences talent, but increasingly at the entrepreneurial level too.*

## Overview

Switzerland is one of Europe's most established life sciences locations. For the second year running, Switzerland was rated number one in the World Economic Forum's Global Competitiveness Report 2010–2011, reflecting its advantages for the life science industry and other research, production and service companies. Switzerland is also a leader in education and is one of the world's most active countries in research.

The density of biotech companies in Switzerland is unparalleled world-wide. Its life sciences companies range from large multinational corporations such as Merck Serono, Novartis and Roche to innovative start-ups.

The main clusters of life science activity can be found in Basel (BioValley), Zurich (Greater Zurich Area) and in Geneva (BioAlps).

There, the highly concentrated presence of the life sciences industry, universities and government assistance for spin-offs support the vibrant life sciences activities in these areas.

Aided by the proximity of top pharmaceutical companies such as Roche and Novartis and by the strong financial sector in Zurich, academic excellence in the biomedical sciences serves as a motor for innovation in the biotech and medtech sector.

Joint activities of universities and private companies provide favorable conditions for young start-up companies. Benefits such as low-cost rental space at the university's labs during the first years and the availability of biotech parks and business incubators in and around Zurich also support life sciences growth.

# — Switzerland

## *Industry framework*

### **Intellectual capacity & innovation capital**

Switzerland has a strong record of creativity and innovation. In the 2010 Innovation Union Scoreboard—a comparative analysis of innovation performance among the countries of the European Union—Switzerland ranked first, confirming its position as Europe’s leader in innovation.

Swiss universities and institutes of technology conduct research at the highest level, working closely with the international research community. The country’s scientific research institutions rank amongst the world’s best.

The Swiss Federal Institute of Technology Zurich, the ETH Zurich, is the top-ranked university in continental Europe, and the University of Zurich, with its University Hospital, is among the top five European universities in biomedical science. Synergies between the two institutions abound, greatly advanced by physical vicinity and complementary research as well as by advanced degree programs.

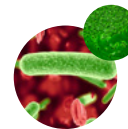
### **Fiscal & political resources**

Life sciences are the dominant start-up industry in Switzerland and benefit from good access to private sources of capital. In the past decade, the sector has emerged as the dominant investment field among innovative start-up firms both in numbers of transactions and in total amounts of investment. After the dot-com bubble burst in 2001, life sciences raced ahead of all other sectors in terms of venture capital investment. Its share has risen from about 20 percent to more than 70 percent since 2004. Even in such a well-developed entrepreneurial ecosystem as Switzerland’s, life sciences have become the most important destination for venture capital.

## *Outlook*

In the short term, the massive appreciation of the Swiss franc, as a result of broader global macroeconomic uncertainty and Switzerland’s safe haven status, is likely to lead to a reduction in nominal exports. This, in turn, means estimated short-term growth rates for the main life science sectors (especially pharmaceutical and chemical industry) remain at 1.8 percent, behind the forecast for overall economic growth of approximately 2 percent.

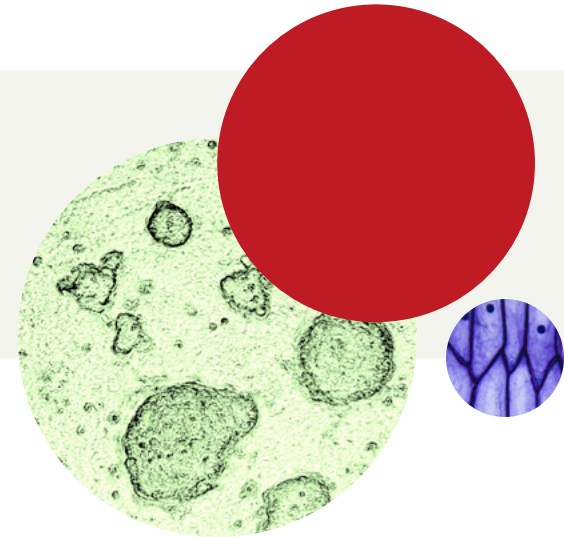
Despite facing emerging competition from a number of global markets, over the long term, Switzerland is likely to remain one of the world leaders in life sciences innovations. The dynamic mix of academic institutions, high concentration of life sciences corporations and leading infrastructure will ensure the long-term success of the industry.



*The massive appreciation of the Swiss franc, as a result of broader global macroeconomic uncertainty and Switzerland’s safe haven status, is likely to lead to a reduction in nominal exports.*

Established cluster

# United Kingdom



1.9%

R&D expenditure  
(% of GDP, 2008)

4,269

Researchers in  
R&D (per million  
people, 2008)

23.0%

High technology  
exports (% overall  
exports, 2009)

9.3%

Total health  
expenditure  
(% of GDP, 2009)

13

World economic  
forum's innovation  
rank (out of 142)

*The United Kingdom's long-established and strong science base is one of the significant factors driving investment and development in the life sciences sector.*

## Overview

The life sciences sector in the United Kingdom is among the largest in the world, and includes more than 3,500 medical and biotechnology companies that, combined, generate annual revenue of £15 billion (\$24.2 billion)<sup>1</sup>. When combined with pharmaceutical exports of £18 billion (\$29.0 billion)<sup>1</sup>, the United Kingdom (U.K.) is a major supplier of life sciences products and services across the globe.

## Cambridge

Cambridge is one the United Kingdom's leading clusters based upon the strengths of Cambridge University. Cambridge University alumni account for 20 percent of the world's Nobel Prize winners in medicine and chemistry. The cluster is home to around 25 percent of Europe's biotechnology companies

and the world's largest medical research charity, the Wellcome Trust, also has a base there.

Due to consistently high demand for lab and office space in Cambridge, the availability of large or self-contained units can be limited, although pockets of smaller space are more widely available. Rents range from £16.00 per square foot per annum (\$25.78)<sup>1</sup> for shell and core lab space, to £26.00–£28.00 per square foot per annum (\$41.89–\$45.12)<sup>1</sup> for fully-fitted space.

## South East of England

The South East of England is an important cluster for a wide range of life sciences companies. Benefiting from proximity to London and the world's busiest international airport Heathrow,

## — *United Kingdom*

the South East region is a mature cluster that provides research sites for three of the top 10 major global pharma companies and a number of biotechnology firms.

Oxford is another cluster of importance for life sciences within the broader south-east region, with more than 100 biopharmaceutical/healthcare companies taking advantage of close links to the city's Oxford University. Much of the office and lab space is located out of town in science and business parks. The Oxford real estate market is stable with limited new construction keeping supply relatively limited. Conventional Grade A office space is available at £22.50–£25.00 per square foot per annum (\$36.25–\$40.28)<sup>1</sup>, with fitted lab space available at similar rents. Availability of office space is greater in the broader south east, and the Western Corridor region, west of London, remains popular with life sciences companies.

### *London*

Although many larger pharmaceutical and biotech companies base their operations outside Central London, the cluster has representation of more than 100 bioscience businesses, not to mention 28 universities and five renowned medical schools. It is also home to UCL Partners, one of Europe's largest academic health science partnerships of hospitals and medical research centres.

London's West End is one of the most expensive office markets in the world. Although some life sciences companies maintain a small office presence in the exclusive areas of Mayfair and St. James', for practical purposes most locate in or around submarkets such as Paddington and Kings Cross near to the major hospitals, universities and research facilities. Reasonable quality Grade A office space in these hubs is available from £40.00–£45.00 per square foot per annum (\$64.45–\$72.51)<sup>1</sup>.

### *North West of England*

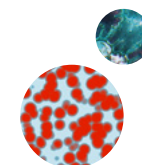
North West England is the United Kingdom's third largest bioscience cluster, with a number of global life sciences companies operating there. Manchester University is one of Britain's largest universities and recently collaborated with GlaxoSmithKline and AstraZeneca on a new research centre. AstraZeneca is one of the global pharmaceutical companies with a large base in the area.

The North West of England is further supported by the strong academic research capabilities of the Universities of Liverpool, partner hospitals and locally based national support facilities such as the National Biomanufacturing Centre. Prime office space in Manchester city centre is available at £28.00 per square foot per annum (\$45.12)<sup>1</sup>.

### *Scotland*

Scotland, is another important hub in the United Kingdom life sciences sector, with more than 500 life sciences companies, increasing by an average of 20 percent a year.

Edinburgh is a hotbed of life sciences innovation, with particular achievements in recent years in the field of stem cell research. The Queen's Medical Research Institute brings together four world class research centres specializing in Cardiovascular Science, Inflammation Research, Reproductive Biology and Regenerative Medicine. The Institute houses more than 600 researchers and aims to tackle a wide range of diseases at the most fundamental cellular level. The supply of prime office space in Edinburgh is limited, and currently costs around £27.50 per square foot per annum (\$44.31)<sup>1</sup>, with incentives still generous at around 32–36 months achievable on a 10-year term.



## — *United Kingdom*

### *Industry framework*

The United Kingdom's life sciences industry has a record of cutting-edge research and is renowned for developing innovative, effective solutions to global and local health issues. It has also served as a hub for scientific and business collaboration, bringing together funding from private and public sources to support innovation and create routes to market. According to U.K. Trade & Investment (UKTI) figures, United Kingdom industries spend around £7.5 million (\$12.1 million)<sup>1</sup> each day on R&D, and have attracted major R&D investments from a range of the world's top life sciences companies. As a direct result, the United Kingdom has created one in four of the world's top 100 medicines and 45 percent of all pipeline products in Europe.

The United Kingdom is home to a number of outstanding universities, four of which consistently rank among the world's top 10. Their expertise and engagement with the industry support innovation and generate a wide range of new discoveries and patents every year. The creation in May 2011 of the Manchester Collaborative Centre for Inflammation Research (MCCIR)—by GSK, AstraZeneca and the University of Manchester—represents one of the most recent examples of this trend, and is aims to establish a world-leading translational centre for inflammatory diseases.

The United Kingdom-based pharmaceutical industry directly employs 72,000 people, of whom 26,000 work in R&D. It is the most popular location in Europe for investment in biotechnology and healthcare. Government policy is to support growth in life sciences with a range of incentives and tax relief measures are available for new investors.

### *Outlook*

Despite the recent stock market turmoil and uncertainty linked to the Eurozone debt crisis, the life sciences sector has continued to show resilience and stable performance in the United Kingdom. Overall private sector employment in the United Kingdom is growing, and the government has recently announced a strong commitment to encourage growth in high-tech and R&D-led industries with a number of tax credits and incentives.

Restructuring and productivity gains from United Kingdom operations remains an important focus for life sciences companies as they adapt functions and locations in response to strategic pressures. Such rationalization has fueled some disposal activity and selective head count reductions in some locations. But a significant level of new investment has also been seen through 2011, with a range of companies committed to expand and increase investment in facilities in the United Kingdom and other mature European markets. This combination of selective investment and continuing efforts to optimize productivity from existing operations is likely to dominate the outlook for life sciences over the next 12–24 months.

1. Six month average conversion rate of £0.62 per US dollar, as of October 2011.



*The life sciences sector in the United Kingdom is among the largest in the world, and includes more than 3,500 medical and biotechnology companies that, combined, generate annual revenue of £15 billion.*

China, India, Indonesia and Singapore

# Asia Pacific

*In this section we discuss four clusters in the Asia Pacific region that are emerging at the forefront of industry activity.*

Emerging clusters in Asia have extremely high growth potential for a variety of reasons. Factors such as growing economies, large populations, rising personal income levels and progressive political policies encourage growth and direct investment from industry leaders.

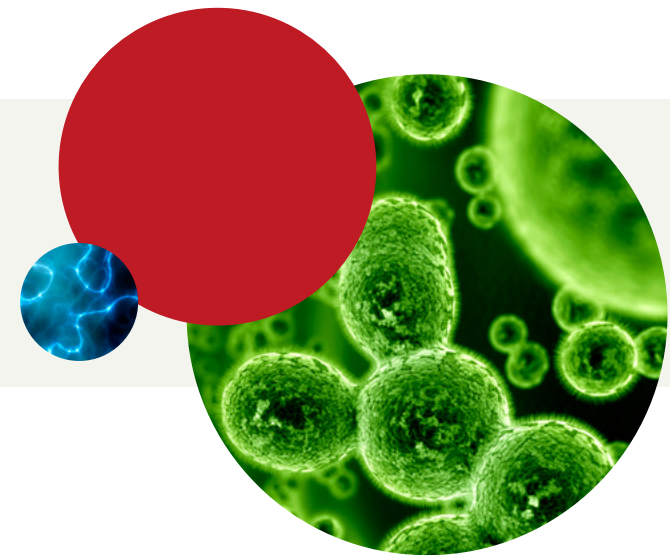
In the coming years, market demand in population-dense Asian Pacific clusters is expected to exceed demand from the mature markets in the United States and Europe. Thus, we examine four emerging clusters in the region.





Emerging cluster

# China



1.4%

R&D expenditure  
(% of GDP, 2007)

1,071

Researchers in  
R&D (per million  
people, 2007)

31.0%

High technology  
exports (% overall  
exports, 2009)

4.6%

Total health  
expenditure  
(% of GDP, 2009)

29

World economic  
forum's innovation  
rank (out of 142)

*The People's Republic of China is quickly emerging as a top destination for life sciences investment due to its huge market potential (large population, improving public health care systems, increasing healthcare expenditure as a percentage of GDP) and low cost manufacturing sector.*

## Overview

China's pharmaceutical industry has enjoyed massive growth over the past decade. The country's emergence onto the radar screen of multi-national life science companies parallels its growth into one of the world's dominant economies with a significant and growing middle class, an increasingly open and inviting marketplace and waves of foreign investors lined up to take part.

Certainly, one reason for interest in China was its low-cost manufacturing capabilities. Historically, Western pharmaceutical makers enjoyed a 30 to 50 percent cost savings by relocating the manufacturing of intermediates, APIs, starting materials and some finished drugs to China. The focus is now on

expanding capabilities beyond manufacturing into more high-tech R&D functions. Multinationals are taking bolder steps as highlighted by AstraZeneca's recent announcement to invest \$200 million on a new plant in China (its biggest-ever investment in one production facility) that will turn out injectables and oral drugs for the domestic market.

With the world's largest population and second-largest economy with a growing middle class, China's prospective consumer base is unmatched by any country worldwide. Additionally, the Chinese government is trying to entice foreign and domestic investment in a local life sciences industry, spending billions on the advancement of science and technology as outlined early 2011 in the 12th Five-Year Plan.

# China

The life science industry is scattered throughout several cities and provinces primarily located in China's eastern and southeastern regions. It is closely aligned with the country's geographic distribution of population and wealth. Clusters have formed around the sources of the best talent, so the key R&D bases for pharma have been in Shanghai and Beijing, where the top five universities in the country are. Other clusters include the cities of Tianjin and Guangzhou within the provinces of Hebei, Shandong, Jiangsu, Zhejiang and Guangdong.

China is estimated to have roughly 4,500 pharmaceutical manufacturers and 8,000 distribution companies, with a fairly even distribution among state-owned, private domestically owned and foreign-owned enterprises. The market is fragmented, with no dominant domestic companies.

Chinese pharmaceutical manufacturers largely focus on non-branded generics. Large foreign companies have so far been interested primarily in manufacturing as well. However, state funding and a return of domestic talent from abroad have fueled the rapidly growing biotechnology sector. Domestic start-ups and multinational companies compete in this growing market. Domestic companies involved in bio and pharma R&D include C&O Pharmaceutical Technology headquartered in Hong Kong, NYSE-traded Wuxi AppTec in Jiangsu Province, Shijiazhuang Pharma Group from Shijiazhuang in the Hebei Province, state-owned Harbin Pharmaceutical Group, NASDAQ-traded Sinovac Biotech in Beijing and Zensun Sci & Tech Co. in Shanghai.

In March 2011, Pfizer announced plans to relocate its antibacterial research unit from Groton, Massachusetts to Shanghai. The company said the move will bring it closer to important hubs for science and technology and give it better access to the Chinese drug market. Other large pharma companies with research operations in China include Eli Lilly, Roche and Novartis.

## Industry framework

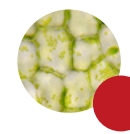
### Intellectual capacity

Similar to most emerging markets, the lack of a workforce with specialized knowledge and skills relevant to the industry poses a real challenge. To combat this, the Chinese government works to attract expatriates. Financial incentives and modern laboratories offered by the Chinese government as part of the five-year plan have successfully attracted 150,000 Chinese professionals and with them, the education and industry experience gained from abroad. Today, the talent availability is excellent. Companies can hire increasing numbers of science graduates who have globally-competitive skills.

### Innovation capital

Several research parks, a few of which are funded by the government, are located throughout the country, supporting budding science and technology enterprises.

- Zhangjiang Hi-Tech Park: The park is located in Shanghai and was established in 1992 as China's state-level high-tech industrial development zone. A multitude of national industries are based here in addition to start-ups and other companies looking to benefit from its incubator program. Earlier this year, EMD Millipore opened a 28,000-square-foot Biopharmaceutical Technical and Training Center in the park to support manufacturers in the area with GMP compliance.
- Suzhou BioBay: Located in Dushu Lake Science & Innovation Education District, the park spans over nine square miles and offers innovation incubator and accelerator support.



*With the world's largest population and second-largest economy with a growing middle class, China's prospective consumer base is unmatched by any country worldwide.*

## China

- Zhongguancun (ZGC) Life Science Park: The professional science park is being developed by the Beijing Municipal Government and includes a two-phase master plan that will cover over 615 acres. Phase I of the project includes a new enterprise incubation center, small business development center, as well as research and development facility, industrial production facility and medical service area totaling 5.8 million square feet, while Phase II includes 8.9 million square feet of medical care and commercial space that integrates clinical, research and teaching resources of Chinese Academy of Medical Sciences and Peking Union Medical College.

### Fiscal & political resources

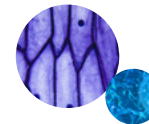
Recognizing the potential of its emerging life sciences industry, the Chinese government is working on multiple initiatives to encourage development. As part of its economic stimulus package, the government allocated over 850 billion yuan (\$132 billion)<sup>1</sup> to healthcare improvements and aims to offer insurance coverage to more than 90 percent of its citizens by year-end 2011. As part of this effort, price controls were put in place on several hundred drugs by the National Development and Reform Commission (NDRC). The goal was to make them more affordable. Biotech, including agricultural biotechnology, bio-manufacturing and fuels, is one of seven strategic emerging industries identified in the 12th Five-Year Plan. The plan calls for government spending of over 12 billion yuan (\$1.9 billion)<sup>1</sup> to support growth of biotechnology through 2015.

New Good Manufacturing Practices (GMP) rules became effective in March 2011, rolling out elevated standards and greater emphasis on pharmaceutical quality control systems. While the new GMP rules are expected to raise manufacturing and production costs, the enhanced standards will level the playing field. Multinational companies and Chinese manufacturers already operating at high GMP standards will be largely unaffected.

### Outlook

China's cost advantage has been eroded by inflation, rising wages, currency appreciation and challenges to the many tax reductions and rebates that China has traditionally offered to its own exporters. The various pressures will certainly reduce China's ability to undercut foreign markets. Balancing these trends, current talent availability, improved funding environment via government support and the increase in quality facilities change the manner in which China competes in the industry. China no longer has to be viable as a low-cost destination in order to attract industry interest and investment. Certainly, the outlook for life sciences in this immense and growing economy is good. Challenges faced by pharmaceutical companies include China's still-weak protections for intellectual property, and GMP compliance.

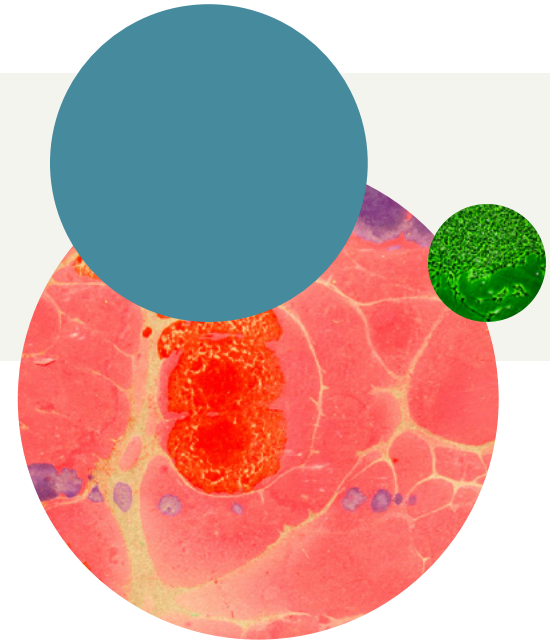
1. Six-month average conversion rate of 6.43792 yuan per US dollar, as of October 2011.



*China no longer has to be viable as a low-cost destination in order to attract industry interest and investment.*

Emerging cluster

# India



0.8%

R&D expenditure  
(% of GDP, 2007)

137

Researchers in  
R&D (per million  
people, 2005)

9.0%

High technology  
exports (% overall  
exports, 2009)

4.2%

Total health  
expenditure  
(% of GDP, 2009)

38

World economic  
forum's innovation  
rank (out of 142)

*India's pharmaceutical market is largely driven by its domestically-produced generic drugs, and while the life sciences industry has achieved double-digit growth in many areas, it remains proportionately small for a nation of a billion people.*

## Overview

A self-reliant industry with low costs of production, the industry in India produces a full range of products and meets around 70 percent of the country's demand for the full suite of pharmaceutical products. India's life sciences industry is predominantly made up of manufacturing entities, contract manufacturing organizations (CMOs), and has a small, but growing, representation in biotechnology.

The production of generics, for both domestic and global use, is India's most robust sector of the industry. Domestic demand for pharmaceuticals has increased in recent years due to improved access to medical care and a rising average income. On the export front, India produces more than 20 percent of the world's generics and continues to gain the interest of global companies due to cost savings and the large presence of United States FDA and European Medicines Agency-approved facilities.

## India

The life sciences industry is largely situated among three of India's twenty-eight states: Maharashtra, Andhra Pradesh, and Gujarat, with smaller representation in the states of Goa and Karnataka. Formation of these clusters was aided by the government's designation of sector-specific Special Economic Zones (SEZ).

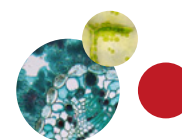
Gujarat, with concentration in the cities of Ahmedabad and Ankleshwar, lists more than 5,000 manufacturing licenses and more than 50 biotechnology companies. Companies in the area support a range of industry functions including bulk manufacturing and R&D, like large domestic companies Zydus Cadila and Intas Pharmaceuticals.

Life science-focused cities within the Maharashtra cluster include Mumbai, Pune, Nashik and Aurangabad and account for roughly 18 percent of the country's output of pharmaceuticals by value, says the Maharashtra Industrial Corporation (MIDC). Industry players represent nearly the full spectrum of the value chain including APIs, formulations, bulk manufacturing and R&D. On the manufacturing side, the state lists more than 3,000 manufacturing licenses. Global industry players with facilities in the state include GlaxoSmithKline, Johnson & Johnson, Pfizer, Abbott and Sun Pharmaceuticals.

The cities of Hyderabad and Medak in the Andhra Pradesh cluster are highly active in formulations, R&D and bulk generic manufacturing and are home to Dr. Reddy's and Aurobindo Pharma. Hyderabad is home to Genome Valley, a biopharmaceutical zone spread across several suburbs. Genome Valley has several centers of excellence including the Centre for DNA Fingerprinting and Diagnostics and the United States Pharmacopeia in addition to smaller research parks like the IKP Knowledge Park and the Alexandria Knowledge Park.

The Indian life sciences industry is highly fragmented and competitive with more than 20,000 registered companies. In fact, the domestic leader, Cipla, barely exceeds a five percent market share. However, the industry structure is quickly changing. Similar to other global markets, India has begun to experience consolidation.

Domestic competitors include Ranbaxi, Lupin, Mankind Pharma, Alkem Labs, Sun Pharmaceutical and Dr. Reddy's Laboratories. Globalization among domestic companies is well underway. Many of India's largest players are expanding into clusters outside of the region. Zydus Cadila, for example, is headquartered in Ahmedabad but is active across the United States, Europe, Japan, Brazil, South Africa and many other emerging clusters.



*The production of generics, for both domestic and global use, is India's most robust sector of the industry.*

# India

## Industry framework

### Innovation capacity

India benefits from a well-educated, English-speaking labor force and enjoys a sizable share of chemists, all crucial components of its robust manufacturing business. Low levels of academic collaboration and a shortage of high-tech professionals, such as molecular biologists have limited the growth of R&D. This is partially offset by an increase in the number of Indian scientists who have opted to return home from abroad.

The clinical trial business in India, running at about 45 billion rupees (\$1 billion)<sup>1</sup> in revenue annually, benefits from the country's large, genetically diverse and medically naive population, which means trials can be conducted quickly and at low cost compared with trials in the West.

### Innovation capital

One of the biggest challenges for India's budding biotechnology sector continues to be lackluster R&D investment. Market leaders such as Ranbaxy and Dr. Reddy's Laboratories allocate only 5–10 percent of their revenues on R&D, compared with an average 15 percent spent by Western pharmaceutical companies.

A number of Indian pharmaceutical companies have spun off their R&D divisions into separate units in hopes of attracting investment capital and scaling up operations. However, the approach has not been as successful as hoped. Some companies now seek to reduce risk through R&D collaboration with other companies.

### Fiscal & political resources

Recognizing the importance of current and future states of the life sciences industry, the central and state governments have developed measures to support various aspects of the industry.

On the biotechnology front, the Indian central and state governments have put competitive tax concessions in place to encourage R&D and support the formulation and distribution aspects of the value chain. In addition, they created an "abbreviated new drug application" to reduce product approval delays.

A few of the tax concessions include:

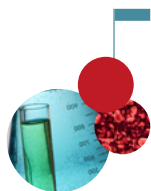
- Tax holidays for industrial operations established in free trade zones or under-developed areas
- Deduction of profits earned from exports
- Liberal depreciation allowances
- Deduction of capital R&D expenditures
- Relief on all contributions to approved domestic research institutions
- For pharmaceutical manufacturing units, an additional weighted deduction of 200 percent for expenditures related to in-house R&D
- A new provision provides 125 percent weighted deduction for expenditures incurred towards outsourcing of R&D activities

The Biotechnology Industry Partnership Programme (BIPP) has been launched by the Department of Biotechnology (DBT) to support high-end biotechnology research capable of generating globally recognized intellectual property. Additionally, a proposal is in place to create the National Biotechnology Regulatory Authority (NBRA), expected to be an autonomous body formed specifically to regulate the biotechnology segment and reduce regulatory overlap.

## India

To support the distribution channels used by the producers of generic drugs and CMOs, the Union Ministry of Health and Welfare, in collaboration with the pharmaceutical industry and airport developers GVK and GMR, plan to set-up dedicated cargo zones to handle pharmaceutical imports and exports.

Price controls are carried out on certain drugs by virtue of the Drugs Price Control Order (DPCO), supervised by the National Pharmaceutical Pricing Authority (NPPA). The Indian Government's Department of Pharmaceuticals has also started medicine shops, called 'Jan Aushadhi,' in various locations. These shops sell generic medicines at lower prices than their corresponding branded medicines.



*Various forecasts indicate that India is on the brink of becoming a major pharmaceutical hub, and in particular a lucrative destination for clinical trials for global giants.*

### Outlook

Various forecasts indicate that India is on the brink of becoming a major pharmaceutical hub, and in particular a lucrative destination for clinical trials for global giants, with several analysts valuing the country's pharmaceutical market at upwards of 2,288 billion rupees (\$50 billion)<sup>1</sup> by 2020. Helping to propel this growth is strong local demand, fueled by the large population base and a growing middle class.

Beyond domestic demand, the area has created a positive reputation in areas essential to the future of the life sciences industry. India already has a strong CMO base and will continue to grow this area of the industry as global companies outsource to drive margins. In addition, with the large number of drugs coming off patent, the robust generic manufacturing market is poised to take advantage of new product areas. While the biotechnology market is still new, there is market share to be had in the realms of biosimilars and contract research. But advancements in high-tech infrastructure and human capital will be needed.

Legal infrastructure, in particular the regulation around ownership of public companies, is a big challenge to carry out business as it can slow down decision making. Another near-term challenge is the management of intellectual property. While the industry is supported by Intellectual Property Protection regime, licensing of most drugs and pharmaceutical products has ended. Manufacturers are now free to produce any drug duly approved by the Drug Control Authority, potentially hindering global players accustomed to more regulated environments.

1. Six-month average conversion rate of 45.7634 rupees per US dollar, as of October 2011.

Emerging cluster

# Indonesia

0.1%

R&D expenditure  
(% of GDP, 2005)

205

Researchers in  
R&D (per million  
people, 2002)

13.0%

High technology  
exports (% overall  
exports, 2009)

2.4%

Total health  
expenditure  
(% of GDP, 2009)

36

World economic  
forum's innovation  
rank (out of 142)

*Reflecting the rising disposable incomes of the population, Indonesia's pharmaceutical sector has seen double digit growth since 2009 and expects 14 percent growth for 2011. Change in legislation regarding investment will give the industry renewed growth.*

## Overview

The value of the market, estimated at Rp 34,508.8 billion (\$4 billion)<sup>1</sup> in 2010 with 10 percent CAGR in the last five years, remains very small for a country of 240 million people. The sector is held back by a lack of local raw materials, increased competition in the generic drugs market, regulatory barriers against international investment, and a lack of innovation. However, economic prospects and changes in lifestyle added to the sheer size of the population make the Indonesian pharmaceutical market attractive.

Of the roughly 200 pharmaceutical manufacturers, the majority located in Java, the top 20 companies account for 80 percent of total production. The industry is largely domestic; four state-owned enterprises play an important role in generics and vaccine production through Kimia Pharma, Indofarma and Bio Farma. Seven out of the top ten companies are local, with the leader, Kalbe Pharma, holding a 14 percent share.

Indonesia imports more than 90 percent of the pharmaceutical raw materials it needs and exports of pharmaceutical products are very limited, with more than 75 percent of locally produced drugs consumed domestically. Exports might increase under terms of the ASEAN Free Trade Area (AFTA).



## — *Indonesia*

About 35 companies are foreign owned. Pfizer, Bayer and GlaxoSmithKline collectively hold eight percent of the market, a very small share due to a series of entry barriers. Only the middle and upper income markets can afford pricey branded drugs. Ownership is limited to 75 percent for foreign investments and regulation 1010/2008 obliges foreign companies to set up local manufacturing.

### *Industry framework*

#### **Intellectual capacity**

One of the issues hampering the development of the pharmaceuticals sector in Indonesia is the lack of skilled labor and of trained staff, particularly at the Ph.D. level.

#### **Innovation capital**

Another issue is the lack of R&D in domestic companies. Product development overwhelmingly relies on foreign licenses or on expired patents. Despite this, several areas of opportunity exist:

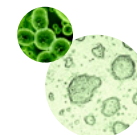
- As incomes rise, consumers begin to demand more quality, thus encouraging local drug companies to innovate.
- The wide variety of tropical diseases could make Indonesia suitable for some R&D activities in this field.
- Herbal medicine (“jamu”) is one area where Indonesia could create a competitive advantage, given the increased interest in and growing imports of ‘alternative medicines’ in Western countries. Raw material in this narrow area is abundant (30,000 of the 40,000 of available medicinal plant species are found in Indonesia) and the Ministry of Health ensures jamu is safe and backed by research.

#### **Fiscal & political resources**

Price cuts of branded generics, a new import tax imposed on raw materials for drug manufacturing and the lack of intellectual property rights (IPR) enforcement make Indonesia a challenging market to operate in. Also posing a challenge is the inclusion of Indonesia on the United States Trade Representative’s Special 301 Priority Watch List in 2011, due to the prevalence of counterfeit pharmaceuticals (the total amount in circulation estimated at 15–20 percent of the total drugs on the market, says the International Pharmaceutical Manufacturers Group).

However, the Indonesian Health Ministry’s focus on improving the country’s business environment will encourage multinational drug makers to set up local manufacturing operations.

- A signatory to the World Trade Organization’s Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs) has led to an improvement in patent protection — extending the term of protection from 14 to 20 years — and the introduction of the reversal of the burden of proof onto the defendant in intellectual infringement cases.
- The introduction of Good Manufacturing Practices as well as the ASEAN Common Technical Dossier and requirements will also encourage local companies to increase quality standards.



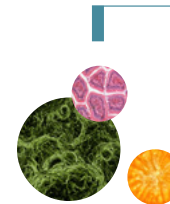
## — *Indonesia*

### *Outlook*

The main challenges to investment in Indonesia include intellectual property issues, low per-capita spending on pharmaceuticals and a small proportion of the elderly in the country. However, considering the size of the market, the sector is poised for considerable growth. Demand for drugs will rise due to an increased need for modern medicines, a growing and aging population, improving healthcare service as well as developing economic conditions.

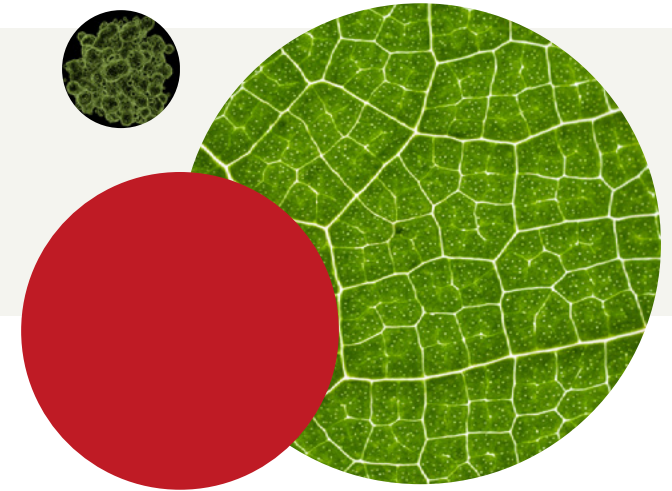
Projected steady sales growth will provide substantial income to companies operating in the country and the government reform underway will encourage investment. The healthy number of mergers and acquisitions and the rationalization of operations that we are starting to see hint that a shift is about to take place in the sector as companies are well aware of the potential lying in the country.

1. Six-month average conversion rate of Rp 8627.19 per US dollar, as of October 2011.



Emerging cluster

# Singapore



2.3%

R&D expenditure  
(% of GDP, 2005)

6,088

Researchers in  
R&D (per million  
people, 2007)

49.0%

High technology  
exports (% overall  
exports, 2009)

3.9%

Total health  
expenditure  
(% of GDP, 2009)

8

World economic  
forum's innovation  
rank (out of 142)

*Stable political structures, strong intellectual property protection, and favorable regulatory and tax policies make Singapore an attractive business location.*

## Overview

Despite the small size of the local market, the Republic of Singapore has the ambitious objective of staying one step ahead of its geographic neighbors and becoming the "Biopolis of Asia". The country has become a top destination for outsourcing of contract research, contract manufacturing and clinical research services by multi-national companies.

Leaders of Asia Pacific research and contract research companies continually identify Singapore as a destination of choice for regional headquarters. While India and China will flourish due to their immense markets, Singapore's mature business-environment makes the island-country a desirable

launching pad into other regional markets. Singapore acts as a trading hub to connect Southeast Asia and the Western world and is a major re-exporter of pharmaceuticals. A large number of multi-national pharmaceutical corporations have established the base of their Asia Pacific operations in Singapore. Singapore is home to manufacturing facilities of eight of the top 10 pharmaceutical companies and all of the top 10 medical technology companies. In addition, several foreign pharmaceutical companies have R&D bases in Singapore, including Abbott Labs, Cell Research Corp, GlaxoSmithKline, MerLion, Novartis, Takeda and Inviragen.

# Singapore

Life sciences activity in Singapore largely occurs in several dedicated parks. The area's largest research park, Biopolis, is located in One North, Singapore's ongoing business park under development by JTC Corporation. One North is located at Buona Vista, proximate to Dover and Holland Village, the National University of Singapore and the National University Hospital. Phase one of Biopolis, a seven-building, 2-million-square-foot integrated biomedical research complex, was completed in 2003. Five of the seven buildings are designated for public institution use. The area is home to the Agency of Science, Technology, and Research (A\*Star). Phase two, completed in 2006, added two buildings totaling roughly 430,000 square feet; work on a third phase is expected to deliver at year-end 2011 and includes two additional buildings, totaling roughly 450,000 square feet. In 2010, JTC announced the fourth and fifth phases of Biopolis. Improvements to lab design for clinical trial support are part of phase four, while phase five will cater to increased demand for biomedical research with two towers providing a gross floor area of just under 500,000 square feet.

The Tuas Biomedical Park (TBP) is a 916-acre biomedical manufacturing cluster developed in two phases by JTC Corporation. The park is located within the larger Tuas industrial zone in Singapore's western region. TBP offers "plug-and-play" opportunities, as well as build-to-suit opportunities for pharmaceutical manufacturers. Large companies such as Pfizer, GlaxoSmithKline, Novartis, Abbott and Roche all have operations at TBP.

## Industry framework

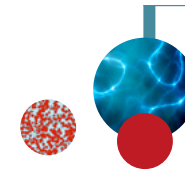
### Intellectual capacity

Aware that R&D is dependent on the presence of talent, the Singaporean government has shaped the local education system to develop graduates with skills for work in life sciences. The government estimates 16,000 individuals are employed in the industry; it promotes life sciences studies and adapts curricula to fit the industry's needs.

### Innovation capital

Two leading research universities are the source for a large share of innovation in Singapore. The National University of Singapore (NUS) has two centres of excellence relevant to the industry— Cancer Science Institute of Singapore and Mechanobiology Institute, Singapore. Nanyang Technological University (NTU) offers additional centres, including the Biomedical Engineering Research Centre, the Centre for Biotechnology, the Centre for Chiral and Pharmaceutical Engineering, the Computer-integrated Medical Intervention Laboratory and the Physiological Mechanics Laboratory in addition to several interdisciplinary centres focused on nanotechnology. Both schools have expanded their research and industry-related graduate programs in recent years.

Government support for universities is provided via the National Research Foundation (NRF) and the Education Ministry. The NRF of Singapore believes development of a critical mass of human capital is crucial to the advancement of its domestic research capabilities. It has funded research centres of excellence, including the two centres at NUS. The co-location of public institutions and private research companies in Singapore's largest research park, Biopolis, facilitates innovation support from the government.



*Singapore's mature business environment makes the island-country a desirable launching pad into other regional markets.*

# Singapore

## Fiscal & political resources

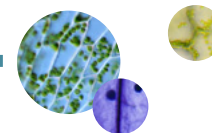
In October 2010, the government announced it would earmark S\$3.7 billion (\$3.0 billion)<sup>1</sup> for biomedical R&D over the next five years as part of its larger Research Innovation and Enterprise 2015 fund. It has also designated several boards and councils to support the growth of the industry:

- Singapore's Economic Development Board (EDB). Its Biomedical Sciences Group (BMSG) promotes private sector manufacturing and R&D activities while Bio\*One Capital functions as the biomedical investment arm of EDB
- Singapore's Agency for Science, Technology and Research (A\*Star). The Biomedical Research Council (BMRC) of A\*Star funds and supports public research initiatives
- The Ministry of Health's (MOH). Its National Medical Research Council (NMRC) funds and supports public research initiatives, as well as awards medical research fellowships for the development of medical research manpower
- Singapore Biomedical Sciences Industry Partnership Office (BMS IPO)
- National Research Foundation (NRF)
- Many of the government councils work in close partnership. The BMRC works with the EDB's Biomedical Sciences Group and Bio\*One Capital on the Singapore Biomedical Sciences (BMS) initiative. The BMS initiative seeks to develop the biomedical sciences sector into one of the country's economic pillars through a three-phase program running from 2000 through 2015.

## Outlook

Singapore is already active among contract research and manufacturing sectors of the industry and hopes to increase penetration into high-tech aspects of research and innovation. Strong intellectual property protection laws have already supported growth in the industry. The country is home to several research start-up companies and has attracted investment by Big Biotech and Big Pharma. Strong infrastructure, strong representation from the industry and government support will help Singapore expand manufacturing and research aspects of the value chain.

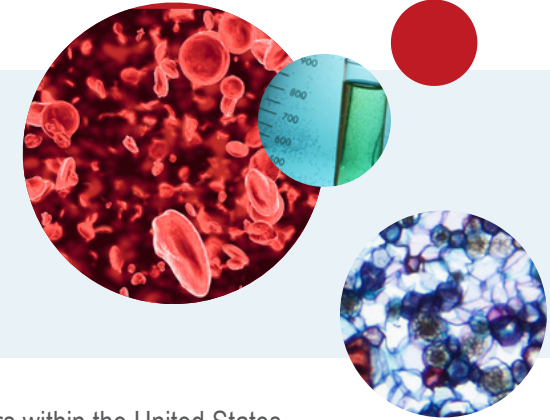
1. Six-month average conversion rate of S\$1.23 per US dollar, as of October 2011.



***Strong intellectual property protection laws have already supported growth in the industry.***

# Closing thoughts

*Life sciences companies seek to balance operations among the three global regions as they strive for efficiency, revenue and margin opportunities.*



## ***The drive for discovery and innovation is causing companies to rethink the way they make location decisions***

Increasingly, life sciences companies are evaluating the efficiency and effectiveness of R&D efforts. Companies are determining what aspects of the value chain are vital to discovery—those that are product lifelines and differentiators. As a result, the industry is bifurcating the drug discovery platform, keeping “core” discovery aspects in-house and in established clusters with rich talent pools, meanwhile leveraging the use of CROs and other outsourced resources for “non-core” aspects, like testing and viability assessment, and often times moving such functions to less expensive and often emerging clusters throughout the globe.

Investments focused on “core” R&D aspects of the value chain continue to fuel activity in established clusters in the United States and Europe. As companies evaluate the financial equation surround innovation, they often times are able to offset the higher real estate costs of established clusters with the advantages of deep intellectual capacity in such locations, and thus the enhanced odds of drug discovery. This suggests that established clusters and the knowledge workers who labor within those clusters can compete globally based on the quality of their innovation and discovery, not simply on hard costs of location. This has sometimes been described as the currency of the future, where ideas for innovation are the new currency in modern enterprises.

We conclude that established clusters within the United States and Europe will continue to report activity surrounding “core” functions in the form of small requirements from start-ups and the occasional right-sizing or re-locating of headquarter operations. Our analysis shows real estate activity is most prominent in cornerstone locales, such as the Bay Area, the New York/New Jersey corridor, San Diego, Boston, Seattle, Philadelphia, the United Kingdom, France, Switzerland and Germany, and we predict these clusters will remain leaders in “core” aspects of the value chain. It should be noted, however, that established clusters have reported a notable decline in speculative construction of laboratory facilities, demonstrating market awareness of constricted demand following the closing of many start-up operations during the recession.

Meanwhile, it is interesting to note the progress of emerging clusters among the global regions. Within the United States, several emerging clusters have been on the radar for some time, but have failed to reach a critical tipping point into becoming an established cluster. Some clusters, like Chicago and Houston, have very strong intellectual capacities and research institutions, but struggle to translate innovation from bench to marketplace due to lacking fiscal support or programming. While others, like Florida, Minneapolis and Indianapolis, have strong industry representation but remain challenged by fragmented framework, most notably lackluster funding from NIH and VC sources.

*(continued)*

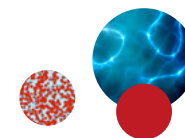
Emerging cluster governments in Asia and Latin America are making investments and improving political policies in order to become more competitive in high-tech aspects of the industry to be in contention for CRO opportunities. Efforts and funding by the Chinese, Singaporean, Indian and, to a lesser extent, Brazilian governments have been the most successful to date. Improvements to intellectual property laws, transparency, regulatory systems and the creation of full service research parks are a part of this effort. Although industry framework remains more fragmented when compared to emerging clusters in the United States, these clusters seem to be progressing at a rapid pace and garnering large amounts of interest from industry players. It will be interesting to witness in the coming years if emerging clusters in Asia and Latin America are able to create the environment necessary for robust, high-tech research communities.

***As we exit recessionary conditions and life sciences companies regain profitability, renewed investments in manufacturing facilities in emerging clusters is expected***

Investments towards non-R&D facilities experienced a pause during the recession. Constrained finances forced companies to create more efficient footprints, as evidenced through the many consolidations and contractions prevalent in the industry in recent years.

Coming out of the recession, companies will want to position themselves to gain market share in emerging markets. Factors such as growing economies, large populations, rising personal income levels and progressive political policies in emerging global clusters encourage growth and direct investment from industry leaders. Additionally, companies will leverage favorable conditions in emerging clusters as they bring on additional manufacturing capacity to take advantage of lower cost structures.

A large share of inward investment in the United States and established countries throughout Europe continues to be focused on manufacturing aspects of the industry. However, we feel that these locations will begin to see investments shift away from manufacturing as Brazil, China, India and other smaller clusters emerge as cost-advantageous sites that provide both revenue and margin opportunities.



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## *Global county statistics definitions & sources\**

**1** Expenditures for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development. Source: World Bank

**2** Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned. Postgraduate PhD students engaged in R&D are included. Source: World Bank

**3** High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Source: World Bank

**4** Total health expenditure is the sum of public and private health expenditure. Source: World Bank

**5** Overall Innovation capabilities includes: capacity for innovation, quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, government procurement of advanced tech products, availability of scientists and engineers and utility patents granted per million people. Source: The World Economic Forum's Global Competitiveness Index 2011-2012

\* For United States statistic sources, please refer to the United States methodology on page 16





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