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Center for Global Health Innovation

The Georgia Life Sciences Industry Trends and Impacts Report, 2022

Performed For: Georgia Bio, An Office of the Center for Global Health Innovation
Performed By: TEConomy Partners, LLC

TECONOMY PARTNERS LLC

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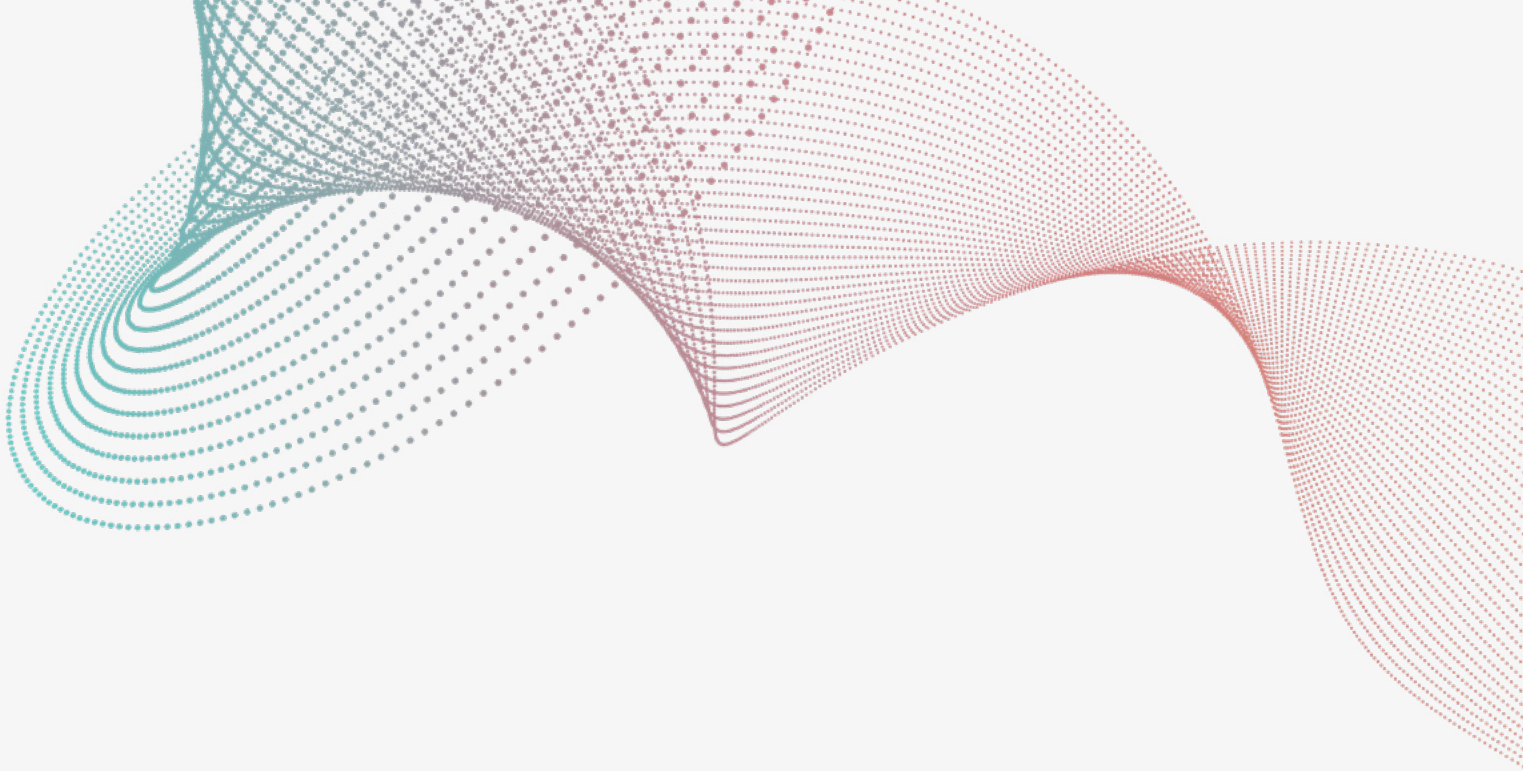

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Executive Summary

Georgia's life sciences industry has experienced strong and steady employment growth in recent years, outpacing even the rapidly growing national industry in its private sector industrial components, and exceeding 78,000 total jobs in 2021.

These high-quality life sciences jobs pay nearly $93,000 annually, on average, or nearly $30,000 more than their counterparts in the overall private sector and span an operational footprint of nearly 4,000 individual business establishments across the state. Amidst the economic and labor market challenges of the last 2 years, the industry's strong continued job growth has helped to bolster Georgia's economy and generate substantial impacts that extend well beyond its direct employment and production activities.

This assessment—conducted on behalf of and in close collaboration with Georgia Bio—represents a biennial update regarding the competitive position and performance of the state's life sciences industry and the innovation ecosystem in which it operates.

An Economic Engine for Georgia

Since 2015, life sciences' employment growth has outpaced Georgia's overall private sector growth by more than two times, reinforcing the industry's role as an important targeted cluster for state economic development, and its critical role as an economic engine for Georgia.

Key findings from the industry economic and impact analyses include the following:

- Georgia's life sciences industry has grown by 20% or 11,225 jobs since 2015, a net increase just exceeding that for the national sector that has risen by 19%.[1]
- Georgia's impressive net job growth in the industry has been driven primarily by the industrial life sciences segment which has increased by nearly 29% and outpaced the nation, while the academic and federal R&D component has experienced more modest growth.
- Life sciences' employment growth has outpaced Georgia's overall private sector growth by more than two times since 2015, reinforcing the industry's role as an important targeted cluster for state economic development, and its critical role as an economic engine for Georgia.
- Georgia has seen four of its seven life sciences subsectors outpace the U.S. in job growth since 2015, led by growth in the state's largest subsector—research, testing, and medical labs which has increased its employment base by 50% since 2015.
- The life sciences' sizable workforce, strong recent growth, and substantial wage premiums paid to its workforce translate into significant impacts on Georgia's economy. In 2021, Georgia's life sciences industry and its multiplier effects generated:
    - A total employment impact of nearly 215,000 Georgia workers across all sectors
    - A combined $50.2 billion in total economic impact to Georgia's economy
    - A total value added impact of $26.7 billion to Georgia's GSP-representing 3.9% of state GSP

1 It is important to note that this sector growth rate does not include changes or growth in the digital health subsector for Georgia or the U.S. due to the highly customized approach required to measure the sector in Georgia, with a detailed explanation provided in the Appendix to this report.

Life sciences industry development differs from other advanced industries and is highly dependent upon a robust and high-functioning innovation ecosystem. A series of ecosystem elements were analyzed for Georgia with comparisons made against national performance (Figure ES-1), and key findings include:

- **NIH Funding:** Georgia institutions exceeded $700 million in annual funding awards from NIH in 2020 and 2021, an increase of 46% from 2015, keeping pace with national funding growth.

- **University Life Sciences R&D:** Georgia's research universities spent nearly $1.4 billion in life sciences R&D in 2020. Despite a modest increase in 2020 of just 1%, Georgia has outpaced national academic R&D growth overall from 2015 through 2020.

- **Venture Capital Investments:** Life science-related VC investments reached new peaks in 2021 for both Georgia and the U.S. In Georgia, nearly 1 of every 2 dollars invested in the sector have been in digital health companies, a share much higher than that for the national sector.

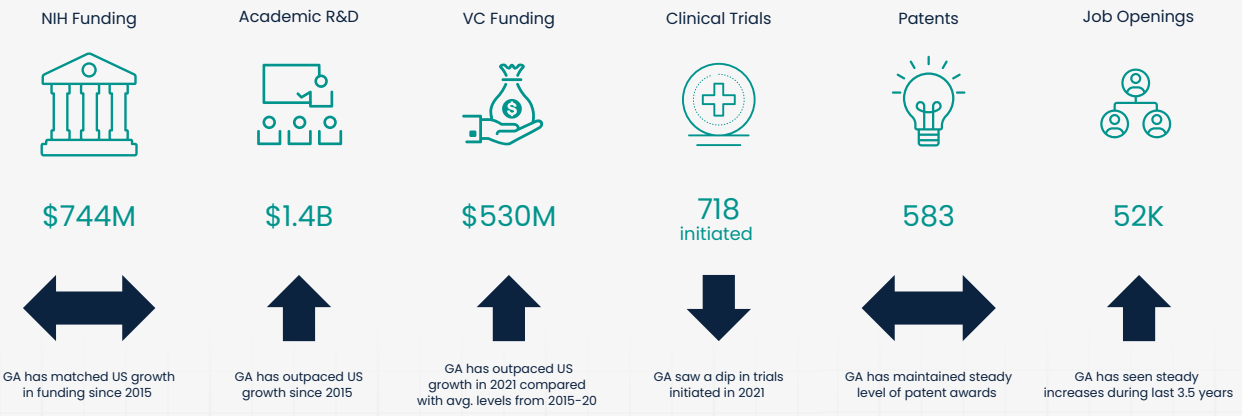
- **Clinical Trials Activities:** Georgia has a sizable presence in clinical trials, with more than 800 initiated in the state each year since 2015, on average.

- **Patent Activity:** Georgia inventers have been awarded 4,040 patents in life science-related technology classes since 2015, an average of 577 per year. Georgia is maintaining a steady level of patents largely in medical device technologies led by industry-assignees and in biopharmaceuticals led by universities. Patent awards are also concentrated in agricultural/agbioscience technology.

- **Workforce & Talent Demand:** Companies across the industrial life sciences in Georgia have published more than 52,000 unique job postings in the last 3.5 years, representing the breadth of both the sector in terms of leading employers with hires, and the roles required in terms of varied skill and educational requirements.

The findings, in general, represent impressive gains for Georgia and continued emergence of its life sciences industry and broader ecosystem. Maintaining this progress, however, is not guaranteed. The economic headwinds of slower growth, high inflation, tight labor markets, and challenging supply chain dynamics, as well as other factors all pose challenges for the industry and its global markets in 2022 and beyond. The life sciences industry, however, has a strong track-record of resiliency during economic downturns including during the COVID-19 pandemic and recent recessions. In uncertain economic times, it is an industry and ecosystem that has proven to be especially durable.

Figure ES-1: Summary Findings Across Georgia's Life Sciences Innovation Ecosystem Performance Metrics, Latest Levels of Activity (Primarily 2021) and Recent Trend Directions



Source: TEConomy Partners' analysis.

I. Life Sciences Industry Performance Trends and Impacts:

A High-Growth Sector Continues to Bolster Georgia's Economy

Georgia's life sciences industry has seen steady, strong growth in hiring in recent years and by 2021 employed more than 78,000 across the state. This sizable industry base rivals that of other strategic sectors and targeted industry clusters in Georgia and reflects the varied nature of the life sciences industry globally, spanning innovative R&D and production activities across several major subsectors shown in Figure 1.

The industry concept utilized in this assessment can be divided into two major groupings—the industrial life sciences, which includes the breadth of private sector corporate activity throughout Georgia and the subsectors listed in Figure 1; and the academic and federal life sciences components that include the intensive R&D activities and associated personnel of Georgia's colleges and universities, as well as the unique federal asset that is the Centers for Disease Control and Prevention (CDC), which is headquartered in Atlanta.[2] Seven in ten Georgia life sciences employees are in the industrial component (55,111 in total), while the remaining 30% are employed within the academic and federal life sciences research complex.

Figure 1: The Life Science Industry in Georgia—Major Subsectors and Employment Totals, 2021

Industrial Life Sciences:

- AG Feedstock & Industrial Life Sciences
- Drugs & Pharmaceuticals
- Medical Devices & Equip.
- Research, Testing, & Medical Labs
- Life Sciences-related Distribution
- Digital Health/Health IT

55,111 Jobs

Academic & Federal Life Sciences

- University Life Sciences R&D
- Federal CDC Employment

23,382 Jobs

Combined 78,493 GA Jobs in 2021

Source: TEConomy Partners' analysis of Lightcast, 2022.3 data set; BLS, CEW; National Science Foundation, HERD Survey; Technology Association of Georgia.

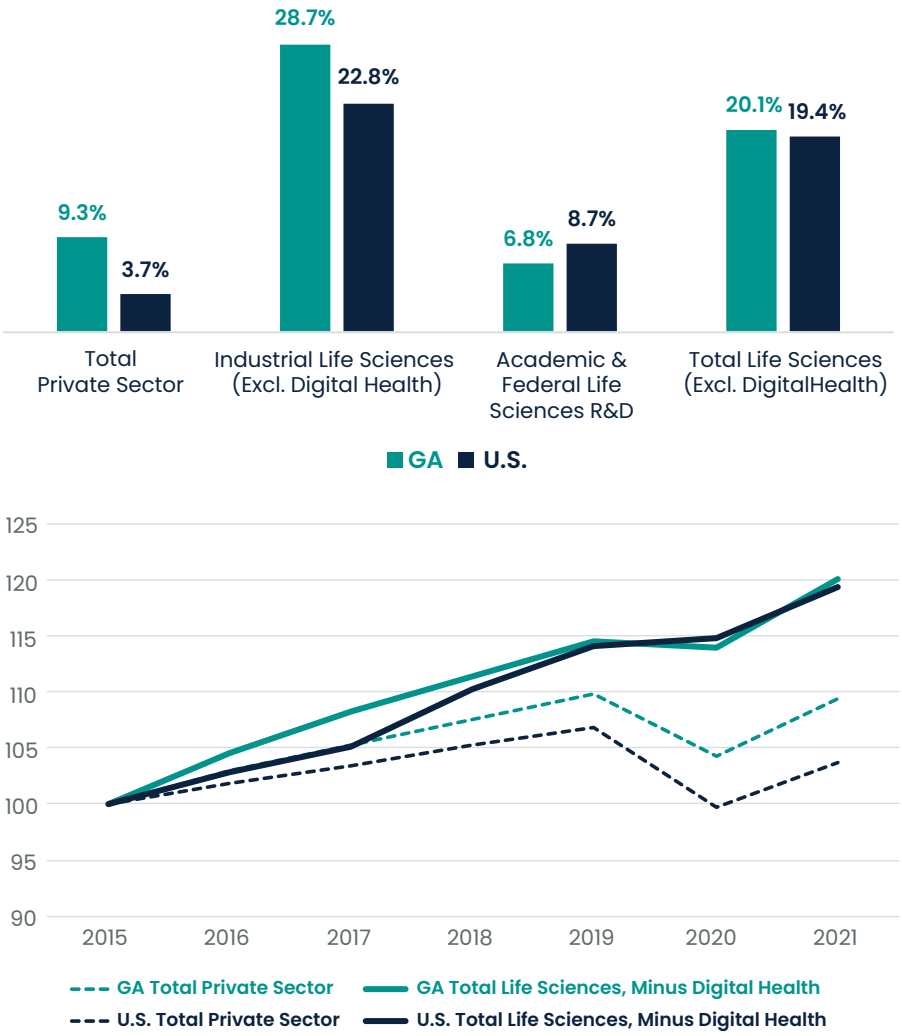
2 For detailed definitions of each major subsector and the life sciences industry overall, as well as for information on the source of these employment data, see the Appendix to this report.

Taken together, Georgia's life sciences industry has grown by 20% or 11,225 jobs since 2015, a net increase just exceeding that for the national sector that has risen by 19% (see Figure 2). It is important to note that this sector growth rate does not include changes or growth in the digital health subsector for Georgia or the U.S. due to the highly customized approach required to measure the sector in Georgia, with details provided in the Appendix to this report.

Georgia's impressive net job growth in the industry has been driven primarily by the industrial life sciences segment which has increased by nearly 29% and outpaced the nation, while growth in the academic and federal R&D component has experienced more modest growth. **Overall, the life sciences have seen employment growth outpace that for Georgia's overall private sector by more than two times, reinforcing the industry's role as an important targeted cluster for state economic development, and its critical role as an economic engine for Georgia.**

This role and the importance of the life sciences from an economic perspective was reinforced during the economic shock of the COVID-19 pandemic in 2020 when total private sector employment in Georgia declined by 5.1% while the life sciences held employment essentially steady, declining by just 0.5%. In 2021, as the broader economy regained its footing, Georgia life sciences firms ramped up their hiring—growing payrolls by 5.4% with widespread growth across nearly all the industry subsectors.

Figure 2: Life Sciences Employment Growth Trends, Georgia and U.S., 2015-21



Source: TEConomy Partners' analysis of Lightcast, 2022.3 data set; BLS, CEW; National Science Foundation, HERD Survey. Due to data limitations from NSF, 2020 and 2021 academic R&D personnel counts are estimated.

Digging deeper, Figure 3 highlights the growth rates at a more granular industry subsector level where Georgia has seen four of its seven life sciences subsectors outpace the U.S. in job growth since 2015.[3] Highlights of trends for the industrial subsectors include:

- Job gains in the life sciences have been propelled by especially strong growth among the state's **research, testing, and medical labs** subsector, the state's largest life sciences component which in 2021 employed 16,388. The subsector has grown its jobs base by an impressive 50% since 2015 with most of the gains occurring since 2018 and with significant contributions from both the commercial biotech and life sciences R&D component as well as in medical labs and diagnostic services. Examples of subsector companies operating in Georgia include Quest Diagnostics, LabCorp, and IQVIA.

- **Life sciences distribution** is Georgia's second-largest subsector also with more than 16,000 state jobs in 2021. Georgia distributors of life science-related products from pharmaceuticals and medical equipment to seeds and agricultural chemicals have increased employment by 18% since 2015, with the majority of the hiring in the 2015-18 period, which has since levelled-off. The largest detailed component—medical, dental, and hospital equipment and supplies—has contributed the most to recent growth. Examples of subsector companies operating in Georgia include McKesson, Cardinal Health, and Owens & Minor.

- Georgia **medical device and equipment manufacturers** have hired at a rapid rate in recent years, increasing the subsector's employment base by nearly 22% since 2015 to almost 6,500 jobs. This growth outpaced that for the national sector by two times and has been widespread across the underlying detailed manufacturing sectors including electromedical apparatus; irradiation equipment; surgical instruments; ophthalmic goods; and a new, more sizable presence emerging in analytical lab equipment. Examples of subsector companies operating in Georgia include Alcon, Intuitive, Medtronic, and Becton, Dickinson and Company (also known as BD).

- The **drugs and pharmaceuticals** subsector has grown employment by 11% in Georgia since 2015, reaching nearly 3,400 jobs in 2021. Following relatively sharp job declines in 2020, state subsector companies reversed some of the losses in 2021 with 8.5% growth. Three of the four detailed industries within the subsector contributed to the overall job growth from 2015, including in medicinal and botanicals; pharmaceutical preparation; and biological products. Examples of subsector companies operating in Georgia include Takeda Pharmaceuticals, Boehringer Ingelheim, and UCB.

- Though modest in size relative to others within the life sciences, Georgia's **agricultural feedstock and industrial biosciences** subsector experienced strong growth since 2015, increasing by 30% to more than 1,400 state jobs. Job gains were driven by hiring in the agricultural chemicals components. Examples of subsector companies operating in Georgia include Nutrien Ag Solutions, Mosaic, and J.R. Simplot.

- Estimates of Georgia's **digital health** sector employment were derived by identifying specific companies operating in the state and total 11,415 jobs in 2021 that span 339 companies such as Azalea Health, Ingenious Med, and Zelis.

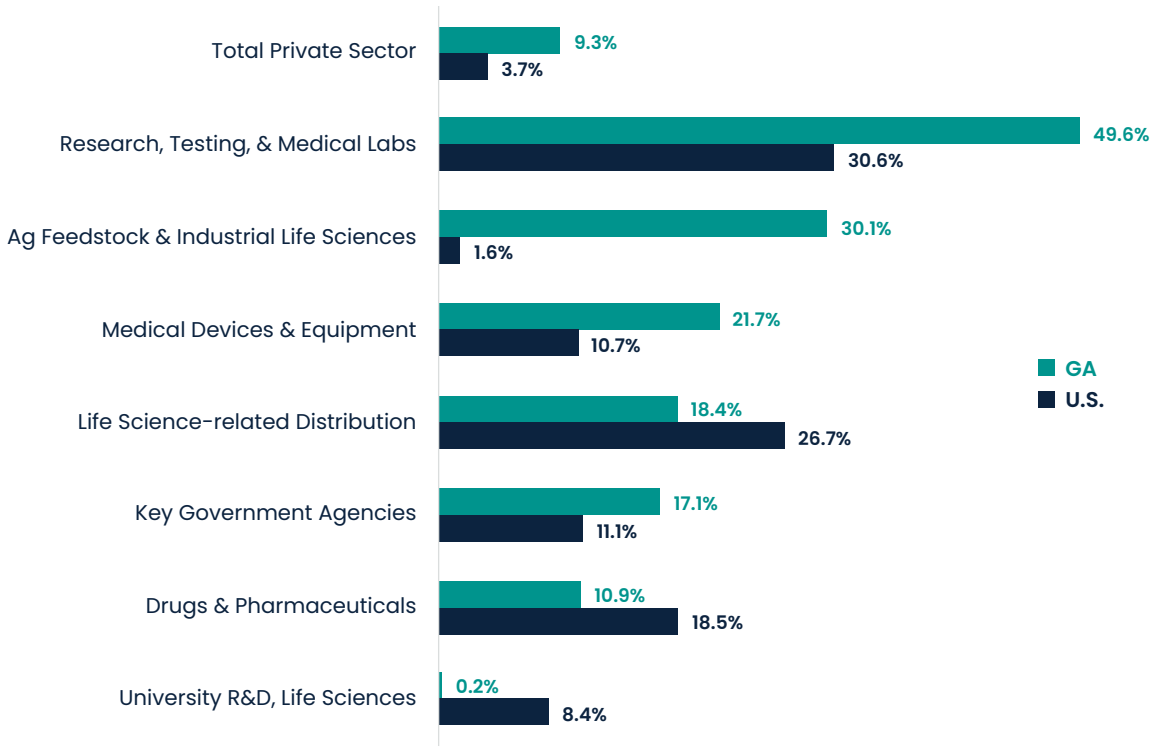
Highlights of trends for the academic and federal subsectors include:

- **Life science-related university R&D personnel**[4] at Georgia colleges and universities totaled 13,393 in 2021, with relatively little overall net change since 2015.

- **Federal public health employment** totaled nearly 10,000 in 2021 almost exclusively working with the CDC, and up by 17% overall since 2015. Most of the recent job gains for the CDC occurred in the last 2 years in response to the pandemic.

3 Note again that these trend data exclude growth for the digital health subsector.
4 Data are sourced and estimated from annual National Science Foundation (NSF) Higher Education R&D surveys, for more information see the Appendix.

Figure 3: Employment Trends in Major Life Sciences Subsectors, GA and U.S., 2015-21



Source: TEConomy Partners' analysis of Lightcast, 2022.3 data set; BLS, CEW; National Science Foundation, HERD Survey. Due to data limitations from NSF, 2020 and 2021 academic R&D personnel counts are estimated.

Georgia's industrial life sciences account for 1.1% of total state private sector jobs, a significant employment base though below the average concentration nationally (1.9%). The relative concentration of an industry in a given state or region can be measured using Location Quotients (LQs) where an LQ of 1.00 for a specific industry or industry cluster represents a concentration that matches the national average. An LQ of greater than 1.00 indicates a greater concentration within the state. When the LQ is significantly above average—1.20 or greater—the state is said to have a "specialization" in the industry.

Relative to national averages, Georgia's life sciences industry is considered to be under-concentrated—its LQ is 0.61 or 61% of the average national concentration for the industrial life sciences. This relative under-concentration holds for most major subsectors. **The exception is for key government public health agencies–primarily the CDC, a truly unique public health asset–as evidenced by its extremely high location quotient of 4.99, meaning Georgia has a nearly five times greater concentration in this sector relative to the national average.**

Georgia Outpacing Nation in Life Sciences Growth

By Pat Wilson, Commissioner, Georgia Department of Economic Development

The State of Georgia has maintained a dedicated focus on building a dynamic hub for life sciences by providing innovative talent, business resources, support for research and development, and easy access to global markets. This past year, new jobs created in Georgia by new and existing bioscience companies grew by 150% — an excellent reflection of the success of these efforts. Leading this growth were global industry powerhouses such as Boehringer Ingelheim, Boston Scientific, Intuitive, and Moderna. These and other companies contribute to the life sciences by developing and manufacturing pharmaceuticals, vaccines, medical devices, cell therapies, regenerative therapies, digital health products, and biotech.

Georgia's bioscience ecosystem is strong in all stages of product development from concept to commercialization. The state fosters a culture of collaboration and innovation resulting in public-private partnerships between research universities, private industry, and nonprofit organizations including the Centers for Disease Control and Prevention (CDC) and the American Cancer Society. These partnerships were on the forefront of combating COVID-19, and they continue to anticipate and tackle medical needs around the world.

As we look to the future, Georgia continues to invest in life-science sector development.

Georgia's strong statewide academic institutions are doing groundbreaking research and contributing to our diverse workforce. More than 150,000 degrees are earned each year through Georgia's public and private higher education institutions, and the number of graduates in life-science related disciplines has increased by 14% over the last five years. Our universities also produce a pipeline of graduates with a range of skills in software development, cybersecurity, data analytics, artificial intelligence, robotics, and mechatronics – all critical for the future of life sciences.

In Georgia, nurturing an interest in life sciences starts early and from the ground up. The partnership between companies, the Technical College System of Georgia, and the Department of Education leads to development of curriculum and work-based learning experiences that meet specific employer needs. These programs inform high school students of the range of careers available, and can even start training students with specific skills needed for certification.

With plenty of expansion space and a skilled workforce to support it, manufacturing is a major driver for national and international investment in Georgia. To encourage further growth within the sector, Georgia legislation recently instated a Life Sciences Manufacturing Tax Credit Bonus. This incentive is offered to new or expanding companies creating jobs in Georgia for the purpose of manufacturing pharmaceuticals, medicines, and medical equipment and supplies in Georgia.

Globally the life sciences industry has experienced a dramatic rise in demand for lab space, and Georgia's life sciences community has been actively identifying ways to meet this need. Science Square, Science Tower, and recent expansions at the University of Georgia (UGA) are only a few of the opportunities underway across the state.

Life sciences is the fastest-growing industry in the nation, and we are excited that Georgia's growth is outpacing the nation. We continue to lead with a partnership approach, and we actively encourage collaboration to bring companies the resources needed to successfully create, test, develop, and distribute their products. The innovative work and cutting-edge developments being done here in Georgia are impacting the world, and we look forward to the future we are creating today.

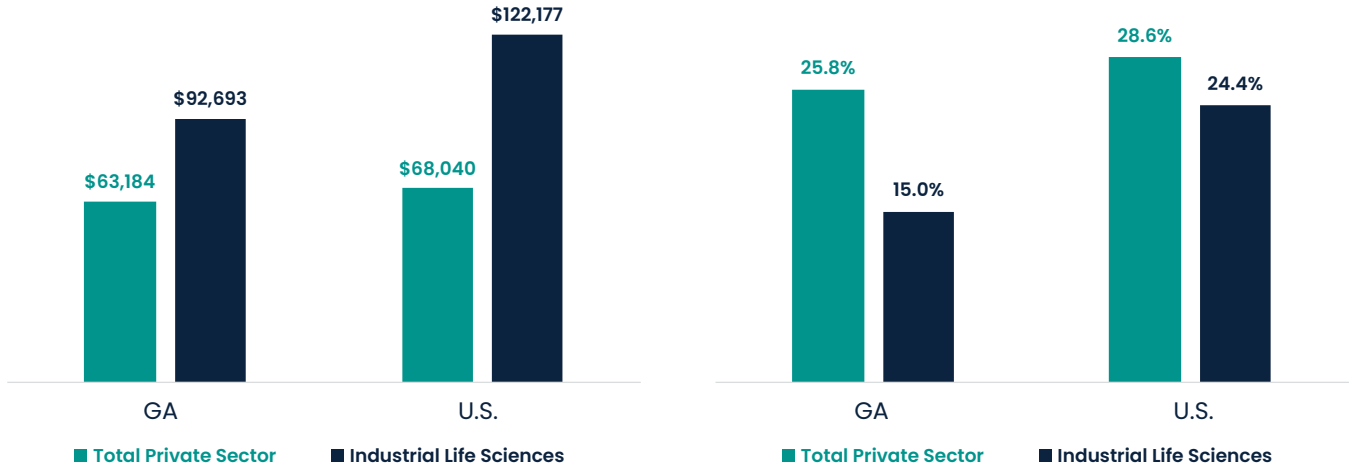
Table 1: Industry Employment, Relative Concentration (Location Quotients), and Establishments, 2021

Life Sciences & Major Subsectors	2021 Employment	Location Quotient, 2021	2021 Establishments
Total Life Sciences	**78,493**	**n/a**	**3,993**
Research, Testing, & Medical Labs	16,388	0.59	1,948
Life Science-related Distribution	16,059	0.86	1,134
University R&D, Life Sciences	13,393	0.74	15
Digital Health/Health IT	11,415	n/a	339
Key Government Agencies (CDC)	9,989	4.99	23
Medical Devices & Equipment	6,461	0.51	308
Drugs & Pharmaceuticals	3,370	0.32	162
Ag Feedstock & Industrial Life Sciences	1,418	0.65	65

Source: TEConomy Partners' analysis of Lightcast, 2022.3 data set; BLS, CEW; National Science Foundation, HERD Survey. Due to data limitations from NSF, 2020 and 2021 academic R&D personnel counts are estimated.

The life sciences are generating high-quality jobs in Georgia, reflecting the strong value-adding activities of the sector and its corresponding demand for high-skilled STEM talent that drive the high-value scientific research, manufacturing, and overall commercialization in the sector. In 2021, Georgians employed in the industrial life sciences earned nearly $93,000 annually, on average, or nearly $30,000 more than their counterparts in the overall private sector (see Figure 4). Despite this strong wage premium in Georgia's life sciences sector, state industry workers earn less than their life sciences counterparts nationally ($122,000). Wage growth in Georgia has grown at double-digit rates since 2015 in both the life sciences and overall, however growth has lagged that for U.S. workers overall.

Figure 4: Average Annual Wages in the Industrial Life Sciences and Private Sectors, Levels and Growth, GA and US, 2015-2021



***Note:** The Digital Health subsector is not included as wage data are not available.

Source: TEConomy Partners' analysis of Lightcast, 2022.3 data set; BLS, CEW.

Economic Impacts of the Georgia Life Sciences Industry:

Strong Value-Adding Industry Activities Support Nearly 215,000 Georgia Workers, Generate $50 Billion in Total Economic Impact for Georgia

The life sciences' sizable workforce, strong recent growth, and substantial wage premiums translate into significant impacts on Georgia's economy. These impacts stem not only from the industry's direct hiring, research, production, and distribution activities, but also from the broader ripple effects generated throughout the state economy from its spending on supply chain goods and services and the spending by industry workers. This distinct set of impacts can be decomposed but also combined into a sum total for the industry and are referred to as:

- **Direct effects:** the specific impacts of the sector(s) in question with one or more direct effects typically driving the economic impact model—in this case the activities of the statewide life sciences cluster;
- **Indirect effects:** the impact of purchases from suppliers by the focus industry or sectors;
- **Induced effects:** the additional economic impact of the spending of direct and supplier employees in the overall economy; and
- **Total impacts:** the combined total or summation of direct, indirect, and induced effects.

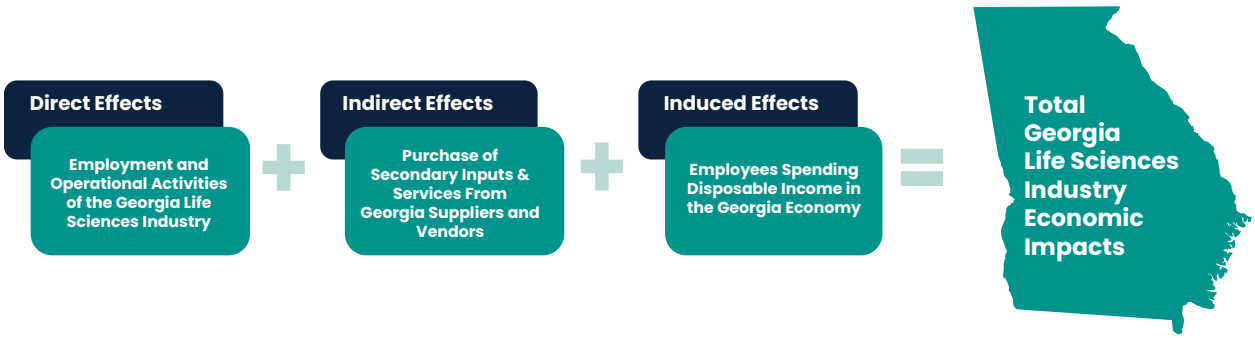
Figure 5 graphically depicts these impact effects for the Georgia life sciences industry.

Highlights and Headlines from the Economic Impact Analysis

In 2021, Georgia's life sciences industry and its multiplier effects generated:

- A total employment impact of nearly 215,000 Georgia workers across all sectors
- A combined $50.2 billion in total economic impact to Georgia's economy
- A total value added impact of $26.7 billion to Georgia's GSP—representing 3.9% of state GSP

Figure 5: Components of Georgia Life Sciences Industry Economic Impacts



Economic Impact Methodology

The standard analytical technique for the quantification of expenditure impacts is input-output (I-O) analysis. I-O analysis, the technique deployed by TEConomy for impact measurement herein, uses a matrix representation of an economy that quantifies the impact of spending by one sector of the economy (e.g., medical device manufacturing) on all other sectors, consumers, and government. TEConomy uses the IMPLAN software and data systems for application of I-O analysis.*

Economic impact analysis makes use of a specific, regionalized I-O model to represent the interrelationships among economic sectors. The data built into the I-O model represent and estimate the flow of commodities to industries from producers and institutional consumers within the specific region. The data also show consumption activities by workers, owners of capital, and imports from outside the region. The data and trade flows built into the model allow for the estimation of the impacts of one sector on all other sectors.

The I-O analysis models the "ripple effect" or "multiplier effect" that originates from Georgia life sciences industry's employment and expenditures in the state economy, flows through suppliers and vendors as additional inputs are purchased, and through industry employees and related supplier workers who spend their wages in the state economy. Impacts of spending outside of the State of Georgia are considered economic leakages and are not included in these values.

* Full impact tables for total life sciences and industrial life sciences only are included in the Appendix.

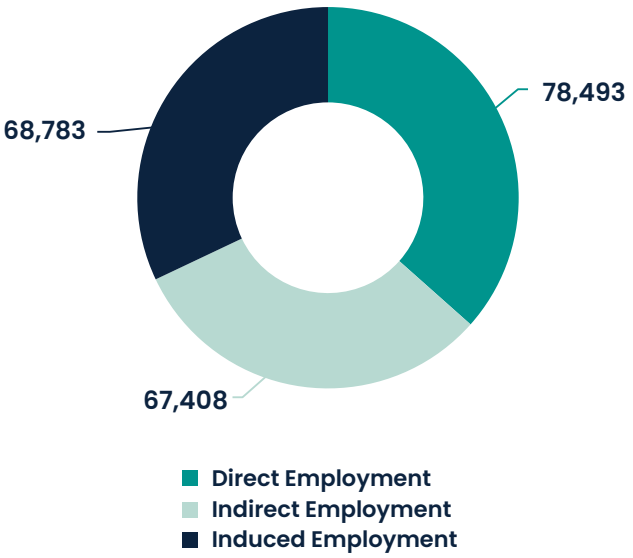
Driven by the Georgia life sciences industry employment figures presented in the previous section, and inclusive of both the industrial and academic and federal life sciences components, the IMPLAN model is used to estimate a variety of impacts for this analysis. Key among these impacts are the following:[5]

Employment Impacts

Representing the total number of jobs supported by the Georgia life sciences industry, ***employment impacts*** include the direct industry jobs as well as the indirect and induced jobs generated through purchases and expenditures.

Based on the sectoral employment values, including an estimate of academic life science research employment and the employment of the CDC, leads to a direct employment value of nearly 78,500 workers. The work and expenditures of these workers supports an additional 136,000 workers leading to a total employment impact of nearly 215,000 Georgia workers across all sectors (Figure 6). This total employment impact translates into an employment multiplier of 2.74 meaning that every direct life sciences industry job in the State of Georgia generates and supports an additional 1.74 jobs within the state's economy.

Figure 6: Employment Impacts of the Georgia Life Sciences Industry

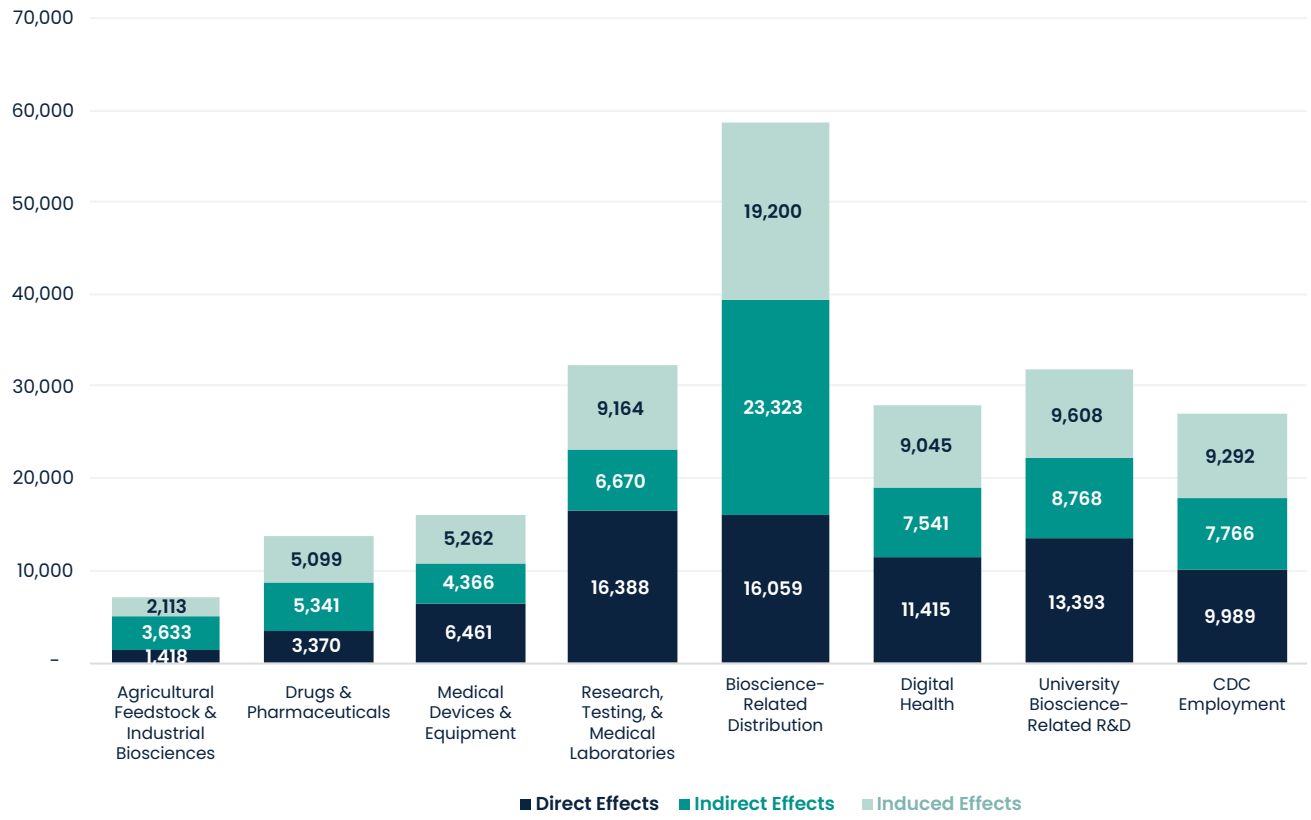


Source: TEConomy analysis, IMPLAN State of Georgia Model.

5 Full impact tables for total life sciences and industrial life sciences only are included in the Appendix.

From a sector-specific perspective, the significant size of the bioscience-related distribution sector generates additional outsized employment impacts (Figure 7). This sector alone accounts for 27% of the industry's total impacts. The non-industrial sectors (e.g., academic R&D and the CDC) combine to account for a similar 27% share of all employment impacts.

Figure 7: Georgia Life Sciences Employment Impacts by Sector, 2021



Source: TEConomy analysis, IMPLAN State of Georgia Model.

Life Sciences Distribution: Leveraging Georgia's Transportation and Logistics Strengths as a Competitive Advantage

According to the Georgia Department of Economic Development:

"Georgia's logistics industry is powered by more than 15,000 logistics establishments employing more than 181,000 in direct logistics industry jobs. With the fourth largest and fastest-growing seaport in the nation, the world's busiest and most efficient airport in Atlanta, 10th largest air-cargo hub in North America, more rail miles than any other state in the Southeast, and a top-ranked highway system, Georgia handles and hauls more than $900 billion of cargo each year. Many of the world's leading logistics companies have operations or headquarters in Georgia including Amazon, The Coca-Cola Company, Delta Air Lines, The Home Depot, Norfolk Southern, and UPS."*

This significant base of multi-modal transportation and logistics infrastructure and associated logistics services providers and expertise represent a major competitive advantage for Georgia...and the life sciences have seized upon this opportunity resulting in:

- An especially large life sciences footprint of wholesale distribution operations spanning 1,134 life sciences-related distribution establishments that employ just over 16,000 Georgians.
- Double-digit employment growth rate from 2015-21 of 18%
- Average annual wages that are among the highest in the Georgia life sciences industry at $105,000.
- The sizable presence of large and leading multi-national companies, including McKesson and Cardinal Health, lead to a strong and above average concentration in medical equipment and supplies distribution in Georgia—8% above the national average (a LQ of 1.08) —and an employment growth rate of 30% since 2015 that has driven growth in the overall subsector.

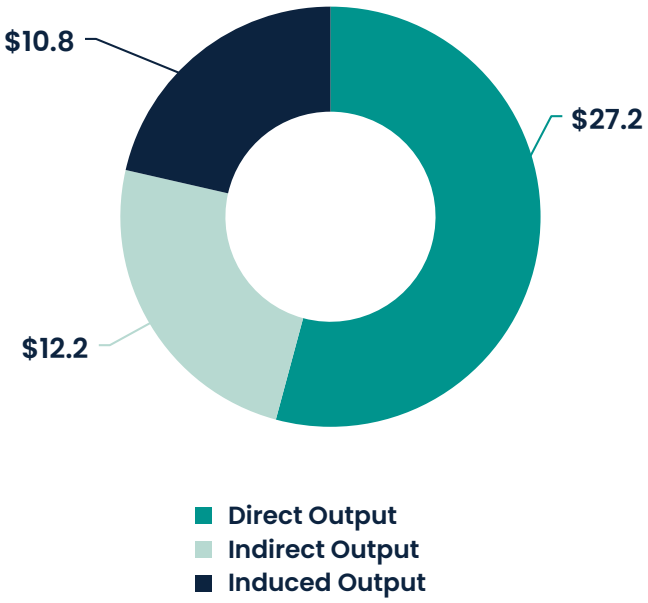
*Source: Georgia Department of Economic Development, Center of Innovation in Logistics.

Output Impacts

Also referred to as production, sales, or business volume, ***output*** is the total value of goods and services produced in the economy.[6] The total output impacts are often cited as the total economic impacts of a firm, industry, or project.

From an output perspective, the estimated direct industry output of $27.2 billion supports a combined $50.2 billion in total economic impact (Figure 8). At this level, every dollar of direct output generated by the Georgia life sciences industry supports an additional $0.85 in related output from the state's economic sectors (an output multiplier of 1.85). Industrial life sciences, not including academic or federal government-related sectors, accounts for $21.5 billion or 79% of the Georgia life sciences' direct output and 77% of the total output.

Figure 8: Output Impacts of the Georgia Life Sciences Industry, $ in Billions



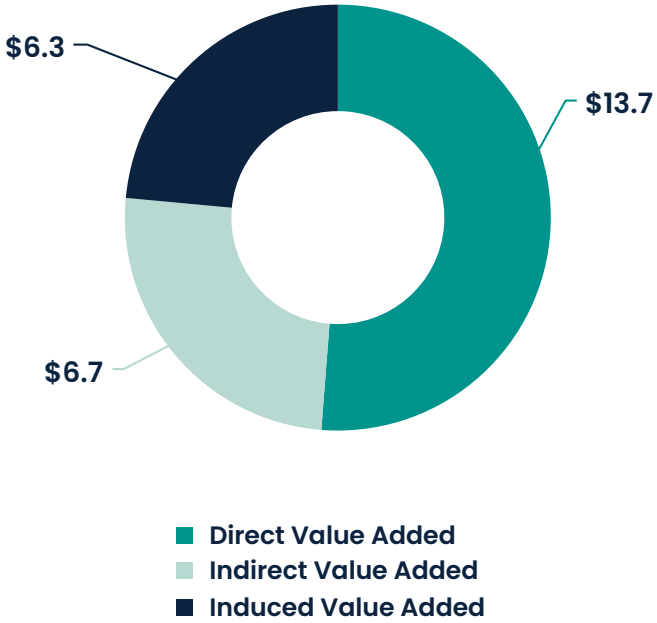
Source: TEConomy analysis, IMPLAN State of Georgia Model.

Value Added Impacts

Value Added represents the difference between an industry's total output and the cost of its intermediate inputs (including labor income). While output impacts measure the total sales or revenues generated, value added is a more concise measure of "wealth" creation contributed to the state, in terms of its contribution to Gross State Product (GSP). Value added is unaffected by those industries that have higher purchased input costs that lead to correspondingly higher sales values, and measures the value produced within the state after subtracting the costs of purchased inputs.

The direct value added impact of Georgia's life sciences industry is estimated to be $13.7 billion. This direct effect accounts for 2% of the state's total GSP. This direct effect generates and supports an additional $13.0 billion in indirect and induced effects, for a total value added impact of $26.7 billion—representing 3.9% of state GSP (Figure 9). This level of total value added impact reflects a multiplier of 1.95—for every $1 dollar of value added generated by the Georgia life sciences industry, an additional $0.95 is generated by related suppliers and other sectors of the Georgia economy.

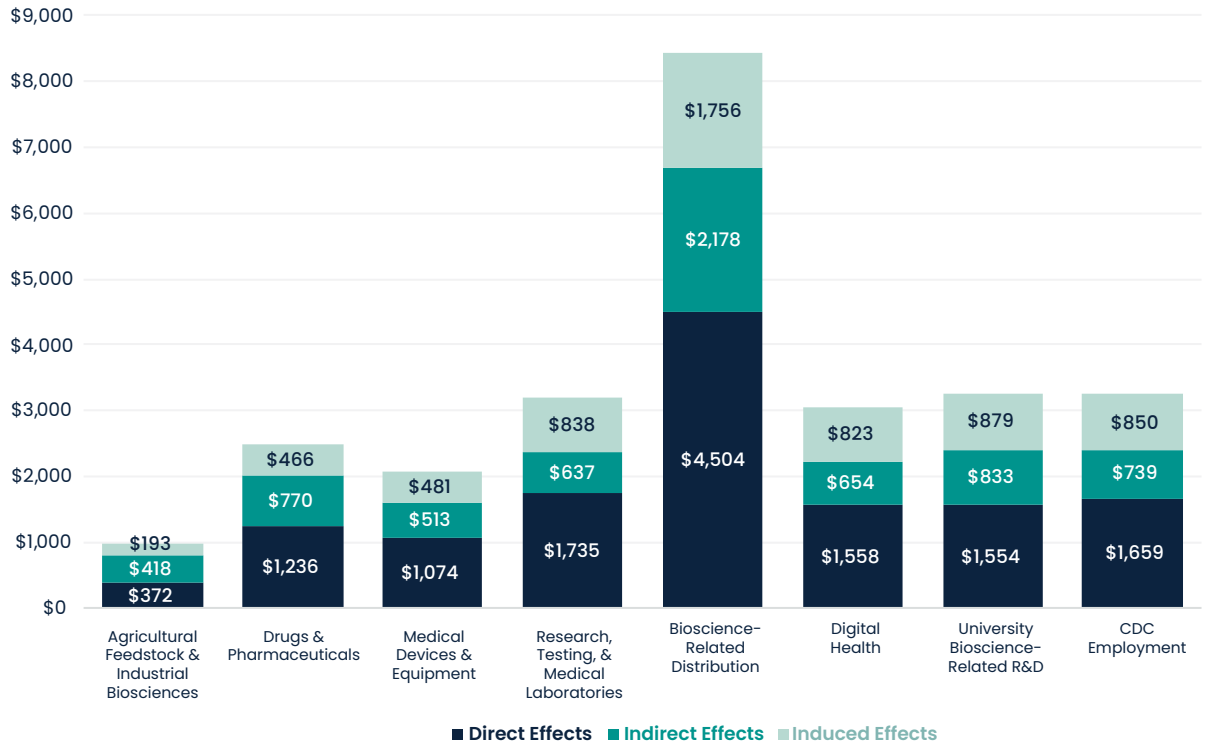
Figure 9: Value Added Impacts of the Georgia Life Sciences Industry, $ in Billions



Source: TEConomy analysis, IMPLAN State of Georgia Model.

6 Note: for public/non-profit entities such as universities, output is more akin to total expenditures.

Figure 10: Georgia Life Sciences Value Added Impacts by Sector, 2021 (Contribution to State GSP; $ in Millions)



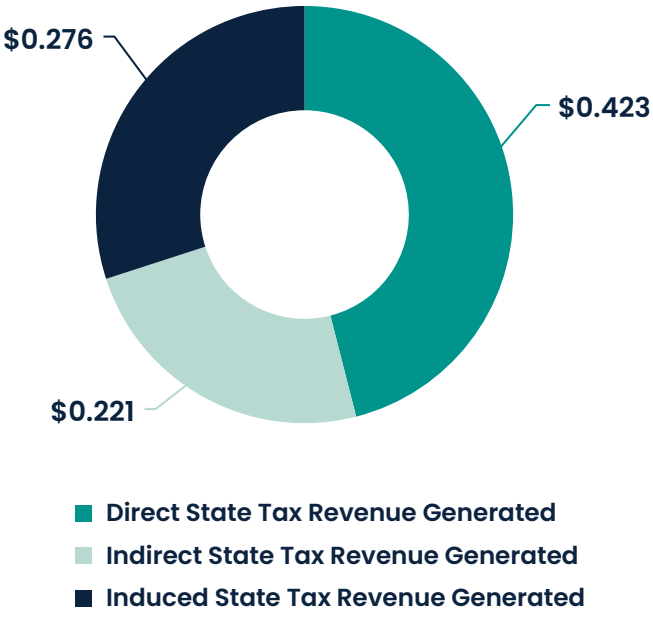
Source: TEConomy analysis, IMPLAN State of Georgia Model.

Again, the significant footprint of the bioscience-related distribution sector delivers similar sized, if not outsized, value added impacts. It is important to remember that for the wholesale, distribution, and logistics services included in this sector, the actual services being provided are generating the value added. The value of the life science-related products being transported are not included as "costs" to this sector, so beyond personnel costs, overall costs are more limited to things like utilities, fuel, security expenses, etc.

State Tax Revenue Impacts

State tax revenue impacts include the estimated revenues to state government from all sources stemming from the core economic impacts. Estimated tax revenue impacts are adjusted for public-sector (tax exempt) direct effects as necessary. For 2021, it is estimated that the Georgia life sciences industry generated over $420 million in direct state tax revenues (Figure 11). The indirect and induced economic activities in the state supported by the life sciences industry generated nearly $500 million in additional state tax revenues. Combined, the Georgia life sciences industry is estimated to have generated $920 million in state tax revenues in 2021.

Figure 11: State Tax Revenue Impacts of the Georgia Life Sciences Industry, $ in Billions



Source: TEConomy analysis, IMPLAN State of Georgia Model.

Georgia Life Sciences Industry Analysis, 2022

By Patty Fritz, Vice President, U.S. Corporate Affairs, UCB

At UCB, we come together every day to work, laser-focused, on a simple question: How will this create value for people living with severe diseases? Patient value is not just what we say but how we live. It is our culture of care, embodied by our patient value strategy. That's because how we do business – from discovery to development to delivery – has been transformed and redesigned around the patient and their individual experience. Patients are at the heart of everything we do, inspiring us, driving our scientific discovery, and leading us to rethink the patient experience. By fulfilling our commitment, driving innovation, and providing patients a meaningful experience, more impactful solutions are on the horizon.

With a team of approximately 8,500 employees and operations in nearly 40 countries, we are a global biopharmaceutical company headquartered in Brussels, Belgium, with our U.S. headquarters of more than 25 years in Atlanta, Georgia. Additional U.S. UCB sites include R&D in Raleigh and Durham, North Carolina, Bedford and Cambridge, Massachusetts and Seattle, Washington, and a policy office in Washington, D.C. Focused in the areas of neurology, rare disease, and immunology, more than 3.5 million patients use our medicines around the world.

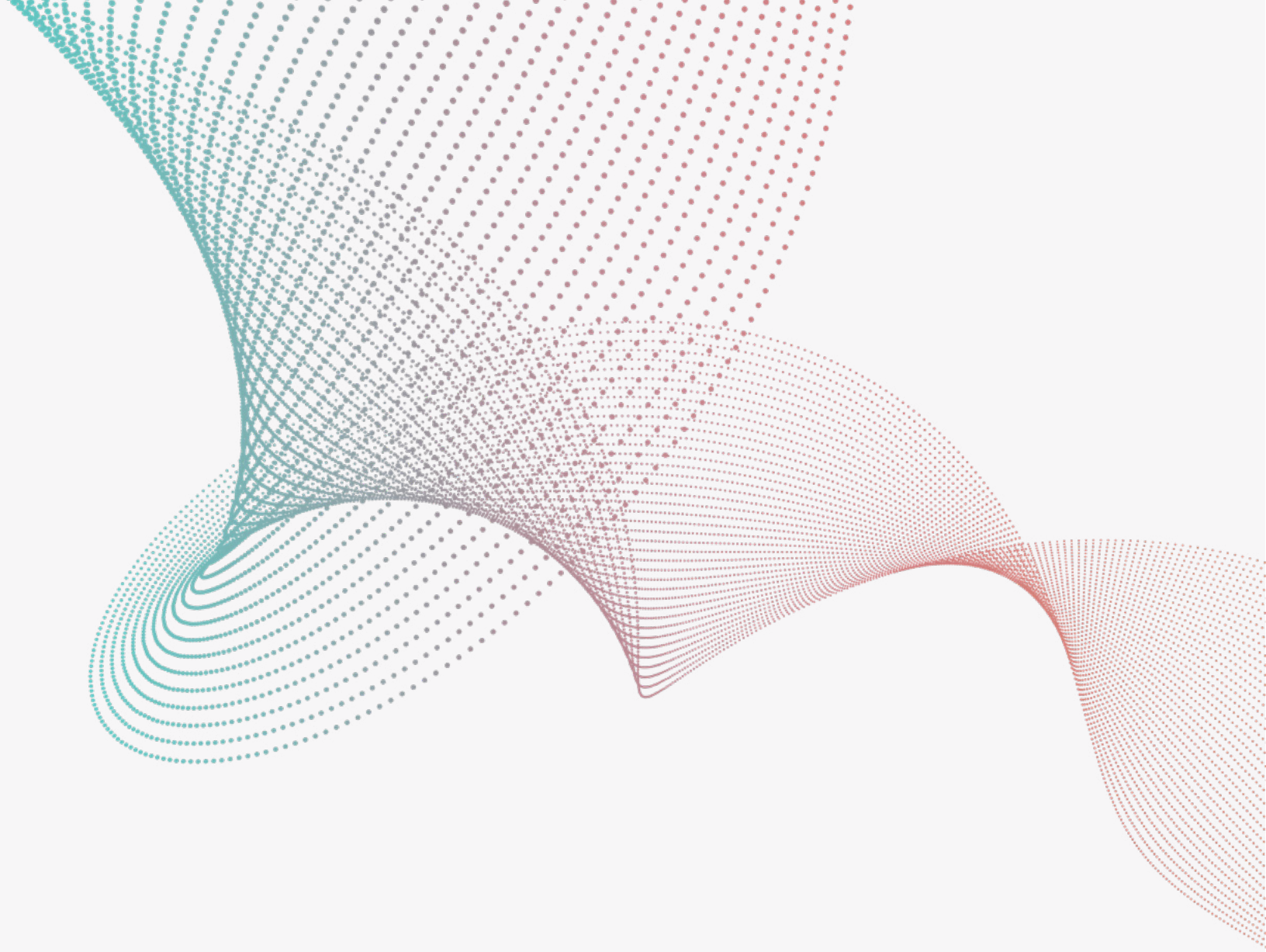
We have been excited to grow our footprint across the U.S., with now nearly 2,000 employees across the U.S. – including robust research & development teams. After starting with no U.S.-based research five years ago, we now have more than 140 people in the research organization, supporting existing projects and identifying new targets and areas for the future.

We invest, on average, a quarter of our revenue annually back into R&D around the globe, making our company one of the most research-intensive in the industry. To enable us to deliver life-changing treatments, it is our teams across discovery, development, and delivery that allow us to impact the lives of patients living with neurological and immunological conditions. As a result of this continue investment, today we are excited to have seven late-stage clinical programs in our pipeline with four expected to receive regulatory approval in the U.S. in 2023.

At UCB, we are proud to be a part of the greater Atlanta community and of our investment in the growth of its healthcare ecosystem. As part of our commitment to the community, we are investing about $47.5 million to expand our 47-acre U.S. headquarters. We expect to create dozens of new roles in Cobb County, supporting our long-term commitment to create jobs and contribute to the growth of the local economy. We recently opened a new 70,000+ square foot building on our campus, the Warehouse. This facility, the most sustainable in UCB's global network, highlights UCB's ongoing commitment to environmental sustainability as recognized by the LEED Gold and WELL Platinum certifications for the project. Phase III of the Atlanta campus redesign and buildout will continue in early 2023.

We were proud to be recognized as a 2021 Top Workplace by the Atlanta Journal-Constitution, and we are confident in our ability to build on this accomplishment by continuing to put our people first. Our commitment to the well-being of our employees allows us to live the UCB mission every day and positively impact the patients, people, and communities we serve.

For more information, please visit www.ucb-usa.com.



II. Georgia's Life Sciences Innovation Ecosystem

Life sciences industry development differs from other advanced industries and is highly dependent upon a robust and high-functioning innovation ecosystem, just some aspects of which include:

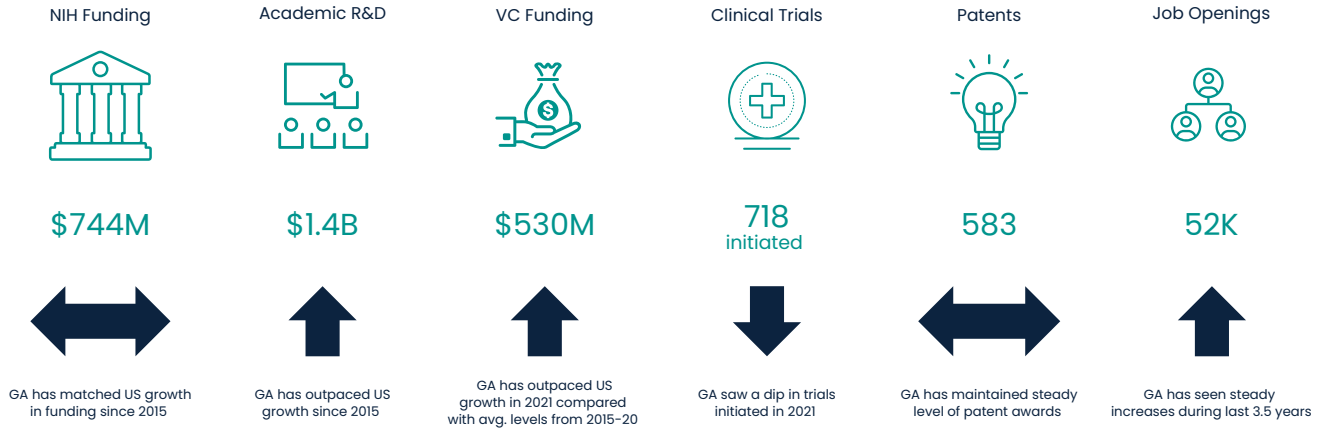
- Recognizing the R&D-intensive nature of scientific breakthroughs, state and regional cluster development in the life sciences calls for especially close connections between industry, clinical healthcare, and academic research. Illustrating this critical connection, the Tufts Center for the Study of Drug Development has found that 80% of the most transformative drugs developed over the last 25 years have resulted from collaborations between industry and academia.
- The industry's foundations in complex science and its rigorous regulatory oversight involving clinical testing and post-approval monitoring translate into long development lead times. For example, to bring a new drug to market typically takes more than a decade and nearly $3 billion, after accounting for the costs of failures.
- The challenging period between scientific discovery and clinical testing, often referred to as the "Valley of Death" particularly for startup or emerging life sciences firms.
- The highly specialized skills, roles, and lab requirements pose further hurdles in terms of workforce and talent development and accessibility.

It is therefore critical when assessing the health and viability of a life sciences ecosystem such as Georgia's to consider the broader ecosystem inputs or elements beyond the ultimate economic outcomes of job creation, wages, and impacts. This section assesses Georgia's position and recent performance in key innovation ecosystem elements, including:

- National Institutes of Health (NIH) funding to Georgia institutions and companies
- R&D expenditures in life sciences fields by Georgia colleges and universities
- Venture Capital (VC) investments in life sciences companies
- Clinical trials activity in Georgia
- Patents awarded to Georgia investors in life science-related technology areas
- Workforce and talent demand

Figure 12 highlights a snapshot of top-line findings across each of the ecosystem elements before each is addressed in a more detailed discussion within this section.

Figure 12: Summary Findings Across Georgia's Life Sciences Innovation Ecosystem Performance Metrics, Latest Levels of Activity (Primarily 2021) and Recent Trend Directions



Source: TEConomy Partners' analysis.

NIH Funding

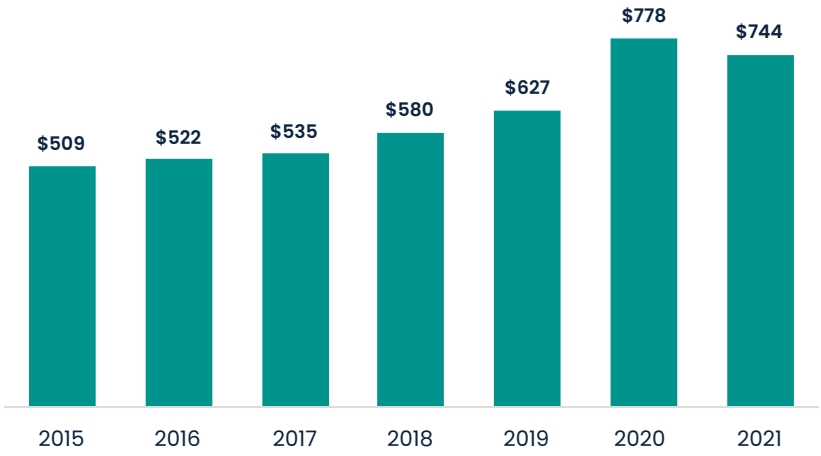
Georgia Institutions Top $700M in Annual Funding Awards in 2020-21, Keep Pace with National Funding Growth Since 2015

Federal funding for life sciences research is a critical element to advancing a science-driven industry. Several agencies fund life sciences research at U.S. colleges and universities, with the National Institutes of Health (NIH) recognized as the "gold standard" for the largest component, biomedical R&D. NIH also funds research at hospitals and other biomedical research institutions as well as small, innovative companies through its Small Business Innovation Research or SBIR program.

After seeing strong growth in NIH awards in 2018 and 2019, and a significant spike in funding in 2020 to reach $778 million that year, Georgia's NIH funding experienced a decline in 2021. Though down from 2020, the $744 million in funding awarded to Georgia institutions in 2021 remains significantly higher than prior years. From 2015 through 2021, Georgia has grown its annual funding level by 46%, essentially matching the national growth rate of 49%.

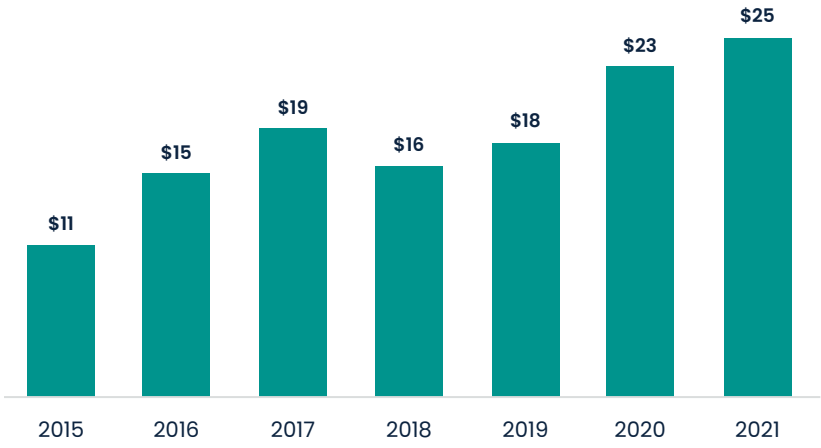
Federal biomedical SBIR and STTR awards from NIH represent key sources of early-stage capital for small, emerging innovative firms. Georgia life sciences companies have successfully secured $25 million in SBIR/STTR awards in 2021, representing a steady increase since 2018 (Figure 14).

Figure 13: Total NIH Funding Awards to Georgia Institutions, 2015-21 ($ in Millions)



Source: TEConomy analysis of NIH RePORT database.

Figure 14: NIH-Funded SBIR/STTR Awards in Georgia, 2015-21 ($ in Millions)



Source: TEConomy analysis of NIH RePORT database.

University Life Sciences R&D

Georgia's research universities spent nearly $1.4 billion in life sciences R&D in 2020 after outpacing national academic R&D growth from 2015-20.

As emphasized in the introduction to this section, the ties between life sciences industry development and university research are especially important for advancing innovation and fueling technology commercialization. In 2020, the latest year for which data are available, Georgia's research universities spent nearly $1.4 billion in life science-related R&D activities (Figure 15). This level of activity places Georgia among the leading states nationally and reflects a life sciences research complex that includes several medical schools including those at Emory University and Morehouse, and other leading research institutions (see sidebar).

State research institutions grew their R&D base steadily through 2019 and in 2020 saw just a 1% increase. Over the 2015 through 2020 period, however, Georgia outpaced national growth in academic R&D activity increasing its base by 36% compared to 28% (Figure 16).

Georgia's Leading Life Sciences Research Institutions

Institution	Life Sciences R&D, 2020 ($M)
Emory University	$749
University of Georgia	$331
Augusta University	$104
Georgia State University	$76
Georgia Institute of Technology	$66
Morehouse School of Medicine	$30
Mercer University	$9
Clark Atlanta University	$6
Kennesaw State University	$6
Fort Valley State University	$5

Source: TEConomy's analysis of NSF, HERD survey.

Figure 15: GA Life Sciences-Related Academic R&D Expenditures ($ in Millions)

Source: TEConomy Partners' analysis of NSF, HERD survey data.

Figure 16: Growth in University Life Sciences R&D Expenditures, GA and U.S., 2015-20

Source: TEConomy Partners' analysis of NSF, HERD survey data.

A pipeline to Georgia's life science future

By Susan Shows, President, Georgia Research Alliance

Where will tomorrow's bioscience companies in Georgia come from?

How will they emerge – and how will they help our state's life science industry evolve?

Part of the answer lies with hope. We hope entrepreneurs will keep pioneering in labs, and larger companies will continue to invest in R&D to spin out new products and startups.

Beyond that hope is a more systemic approach, one that ensures an ever-flowing pipeline of new and innovative life science companies in Georgia. That approach is the Georgia Research Alliance.

GRA's unique – and I don't use the word lightly – role is to help scientists at Georgia's research universities do more research and start more companies. We work at the nexus of exploration and entrepreneurship:

- First, we help the universities recruit more superstar scientists to Georgia, men and women who are leaders in advancing discovery in their fields. They arrive as GRA Eminent Scholars and GRA Distinguished Investigators, and they bring skilled teams and research dollars with them.
- GRA also adds critical technology and tools in university labs to help researchers win more grants and contracts and speed discovery. (We also helped create a way for the university scientists to access and share each other's core facilities and equipment.)
- Finally, we work to get more discoveries and inventions out of the lab and into the world. GRA's venture development program provides crucial early-stage investment and advice from seasoned life science executives. And the GRA Venture Fund adds more of both to the most promising companies.

GRA has repeated this cycle for more than 30 years now, with extraordinary results. A recent analysis revealed that 25% of outside research funding coming to Georgia is awarded to a research team built around GRA-recruited talent – and yet these teams comprise just 5% of the university research workforce in our state. And it's no coincidence that Georgia has steadily climbed the ranks in academic R&D – from 12th just a few years ago to no. 9 in the U.S. today.

A lot of this scientific exploration is happening in life sciences, and the same is true on the entrepreneurial side. Two out of three companies that have received venture development funding from GRA are bioscience enterprises, and 65 cents out of every venture dollar that GRA invests in university startups is awarded to a life science project or startup.

What's most significant is that these investments are made very early in a company's development – that period between the first dollars ponied up by angels and friends and the venture capital that will come later. The grants and loans we award follow a rigorous review, and entrepreneurial scientists at Georgia's universities express gratitude for GRA providing that seed capital when they needed it most.

Not every startup survives, but many do, and several have made it big. GRA helped AKESOgen launch out of Emory in 2010, and after a few years, the company experienced meteoric growth. The provider of genetic testing and analysis for a wide range of purposes and clients, AKESOgen was acquired in 2019 by Tempus, a tech company advancing precision medicine through artificial intelligence.

Another enterprise in GRA's venture portfolio, Axion BioSystems (born at Georgia Tech), supplies life science companies and research enterprises with sophisticated technology to monitor activity inside human cells. It too flourished, growing to 60 employees. In summer 2021, Summa Equity announced its acquisition of Axion, with plans to scale capacity right here in Georgia.

Several dozen life science startups currently receive early-stage investment and guidance from GRA, and you can check them out at GRA.org. Remarkably, 88% of GRA-backed startups are still in business after four years, compared to the national average of 44%. All told, these young companies generated almost $100 million in revenue in the last two years, a figure that underscores their promise and potential.

Which of these will make the biggest contributions to the growth and evolution of Georgia's life sciences industry? It's impossible to say. But the companies will come, and their contributions will be made – because in GRA, Georgia has a partner with a pipeline.

Shows is president of the Georgia Research Alliance (GRA.org).

Life Sciences Venture Capital Investments

Life science-related VC investments reached new peaks in 2021 for both Georgia, U.S. In Georgia, nearly 1 of every 2 dollars invested in the sector are in digital health companies, a share much higher than that for the national sector.

Access to capital is especially vital for R&D-intensive life sciences companies facing long time horizons to guide innovations through to commercial outcomes and steady revenues. In particular, seed- and early-stage companies require funding, often in multiple tranches or rounds to sustain their product development as well as to conduct the rigorous pre-clinical and clinical testing required to meet industry regulations.

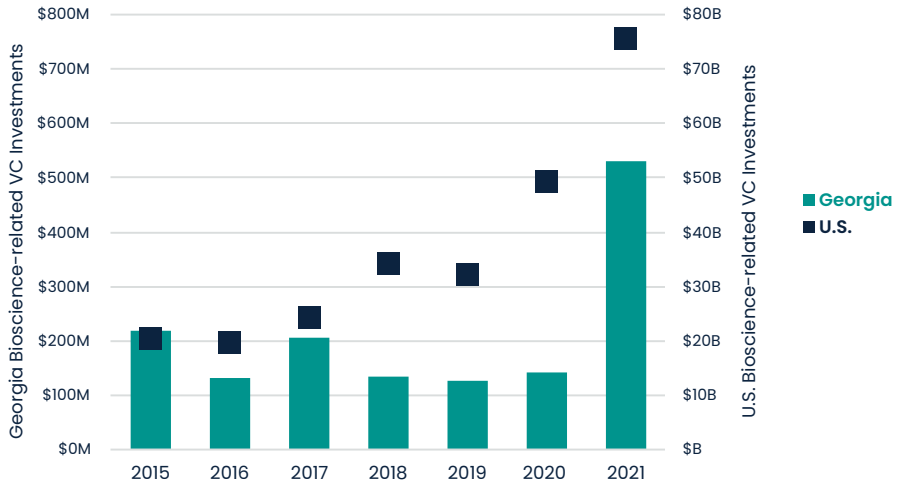
After averaging $159 million annually in life sciences-related VC investments from 2015 through 2020, Georgia firms in the sector saw a substantial increase in funding in 2021 to $530 million (Figure 17). This one-year rise to a significant new peak for the state coincided with a major spike seen nationally for the life sciences.

Leading Georgia companies receiving investments and driving recent trends include:

- A major driver of the state's 2021 spike in life sciences VC was two major investments in **Antios Therapeutics** totaling $171 million. Antios is a clinical-stage biopharmaceutical company based in Atlanta and working to develop novel therapies to both treat and cure viral diseases. It's lead candidate targets a major unmet worldwide need for potentially curing chronic HBV, the hepatitis B virus that affects up to 300 million people globally.
- **Florence Healthcare**, a health IT company also based in Atlanta, has raised nearly $90 million in VC funding in the last few years, including the bulk of that investment in 2021 ($80 million). The company has developed and offers electronic workflow software designed to simplify clinical trial documentation and compliance through reducing redundancies, enabling remote monitoring, and streamlining trial operations.
- **BioIQ, recently acquired by LetsGetChecked** in April 2022, has secured $74 million in VC funding from 2016-19 across several tranches. The company is based in Atlanta and connects people to health testing via its software platform designed to make testing more accessible and ultimately to lead to enhanced insights for patient health and healthcare partners.
- **MiRus**, based in Marietta, is a commercial stage medical device company leveraging innovative metal alloys for implants that treat spinal and orthopedic degeneration and deformities and development of structural heart disease solutions. A VC investment round in 2021 totaled $65 million, further driving the recent increase in statewide life sciences funding.

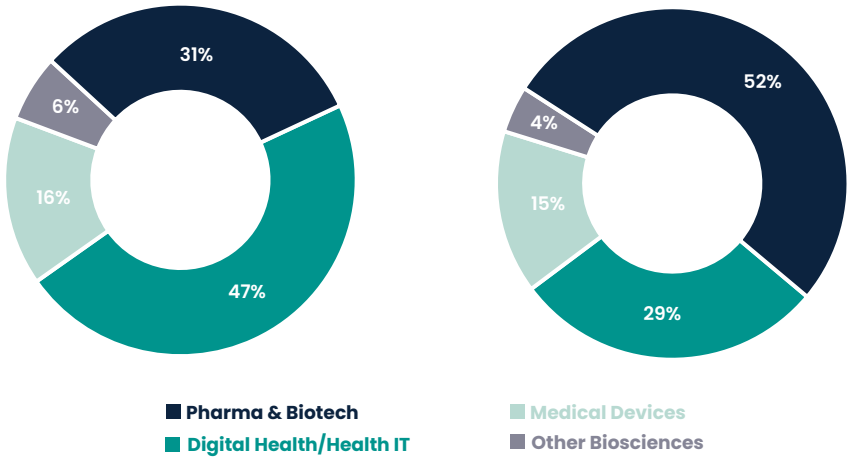
The product innovation, solutions, and market focus of the aforementioned companies provides a glimpse into the composition of VC investments by major segment. While Georgia's leading VC segments are similar to those seen nationally, state companies receiving investments are much more concentrated in the digital health or health IT segment, representing nearly one of every two dollars invested in the Georgia life sciences sector compared with less than one in three nationally.

Figure 17: Trend in Life Science-Related VC Investments, GA and U.S., 2015-21



Source: TEConomy Partners' analysis of PitchBook data.

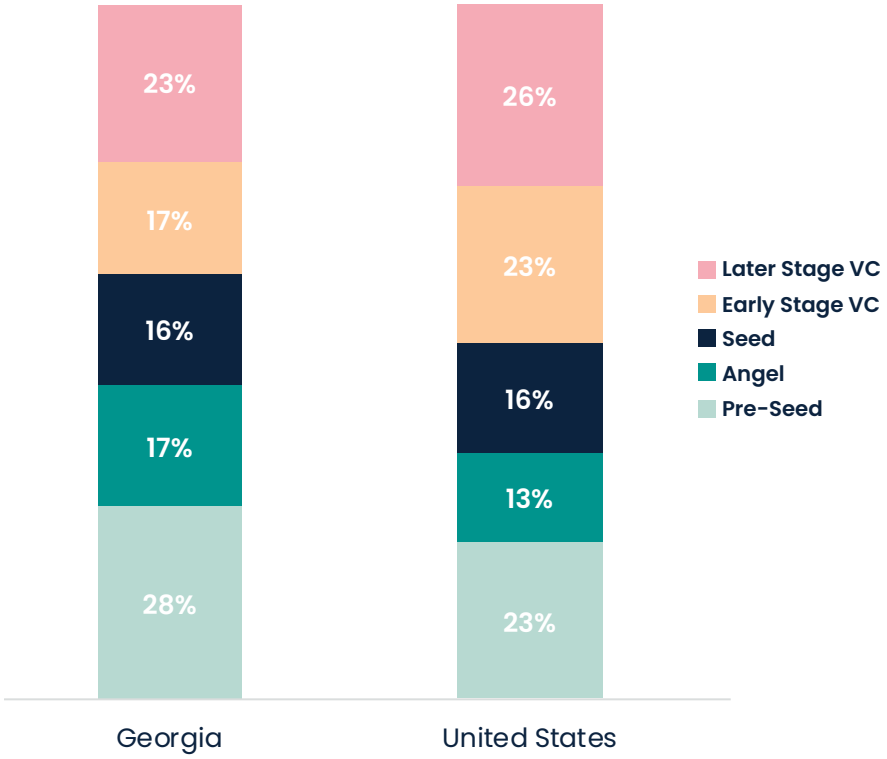
Figure 18: The Industrial Composition of Life Sciences VC Investments—GA vs. U.S., 2015-21 (Cumulative)



Source: TEConomy Partners' analysis of PitchBook data.

Georgia's life science-related VC investments have been more concentrated in the earliest stages of corporate development, with greater shares of funding in the pre-seed and Angel investor levels compared to the national distribution (Figure 19).

Figure 19: Life Science-Related VC Investments by Company Stage, 2015-21 (Cumulative)



Source: TEConomy Partners' analysis of PitchBook data.

Clinical Trials Activities

Georgia has a sizable presence in clinical trials activities with more than 800 initiated in the state each year since 2015, on average.

A unique challenge for life sciences innovation is the need for clinical testing in humans to demonstrate the safety and efficacy under strict FDA regulatory oversight of investigational therapeutics as well as novel devices. While the life sciences are known for being at the leading edge of new technology advances, such as genomics/personalized medicine, regenerative medicine, and immunotherapies, no new medical treatments can be approved without first passing a rigorous, multi-phased clinical trial process overseen by the FDA.

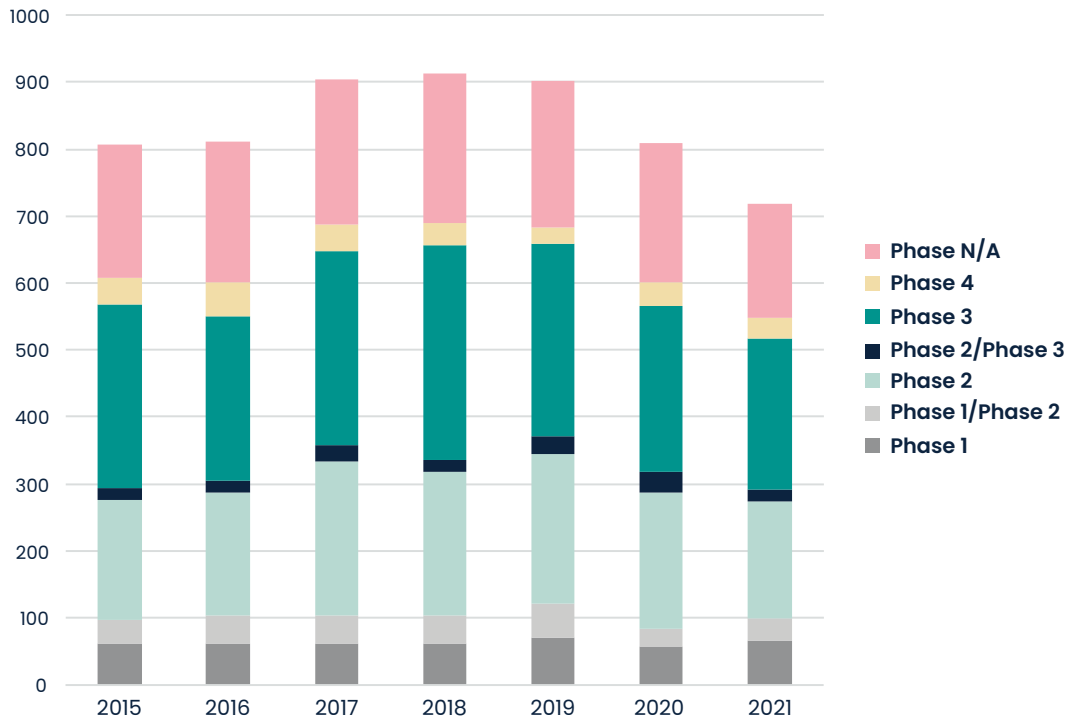
Georgia has a sizable presence of active clinical trials. An analysis of clinicaltrials.gov, the NIH-sponsored registry of federally and privately supported clinical trial activities, shows that, on average, 838 distinct clinical trials were initiated in Georgia each year from 2015 through 2021.

The trend in clinical trials initiated shown in Figure 20 below, shows the recent peaks in trials activity occurred prior to the COVID-19 pandemic in 2017 through 2019 when Georgia sites averaged 907 trials each year. The number of trials initiated dipped in both 2020 and 2021, reflecting the challenges to both patients and trial sites of conducting trials during the pandemic outside of COVID-19 related trials or those for high-risk patients with life-threatening conditions. In 2020 McKinsey noted that clinical trials have been "affected with

Clinical trials spending and indirect activities themselves are a significant economic driver for states. TEConomy found in its most recent study of the economic impacts of clinical trials that Georgia-based trials generated an estimated $1.1 billion in total site-based impacts for the state economy in 2017 based on active trials and enrollments.

Source: TEConomy Partners, Biopharmaceutical Industry-Sponsored Clinical Trials: Growing State Economies, 2019.

Figure 20: Clinical Trials Initiated in Georgia by Start Year and by Phase, 2015-21



Source: TEConomy Partners' analysis of clinicaltrials.gov database.

disruptions in both new enrollment and in keeping existing patients on therapies."[7]

The composition of trials by phase has generally held steady over time, though 2021 saw an increase in the share of Phase 1 trials—from an average of 7% of all trials from 2015-20, to 9% of trials in 2021.

Though the majority of clinical trials initiated have been led by industry (71%), Emory University leads all organizations as the lead sponsor of clinical trials in Georgia by a wide margin, with 449 trials initiated during the 7-year period since 2015. One-quarter of clinical trials led by Emory researchers are in oncology, followed by interventions that target conditions of the central nervous system (13%), metabolic diseases (10%), and infectious disease (10%)—all shares that are similar to those seen across the Georgia clinical trials complex.[8]

Behind Emory among the lead sponsors of Georgia-based trials are the following organizations each with 50 or more trials and spanning federal funding from NIH Institutes as well as numerous multi-national biopharmaceutical companies:

- National Cancer Institute (NCI)
- AstraZeneca
- Eli Lilly and Company
- Hoffmann-La Roche
- Novartis Pharmaceuticals
- Bristol-Myers Squibb
- Pfizer
- Janssen Research & Development, LLC
- National Institute of Allergy and Infectious Diseases (NIAID)
- AbbVie
- Merck Sharp & Dohme Corp.
- Gilead Sciences
- Novo Nordisk A/S
- GlaxoSmithKline
- Allergan
- Augusta University

7 McKinsey & Company. "The Next Normal." https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/Covid-19-implications-for-life-sciences-r-and-d-recovery-and-the-next-normal.

8 Disease and focus areas of clinical trials are assigned by TEConomy Partners using keywords in text descriptions. A clinical trial can be assigned more than one disease or other focus area.

On the Precipice

Jayne Morgan, M.D., Executive Director, Covid Task Force, Piedmont Healthcare & On-Air Medical Expert

Atlanta is on the precipice of an explosion in biotechnology and certainly poised to lead the takeover of the Southeast in biotechnology innovation. I say this with some pride, and I don't say this lightly. Having spent the last 16 years in this sector, the growth is evident to anyone paying attention. And talent runs deep here. It's no wonder we are called THE hottest market for Gen Z.

Back in 2006, I worked at Solvay Pharmaceuticals as the Global Clinical Director for CardioMetabolics as well as Business Development and Licensing. Back then, there were few others in town to rival Solvay with CardioMems, and CryoLife rounding out the top 3. Emory University was the most active in both bench and clinical trial research as well as tech transfer and brought important contributions to HIV antiretrovirals. Georgia Tech retained its top status as the premier Engineering and Biotech Institute with whom to collaborate, and the Georgia Research Alliance began a rise to prominence, simultaneous to the development of several other smaller networks, and of course the CDC has always been right in our back yards. However, we remained disconnected and lacked cohesiveness, and our hospital systems while sprawling, were sleepy and disconnected. Moreover, while many start-ups were beginning right here in Atlanta, they would subsequently leave to blossom to commercialization in other places, ostensibly Silicon Valley, or Boston. Atlanta was a giant in waiting.

So how did we get to this biotech boom? Part of the story rests with the diligent work of Georgia Bio in expansion and dedication. The other part of the story rests on individual focus over long periods of time building the groundwork and doing the grunt work. These are people like Lee Herron, Sherry Farrugia, Michael Fisher, Valerie Montgomery Rice, Bob Crutchfield, George White, Tiffany Wilson, and myself (Jayne Morgan, MD) just to name a few. Heads down, eyes up.

We all worked in our corners, and at Piedmont, I specifically started the Phase I Structural Heart Program then expanded research and clinical trials beyond the satellite facility in Atlanta to Piedmont Fayette, to begin to include more rural populations into the many trials that I was rapidly expanding at the time, then fleshing out an Innovation Accelerator for licensing opportunities. Piedmont became the #1 training facility for Mitral and Tricuspid transcatheter valve implants because of these early efforts and experts began traveling to Atlanta to learn and hone these techniques. Additionally, with serial entrepreneurs such as Jay Yadav of MiRus displaying repeated innovation and commercialization successes, we all contributed individually ultimately coalescing into the whole.

And seemingly suddenly, after 2 decades of drudgery, we are bursting onto the scene with real leadership, vision, and financing, poised to dominate the Southeast and rival other areas of the United States. What has changed? For one, many of the networks began working together and forming coalitions. One such network is the Georgia AI Manufacturing Coalition led by Georgia Tech and includes Spelman College, and the Russell Innovation Center of Entrepreneurs.

This coalition (The Georgia AI Manufacturing Coalition) was recently awarded a $65 million dollar grant from the US Economic Development Administration (EDA) of President Biden to establish the AI Manufacturing Pilot Facility at Georgia Tech, a hub for research, testing, and training in AI systems. Additionally, we have the rapid expansion of The Morehouse School of Medicine in both geography, edifices, and footprint, as they just accepted their largest class of incoming medical students ever and have expanded to PAs, Masters and Doctorate programs. Add to this the forward thinking of the Metro Chamber of Commerce that became connected and committed to diligently recruit and retain big biotech companies as well as small ones that 'became big' under the leadership of David Hartnett. These include Mailchimp, Microsoft, Google, Trident, Boston Scientific's $62.5 million dollar Innovation hub, and Alcon to name a few. Alcon in particular has worked in cooperation with the University of GA since 2013 to expand via a $97 million dollar investment.

From Georgia Tech's Science Square to the Center for Global Health Innovation under the leadership of Maria Thacker-Goethe, Atlanta, and Georgia, began a rapid and exponential growth and commitment in the biotechnology arena. With multiple universities right at our fingertips generating incredible talent from HBCUs, state schools, and private universities, Georgia boasts it all! This is an exciting time to be in Georgia and in Atlanta, and now there is no need to venture further.

Patent Activity

Georgia inventors are maintaining a steady level of patents, largely in medical device technologies led by industry-assignees and biopharmaceuticals led by universities.

The life sciences commercialization process often begins with patents, which represent the means by which individuals, businesses, universities, and other entities protect invented intellectual property (IP). Georgia inventers have been awarded 4,040 patents in life science-related technology classes since 2015, an average of 577 per year (Figure 21). Award totals peaked in 2019 but have remained relatively stable over time. Looking forward, patent applications with a Georgia inventor have risen dramatically since 2019; further growth in award volume could be on the horizon for the state.

Medical and surgical devices are by far the largest area of patenting activity in the life sciences, accounting for nearly 51% of all patent records. Drugs and pharmaceuticals were second with just over 20% of all patent records, and other areas had less volume.

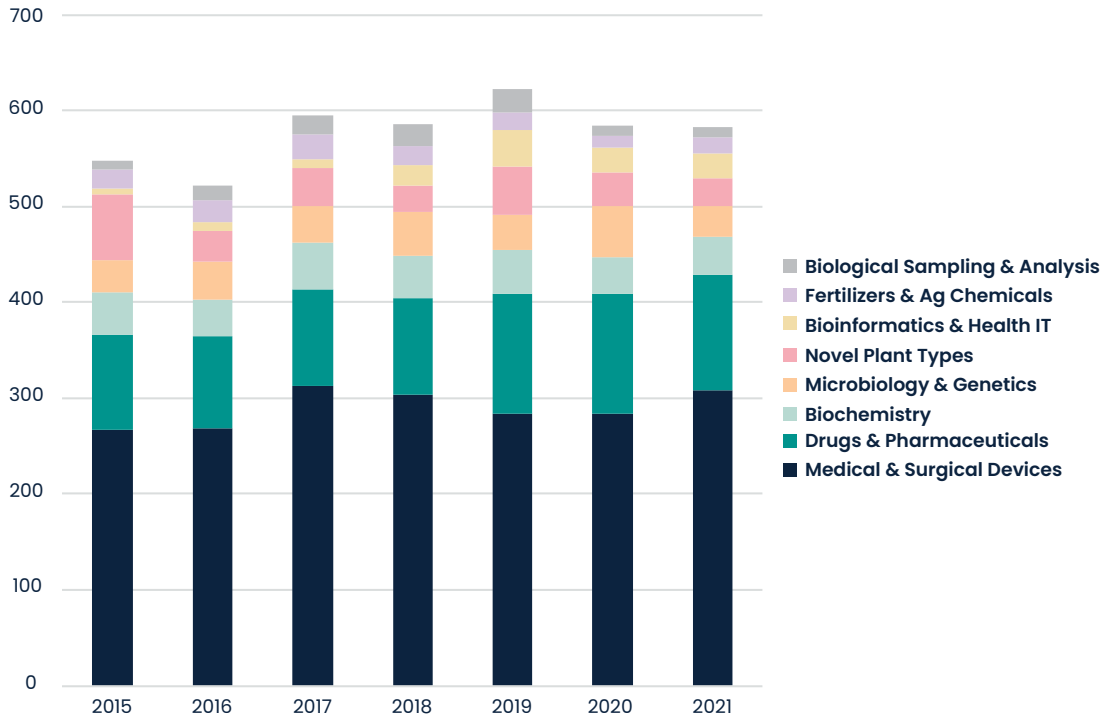
Considering both the technology focus areas and the entities conducting the innovation, Georgia's life sciences patent activity can largely be segmented into two primary themes (Figures 22 and 23):

- University-assigned patents focused on drug development in biopharmaceutical applications; and
- Industry-assigned patents mainly focused on medical device innovations with additional activity in areas of agbiosciences

Emory University has had the highest volume of patent awards overall and is where the vast majority of the drugs

Looking forward, patent applications with a Georgia inventor have risen dramatically since 2019; further growth in award volume could be on the horizon for the state.

Figure 21: Trends in Life Science-Related Patent Awards to Georgia Inventors and Assignees, by Patent Class, 2015-21



Source: TEConomy Partners' analysis of USPTO data from Clarivate Analytics.

and pharmaceutical activity is being driven, with a focus in oncology. Georgia State University and Augusta University are also among the universities focused in biopharmaceutical patenting.

Industry assignees were highly focused around the medical devices space as well as more modest activity in agbio-related crop science and veterinary medicine areas. Few leading industry patenting companies were focused primarily on therapeutics development. Highlights and examples of patent awards across industry leaders include:

Key medical device companies (some with secondary focus in biopharma) include:

- Kimberly Clark Worldwide – Absorbent articles/liners for sanitary products with antimicrobial or disinfectant properties
- Avent Inc. (now doing business as Avanos) – Catheter and other medical tube systems and placement, implantable medical device guidance sensors/electronics
- Cormatrix Cardiovascular – Prosthetic heart valves, regenerative medicine materials/structures for cardiovascular applications
- MiMedx Group Inc. – Advanced wound care, tissue grafts for variety of regenerative medicine applications
- Amendia Inc. – Orthopedic fasteners and bone implants
- Depuy Synthes Products – Bone fixation/anchor devices and systems
- CR Bard Inc. – Catheter devices

Agbioscience-related innovators include:

- Bayer (formerly Monsanto) focused on crop science
- Merial Inc. (a subsidiary of Boehringer Ingelheim) focused on veterinary medicines

Two universities with major innovation activities where patent awards have run counter to overarching themes are the University of Georgia with its life sciences innovation focused in the agbiosciences in applications spanning novel plant types and microbiology and genetics; and Georgia Tech with its focus tilted more toward medical and surgical device innovation.

AgTech Innovation: A Differentiator for Georgia

Agriculture represents Georgia's oldest and largest industrial sector, and today the state's farmers and agribusinesses combine to sell nearly $9.6 billion annually in agricultural products.* This translates into broad and substantial economic impact across the state, with agriculture estimated to contribute $69.4 billion annually to Georgia's economy.**

Global challenges such as feeding an increasing global population, impacts of climate change on future production, and constraints of limited land, water, and other resources are driving significant technology innovation or "AgTech" in the sector and converging with other technology, research, and digital application areas for solutions. Recognizing these competencies and opportunities in Georgia, the State Department of Economic Development has made AgTech a focus of its Center of Innovation programming and resources to enhance networks and leverage opportunities for economic growth.

Several components of the industry and ecosystem analysis point to exciting aspects of AgTech innovation and competitive advantage within Georgia's life sciences sector, specifically:

- Employment growth of the agbiosciences industry subsector reaching 30%
- $131.5 million in agricultural sciences R&D expenditures by Georgia research universities in 2020, representing an outsized share of ag innovation relative to the national average and led by UGA—Georgia is rapidly outpacing the nation in its university ag sciences R&D, growing its base by 56% since 2015 vs. 4% growth nationally.
- Concentration of patent innovations in crop science, veterinary medicines, novel plant types, ag chemicals, and plant-related microbiology and genetics at both Georgia universities and companies.

*Source: Georgia Farm Bureau and the Census of Agriculture, 2020.
**Source: UGA Center for Agribusiness and Economic Development.

Boehringer Ingelheim invests in Georgia

Randolph Legg, President and Head of Commercial Business, Boehringer Ingelheim Animal Health USA

At Boehringer Ingelheim Animal Health USA, improving the health and well-being of animals, and the people who care for them, is at the core of what we do because we know the lives of humans and animals are interconnected in deep and complex ways. Simply stated: when animals are healthy, humans are healthy, too.

As part of the Germany-based and family-owned Boehringer Ingelheim, we use the synergies between our Animal Health and Human Pharma businesses to deliver value through innovation. We drive this innovation through industry-leading investment in R&D and by embracing the power of partnerships to realize more scientific opportunities. Our portfolio contains widely used and well-respected vaccines, parasite-control products and therapeutics for pets, horses and livestock.

Our U.S. Animal Health business is powered by more than 3,000 people around the country, with employees in every state and seven major sites -- three of those sites are here in Georgia.

We employ 600 people at our US Animal Health headquarters in Duluth, just outside of Atlanta. We're active members in the Metro Atlanta Chamber, Georgia Bio, and Georgia Chamber, which drives our focus to participate in economic development initiatives to advocate for investment in the life-sciences industry in Atlanta and the rest of the state.

Located in the "Poultry Capital of the World," our Gainesville poultry vaccine manufacturing plant produces nearly 60 billion poultry vaccine doses every year to help protect poultry from disease in more than 50 countries. Earlier this year, the Gainesville site was certified carbon neutral, becoming Boehringer Ingelheim's first major manufacturing facility in the U.S., and third site globally, to achieve carbon neutral status.

Boehringer Ingelheim is committed to making the company, surrounding communities, and the world more environmentally sustainable--now and for future generations. Our Gainesville site's achievement inspires our worldwide team as we make progress toward our goal to become carbon neutral in all company operations by 2030.

Exciting things are also happening at our location in Athens. We recently announced plans to expand our Animal Health Global Innovation Center, investing $57 million to increase laboratory space and bring added R&D capabilities—including 55 new positions—to the site. Continuing our sustainability journey, we will be incorporating sustainable construction methods in our new and expanded facilities by deploying carbon neutral, recycled or repurposed materials, as well as smarter monitoring platforms that will reduce our energy consumption overall.

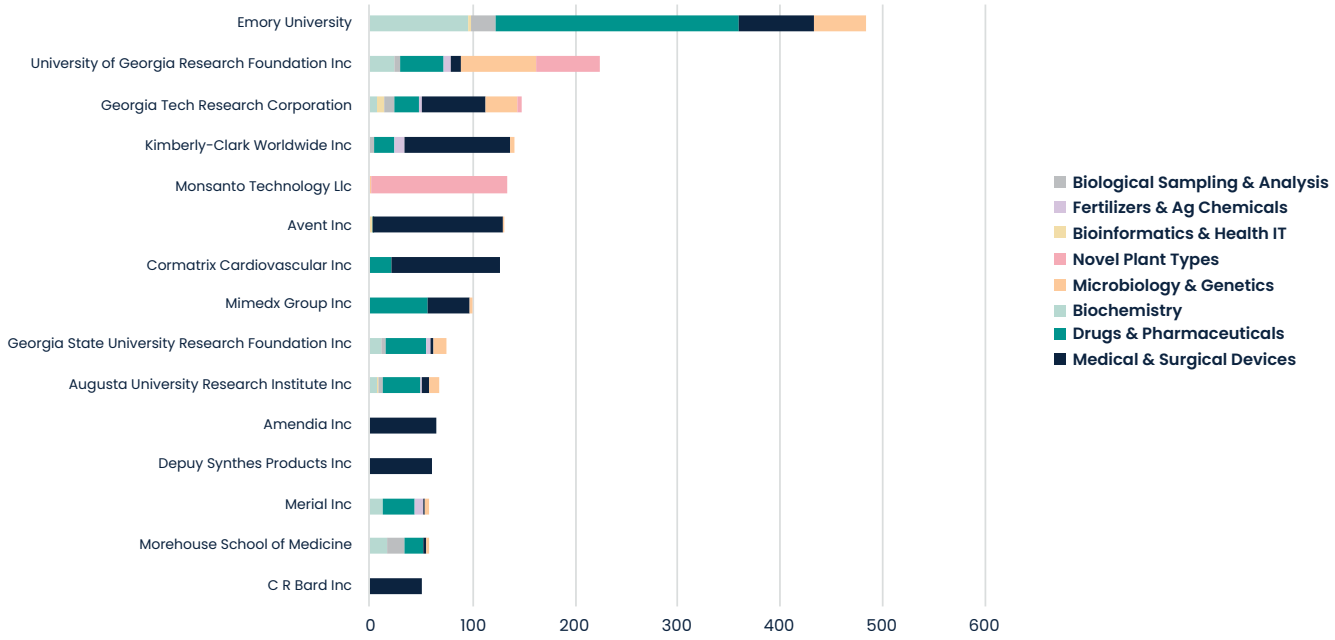
Boehringer Ingelheim Animal Health has been a longstanding partner of the University of Georgia. We have engaged in many areas including the College of Veterinary Medicine, the Franklin College of Arts and Sciences, the College of Engineering, as well as the Innovation Gateway and Startups teams. From research to philanthropy to student recruitment, our broad engagement has made a lasting impact across UGA's campus.

Additionally, we support several philanthropic endeavors at the University of Georgia. The most recent philanthropic gifts supported the College of Veterinary Medicine's Georgia Veterinary Scholars Program and a PhD Fellowship in bovine parasitology.

Our commitment to nurturing innovation in Georgia doesn't stop there. We are proud to be part of Georgia's Innovation Crescent, a coalition of 15 counties and economic development entities that support innovation in Georgia.

Boehringer Ingelheim's goal is to continue to bring breakthrough innovation that will improve the health of animals, people and the environment. We are proud to call Georgia home and to be a part of the efforts to advance the growth of the state's life sciences industry.

Figure 22: Leading Patent Assignees (50+) by Life Sciences-Related Patent Class Grouping, 2015-21



Source: TEConomy Partners' analysis of USPTO data from Clarivate Analytics.

Figure 23: Leading Areas of Georgia Life Sciences Patent Innovation, 2015-21 (Cumulative)

Medical & Surgical Devices

- Surgical devices, with a focus on surgical instruments for fastening, stapling, etc. with some presence of computer-aided surgery technologies
- Filters, Implantables, & Prosthetics, with a focus on bone fusion implants and joint replacements
- Diagnostic Devices, with a focus on endoscope systems and transdermal sensing
- Injection, Inhalation, Catheters, & Drainage Devices, with a focus on integrated injector systems and catheter delivery
- Clinical Equipment Supplies, with a focus on absorbent bandages/dressings/sanitary products

Drugs & Pharmaceuticals

- Biopharmaceuticals with a wide variety of disease area therapeutics represented including:
  - Receptor modulators/inhibitors for cancer treatment (mostly immunotherapy driven)
  - Formulations of a variety of other drugs with applications in infectious disease, regenerative medicine, specialized dosing/formulation/delivery methods

Source: TEConomy Partners' analysis of USPTO data from Clarivate Analytics.

Both Georgia Bio and its ecosystem and educational partners across the state are highly focused on meeting and better understand the industry's talent challenge. Identifying, recruiting, hiring, and retaining the breadth of skilled workers required to advance leading-edge scientific and commercial R&D and innovation, prototyping and production, distribution, sales and marketing, as well as other business operations functions is often cited as the leading challenge by life sciences leaders.

Workforce & Talent Demand

Profiling the Life Sciences Talent Challenge: Highlighting the Roles and Skills Most In-Demand by Georgia Employers and the Efforts of Georgia Bio and its Partners to Develop and Excite the Workforce of Tomorrow

This analysis utilizes information and analytics from more than 52,000 unique Georgia life sciences job postings from the last 3.5 years (January 2019 through June 2022) and provides a high-level snapshot of key demand aspects to help inform the efforts of educators, workforce trainers, Georgia Bio and the Georgia Bio Institute, as well as other state and regional workforce and talent stakeholders.[9] The level of job postings has been steadily rising during this few-year period.

The leading companies hiring in Georgia (see sidebar) reflect the breadth of the industry and its subsectors across the state spanning medical labs (Quest Diagnostics, LabCorp); distribution (McKesson, Cardinal Health, Owens & Minor); contract research organizations (IQVIA); drugs and pharmaceuticals (Boehringer Ingelheim, CSL, Johnson & Johnson); and medical devices (Intuitive, Medtronic, and Becton, Dickinson and Company).

Figure 24 shows the leading technical and production-related job titles featured in these job postings and illustrate the varied roles across these organizations. The occupations span skill and education levels and can be thought of in groupings of "middle-skills"—those that require some education and training beyond high school but less than a four-year degree (e.g., medical technicians and many production/operator roles); and "high-skills"—those that typically require a bachelor's degree or higher (e.g., managers, data scientists, and quality control professionals).

The education requirements described in these job postings reflect the industry's need and demand for a highly skilled workforce, with 75% of jobs requiring or preferring a postsecondary degree at the Associate's level and above, and about two-thirds requiring a Bachelor's degree or higher (Figure 25). Experience levels are varied, with 41% of jobs requiring somewhere between two and six years of experience for the position.

With these requirements acknowledged, it is important to note the opportunities available for individuals with a high school diploma and little to no experience to enter the life sciences industry; and recognizing the strong growth of this industry in Georgia, it is critical to engage students and adults across a wide range of skill, education, and experience levels to meet the strong demand for talent.

Georgia life sciences companies have generated more than 52,000 unique job postings in the last 3.5 years. This represents 1.1% of all state postings.

Who's Hiring?

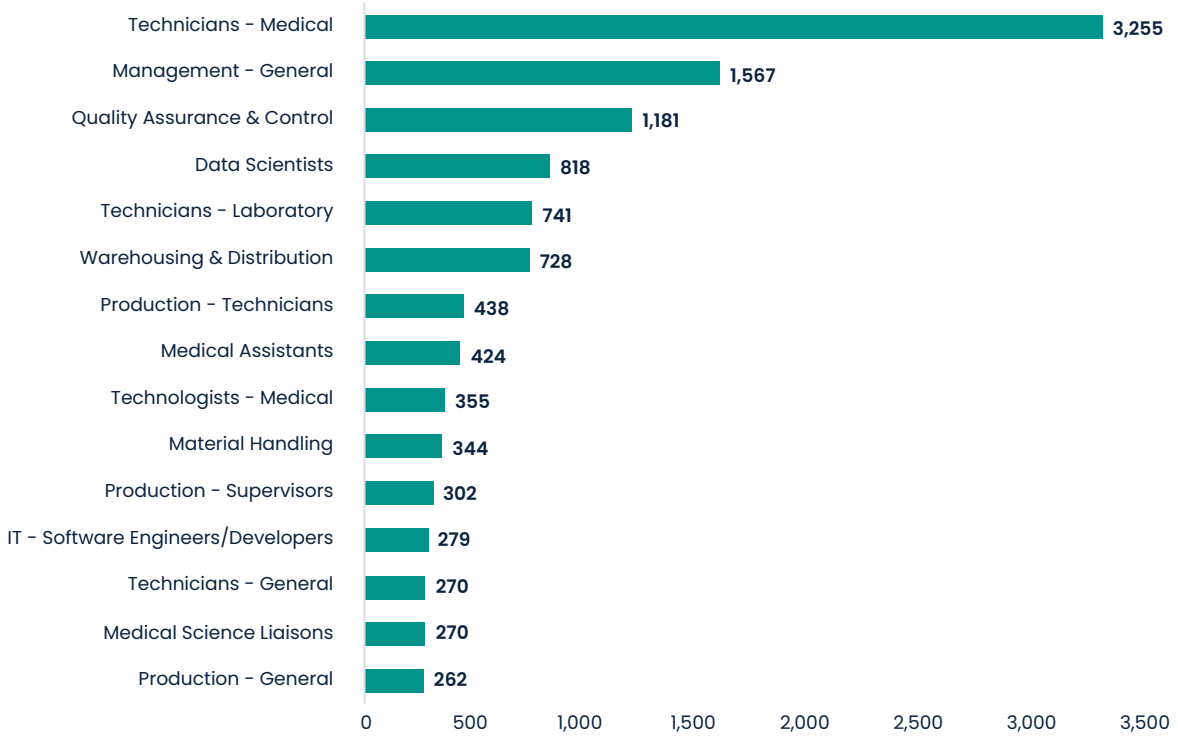
Includes those with 500+ Unique Postings in Descending Order

- Quest Diagnostics
- McKesson
- IQVIA
- Boehringer Ingelheim International
- CSL
- Johnson & Johnson
- LabCorp
- Grifols
- Takeda Pharmaceutical Company
- Becton, Dickinson and Company (also known as BD)
- Pfizer
- ProMedica
- Thermo Fisher Scientific
- Cardinal Health
- UCB
- Owens & Minor
- CryoLife
- Intuitive
- Abbott Laboratories
- Medtronic
- Medline Industries

Source: TEConomy Partners' analysis of Lightcast Job Postings Database.

9 Analysis is based on data developed and provided by Lightcast through its Job Posting Analytics database. Analyses presented here have been limited to the industrial life sciences components of the industry with separate commentary provided regarding CDC hiring. University R&D personnel are not included in this analysis due to the inability to effectively isolate job postings among institutions solely for the life sciences.

Figure 24: Leading Technical and Production-Related Job Titles* in Life Science Industry Job Postings, 2019—Q2:2022

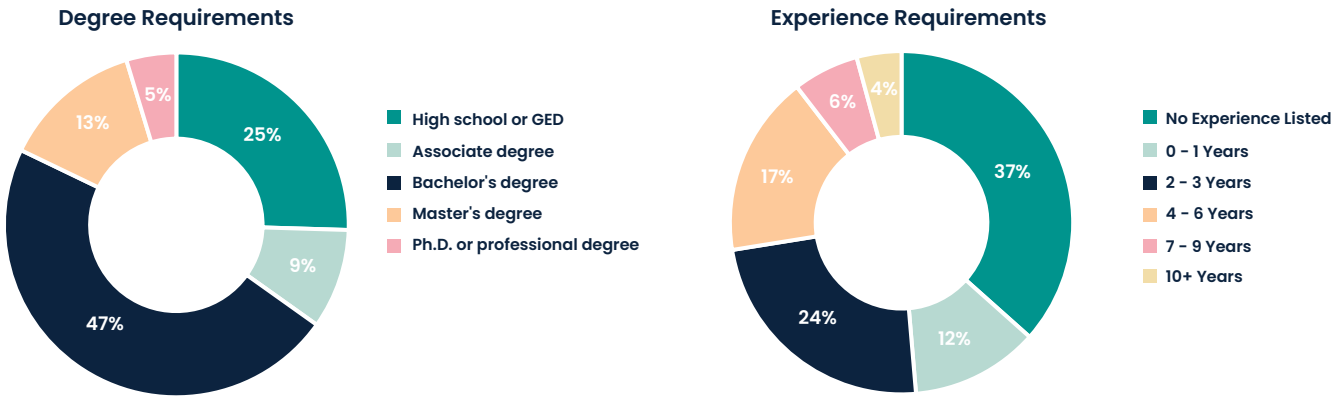


Note: Lightcast limits information on job titles and corresponding numbers of postings to the top 1,000, restricting the ability to provide comprehensive totals by categories.

***Note:** This analysis reflects leading job titles in technical and production and distribution-related roles in the life sciences job postings, it excludes large segments of the industry workforce in sales, customer service, and other functions to focus on more actionable intelligence for life sciences-specific education and workforce development.

Source: TEConomy Partners' analysis of Lightcast, JPA Database, Q3 2022 data set.

Figure 25: Degree and Experience Requirements from Georgia Life Sciences Job Postings, 2019—Q2:2022



Source: TEConomy Partners' analysis of Lightcast, JPA Database, Q3 2022 data set.

Spotlight on Centers for Disease Control (CDC) Job Postings

The CDC represents a major demand driver for senior scientific and technical talent in Greater Atlanta. From January 2019 through June of 2022, the CDC advertised for more than 2,100 unique job openings. Unlike the leading occupations in jobs posted within the industrial life sciences in Georgia, the CDC, not surprisingly, has strong demand for scientist roles at advanced degree levels that include:

- Health Scientists
- Microbiologists
- Epidemiologists
- Behavioral Scientists

Additionally, the CDC is hiring for analyst talent in leading job postings for Public Health Analysts as well as numerous IT professionals.

Strengthening Georgia's Bioscience Workforce Pipeline to Meet the Talent Needs of a High-Growth Industry: The BioEd Institute

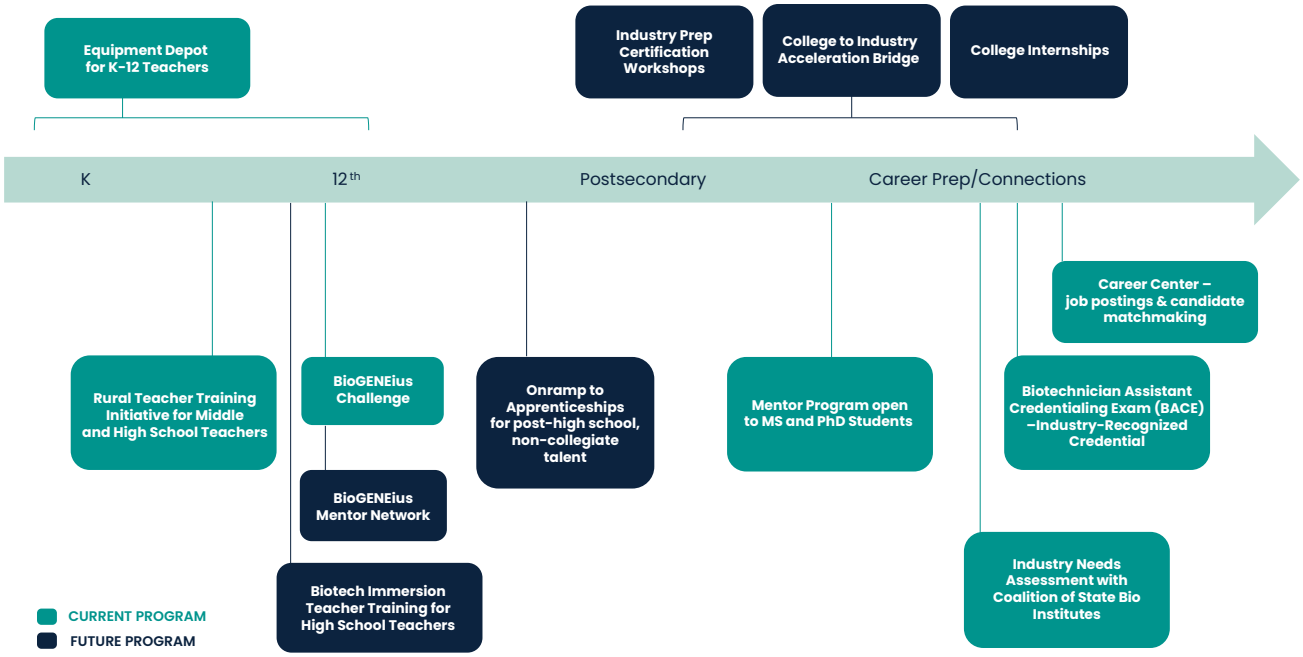
The BioEd Institute is an Office of the Center for Global Health Innovation, focused on strengthening the state's life sciences workforce pipeline through a broad set of targeted "classroom-to-career" initiatives that span all educational levels and align with industry needs. The Institute meets this mission by supporting and initiating teacher professional development, providing industry-grade lab and other equipment, training students for current workforce needs, and connecting students and teachers with industry professionals and mentors.

The BioEd Institute works toward advancing three strategic priorities:

- Build the capacity of K-12 schools to generate Georgia's future life science workforce
- Strengthen our current workforce through professional development and career services
- Create an interconnected community of students, educators, researchers, and professionals in Georgia

Figure 26 highlights the impressive breadth of Institute led and supported education and workforce training efforts and career connections both underway and those planned for the near future. For more information on the Institute and individual programs visit: https://gabio.org/georgia-bioed/.

Figure 26: Georgia BioEd Institute Program Overview, 2020-23



Source: Georgia BioEd Institute.

Conclusion

The findings from this report, in general, represent impressive gains for Georgia and continued emergence of its life sciences industry and broader ecosystem. Maintaining this progress, however, is not guaranteed. The economic headwinds of slower growth, high inflation, tight labor markets, and challenging supply chain dynamics, as well as other factors all pose challenges for the industry and its global markets in 2022 and beyond. The life sciences industry, however, has a strong track-record of resiliency during economic downturns, including during the COVID-19 pandemic and recent recessions. In uncertain economic times, it is an industry and ecosystem that has proven to be especially durable.

Appendix

Defining the Life Sciences Industry for Georgia

The industrial life sciences concept utilized in this report combines a set of detailed, 6-digit NAICS industry classifications developed by TEConomy Partners in collaboration with Georgia Bio and its stakeholders, shown in Table A-1 below. The employment, establishment, and wage data associated with these detailed industry classifications are sourced from the U.S. Bureau of Labor Statistics' Census of Employment and Wages Program (CEW), accessed by TEConomy through an enhanced version of the data set provided by Lightcast (formerly Emsi).

The industry analysis has been supplemented to include the digital health or health IT subsector of the industry using a highly customized approach. TEConomy developed a detailed micro-firm level database and corresponding employment estimates utilizing several key sources, including leveraging a unique new database under development by the Technology Association of Georgia; recent reporting by the Georgia Institute for Healthcare Information Technology (IHIT); and proprietary databases including Hoovers Dun & Bradstreet and PitchBook.

Recognizing the overlaps that occur between digital health and medical devices, for example, care has been taken to isolate digital health but to not double-count companies more likely to have been classified in an existing industrial life sciences NAICS code. The database is comprised of companies with products or services centered on the life science industry. While the industry relies on many key service providers in the IT space, such firms are not considered to be digital-health oriented unless their focus is (nearly) exclusively life sciences-oriented.

Table A-1: NAICS-Based Industry Definition of the Industrial Life Sciences Sector (Not Including Digital Health)

Life Sciences Subsector	NAICS	NAICS Description
Agriculture Feedstock & Industrial Biosciences	311221	Wet Corn Milling
	311224	Soybean and Other Oilseed Processing
	325193	Ethyl Alcohol Manufacturing
	325311	Nitrogenous Fertilizer Manufacturing
	325314	Fertilizer (Mixing Only) Manufacturing
	325320	Pesticide and Other Agricultural Chemical Manufacturing
Drugs & Pharmaceuticals	325411	Medicinal and Botanical Manufacturing
	325412	Pharmaceutical Preparation Manufacturing
	325413	In-Vitro Diagnostic Substance Manufacturing
	325414	Biological Product (except Diagnostic) Manufacturing
	334510	Electromedical and Electrotherapeutic Apparatus Manufacturing
	334516	Analytical Laboratory Instrument Manufacturing
	334517	Irradiation Apparatus Manufacturing
	339114	Dental Equipment and Supplies Manufacturing
	339115	Ophthalmic Goods Manufacturing

Life Sciences Subsector	NAICS	NAICS Description
Research, Testing & Medical Laboratories	541380*	Testing Laboratories
	541713*	Research and Development in Nanotechnology
	541714	Research and Development in Biotechnology (except Nanobiotechnology)
	541715*	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)
	621511	Medical Laboratories
	621512	Diagnostic Imaging Centers
	621991	Blood and Organ Banks
Bioscience-related Distribution	423450*	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers
	424210*	Drugs and Druggists' Sundries Merchant Wholesalers
	424910*	Farm Supplies Merchant Wholesalers

*TEConomy includes only the portion of these industries engaged in relevant life sciences activities.

Industry employment data for the Centers for Disease Control and Prevention were also sourced from the U.S. Bureau of Labor Statistics' Census of Employment and Wages Program (CEW), accessed by TEConomy through an enhanced version of the data set provided by Lightcast (formerly Emsi) using NAICS industry code 92312— Administration of Public Health Programs, limited to the public (federal) sector.

Employment estimates and analysis for college and university life sciences R&D personnel were sourced from the National Science Foundation's Higher Education R&D Survey and applying the life sciences share of total academic R&D expenditures to develop an estimate for academic life sciences R&D personnel. This estimate does not include all faculty and staff employment within life science-related academic departments.

Georgia Life Sciences Impacts

Table A-2: Georgia Life Sciences – Total Impacts (Including Industry, Academia, and CDC)

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)	Local/ County Tax Revenue ($M)	State Tax Revenue ($M)	Federal Tax Revenue ($M)
Direct Effect	78,493	$7,842.28	$13,692.15	$27,217.51	$347.38	$423.49	$1,702.11
Indirect Effect	67,408	$4,349.49	$6,742.78	$12,248.50	$173.05	$220.84	$898.65
Induced Effect	68,783	$3,311.91	$6,286.75	$10,763.17	$296.15	$275.99	$735.26
Total Impacts	214,684	$15,503.67	$26,721.68	$50,229.19	$816.59	$920.32	$3,336.02
Multiplier	2.74	1.98	1.95	1.85			

Source: TEConomy analysis, IMPLAN State of Georgia Model. Direct Employment includes an estimated life sciences academic employment using data from the National Science Foundation, Higher Education R&D (HERD) Survey, 2020.

Table A-3: Georgia Life Sciences – Industry Life Sciences Only Impacts

Impact Type	Employment	Labor Income ($M)	Value Added ($M)	Output ($M)	Local/ County Tax Revenue ($M)	State Tax Revenue ($M)	Federal Tax Revenue ($M)
Direct Effect	55,111	$5,438.19	$10,478.82	$21,484.61	$345.36	$365.70	$1,231.92
Indirect Effect	50,873	$3,346.83	$5,170.39	$9,343.78	$144.76	$176.93	$692.69
Induced Effect	49,883	$2,402.28	$4,557.84	$7,802.61	$214.67	$200.09	$533.24
Total Impacts	155,868	$11,187.30	$20,207.04	$38,631.00	$704.79	$742.72	$2,457.86
Multiplier	2.83	2.06	1.93	1.80			

Source: TEConomy analysis, IMPLAN State of Georgia Model.

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Provide state-of-the-art **tools**.

Watch the **grants** come in.

See **advances** made.

Behold a **breakthrough**.

Explore the market **potential**.

Launch a **company**.

Unleash its **growth**.

Repeat.

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These statistics speak for themselves - Life Science in Georgia is alive and well.

36K+ workers in Life Science fields

+7% Projected growth in Life Science Workforce by 2031

14th State ranking for Life Science professionals

40+ Life Science-related eminent scholars

The Georgia Chamber Foundation supports growing this industry and its workforce through strategic partnerships statewide.

To learn more visit, gachamber.com/foundation

Home to world-class academic and research institutions, public health and healthcare powerhouses, and a robust business community, Metro Atlanta is rising to meet the needs of its growing life sciences industry in research and development, manufacturing, and much more. Metro Atlanta and Georgia are also digital health powerhouses, with 250 companies delivering leading-edge healthcare technology that improves care quality, reduces costs, and saves lives.

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