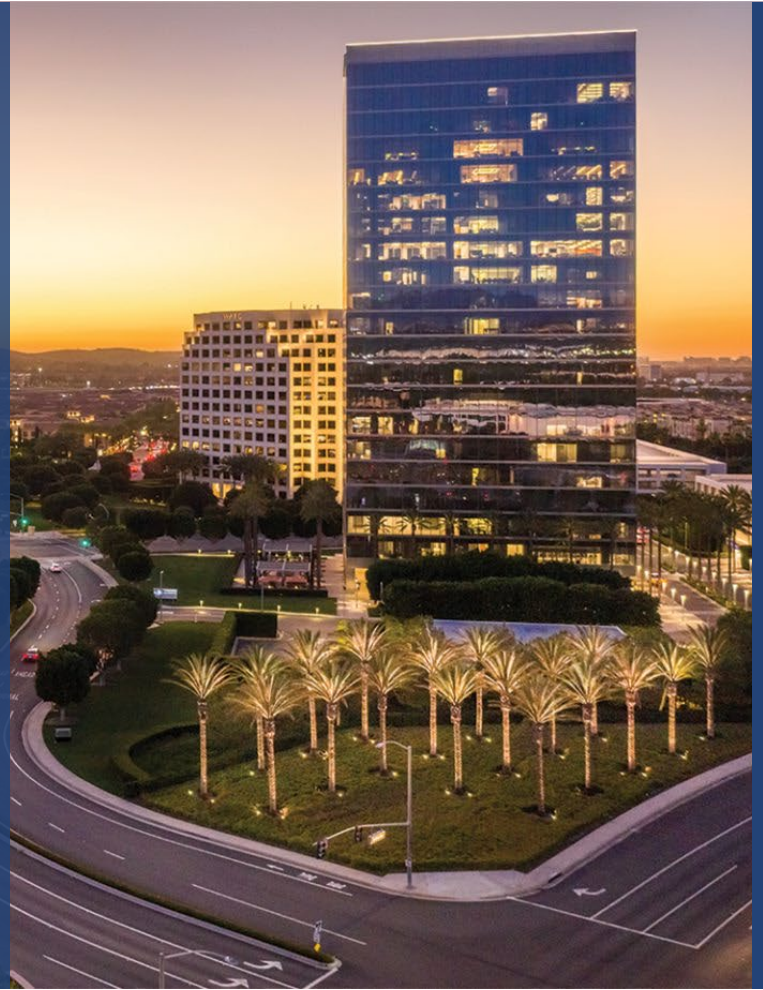




# 2024 Irvine Innovation Economy Report

August 2024



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## CONTRIBUTORS

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## ABOUT THE CITY OF IRVINE

Located in the heart of Southern California, Irvine is a thriving and diverse center of business, with over 275,000 jobs in a variety of industries, including manufacturing, legal, financial and professional services, software, accounting, and scientific and medical research. Just minutes from Orange County's best beaches, Irvine offers coastal amenities with a sustainable lifestyle as America's No. 1 master-planned community. Irvine's strategic location, strong partnerships, and values of creativity and innovation set the city apart as an ideal place for businesses to thrive. Irvine provides at a high level most everything that is of value to a business: opportunities, local high-skilled employees, public education support, safety, and quality infrastructure.

## ABOUT GREATER IRVINE CHAMBER OF COMMERCE

Working to advance the economic vitality of greater Irvine, the Greater Irvine Chamber focuses on helping businesses in the region to start and grow, attracting domestic and global businesses to expand in Irvine, supporting international business and commerce, and providing lead generation and professional networking opportunities.

## ABOUT BW RESEARCH

BW Research is an independent economic research organization, experienced in workforce and economic development analyses. BW Research has led over one hundred workforce, supply chain, community benefit, policy, and market research studies over the last fifteen years. BW Research serves both public and private sector clients, including economic development organizations, cities, counties, workforce development boards, and educational institutions.

## ABOUT THE IRVINE INNOVATION ECONOMY REPORT

The Irvine Innovation Economy Report employs a data-driven approach to identifying economic development opportunities for the City of Irvine, highlighting key innovation industries with the greatest potential to generate high-quality jobs in the region through 2030. The report is the culmination of a collaborative research effort incorporating perspectives of key stakeholders from the City and its economic and workforce development partners in academia and local business, as well as local venture capital investors, all of whom play critical roles in maintaining the city's legacy of thoughtful growth and laying the foundation for a more prosperous, resilient future for the city of Irvine.

# Executive Summary



The City of Irvine and the Greater Irvine Chamber of Commerce have engaged BW Research to prepare the 2024 Irvine Innovation Economy Report, which highlights key innovation industries with the potential to drive economic and fiscal growth in Irvine through 2030.<sup>1</sup> Employing a data-driven approach to its strategic planning efforts allows the City of Irvine to efficiently leverage its existing assets while attracting outside resources to build a more prosperous and resilient economy.

## KEY FINDINGS

1. Since its inception, the City of Irvine has played a pivotal role in building the foundation for a business-friendly environment. The following elements are perceived as strengths of the city:
  - a. A planned community built on high-quality educational institutions and a well-educated workforce.
  - b. A vibrant local business community, with both small and larger anchor businesses that are well-served by local government.
  - c. A history of well-planned and robust real estate development, a driver of Irvine’s economy in the past, but not likely in the future.
  - d. A community that provides a high quality of life, attracting entrepreneurs, investors, and business leaders.
2. Current drivers of Irvine’s innovation economy include:
  - a. **Healthcare Innovation**, including advanced diagnostics, genomic sequencing, and telehealth technologies, which accounted for approximately 21,000 city jobs in 2023; major employers in this industry include UCI Health and Kaiser Permanente.
  - b. **Medical Technologies**, including remote monitoring technologies, surgical robotics, and cardiovascular technologies, which accounted for over 19,000 city jobs in 2023; major employers in this industry include Edwards Lifesciences, B Braun Medical, and Masimo.
  - c. **Enabling & Creative Technologies**, including advanced computing and gaming, which accounted for over 22,000 city jobs in 2023; major employers in this industry include Broadcom and Activision Blizzard.
3. Based on its performance relative to comparable innovation hubs throughout the United States, the city of Irvine is classified as a “Moderate Innovator,” with opportunities for growth in patent

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<sup>1</sup> High-quality jobs are defined as jobs that pay an equitable living wage (at minimum) to all workers and offer meaningful opportunities for advancement in diverse, equitable, and inclusive workplaces.



activity, new business formation, federal R&D spending, and university R&D spending. The lack of later-stage venture capital was identified as a primary area of weakness for the city.

## METHODOLOGY

The research team initially analyzed historical data on the industries and occupations that historically drove innovation and economic activity in the city of Irvine, identifying key technologies, local businesses, and areas of R&D that contributed to the city’s growth.

Following this initial assessment, the research team conducted executive interviews with key stakeholders to assess their perspectives on potential opportunities for economic growth centered around innovation. Subsequently, literature reviews were performed to identify innovation hubs focused on comparable industries located in the United States to:

- Develop an innovation scorecard to assess the strength of Irvine’s innovation economy.
- Identify gaps in Irvine’s current innovation ecosystem to inform preliminary policy recommendations regarding potential development strategies.
- Establish benchmarks for potential growth in comparable innovation hubs.
- Compile a list of best practices adopted by comparable innovation hubs.

The research team then forecasted the potential economic impacts of investments in each of the target innovation industries using IMPLAN, an economic modeling software, based on these growth benchmarks and ranked the menu of investment opportunities based on an assessment of (i) likelihood of growth and (ii) magnitude of potential economic, fiscal, and employment impacts.

The City of Irvine and the Greater Irvine Chamber of Commerce will conduct additional stakeholder outreach to assess next steps, including prioritization of economic development options stated herein.

## CONCLUSIONS AND RECOMMENDATIONS

1. Based on a consideration of (i) Irvine’s existing workforce and research assets in medical devices and healthcare innovation, mobility, computing, and gaming; and (ii) an assessment of demand drivers for emerging technologies, the research team concludes that the following innovation scenarios have the potential to drive economic and fiscal growth in Irvine through 2030:

<b>Evolution of Healthcare Innovation</b>	Potential growth is predicted based on Irvine’s potential to continue to evolve as a premier healthcare destination, leveraging its historical strengths in medical devices and healthcare delivery into the design and creation of next-generation healthcare technologies and advanced treatment delivery.
<b>Enabling &amp; Creative Technologies</b>	Potential growth is predicted based on Irvine’s potential to successfully leverage its legacy of innovation in tech to lean into (i) enabling technologies that enhance productivity across a wide range

of industries, such as AI, quantum computing, and technologies that enable smart manufacturing; or (ii) creative technologies such as gaming and simulations.

**Climate Transition/  
Decarbonization  
Technologies**

Potential growth is predicted based on Irvine’s potential to support the growth of a cleantech industry focused on innovations supporting the transition to a clean energy economy, such as clean hydrogen, cleantech software, alternative vehicles, and electric mobility applications.

**Next-Generation  
Defense  
Technologies**

Potential growth is predicted based on Irvine’s potential to leverage its proximity to major aerospace and defense companies in Southern California, and to build on its historical experience in mobility, to pursue opportunities in military vehicle electrification and defense and space technologies.

2. Based on an assessment of the potential likelihood of growth and the potential economic and fiscal impacts associated with investments in each sector, the research team concluded that:

**Enabling & Creative  
Technologies**

Enabling & Creative Technologies have the highest potential economic and fiscal impacts for the city of Irvine, and growth in this scenario is highly likely. In this scenario, investments in Enabling & Creative Technologies could create over 15,000 high-quality jobs over the next six years, with average wages of \$135,736, representing an addition of \$7.5 billion in labor income, \$12.5 billion in gross regional product, and \$88 million in taxes for the city of Irvine.

**The Evolution of  
Healthcare  
Innovation**

Enabling & Creative Technologies is the most likely growth scenario, given Irvine’s legacy of innovation in medical devices and healthcare delivery. However, it is expected to yield lower economic and fiscal impacts than Enabling & Creative Technologies. In this scenario, investments in the Evolution of Healthcare Innovation could create over 3,300 high-quality jobs with average wages of \$77,530, representing an addition of \$1.2 billion in labor income, \$1.4 billion in gross regional product, and \$4.8 million in taxes for the city of Irvine.

**Climate Transition/  
Decarbonization**

Climate Transition/Decarbonization technologies are less likely to grow in Irvine than Enabling & Creative Technologies or Evolution of Healthcare Innovation but could generate larger economic and fiscal impacts than the Evolution of Healthcare Innovation. In this scenario, investments in Climate Transition/Decarbonization technologies could create over 2,600 high-quality jobs with an average salary of \$118,221, generating an incremental \$1.3 billion in labor income, \$1.9 billion in gross regional product, and \$32 million in taxes for the city of Irvine.

**Next-Generation  
Defense  
Technologies**

Next-Generation Defense Technologies are as likely to grow as Climate Transition/Decarbonization but are likely to yield a lower level of economic and fiscal impacts. In this scenario, investments in Next-

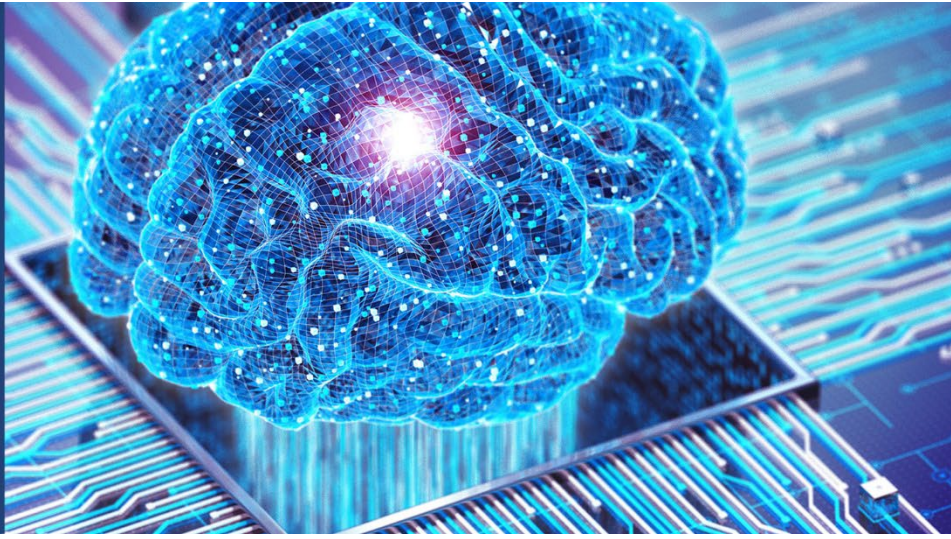
Generation Defense Technologies could create nearly 1,500 high-quality jobs with average annual wages of \$131,653, representing an incremental \$864 million in labor income, \$1.4 billion in gross regional product, and nearly \$9.0 million in taxes for the city of Irvine.

3. The research team recommends that the City of Irvine and the Greater Irvine Chamber of Commerce consider the following next steps based on the results of this study:

<b>Assemble advisory groups</b>	Assemble advisory groups for each potential development scenario, which include potential investors, current local employers, and public sector organizations within each industry, and <b>identify a champion</b> to represent each advisory group.
<b>Identify the role</b>	Identify the role that the City of Irvine and its partners, including the Greater Irvine Chamber of Commerce, can play in supporting the work of the advisory groups.
<b>Assemble a strategic plan</b>	Assemble a strategic plan based on feedback from the advisory groups, which considers Irvine’s connectivity to Orange County and the greater Southern California region.
<b>Define and deliver an “Invest in Irvine” marketing message to potential funders</b>	Define and deliver an “Invest in Irvine” marketing message to potential funders. Given the lack of later-stage capital in Irvine, it is recommended that the City collaborate with its regional development partners and Chambers of Commerce to define and deliver a marketing message that not only emphasizes Irvine's historical efforts to develop a business-friendly city with a high quality of life, but Irvine's current efforts to invest in an innovation economy that will spur economic growth and prosperity for the city's residents and businesses.
<b>Form a venture capital association</b>	Form a venture capital association that acts as a clearinghouse for information regarding the local venture capital environment and operates a website providing a platform to link players in the local venture capital ecosystem, to signal the City’s commitment to developing the venture capital ecosystem.
<b>Engage with venture capital experts</b>	Engage with venture capital experts to assist with efforts to develop the local venture capital ecosystem, to increase the likelihood that policies adopted targeting growth in late-stage venture capital investment will be appropriate and effective.



# Definition of an Innovation Economy



Productivity, the historic determinant of economic growth, has slowed significantly in recent years, driving regional economies to explore investments in innovation in digital technologies to fuel growth. Thus, innovation economies centered around technology have emerged and grown through a process of cumulative causation, in which early investments of knowledge and capital create a feedback loop that continues to attract workforce talent, startups, and investment, stimulating future growth.

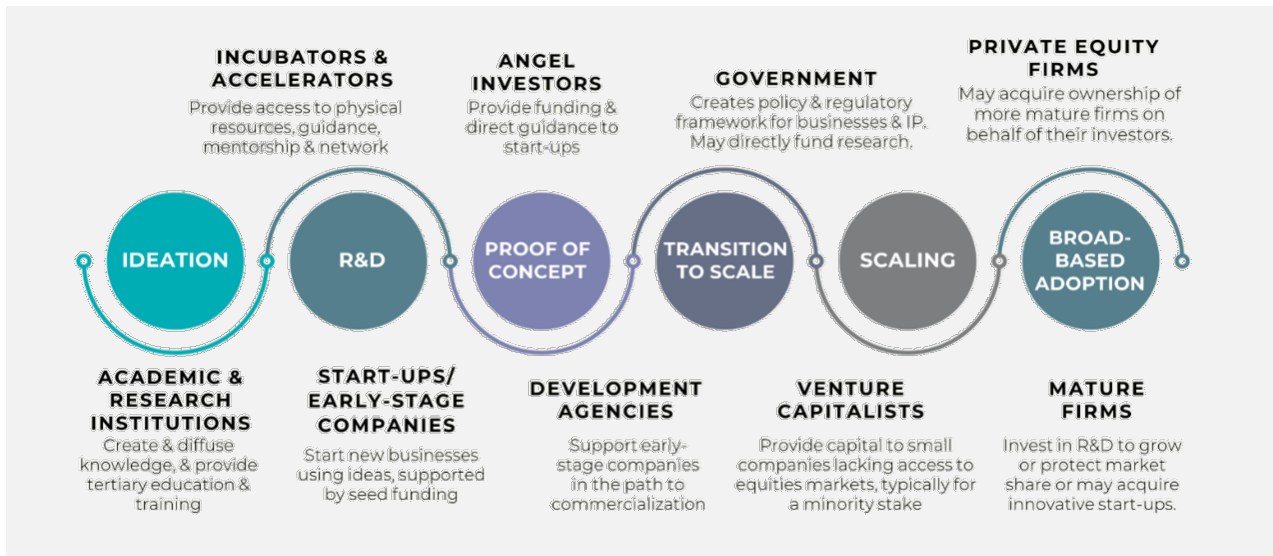
An innovation economy can be broadly defined as a region in which:

- Entrepreneurs & stakeholders cluster and connect to fuel the commercialization of new products, services, business models, or processes.
- Innovations drive economic growth, creating high value-added opportunities with large economic and employment multipliers.
- Innovations fuel growth in supply chains in connected industries, generating economic and fiscal benefits.

Figure 1 summarizes the critical roles played by various stakeholders supporting the growth of a regional innovation economy. As shown, collaboration between private firms and universities is critical to the diffusion of knowledge in an innovation economy. Incubators and accelerators, development agencies, angel investors, venture capitalists, and private equity firms provide critical support to early-stage firms in the path to commercialization. Mature firms also support innovation through direct investments in R&D, acquisitions of technology developed by start-ups, or via direct support to smaller firms.

Local governments not only play a critical role in creating policy and regulatory frameworks for local businesses and protection of intellectual property rights that can incentivize businesses to relocate to, or remain in, an area, but may also serve as a critical source of funding for research and development.

**Figure 1: Innovation Economy Stakeholders**



The City of Irvine has played a key role in developing its local innovation economy through intentional planning of a city centered around a strong research university, and through the removal of potential impediments to growth of businesses in the city.



# Irvine Overview

This section summarizes key milestones in the development of Irvine’s innovation economy, identifying Irvine’s current pillars of innovation, and summarizing venture capital investments in the region.

## STORY OF INNOVATION IN IRVINE

### **1960s**

#### **Defining the Vision for the City of Irvine**

In the 1960s, Irvine’s founders engaged in the master planning of a city built around a new university, creating a strong identity for Irvine as a city centered on the principles of innovation, research, and learning. The plans incorporated a thoughtful mix of housing, retail, and civic amenities, as well as open space. The City of Irvine adopted a private sector approach to building communities, which evolved into a strategy that aimed to support businesses.

### **1970s**

#### **Developing Quality Real Estate & Infrastructure**

In the 1970s, the Irvine Business Complex was completed, creating office buildings in strategically located business centers to ensure a strong job base for the growing city. During this period, investments were driven by real estate rather than innovation. Since its earliest beginnings, the City of Irvine has prioritized creating a business-friendly climate that lowers barriers to growth faced by budding entrepreneurs and attracts potential investors.

### **1980s**

#### **Attracting High-Quality Anchor Tenants**

In the 1980s, Irvine began to attract high-quality anchor tenants to its Spectrum District, including Mazda Motor Corp. and Edwards Lifesciences, catalyzing the growth of major industry clusters. These large firms served as magnets for incubators, accelerators, and venture capital firms. In addition, plans for the Irvine Company’s \$1 billion Irvine Center retail-commercial project were approved in the 1980s.

### **1990s**

#### **Creating a Strong Innovation Backbone to Catalyze Investments**

In the 1990s, the UCI Research Park was founded to attract biomedical and high-tech companies to the city. The proximity of the park to a major research campus provided the private sector with access to UCI’s wealth of academic and research resources, fostering collaboration between UCI researchers and major local tech and mobility firms such as AOL, Canon, Toyota, and Cisco.

## 2000s

### Developing a Local Talent Ecosystem

In the 2000s, the UCI Research Park was officially designated a “Power Park” by the U.S. Department of Energy, one of only four designated Power Parks in the nation and the second in California. By 2004, the Park included 2.4 million square feet of research space and housed thirty corporations, start-ups, and UCI-affiliated offices.

## 2010s

### Growing a Critical Mass of Venture Capital

The UCI Beall Center for Innovation and Entrepreneurship was founded in 2014, providing one-on-one consulting, fundraising opportunities, and mentorship and guidance to aspiring UCI entrepreneurs. In addition, venture capital investments began to surge in 2019, triggering an investment boom that took off in 2020.

## 2020s

### Redefining Priorities as Paradigms Shift

In the 2020s, Irvine reached an inflection point in its development as major disruptors drove paradigm shifts. The COVID-19 pandemic triggered shock waves through the economy, forcing regions worldwide to reevaluate strategic priorities related to growth and resilience. Post-pandemic, the rapid adoption of breakthrough technologies has begun to transform industries and offer new opportunities for growth.

## CURRENT STATE OF INNOVATION IN IRVINE

Table 1 illustrates Irvine’s three primary innovation industries: **Healthcare Innovation**, which encapsulates technologies such as advanced diagnostics, genomic sequencing, and telehealth; **Medical Technologies**, which encapsulates technologies such as remote monitoring technologies, surgical robotics, and cardiovascular technologies; and **Enabling and Creative Technologies**, which encapsulates technologies such as artificial intelligence, quantum computing, gaming, and simulations.

Each innovation industry has a sizeable employment base, robust ecosystem of firms, and significant VC funding availability in Irvine, as shown in the following tables and figures.

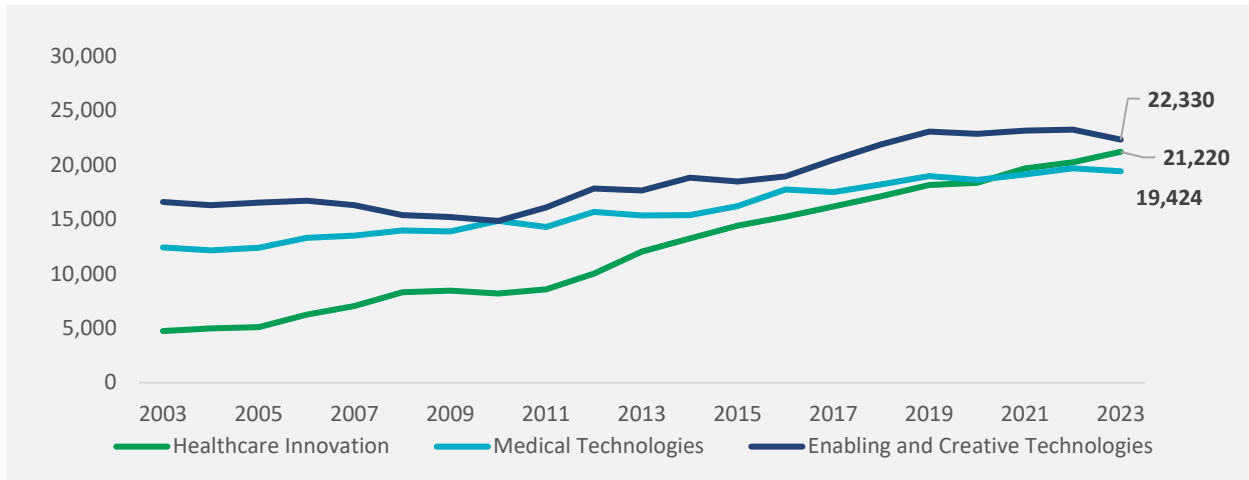
Table 1. Primary Innovation Industries in Irvine<sup>2</sup>

INNOVATION INDUSTRY	EXAMPLE TECHNOLOGIES	EMPLOYMENT (2023Q4)	AVERAGE ANNUAL WAGE (2023Q4)	KEY LOCAL EMPLOYERS
<b>Healthcare Innovation</b>	Advanced Diagnostics, Genomic Sequencing, Telehealth	21,220	\$62,635	UCI Health, Kaiser Permanente
<b>Medical Technologies</b>	Remote Monitoring Tech, Surgical Robotics, Cardiovascular Tech	19,424	\$115,711	Edwards Lifesciences, B Braun Medical, Masimo
<b>Enabling and Creative Technologies</b>	Artificial Intelligence, Quantum Computing, Gaming/Simulations	22,330	\$152,664	Broadcom, Activision Blizzard

<sup>2</sup> JobsEQ 2023 Q4. Bureau of Labor Statistics. Quarterly Census of Employment and Wages (2023).

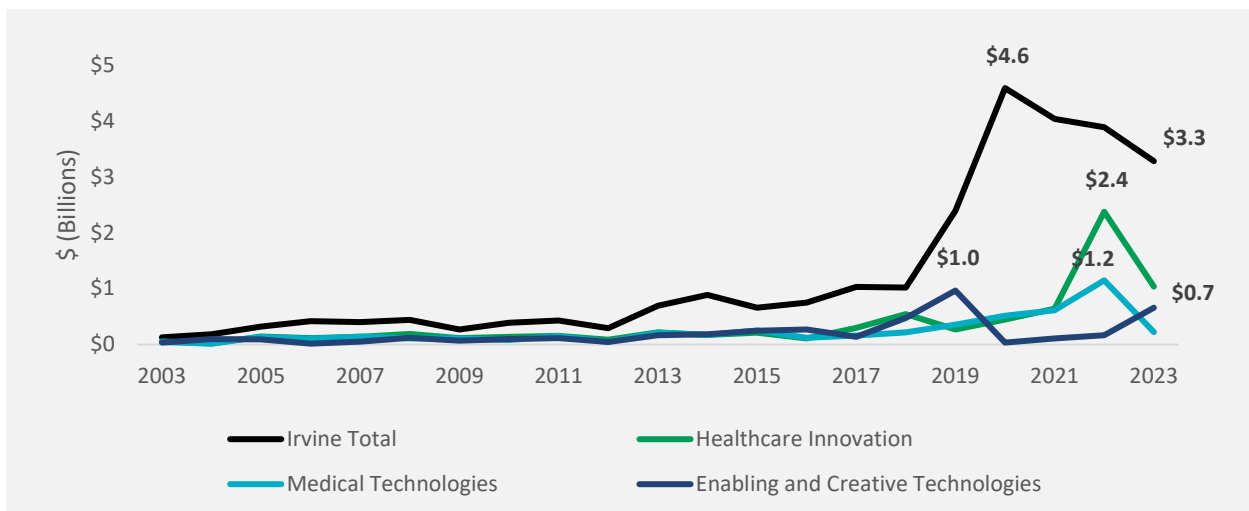
Employment in Irvine’s primary innovation industries has steadily increased over the past 20 years, with the Healthcare Innovation industry growing 347% from 2003 to 2023. Employment in Medical Technologies and Enabling and Creative Technologies increased 56% and 34% in the past 20 years, respectively (Figure 2).

**Figure 2. Historical Employment by Primary Innovation Industry in Irvine (2003 – 2023)<sup>3</sup>**



Furthermore, as described previously, venture capital funding in Irvine remained relatively flat until 2019, reaching an all-time high of \$4.6 billion in funding in 2020. Healthcare Innovation funding peaked in 2022 at \$2.4 billion, while Medical Technologies funding also peaked in 2022 at \$1.2 billion. Enabling and Creative Technologies funding peaked in 2019 at \$1 billion, though the industry received \$0.7 billion of funding in 2023, in contrast to decreasing funding availability in the other two innovation industries (Figure 3).

**Figure 3. Venture Capital Funding by Primary Innovation Industry in Irvine (2003 – 2023)<sup>4</sup>**



<sup>3</sup> JobsEQ 2023 Q4. Bureau of Labor Statistics. Quarterly Census of Employment and Wages (2023).

<sup>4</sup> Crunchbase. Funding Rounds in Irvine, CA (2003-2023).



Venture Capital Awards in Irvine are concentrated in early-stage Pre-seed, Angel, and Seed funding rounds, with these three categories representing one-third (33%) of all funding awards over the past 10 years. Late-stage Post-IPO Equity and Post-IPO Debt funding accounts for just over one in ten (12%) funding awards over the past 10 years (Table 2).

**Table 2. Venture Capital Awards by Funding Round Type (2014 – 2024)<sup>5</sup>**

FUNDING ROUND TYPE	NUMBER OF FUNDING AWARDS	% OF TOTAL FUNDING AWARDS
Seed	205	23%
Series A	62	7%
Series B	47	5%
Debt Financing	60	7%
Post-IPO Equity	75	9%
Series C	36	4%
Pre-Seed	59	7%
Grant	52	6%
Post-IPO Debt	29	3%
Angel	23	3%
All Other Funding Types <sup>6</sup>	225	26%

<sup>5</sup> Crunchbase. Funding Rounds in Irvine, CA (2014-2024). 2024 was excluded from Figure 2 to avoid understating 2024 Venture Capital Funding amounts.

<sup>6</sup> All Other Funding Types include Series D – F funding, crowdfunding, private equity investments, and other non-equity assistance.



# Innovation Scorecard

To quantify and assess Irvine’s performance as an innovation hub, the research team conducted literature reviews and other secondary research to identify domestic regional innovation hubs that could serve as benchmarks for Irvine’s innovation economy (Table 3). Each of the eleven benchmark regions are comparable in size, scale, and workforce supply to Irvine; are renowned for their existing robust innovation pipelines; and provide the basis for assumptions on projected growth outlined in the section of this report outlining modeling strategies. In addition, the benchmark regions provide examples of best practices for economic development strategies that support the growth of regional innovation hubs. Appendix B: Innovation Hub Case Studies provides brief summaries of each of the innovation hubs listed in Table 3.

**Table 3. Regional Innovation Hubs**

STATE	REGIONAL INNOVATION HUB	CORE TECHNOLOGY FOCUS
TX	Austin	Healthcare, Information Technology, and Life Sciences
IL	Bloch Tech Hub	Quantum Computing and Communications
MA	Boston Kendall Square	Finance, Biotechnology R&D
CO/NM	Elevate Quantum Tech Hub	Quantum Information Technology
CA	Long Beach	Aviation and Aerospace R&D
MN	Medical Alley	Medical Devices and Technologies
PA	Oakland Innovation District	Biomedical and Engineering R&D
AZ	Phoenix	Advanced Manufacturing
NC	Research Triangle Park	Healthcare, Software, Academic R&D
WA	Seattle	Aviation, Software, and Information Technology
UT	Silicon Slopes (SLC)	Software and Information Technology



The research team then developed an “Innovation Scorecard” that utilized the following metrics to measure innovation activity<sup>7</sup> in each region:

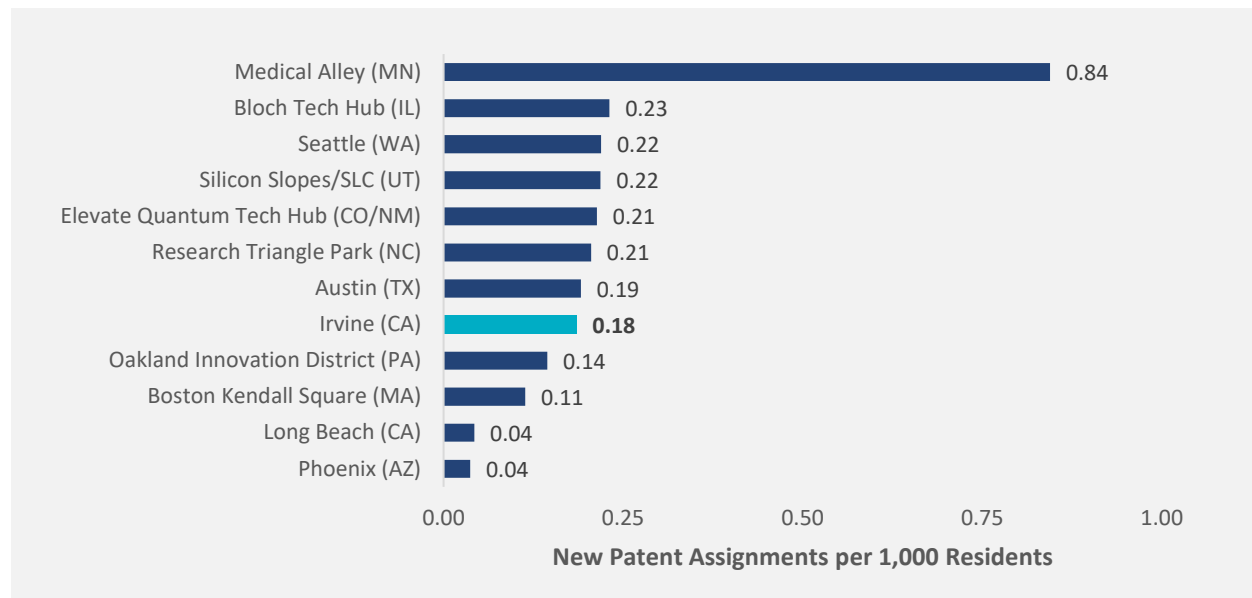
1. **Patent Activity** – measured through new patent assignments per 1,000 residents.
2. **New Business Formation** – measured through new business applications per 1,000 residents.
3. **Venture Capital Spending** – measured through VC spending as a percentage of regional GDP.
4. **Federal R&D Spending** – measured through Federal R&D spending as a percentage of regional GDP.
5. **University R&D Spending** – measured through university R&D expenditure rankings.

These metrics quantify public sector innovation funding and grant opportunities (metrics 4, 5), private sector investments and expenditures (metric 3), and the commercialization of new products, devices, or concepts (metrics 1, 2). The following subsections provide additional detail regarding Irvine’s performance relative to the eleven innovation hubs with respect to each of the aforementioned metrics.

## PATENT ACTIVITY

Patent activity is a key indicator of innovation activity, as it represents the legal formalization of a novel concept, a prerequisite step to product commercialization.<sup>8</sup> As shown in Figure 4, Medical Alley has the highest level of new patent assignments, with 0.84 new patents assigned per 1,000 residents in 2022. Long Beach and Phoenix have just 0.04 patents assigned per 1,000 residents, the lowest patent activity among all innovation hubs. **Irvine produces 0.18 patent assignments per 1,000 residents, slightly below the median of 0.21 patents per 1,000 residents.**

Figure 4. Patent Activity in Regional Innovation Hubs (2022)<sup>9</sup>



<sup>7</sup> Metrics are normalized by regional population size or GDP to facilitate comparisons across regions.

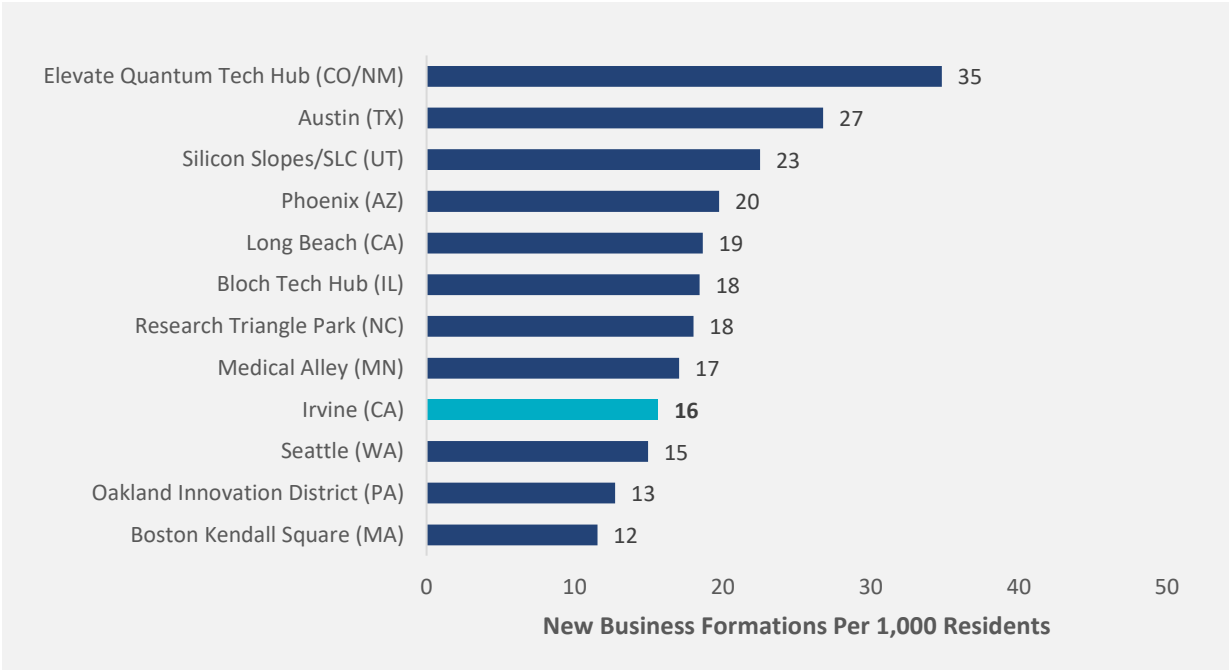
<sup>8</sup> Figure 1 utilizes New Patent Assignments – given lengthy patent approval and assignment processes, this metric may not fully capture current-year patent activity in a given region.

<sup>9</sup> U.S. Patent and Trademark Office. New Patent Assignments (2022). U.S. Census Bureau. Annual Population Estimates (2022).

## NEW BUSINESS FORMATION

New business formation is also a key indicator of innovation activity, as it represents another milestone in product commercialization, establishing further legal precedent and ownership rights for innovators and entrepreneurs. Elevate Quantum Tech Hub has the highest level of new business formations, with 35 new businesses created per 1,000 residents in 2022, while Boston Kendall Square has the lowest level of new business formations, with just 12 new businesses created per 1,000 residents (Figure 5). **Irvine created 16 new businesses per 1,000 residents, slightly below the median of 18.**

Figure 5. New Business Formation in Regional Innovation Hubs (2022)<sup>10</sup>

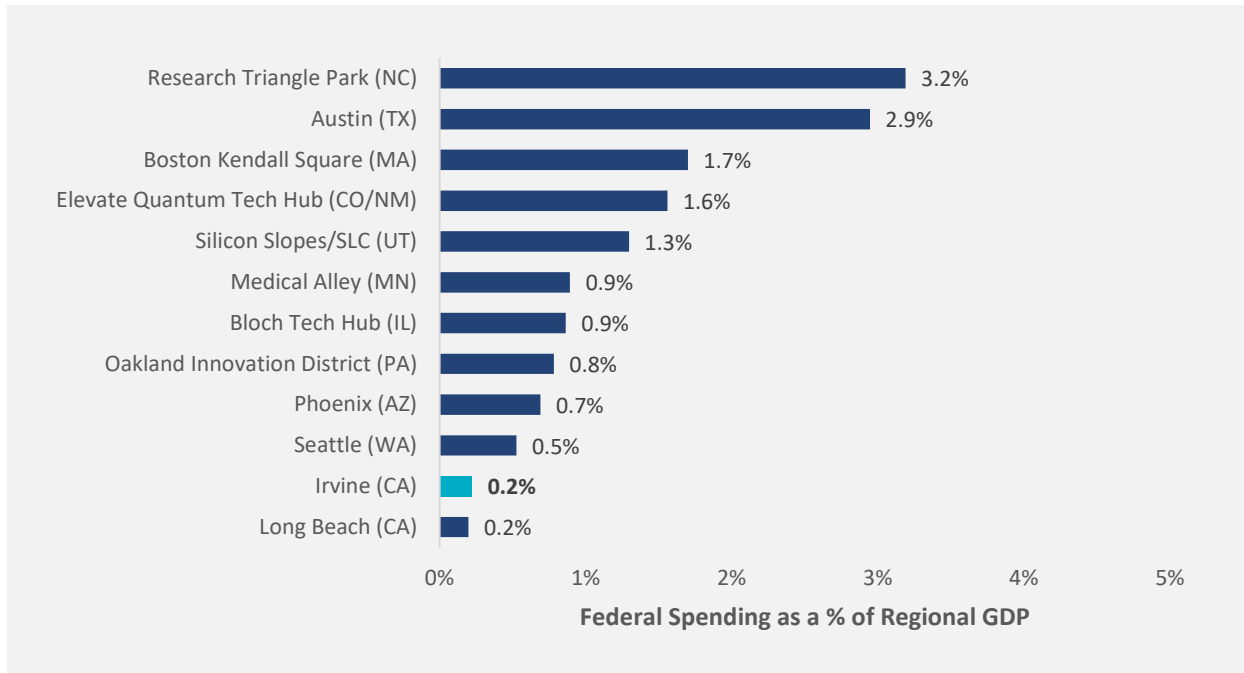


## FEDERAL R&D SPENDING

Federal R&D Spending is a crucial innovation metric to assess federal-level funding allocations and priorities. As shown in Figure 6, Research Triangle Park and Austin have the highest levels of federal R&D spending as a percentage of GDP, with federal spending representing 3.2% and 2.9% of each region’s total GDP, respectively. **Federal spending in Irvine represents just 0.2% of its GDP**, on par with Phoenix (0.7%), Seattle (0.5%), and Long Beach (0.2%).

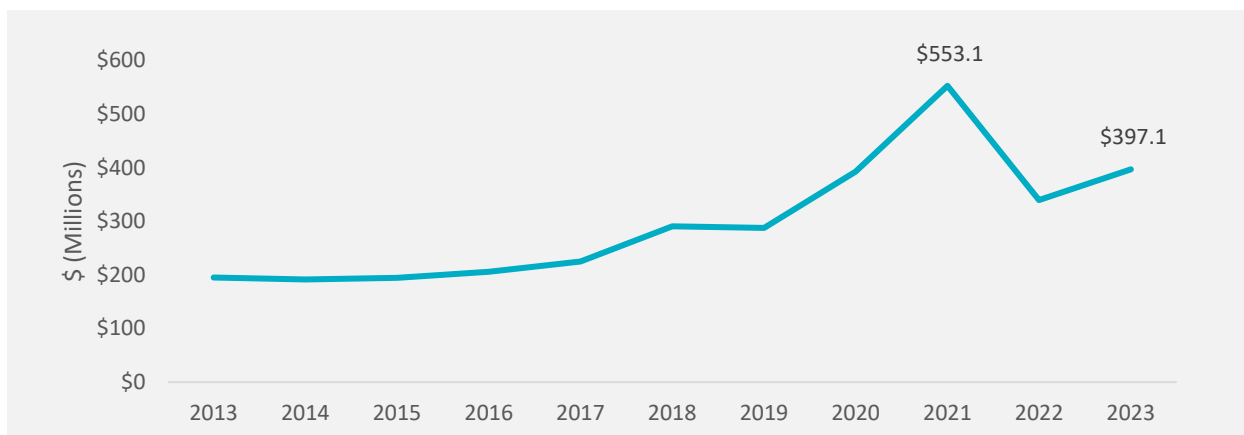
<sup>10</sup> U.S. Census Bureau. Business Formation Statistics (2022). U.S. Census Bureau. Annual Population Estimates (2022).

**Figure 6. Federal R&D Spending in Regional Innovation Hubs as a % of Regional GDP (2024)<sup>11</sup>**



Despite Irvine’s low levels of Federal R&D Spending relative to other innovation hubs, Federal R&D Spending in Irvine has increased significantly in the past 10 years, with nearly \$400 million of federal grants awarded in 2023, representing a 104% increase from 2013 (Figure 7). Additionally, federal R&D Spending in Irvine is heavily concentrated in healthcare and medical technologies, with the Department of Health and Human Services (DHHS) and the National Science Foundation (NSF) accounting for 75% of all grant awards in the past 10 years (Figure 8).

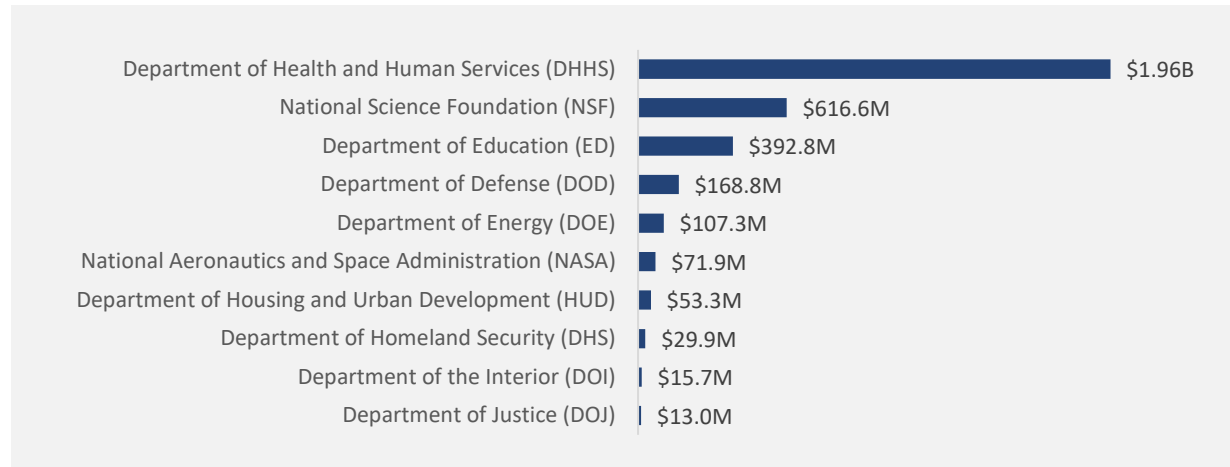
**Figure 7. Federal R&D Grant Obligations in Irvine (2013 – 2023)<sup>12</sup>**



<sup>11</sup> USAspending.gov. Federal Expenditure Obligations (2024). Bureau of Economic Analysis. Gross Domestic Product – All Industries (2022).

<sup>12</sup> USAspending.gov. Federal Award Data (2013 – 2023).

**Figure 8. Federal R&D Grant Obligations in Irvine by Agency (2013 – 2023)<sup>13</sup>**

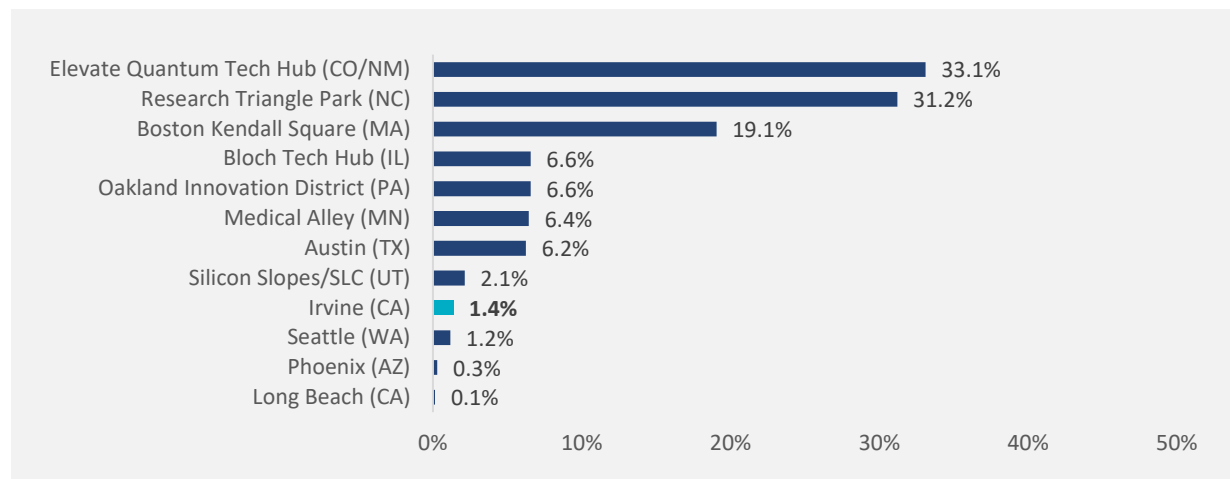


## VENTURE CAPITAL SPENDING

Private sector Venture Capital Spending catalyzes growth in emerging innovation industries and can be targeted with greater precision than Federal R&D Spending, which is often subject to lengthy and complex pre-documentation and disbursement processes. High levels of Venture Capital Spending represent private sector signals of market potential and is a leading metric for innovation activity.

Figure 6 shows Elevate Quantum Tech Hub and Research Triangle Park have the highest levels of Venture Capital Spending as a percentage of GDP of all innovation hubs listed, with Venture Capital Spending representing 33.1% and 31.2% of each region’s total GDP, respectively. Phoenix and Long Beach have the lowest levels of Venture Capital Spending, with spending representing just 0.3% and 0.1% of each region’s total GDP, respectively. **Irvine’s Venture Capital Spending in 2024 represented 1.4% of total GDP, on par with Seattle (1.2%) and Silicon Slopes (2.1%).**

**Figure 9. Venture Capital Spending in Regional Innovation Hubs (2024)<sup>14</sup>**



<sup>13</sup> USAspending.gov. Federal Award Data (2013 – 2023).

<sup>14</sup> Crunchbase. Venture Capital Spending (2024). Bureau of Economic Analysis. Gross Domestic Product – All Industries (2022).

## UNIVERSITY R&D SPENDING

University R&D Spending provides a measure of innovation activity within a region’s education system, a crucial indicator of not only innovative academic research, but also talent development and potential industry collaborations between universities and private firms.

Table 4 displays national university rankings by internal R&D expenditures. As shown, Seattle’s Washington University has the highest levels of University R&D Spending, ranking #5 among all U.S. universities in 2022. Research Triangle Park’s University of North Carolina and Duke University also possess high levels of R&D Spending, ranking #10 among all U.S. Universities. **UC Irvine ranks #57 in R&D Spending**, comparable to the University of Utah (#47) and the University of Colorado, Boulder (#50).

**Table 4. University R&D Spending Rankings in Regional Innovation Hubs (2022)<sup>15</sup>**

REGIONAL INNOVATION HUB	UNIVERSITY	UNIVERSITY RANKINGS BY INTERNAL R&D EXPENDITURES
Seattle	University of Washington	5
Research Triangle Park	University of North Carolina, Duke University	10
Medical Alley	University of Minnesota	20
Boston Kendall Square	Massachusetts Institute of Technology	30
Austin	University of Texas, Austin	35
Phoenix	Arizona State University	38
Oakland Innovation District	Carnegie Mellon University	41
Bloch Tech Hub	University of Chicago, Northwestern University	42
Silicon Slopes/SLC	University of Utah	47
Elevate Quantum Tech Hub	University of Colorado, Boulder	50
<b>Irvine</b>	<b>UC Irvine</b>	<b>57</b>
Long Beach	CSU Long Beach	303

UC Irvine received \$653 million in grant and contract awards from federal, private, and non-profit sources in FY 22-23, representing a 13% increase from the previous year and a 111% increase over FY-13-14 awards. Additionally, over one-third (35%), or \$231 million, of UC Irvine funding originated from private and non-profit firms in FY 22-23.

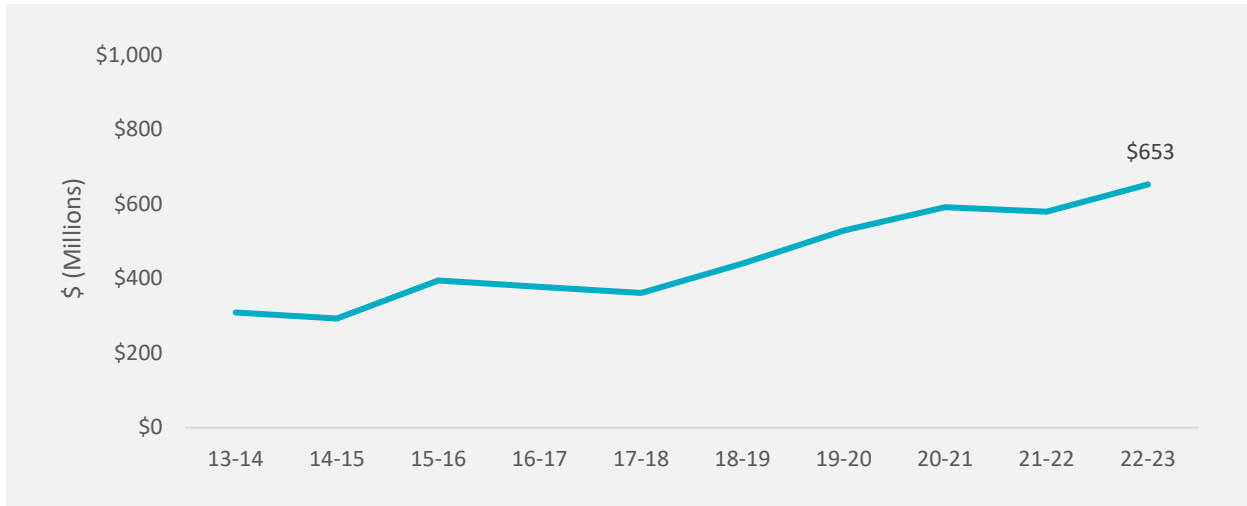
Notable funded projects for FY 22-23 include a \$6.8 million grant from Amgen<sup>16</sup> to support immunotherapy research for leukemia, and \$5 million from Revolution Medicines<sup>17</sup> to conduct advanced solid tumor treatment research.

<sup>15</sup> National Science Foundation (NSF). University Rankings by Total R&D Expenditure (2022). For regions with more than one university, average rankings are utilized.

<sup>16</sup> Amgen is a biotechnology firm based in Thousand Oaks, CA. <https://www.amgen.com>.

<sup>17</sup> Revolution Medicines is a biotechnology firm based in Redwood City, CA. <https://www.revmed.com>.

**Table 5. Grants and Contracts Awards at UC Irvine (FY 13/14 – FY 22/23)<sup>18</sup>**



## INNOVATION SCORECARD RANKINGS

After assessing the performance of each of the regional innovation hubs with respect to the aforementioned metrics, the research team assigned rankings to each regional innovation hub as follows:

1. **Top Innovator** – strengths across all five metrics.
2. **Strong Innovator** – weakness in one metric.
3. **Moderate Innovator** – weaknesses in two metrics.
4. **Emerging Innovator** – weaknesses in three to four metrics.
5. **Nascent Innovator** – weaknesses in four to five metrics.

Top Innovators are characterized by a well-established innovation and R&D ecosystem, robust VC funding pipeline, and high relative levels of business formation and patent activity, while Strong, Moderate, Emerging, and Nascent Innovators exhibit weaknesses in one or more metrics.

Table 6 displays the Innovation Scorecard results. As shown, Boston Kendall Square, Research Triangle Park, and Elevate Quantum Tech Hub rank as Top Innovators in contrast to regions such as Phoenix and Long Beach, which rank as Nascent Innovators. While the City of Irvine has positioned itself as a staunch supporter of local businesses and displays relative strength in patent activity and new business formation, there is still room for growth as an innovation hub, particularly within the venture capital market. Thus, Irvine received the rank of Moderate Innovator.

<sup>18</sup> UC Irvine News and UC Irvine Office of Research (FY 13/14 – FY 22/23).

**Table 6. Innovation Scorecard Rankings**

STATE	REGIONAL INNOVATION HUB	OVERALL INNOVATION SCORE
MA	Boston Kendall Square	1
NC	Research Triangle Park	1
CO/NM	Elevate Quantum Tech Hub	1
MN	Medical Alley	2
IL	Bloch Tech Hub	2
TX	Austin	3
PA	Oakland Innovation District	3
<b>CA</b>	<b>Irvine</b>	<b>3</b>
UT	Silicon Slopes (SLC)	4
WA	Seattle	4
AZ	Phoenix	5
CA	Long Beach	5

As outlined in callout boxes throughout the remainder of the report, the research team engaged with various key stakeholders in the city of Irvine to assess their perspectives on Irvine’s strengths and weaknesses as an innovation economy, and on potential opportunities for economic growth for the city that center around innovation. The stakeholder engagement process is critical to fostering connections, trust, confidence, and buy-in for the city’s key initiatives, and mitigating potential risks of misalignment of priorities and resistance to change.

### STAKEHOLDER VOICES

Numerous venture capital investors highlighted potential areas for improvement in the city’s venture capital ecosystem, which was described as **“disorganized,”** with **“too many siloes and not enough coordination between players.”** Additionally, the need for late-stage capital was highlighted to prevent emerging companies from leaving the city to obtain additional funding. Stakeholders cited CrowdStrike as a notable example of a high-profile company that emerged in Irvine, but ultimately relocated due to funding constraints.

The relative lack of venture capital funding opportunities in Orange County as compared to Los Angeles County was characterized as a **“self-fulfilling prophecy”** where Los Angeles County is perceived as a hotspot for venture capital, which attracts additional venture capital to the region. Venture capital flows in Orange County were also perceived as largely originating from outside the region, with relatively **few reinvestments** in local companies.

However, one venture capital investor noted a **growth in deal flow for medtech startups** over the last decade, with increased interest in venture capital funding from companies in the vascular/shunt development, ophthalmology, and AI in medtech space. While pharmaceutical startups have reportedly approached Irvine venture capital investors for funding, Irvine has been historically unable to engage with these entrepreneurs since pharmaceutical startups have larger funding needs and their pathways to commercialization are more arduous, given stringent FDA requirements.



# Executive Interviews



The research team conducted executive interviews with thirteen key stakeholders in the city of Irvine, including representatives of economic development organizations, universities, venture capital investors, and local businesses.

Based on these interviews, key stakeholders believe that the city possesses the following strengths:

- Strong pipeline of talent from UCI, Chapman University, and community colleges
- Robust K-12 education system
- Strong transportation infrastructure
- High quality of life
- Presence of major employers and innovators in healthcare, computing, gaming, and mobility
- Breadth of support available to startups, including finance, consulting, and legal services

However, key stakeholders also highlighted the need for improvements in the following areas:

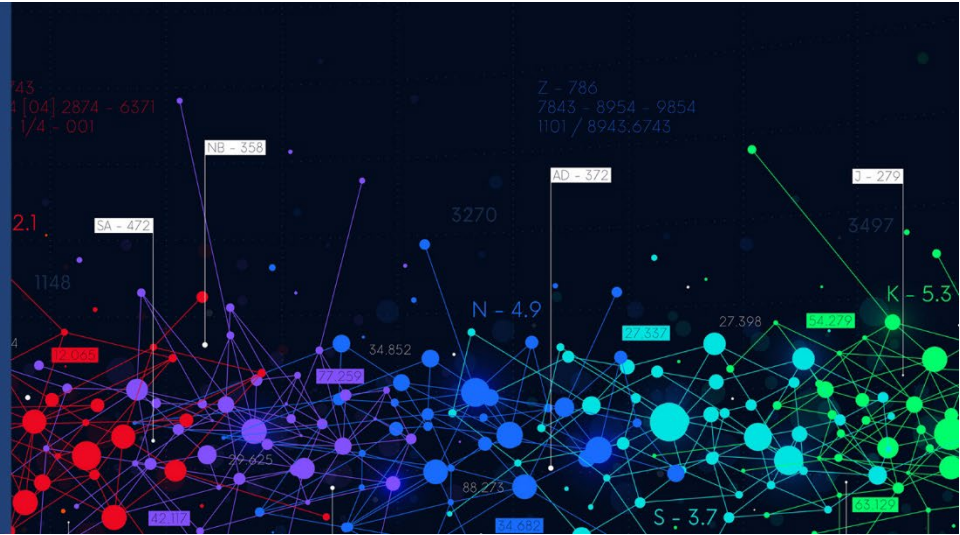
- High cost of living
- Lack of availability of housing options
- Difficulty attracting talent under the age of twenty-five due to Irvine's reputation as a family-centric community
- Lack of availability of late-stage venture capital funding
- Lack of a unified startup community

Stakeholders perceived the following industries as having the highest potential for growth in the city of Irvine:

- **Evolution of Healthcare Innovation:** Potential growth is predicted based on Irvine's potential to continue to evolve as a premier healthcare destination, leveraging its historical strengths in medical devices and healthcare delivery into the design and creation of next-generation healthcare technologies and advanced treatment delivery.
- **Enabling & Creative Technologies:** Potential growth is predicted based on Irvine's potential to successfully leverage its legacy of innovation in tech to lean into (i) enabling technologies that enhance productivity across a wide range of industries, such as AI and quantum computing; or (ii) creative technologies such as gaming and simulations.

- **Climate Transition/Decarbonization Technologies:** Potential growth is predicted based on Irvine’s potential to support the growth of a cleantech industry focused on innovations supporting the transition to a clean energy economy, such as clean hydrogen, cleantech software, alternative vehicles, and other clean energy electric mobility applications.
- **Next-Generation Defense Technologies:** Potential growth is predicted based on Irvine’s potential to leverage its geographic proximity to major aerospace and defense companies in Southern California, and to build on its historical experience in mobility, to pursue opportunities in military vehicle electrification, and defense and space technologies.

# Modeling Potential Impacts



## IMPLAN

Following the executive interviews, literature reviews, and supplementary secondary research, BW sought to model potential economic and fiscal impacts associated with investments in each of the target innovation industries.

BW Research used IMPLAN, a static Input-Output model that analyzes the effects of a specific economic stimulus on a given region using complex models of industry spending patterns, demand for commodities, and industry links at the local level. The cumulative effects of the jobs are quantified, and results are categorized into direct, indirect, and induced effects. Direct effects show the change in the economy associated with job growth in the given industry, or how the industry experiences the change. Indirect effects include all the backward linkages, or the supply chain responses as a result of industry growth. Induced effects refer to household spending and are the result of workers who are responsible for the direct and indirect effects of spending their wages.

In addition to projected job impacts, IMPLAN generates statistics on incremental labor income, gross regional product, and fiscal impacts (i.e., taxes) generated by specified investments.

The following section describes each of the growth scenarios modeled in IMPLAN in detail.

## GROWTH SCENARIOS

BW Research projected growth in each of the four innovation industries based on historical growth rates observed in comparable innovation economies. Growth rates were selected from time periods associated with consistent employment growth and were then applied to current employment numbers in Irvine to estimate total job growth from 2024 through 2030. Marginal job gains were modeled through IMPLAN to estimate the economic impact of the economic growth through direct, indirect, and direct measures.



Note that the economic impact results herein represent **additional jobs created** and associated impacts created based on projected job growth. For example, the local tax figures displayed in each scenario represent the **incremental tax revenue** generated from the additional jobs added during the forecast period, rather than the total local taxes generated during the forecast period.

## Evolution of Healthcare Innovation

For the Evolution of Healthcare Innovation scenario, Houston, Texas, was used as a case study to model possible economic development impacts for Irvine and Orange County, respectively. Houston hosts the largest medical center in the world, Texas Medical Center, just 10 minutes from its downtown area.<sup>19</sup> The research team calculated the average annual growth rate of healthcare jobs in Houston, Texas from 2006-2011, which coincided with a notable expansion of Houston’s medical center spurred by an investment in the Houston Medical Center’s Northwest Tower. This expansion created 161,800 square feet of emergency care, examination, imaging rooms, and is similar in scope to construction projects expected to be constructed in Irvine, California from 2024 to 2030.

**STAKEHOLDER VOICES**

Some industry stakeholders characterized the evolution of healthcare innovation as “the most clear and obvious [choice] for Irvine” since “medical devices are where Irvine stands out in terms of jobs,” with key medtech innovators such as Edwards Lifesciences already operating in Irvine. These stakeholders believed that an emphasis on healthcare innovations in new products and novel approaches have the highest potential for growth for the city. Expansions into digital health in local health systems such as UCI, Hoag, and Providence would allow for the integration of AI into next-generation healthcare delivery, allowing for innovations in this space. Other related industries with potential overlaps with healthcare innovation cited as having growth potential for the city included ocular and dental. Pharma was considered a more distant opportunity for long-term growth.

Assuming a 2.9 percent rate of growth in healthcare employment, consistent with Houston’s healthcare job growth over the period from 2006 to 2011, IMPLAN projects the potential job creation of 3,118 jobs in Irvine’s healthcare economy in this scenario, with an additional 141 jobs created as a result of indirect and induced impacts in other industries.

The economic benefits of this growth extend beyond job creation. The healthcare sector in Irvine is projected to contribute an additional \$4,835,039 in local taxes from 2024 to 2030. Incremental labor income for residents is expected to reach approximately \$1.1 billion, and contributions to Irvine’s Gross Regional Product are expected to reach \$1.4 billion. Healthcare professionals in Irvine are anticipated to earn an average salary of \$77,530, reflecting the sector’s competitive pay but falling beneath the anticipated earnings projected in other growth scenarios.

**Figure 10. Evolution of Healthcare Innovation – Potential Economic & Fiscal Impacts, 2024-2030**

	Orange County	Irvine
<b>Local Taxes</b>	\$21,243,617	\$4,835,039
<b>Local Employment</b>	5,088	3,329
<b>Labor Income to Residents</b>	\$1,636,106,303	\$1,145,736,904
<b>Gross Regional Product</b>	\$2,260,742,596	\$1,423,187,896
<b>Average Salary</b>	\$75,207	\$77,530

<sup>19</sup><https://www.houstontx.gov/abouthouston/health.html#:~:text=Houston%20is%20known%20internationally%20as,medical%20communities%20in%20the%20world>.

## Enabling and Creative Technologies

San Francisco is recognized as a city of economic growth largely driven by Enabling and Creative Technologies. The city's unique position, closely tied to Silicon Valley, places it at the heart of technological innovation. The collection of startups in San Francisco reflects a vibrant ecosystem where cutting-edge technologies such as artificial intelligence, next-generation gaming devices, and innovative quantum technology are being developed and commercialized. This environment fosters a dynamic space where new ideas can rapidly transition from concept to market, significantly contributing to Irvine's economy. Therefore, San Francisco was selected as a benchmark for potential economic growth in Enabling and Creative Technologies.

San Francisco has seen rapid employment growth in the Enabling and Creative Technologies industry from 2017 to 2023, averaging approximately 7.1% growth each year. Based on San Francisco's historical growth rate, the research team forecasts that investments in Irvine's Enabling and Creative Technologies innovations can create 13,579 additional jobs in Enabling and Creative Technologies from 2024 to 2030, and an additional 2,013 jobs through induced and indirect impacts, with average annual wages of \$135,736.

In this scenario, investments in Enabling and Creative Technologies are projected to contribute an estimated \$88.4 million in local tax revenues for Irvine from 2024 to 2030, an \$83 million increase compared to the Evolution of Healthcare Innovation growth scenario. Incremental labor income for residents within Enabling and Creative Technologies is expected to reach approximately \$7.5 billion whilst contributing \$12.5 billion to Irvine's Gross Regional Product.

### STAKEHOLDER VOICES

Numerous venture capital stakeholders cited **enabling technologies** as a key opportunity for the city since "software is easiest to get off the ground" and numerous early-stage software startups are already headquartered in Irvine. Key opportunities cited included **AI in biomedical devices, robotic surgery tools, cybersecurity, and fintech**.

In addition, multiple investors cited opportunities for the city of Irvine to focus on **quantum innovation**. While the city of Irvine was not regarded as currently having a competitive advantage with respect to an existing quantum workforce, the city has the opportunity to seize a **first-mover advantage** in quantum research, since this field is emerging and has high potential for growth, due to growth in adoption of AI. Future AI implementation is expected to be limited by computing speed, and quantum computing is expected to help mitigate those concerns, accelerating data processing. Growing demand for cybersecurity is also expected to fuel demand for quantum technologies.

Numerous stakeholders also cited **Activision Blizzard** as a key local employer within Irvine's gaming cluster, which has already spun off numerous gaming startups and attracted other gaming companies and skilled gaming talent to Irvine. Irvine also possesses the advantage of **proximity to skilled talent in Los Angeles** and benefits from **UCI's initiatives to build a gaming storytelling program**, and there is an opportunity for the city to lean into its existing strengths in gaming.

Figure 11. Enabling and Creative Technologies – Potential Economic & Fiscal Impacts, 2024-2030

	Orange County	Irvine
Local Taxes	\$234,274,085	\$88,403,117
Local Employment	33,406	15,593
Labor Income to Residents	\$12,655,355,948	\$7,472,339,687
Gross Regional Product	\$20,990,618,438	\$12,487,950,095
Average Salary	\$103,520	\$135,736

## Next-Generation Defense Technologies

Fort Worth, Texas, was selected as the basis for the projected growth of next-generation defense technologies in Irvine due to its established expertise and success in the sector. Texas is the number one state in terms of total defense spending, with \$68.4 billion spent in 2023.<sup>20</sup> Furthermore, as a prominent hub for defense and aerospace industries, Fort Worth's experience with major contractors and its significant economic impact serves as a valuable model for Irvine.

Major defense technology organizations, including Lockheed Martin and Bell, reside in Fort Worth, and other companies located in surrounding areas include L3Harris and Raytheon. Fort Worth is also home to the Naval Air Station Reserve Base Fort Worth (NAS JRB Fort Worth), which employs an estimated 15,164 people through direct and indirect employment and has an estimated total economic impact of \$2.7 billion.<sup>21</sup>

### STAKEHOLDER VOICES

Numerous stakeholders cited Irvine's proximity to defense unicorn **Anduril** as providing a significant opportunity for growth in next-generation defense technologies. Irvine's historical experience in **mobility** with key local employers such as Karma, Rivian, and Lucid Motors is expected to provide the city with a comparative advantage in developing next-generation defense technologies, with **new satellite and aerospace startups** having reportedly emerged in Irvine in recent years.

Fort Worth has demonstrated substantial growth in the defense technologies sector, with a robust track record of economic expansion, averaging 7.5 percent annual growth over the period from 2017 to 2023. Applying similar growth projections to Irvine, investments in the Next-Generation Defense Technologies industry could generate an additional 1,370 jobs in Defense Technologies in Irvine between

2024 and 2030, as well as an additional 129 jobs created through induced and indirect effects.

From 2024 to 2030, investments in Next-Generation Defense Technologies could contribute nearly \$9 million in incremental local taxes, nearly \$864 million in labor income, and \$1.43 billion in Gross

<sup>20</sup> [https://oldcc.gov/sites/default/files/defense-spending-rpts/OLDCC\\_DSBS\\_FY2023\\_ExecutiveSummary\\_May2024-Revised.pdf](https://oldcc.gov/sites/default/files/defense-spending-rpts/OLDCC_DSBS_FY2023_ExecutiveSummary_May2024-Revised.pdf)

<sup>21</sup> [https://gov.texas.gov/uploads/files/organization/military/Biennial\\_2021-2022\\_Final\\_2022-07-01.pdf](https://gov.texas.gov/uploads/files/organization/military/Biennial_2021-2022_Final_2022-07-01.pdf)

Regional Product for the city of Irvine. The average salary for newly created positions in the sector is forecasted to reach \$131,653, highlighting the sector's competitive pay scale.

**Figure 12. Next-Generation Defense Technologies – Potential Economic & Fiscal Impacts, 2024-2030**

	ORANGE COUNTY	IRVINE
<b>Local Taxes</b>	\$31,480,658	\$8,971,784
<b>Local Employment</b>	3,721	1,498
<b>Labor Income to Residents</b>	\$1,774,952,051	\$863,831,075
<b>Gross Regional Product</b>	\$2,922,697,844	\$1,431,663,343
<b>Average Salary</b>	\$119,467	\$131,653

### Climate Transition/Decarbonization

The scenario used for Climate Transition/Decarbonization is unique due to the distribution of clean energy jobs across different industries and the tendency of clean energy generation to be located in more rural and suburban environments.

For these reasons, Middlesex County, Massachusetts, was selected as the case study to model Irvine’s possible growth in the clean energy sector due to Climate Transition/Decarbonization. Middlesex County encompasses a large proportion of Boston, specifically Cambridge, and the northern regions of the state. Since 2010, Massachusetts has seen an 80 percent job growth in clean energy industry, adding 48,174 jobs.<sup>22</sup> In Massachusetts, Middlesex County was selected due to its inclusion of Cambridge, a technological and education hub in Boston, and its significant involvement in clean energy with 1.9 percent of employment in the county in clean energy occupations.<sup>23</sup>

Drawing parallels from Middlesex County’s experience, Irvine is projected to see substantial advancements in clean energy due to Climate Transition/Decarbonization, with a projected annual jobs growth rate of 5.6 percent in this scenario, equivalent to the average rate of job growth in Middlesex County over the period from 2017 to 2023.

In this scenario, investments in Climate Transition/Decarbonization could create 2,659 jobs between 2024 and 2030, 2,257 of which are directly attributable to clean energy employment and the remaining 403 jobs created from indirect or induced impacts.

Based on the 2,659 jobs generated, incremental local taxes are expected to reach \$31.6 million and labor income for residents is anticipated to reach approximately \$1.3 billion, contributing approximately \$1.9 billion to Irvine’s Gross Regional Product.

<sup>22</sup> <https://www.masscec.com/reports/industry-2023/>

<sup>23</sup> USEER



The average salary for positions within the clean energy sector in Irvine is forecasted to reach \$118,221, indicating competitive pay. This salary level underscores the sector’s potential to attract skilled professionals while driving economic growth.

**Figure 13. Climate Transition/Decarbonization Scenario Results**

	ORANGE COUNTY	IRVINE
<b>Local Taxes</b>	\$53,607,717	\$31,620,250
<b>Local Employment</b>	5,219	2,659
<b>Labor Income to Residents</b>	\$2,070,341,586	\$1,338,231,360
<b>Gross Regional Product</b>	\$3,140,760,158	\$1,911,511,967
<b>Average Salary</b>	\$96,853	\$118,221

**STAKEHOLDER VOICES**

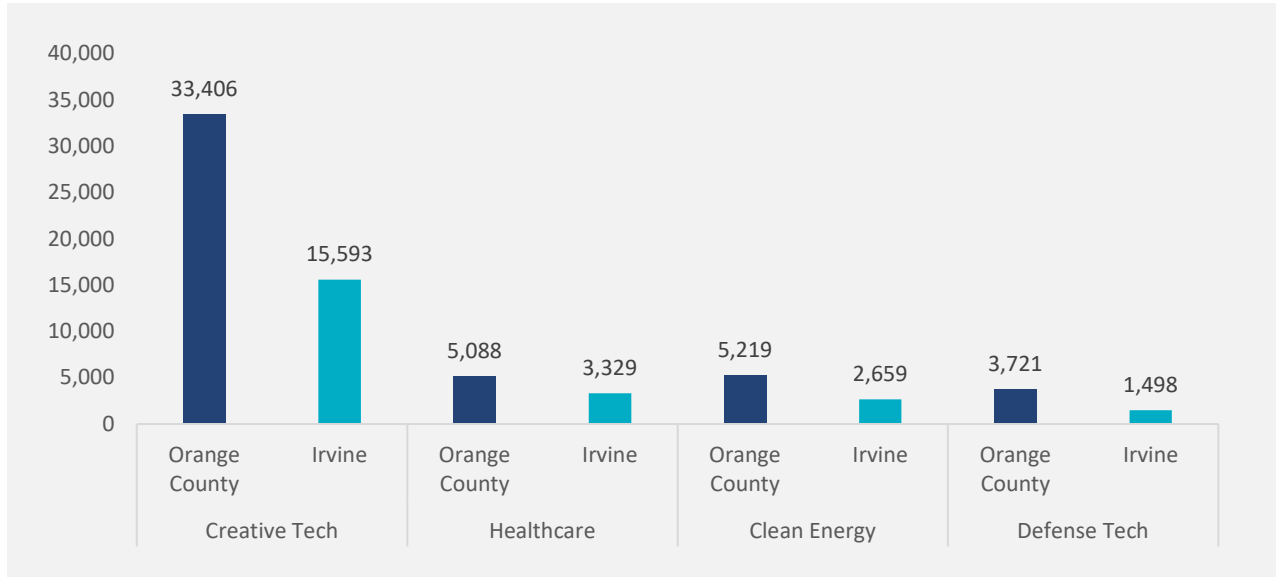
Opinions regarding the city’s potential for growth in the Climate Transition/Decarbonization scenario were mixed. Some stakeholders believed that significant opportunities exist for Irvine within the **intersection of electric vehicles and logistics or mobility applications** due to the presence of key electric vehicle companies in Irvine such as Rivian and Karma Automotive. **Electric vehicle battery technology** and **battery recycling** were also cited as potential areas of growth for the city since R&D in quick-charging electric vehicle batteries remains in its early stages and the UCI could take the lead in this field. **Innovations in hydrogen** were also cited as potential growth drivers given recent federal funding awards to ARCHES, California’s emerging hydrogen hub.

Stakeholders were divided on whether **cleantech software** represents a significant growth opportunity for Irvine. Some stakeholders believe that the city’s proximity to skilled talent in San Diego and Riverside present Irvine with opportunities to grow its cleantech software industry, while others feel that Irvine may lack the critical mass to develop a local cleantech software cluster.

## Summary

Figure 14 summarizes the projected jobs impacts for each of the growth scenarios.

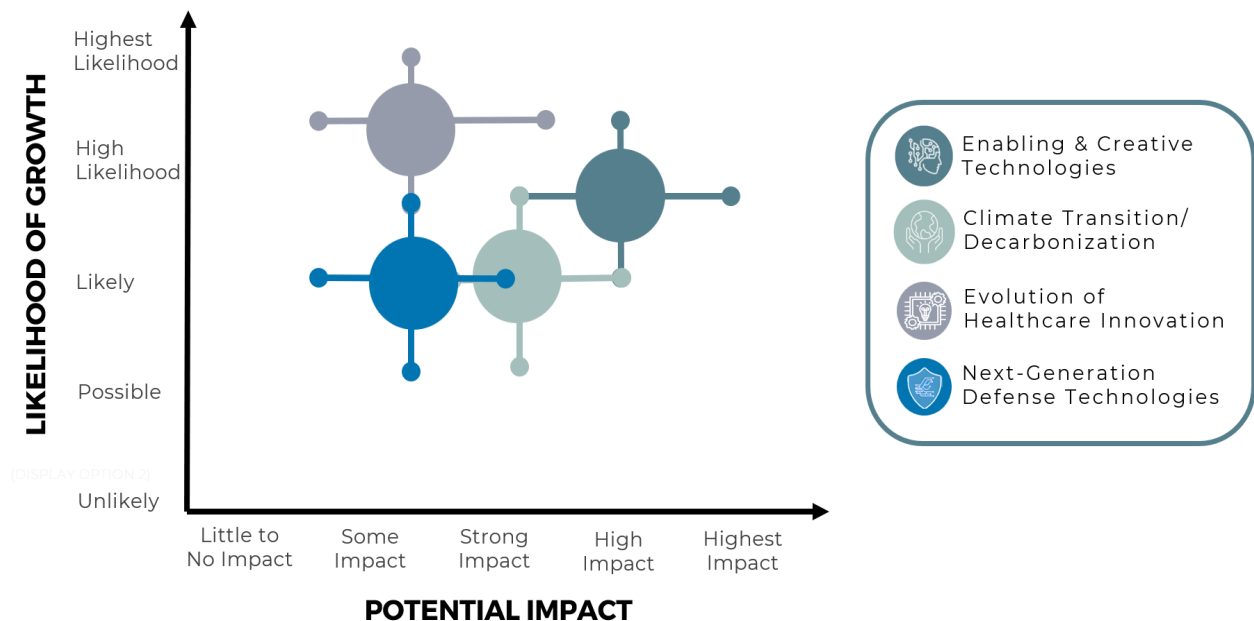
**Figure 14. IMPLAN Growth Scenario Modeling Outputs: Irvine & Orange County (2024 – 2030)**



## GROWTH SCENARIO RANKING & PRIORITIZATION

Finally, the research team ranked the potential growth scenarios according to their potential impacts and likelihood of growth, as shown in Figure 15.

**Figure 15. Potential Growth Scenario Impact & Likelihood Mapping**



Based on this assessment, the research team concluded that:

- **Enabling & Creative Technologies** have the highest potential economic and fiscal impacts for the city of Irvine, with a high likelihood of growth. In this scenario, investments in Enabling & Creative Technologies can create over 15,000 high-quality jobs over the next six years, with average wages of \$135,736, representing an addition of \$7.5 billion in labor income, \$12.5 billion in gross regional product, and \$88 million in taxes for the city of Irvine.
- **Evolution of Healthcare Innovation** has the highest likelihood of growth, given the city's legacy of innovation in medical devices and healthcare delivery, but potential economic and fiscal impacts of investments in the Evolution of Healthcare Innovation are lower than those projected under the Enabling & Creative Technologies growth scenario. In this scenario, investments in the Evolution of Healthcare Innovation could create over 3,300 high-quality jobs with average wages of \$77,530, representing an addition of \$1.2 billion in labor income, \$1.4 billion in gross regional product, and \$4.8 million in taxes for the city of Irvine.
- **Climate Transition/Decarbonization** has a relatively lower likelihood of growth in Irvine than the Enabling & Creative Technologies or Evolution of Healthcare Innovation scenarios but could generate larger economic and fiscal impacts than the Evolution of Healthcare Innovation scenario. In this scenario, investments in Climate Transition/Decarbonization technologies could create over 2,600 high-quality jobs with an average salary of \$118,221, generating an incremental \$1.3 billion in labor income, \$1.9 billion in gross regional product, and \$32 million in taxes for the city of Irvine.
- **Next-Generation Defense Technologies** have a similar likelihood of growth compared to the Climate Transition/Decarbonization scenario, but the lowest level of projected economic impacts relative to all other growth scenarios. In this scenario, investments in Next-Generation Defense Technologies could create nearly 1,500 high-quality jobs with average annual wages of \$131,653, representing an incremental \$864 million in labor income, \$1.4 billion in gross regional product, and nearly \$9.0 million in taxes for the city of Irvine.

Appendix A: Executive Interview Discussion Guide presents the discussion guides used in the executive interviews, while Studies presents case studies of selected innovation hubs in the United States.

Appendix C: Definitions for Industry Categories lists the NAICS codes used to define each of the target innovation industries within the growth scenarios highlighted above.

# Appendix A: Executive Interview Discussion Guide

## Section 1. Introduction & Background

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Hello, my name is \_\_\_\_\_ and I am with BW Research, an independent research firm. I am part of a research team that is working with the City of Irvine to understand the needs and opportunities of the regional economy.

**(If needed):** Depending on your input, this discussion could take anywhere from 10 to 15 minutes of your time.

### Section 1 - INTRODUCTORY QUESTIONS

#### I. Profile & General Information [FILL OUT IN ADVANCE AS INFORMATION IS AVAILABLE]

Name:

Title:

Organization:

Length of current role:

Stakeholder Category

1. Local, Regional, Statewide Partners in Economic Development & Entrepreneurship
2. Early Investors, VC, Financial Supporters who Know Irvine and our key clusters
3. Researchers & Technologists, (Feedback on Pre-commercialization)
4. Employers, particularly those in key industry clusters or related (ICT, Biotech/med, HC)
5. Local, Regional, & Statewide partners in Workforce Development & Training/Education

## Section 2. History of Irvine's Innovation

---

I want to ask you a few questions about Irvine and its role in the orange County and Southern California Economy.

1. Do you work or live in Irvine, if yes how long (to both), and could you briefly describe your interactions and relationship with Irvine and the surrounding region in Orange County?
  - A. Live in Irvine YES (HOW MANY YEARS \_\_\_\_\_) – NO (IF NO WHERE \_\_\_\_\_)
  - B. Work in Irvine YES (HOW MANY YEARS \_\_\_\_\_) – NO (IF NO WHERE \_\_\_\_\_)
  - C. Relationship notes to Irvine \_\_\_\_\_
  
2. How has Irvine's economy changed over the last 20 years, or as long as you have been here, and what do you think is driving those changes?
  - A. GET OPEN-ENDED RESPONSE THEN PROBE ON:
  - B. What are the key industries, technologies, companies that have driven or driving innovation in Irvine from 2000 to 2024?
  - C. What drove those key industries, technologies, or companies in Irvine to grow and flourish?
  
3. What are the key industries, technologies, and/or companies that drive Irvine's economy today?
  - A. GET OPEN-ENDED RESPONSE THEN PROBE ON:
  - B. Would you classify these industries/technologies/companies as innovative, and if yes why (what makes them innovative)?
  - C. What are the key elements to support these industries/technologies/companies – how would you rate Irvine in each of these areas
    - a. Research and innovative ideas/IP
    - b. Early investment and VC
    - c. Entrepreneurship and early business development
    - d. Expansion and growth of the company
    - e. Workforce and talent development
  
4. Looking at the next 5 to 10 years, what are the industries or technologies that you expect to grow in Irvine?
  - A. GET OPEN-ENDED RESPONSE THEN:
  - B. Which of these industries or technologies would you consider innovative and why?
  - C. What are the strengths and opportunities of these emerging industries or technologies?
  - D. What are the challenges facing these emerging industries or technologies?

### Section 3. Looking Forward and Developing Key Metrics & Indicators

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Lastly, I want to ask you a few questions about the growth of the innovation economy in and around Irvine.

5. What are the key attributes or characteristics of a vibrant, innovative local economy? [IF NEEDED: A city or a region]
  - a. GET OPEN-ENDED RESPONSE THEN:
  - b. Are there examples of Cities or region's that you think of that have innovative economies, if yes, can you describe them?
  - c. Are there measures, or specific characteristics that help identify an innovative economy?
  
6. Are there any examples of investments or programs that you are aware of, that have supported innovation in a local or regional economy? If yes, could you describe where and what the program or investment was and how it worked?
  - a. GET OPEN-ENDED RESPONSE THEN:
  - b. What the program or investment successful or not, and if so why, if not why not?
  
7. Would you characterize Irvine as an innovative economy, if yes, why, if not why not?
  - a. GET OPEN-ENDED RESPONSE THEN:
  - b. How would you grade Irvine as an innovation economy (A – F) and why?
  - c. What are the strengths of Irvine's Innovation Economy?
  - d. What are the weaknesses of Irvine's Innovation Economy?
  - e. What are the stronger innovative economic City's or regions?
    - i. Within the US
    - ii. Outside the US / Internationally.
  
8. Can we share your name and responses with the Irvine Economic Development Team? (IF NEEDED: This will just be used to
  - a. Yes, you can share my name and responses with the Irvine ED team.
  - b. No, I would prefer to remain anonymous.

Thank you very much for your time and expertise in this discussion.

If you have any interest in seeing the findings of this research, please let us know and when it is completed, we will make sure you get a copy.

A. Name of Respondent \_\_\_\_\_

B. Position \_\_\_\_\_

C. Date and time of Interview \_\_\_\_\_

D. Relevant Contact Information

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

E. Organization \_\_\_\_\_

F. Segment \_\_\_\_\_



# Appendix B: Innovation Hub Case Studies

## AUSTIN INNOVATION HUB (TX)

The Austin Innovation Hub leverages the strengths of the University of Texas at Austin (UT Austin), Texas A&M University in College Station, and several two-year colleges and training institutes. A PPP comprised of UT Austin, key local business leaders, and the local and state government sought to attract key local employers to the area, including IBM, Texas Instruments, and Motorola. Subsequently, Michael Dell created Dell Computer while attending UT Austin.

The PPP also sought to attract the Microelectronics and Computer Technology Corporation (MCC) – the first private high-tech consortium – to Austin. Subsequently, the PPP attracted SEMATECH, a national research consortium of semiconductor manufacturers, to the area. Both consortiums played a critical role in building the R&D capabilities of Austin’s research cluster.

Growth in the Austin area was supported by a business-friendly climate and a high quality of life. The city has a well-developed transportation infrastructure system and liberal zoning restrictions, with land is available for property expansion, as well as cultural amenities associated with Austin’s lifestyle brand as a trendy music and cultural center hosting events such as SXSW.

The government has played a significant role in supporting the growth of Austin as an innovation hub. In 2015, the federal government financed 53 percent of the R&D expenditures of UT Austin. The State of Texas has funded and supported UT Austin, creating a Permanent University Fund for the UT and Texas A&M state universities. In addition, the State created the Texas Emerging Technology Fund to help finance the R&D and commercialization of emerging technologies.

The City of Austin has collaborated with the State of Texas to attract research consortia to Austin, and commissioned an economic plan focused on science and technology as potential drivers of economic growth.

## BLOCH QUANTUM TECH HUB (IL)

The Bloch Quantum Tech Hub, led by the Chicago Quantum Exchange (CQE), is based at the University of Chicago, and anchored by Argonne National Laboratory, Fermi National Accelerator Laboratory, the University of Illinois Urbana-Champaign, the University of Wisconsin-Madison, and Northwestern University. The Bloch Tech Hub seeks to foster innovation in quantum computing, communications, sensing, and related solutions, to enable novel solutions for logistics optimization, drug discovery, fraud detection, secure data sharing, and more.

Leveraging Chicago's research universities, national labs, and industry partners in finance, transportation, and manufacturing, the Bloch Tech Hub seeks to increase industry access to shared-use quantum facilities and hardware to meet industry needs and generate good-paying jobs.

The Bloch Quantum Tech Hub benefits from its proximity to world-leading quantum information science and engineering research leaders in the greater Chicago area, including the University of Chicago, the US Department of Energy's Argonne National Laboratory and Fermi National Accelerator Laboratory, the University of Illinois Urbana-Champaign, the University of Wisconsin–Madison, and Northwestern University, as well as academic institutions like the University of Illinois Chicago and Chicago State University, both minority-serving institutions (MSI) that are leaders in quantum science education.

In addition, the state of Illinois is home to a growing number of quantum businesses and startups, including EeroQ, qBraid, memQ, which all have headquarters in Chicago; and Infleqtion, QuantCAD, and Great Lakes Crystal Technologies, which have offices in the region. Since 2017, Illinois quantum startups have raised at least \$33.2 million through 27 deals — the second-highest number of deals by quantum startups after California, according to a report released by World Business Chicago.

In addition, the State has proposed a historic \$500 million investment in quantum technologies to support the expansion of the Bloch Quantum Tech Hub. This substantial investment is included in the State's proposed FY25 budget, and includes plans to develop a state-of-the-art quantum campus, including a cryogenic facility crucial for quantum technologies and next-generation microelectronics.

### **ELEVATE QUANTUM TECH HUB (CO/NM)**

The Elevate Quantum Tech Hub in Colorado/New Mexico is strategically located near the University of Colorado and the National Institute of Standards and Technology (NIST), two Boulder-based institutions that have focused on furthering quantum research since the 1950s. Both organizations also partnered to create The Joint Institute for Laboratory Astrophysics (JILA), which creates quantum innovations using interlocking lasers. Researchers in the state of Colorado have won four Nobel Prizes in quantum computing since the 1990s.

Key members of the Elevate Quantum Tech Hub also include the Los Alamos and Sandia national labs in New Mexico, the Lawrence Livermore National Laboratory out in California, and thirteen higher education institutions in the region that support quantum research. While Colorado already has the highest concentration of quantum technology workers in the world, the Elevate Quantum Tech Hub is currently working to establish training programs in schools like Front Range Community College to ensure that the state's supply of quantum technicians remains sufficient to meet workforce demands. Key local employers in the region include Atom Computing, Infleqtion, Maybell and Quantinuum.

### **KENDALL SQUARE BIOTECHNOLOGY HUB (MA)**

Kendall Square, located near the Massachusetts Institute of Technology (MIT), is a biotechnology hub comprised of academic researchers, startups, and leading pharmaceutical companies. Anchor institutions in Kendall Square include MassBIO, the world's first biotech trade organization, which was launched in Massachusetts in 1985; the Cambridge Innovation Center; and the Massachusetts Life Sciences Center; which facilitate economic development and support biotech research and innovation through grants, loans, capital infrastructure investments, tax incentives, and workforce programs.

A key major employer is Biogen Idec, which opened its first U.S. facility dedicated to R&D in Kendall Square in 1983 due to several factors:

- Proximity to leading molecular biologists at MIT and Harvard
- Proximity to the greater Boston community
- Incentives offered by the City of Cambridge, including streamlined processes for licensure and procurement

As Biogen continued to grow, numerous other biotech firms were attracted to the area, including Novartis, Pfizer, and Genzyme. Today, nearly 1,000 biotech companies in Greater Boston alone employ more than 100,000 people, and the state of Massachusetts now produces approximately 15 percent of the U.S. drug development pipeline, and 7 percent of the global drug development pipeline.

Both the City of Cambridge and the State of Massachusetts have taken important steps to support the growth of Kendall Square as a biotechnology innovation hub. The Cambridge City Council passed a law allowing recombinant DNA research in 1977, which promoted early biotech advancements and solidified biotechnology as a core industry cluster. In addition, the State of Massachusetts has invested heavily in the biotech industry through the Massachusetts Life Sciences Center, which since 2007 has generated over \$700 million and \$3.1 billion in additional investment and created over 13,000 jobs.

## **MEDICAL ALLEY (MN)**

Medical Alley, spanning from Rochester to Duluth, Minnesota, is a renowned hub for health technology innovation located near the University of Minnesota. The Medical Alley Association was created by a PPP in 1984 as a venture platform that lowers the costs of starting and scaling new companies. It has an extensive global network of over eight hundred healthcare partners and facilitates startups.

In 2012, the Medical Alley Association created the Medical Device Innovation Consortium to advance medical device regulatory science at an industry level. In 2021, Medical Alley Starts was created, with the purpose of attracting business investments through the Minnesota Forward Fund, which provides grants, loans, and forgivable loans for infrastructure or economic development projects. Other programs incentivizing health technology innovation in Medical Alley include the Angel Tax Credit, which targets founders in minority groups, and the Border-to-Border Broadband Development Grant program, which connects businesses to high-speed broadband.

In 2023, the MPact Health Care Innovation vision was announced, which seeks to streamline the implementation of novel healthcare technologies.

## **OAKLAND INNOVATION HUB (PA)**

The Oakland innovation hub, located in Pittsburgh, Pennsylvania, is anchored by two major research universities: Carnegie Mellon University and the University of Pittsburgh, which provide Oakland with an employee base of nearly 19,500 workers employed by the universities and nearly 11,000 employed by local hospitals. Pittsburgh's universities account for over \$1 billion in R&D, and specialize in research in life sciences, robotics, gerontology, AI, cell tissue engineering, neurotrauma, and software. The University of Pittsburgh's Medical Center (UPMC) ranks among the top medical research institutions in the U.S., and directly supports more than 90,000 jobs in the city; UPMC has generated \$46 billion in economic impact to date and accounted for \$293 million in business and procurement spending in 2021.

Although it encompasses only approximately three percent of the city’s land area, the Oakland innovation hub accounts for 10 percent of residents and 29 percent of jobs and constitutes over one-third of the state of Pennsylvania’s university research output. The hub encompasses dozens of startup companies (e.g., NoWait, Peptilogics) and co-working spaces (e.g., Avenu, Ascender), and is home to the Pittsburgh Technology Council, as well as large scientific and technology firms (e.g., Thermo Fisher Scientific).

The City of Pittsburgh commenced focused efforts to build the Oakland innovation hub based on recommendations prepared by the Brookings Institute in 2018 that proposed increased investments in Oakland’s universities and hospitals to create thousands of new jobs in research and technology. The City’s efforts have been supported by the Oakland Business Improvement District (BID), a place management organization created in 1999 to grow revenues in the Central Oakland business district which now supports the reinvention of Oakland as a global innovation hub.

## **PHOENIX (AZ)**

Phoenix, Arizona is home to more than 2,800 manufacturing companies in industries ranging from aerospace to computer and electronic products to transportation, and more, including Intel, Boeing, NXP Semiconductors, and Medtronic Microelectronics Center, among others. In 2020, TSMC – one of the world’s largest dedicated foundries with fabrication facilities (fabs) and subsidiaries spanning Asia, Europe, and North America – announced plans to invest \$12 billion in constructing a fab in Phoenix. Subsequently, in December 2022, TSMC announced its commitment to build a second fab in Phoenix, increasing its total investment to \$40 billion. In April 2024, TSMC announced plans to construct a third fab in Phoenix, bringing its total U.S. investment to over \$65 billion, the largest foreign direct investment in Arizona history and the largest foreign direct investment in a greenfield project in U.S. history to date. TSMC Arizona was expected to create approximately 6,000 direct jobs, as well as over 20,000 construction jobs and tens of thousands of indirect jobs.

Phoenix’s advanced manufacturing hub is located near Arizona State University (ASU), Northern Arizona University (NAU), and the University of Arizona (UArizona), which offer a full range of engineering, engineering technology/technician, and industrial/production-related curricula. ASU’s Fulton School of Engineering undergraduate program was ranked within the top 20 percent of programs by U.S. News & World Report and instructs over 16,000 students per year on solutions to manufacturing challenges in energy, health, sustainability, education, and security.

Phoenix offers a competitive operating environment where state and local government enable speed-to-market through fast-track permitting, a minimalist regulatory approach, no corporate franchise tax, and right-to-work legislation.

## **RESEARCH TRIANGLE PARK (NC)**

Research Triangle Park (RTP) is one of the largest research parks in the U.S., strategically located between three key educational institutions: the University of North Carolina at Chapel Hill (UNC), Duke University, and North Carolina State University (NC State). RTP was created due to efforts undertaken by a public-private partnership (PPP) comprised of government, university, and business leaders.

RTP is a good example of success of coordinated efforts to grow an innovation cluster within a region without a preexisting dense network of universities and innovative local industries. When RTP was first formed in the 1950s, per capita income in Raleigh, Cary, and Durham was below the state and national averages; RTP's per capita income now greatly exceeds the state and national averages and is among the wealthiest in the southwest.

Initially, the PPP assessed relative research strengths of local universities to identify development targets, and worked with university professors who acted as recruiters, soliciting companies to relocate to the RTP area using industry-specific brochures created by the PPP.

The State also provided critical support to development of the RTP, with North Carolina Governor Terry Sanford securing a commitment to build an environmental health sciences center in RTP in 1965 by offering the National Institutes of Health free land for the project.

In addition, the State of North Carolina convinced IBM to establish a presence at RTP by committing to link RTP with Raleigh and Cary via a four-lane highway, which would later become the Interstate 40. In the decades that followed, IBM brought about 40 IBM organizations to RTP, including a significant part of its product development and headquarters functions.

Furthermore, in 1984, North Carolina's General Assembly established the North Carolina Biotechnology Center (NCBT), the world's first government sponsored economic development organization in biotechnology. The establishment of the NCBT was the beginning of a successful effort by the state to achieve a leading position in this field. The NCBT spearheads the study of hundreds of prospective biotech company recruits, gathering data from conferences and industry events to gain advanced knowledge of plans by companies to establish new facilities.

Finally, in 2018, state legislation G.S. 105-164.14A(a)(8) was modified to attract large projects by reducing the investment and new jobs requirements for "transformative projects" under one of the state's largest incentive programs.

## **SILICON SLOPES (UT)**

The Silicon Slopes tech hub, located just south of Salt Lake City, Utah, is home to a growing tech industry and is frequently compared to Silicon Valley in California. Salt Lake City has a legacy of government contracting work, including involvement in the creation of the Internet in the 1960s, and the state has continued to foster partnerships with the U.S. military related to data storage and drone technology. Major tech companies founded in Utah include WordPerfect and Fusion.io.

Several major tech companies have operated in Utah, including Adobe, Microsoft, and eBay, and the state has been home to thousands of tech startups, at least four of which were unicorns (Pluralsight [acquired by private equity firm Vista Equity Partners in 2021], Qualtrics [acquired by SAP in 2019], Domo, and XANT [acquired by Aurea in 2021, and formerly doing business as InsideSales]). Silicon Slopes is anchored by Brigham Young University and the University of Utah, which offer a deep pool of educated job candidates.

# Appendix C: Definitions for Industry Categories

Table 7. Industry Category Definition

INDUSTRY/SCENARIO	NAICS CODE	DESCRIPTION
Enabling and Creative Technologies	334111	Electronic Computer Manufacturing
Enabling and Creative Technologies	334112	Computer Storage Device Manufacturing
Enabling and Creative Technologies	334118	Computer Terminal and Other Computer Peripheral Equipment Manufacturing
Enabling and Creative Technologies	334210	Telephone Apparatus Manufacturing
Enabling and Creative Technologies	334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
Enabling and Creative Technologies	334290	Other Communications Equipment Manufacturing
Enabling and Creative Technologies	334310	Audio and Video Equipment Manufacturing
Enabling and Creative Technologies	334412	Bare Printed Circuit Board Manufacturing
Enabling and Creative Technologies	334413	Semiconductor and Related Device Manufacturing
Enabling and Creative Technologies	334416	Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing
Enabling and Creative Technologies	334417	Electronic Connector Manufacturing
Enabling and Creative Technologies	334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
Enabling and Creative Technologies	334419	Other Electronic Component Manufacturing
Enabling and Creative Technologies	334610	Manufacturing and Reproducing Magnetic and Optical Media
Enabling and Creative Technologies	513210	Software Publishers
Enabling and Creative Technologies	517111	Wired Telecommunications Carriers
Enabling and Creative Technologies	517112	Wireless Telecommunications Carriers (except Satellite)
Enabling and Creative Technologies	517121	Telecommunications Resellers
Enabling and Creative Technologies	517122	Agents for Wireless Telecommunications Services
Enabling and Creative Technologies	517410	Satellite Telecommunications
Enabling and Creative Technologies	517810	All Other Telecommunications
Enabling and Creative Technologies	518210	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services
Enabling and Creative Technologies	541511	Custom Computer Programming Services
Enabling and Creative Technologies	541512	Computer Systems Design Services
Enabling and Creative Technologies	541513	Computer Facilities Management Services
Enabling and Creative Technologies	541519	Other Computer Related Services

INDUSTRY/SCENARIO	NAICS CODE	DESCRIPTION
Clean Energy	221111	Hydroelectric Power Generation
Clean Energy	221113	Nuclear Electric Power Generation
Clean Energy	221114	Solar Electric Power Generation
Clean Energy	221115	Wind Electric Power Generation
Clean Energy	221116	Geothermal Electric Power Generation
Clean Energy	221117	Biomass Electric Power Generation
Clean Energy	221118	Other Electric Power Generation
Clean Energy	541620	Environmental Consulting Services
Clean Energy	541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)
Defense Technology	325920	Explosives Manufacturing
Defense Technology	332992	Small Arms Ammunition Manufacturing
Defense Technology	332993	Ammunition (except Small Arms) Manufacturing
Defense Technology	332994	Small Arms, Ordnance, and Ordnance Accessories Manufacturing
Defense Technology	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
Defense Technology	334519	Other Measuring and Controlling Device Manufacturing
Defense Technology	336110	Automobile and Light Duty Motor Vehicle Manufacturing
Defense Technology	336411	Aircraft Manufacturing
Defense Technology	336412	Aircraft Engine and Engine Parts Manufacturing
Defense Technology	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing
Defense Technology	336414	Guided Missile and Space Vehicle Manufacturing
Defense Technology	336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
Defense Technology	336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
Defense Technology	336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing
Healthcare	621111	Offices of Physicians (except Mental Health Specialists)
Healthcare	621112	Offices of Physicians, Mental Health Specialists
Healthcare	621210	Offices of Dentists
Healthcare	621310	Offices of Chiropractors
Healthcare	621320	Offices of Optometrists
Healthcare	621330	Offices of Mental Health Practitioners (except Physicians)
Healthcare	621340	Offices of Physical, Occupational and Speech Therapists, and Audiologists
Healthcare	621391	Offices of Podiatrists

INDUSTRY/SCENARIO	NAICS CODE	DESCRIPTION
Healthcare	621399	Offices of All Other Miscellaneous Health Practitioners
Healthcare	621410	Family Planning Centers
Healthcare	621420	Outpatient Mental Health and Substance Abuse Centers
Healthcare	621491	HMO Medical Centers
Healthcare	621492	Kidney Dialysis Centers
Healthcare	621493	Freestanding Ambulatory Surgical and Emergency Centers
Healthcare	621498	All Other Outpatient Care Centers
Healthcare	621511	Medical Laboratories
Healthcare	621512	Diagnostic Imaging Centers
Healthcare	621610	Home Health Care Services
Healthcare	621910	Ambulance Services
Healthcare	621991	Blood and Organ Banks
Healthcare	621999	All Other Miscellaneous Ambulatory Health Care Services
Healthcare	622110	General Medical and Surgical Hospitals
Healthcare	622210	Psychiatric and Substance Abuse Hospitals
Healthcare	622310	Specialty (except Psychiatric and Substance Abuse) Hospitals