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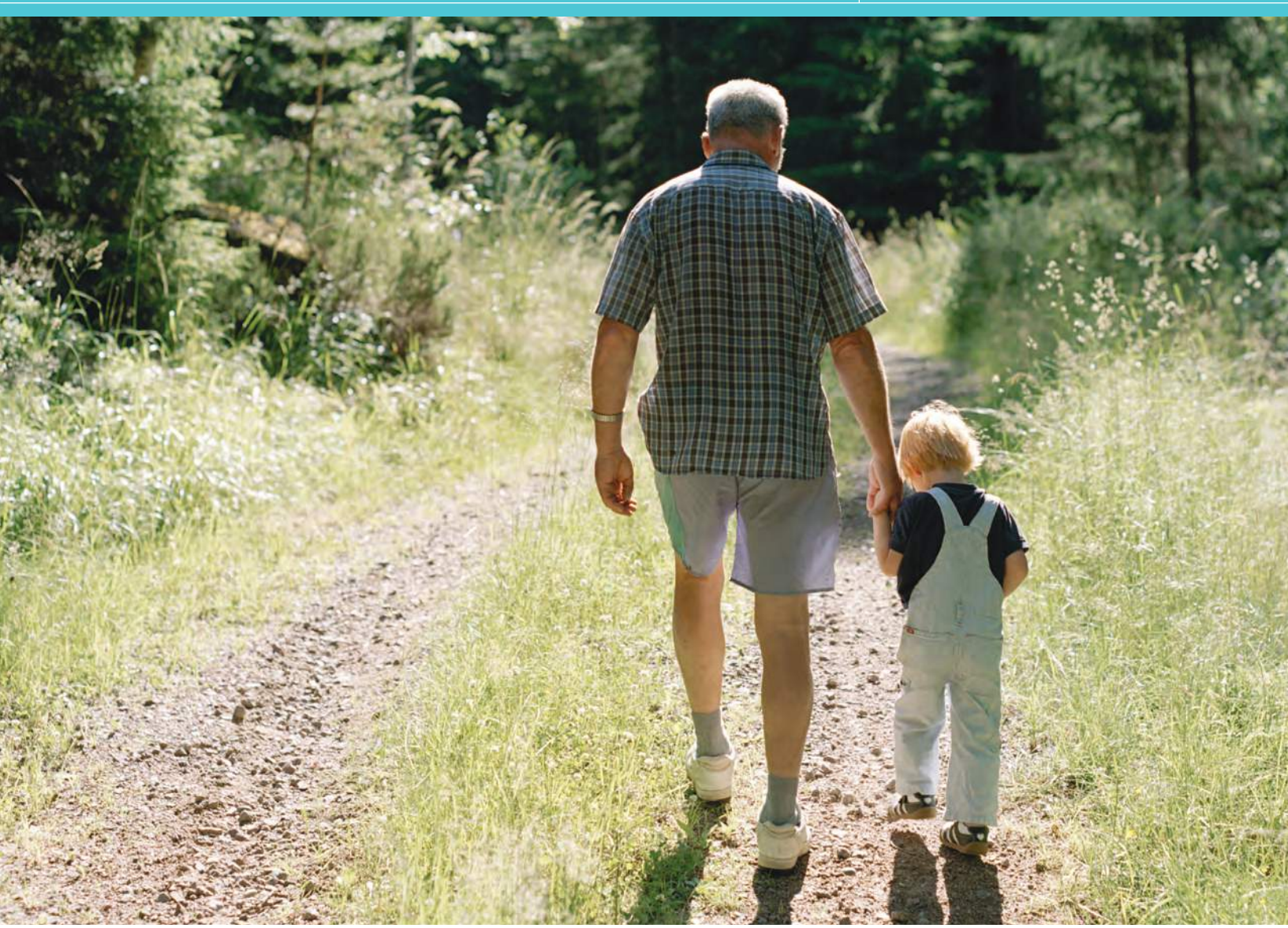
ARIZONA'S BIOSCIENCE ROADMAP

2014–2025

Advancing the Biosciences and Improving Health Outcomes



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ARIZONA'S BIOSCIENCE ROADMAP

Dear Fellow Arizonans,

THE FIRST DECADE OF Arizona's Bioscience Roadmap achieved impressive results and laid the groundwork for future development and greater success. The formal strategic plan launched in 2002 helped propel Arizona to become one of the nation's top emerging states in the biosciences. Over the past year, the Flinn Foundation and bioscience leaders from across the state reevaluated the Roadmap's long-term goals and initiated an effort to update the plan to ensure that Arizona continues its ascent in this critical industry.

The 2014-2025 version of Arizona's Bioscience Roadmap will guide the development of Arizona's bioscience sector over the next decade. As the first decade of the Roadmap emphasized the development of a solid research infrastructure, the next will continue to expand research but stress commercialization, entrepreneurship, the need to create a critical mass of firms, and development of talent. It calls for a renewed commitment to collaboration and a scaled-up effort in both resources and focus.

Arizona has made great strides relatively quickly. Yet, the updated Roadmap reinforces the long-term nature of this undertaking. We are confident that with the support and backing of private industry, researchers, academia, investors, state and local elected officials, and the people of Arizona, the state will continue its trajectory to become a national leader in select areas of the biosciences and a competitive force on the global level.

Thank you for the support over the past decade. We look forward to your continued partnership to bring the 2025 goals to fruition.

David J. Gullen, M.D.
CHAIR, BOARD OF DIRECTORS
FLINN FOUNDATION

Jack B. Jewett
PRESIDENT & CEO
FLINN FOUNDATION

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REPORT AT A GLANCE

ARIZONA'S BIOSCIENCE ROADMAP, a long-term strategic plan commissioned by the Flinn Foundation in 2002, is being updated for its second decade with the goal of Arizona becoming globally competitive and a national leader in select areas of the biosciences by 2025. A strong bioscience sector would help to strengthen and diversify Arizona's economy and provide Arizonans access to the latest health care innovations.

The updated Roadmap plan was compiled by the Battelle Technology Partnership Practice based on research and input from Arizona leaders in science, business, academia, and government, plus national bioscience experts.

The plan intends to build on progress made during the first decade and address critical gaps and needs. In the first decade, Arizona strengthened its research infrastructure and expanded efforts to commercialize research into products, jobs, and firms. The state made headway in growing its modest industry base; Arizona is now considered one of the nation's fastest-growing bioscience states.

The Roadmap plan features five overarching goals, 17 strategies, and 77 potential actions. The goals and strategies will frame Roadmap efforts over the decade; the actions are optional and will evolve based on their feasibility and potential impact.

To achieve the Roadmap's vision, five transformative steps are recommended: make **risk capital** more readily available to Arizona's early-stage bioscience firms; boost the **research revenues** of the state's research-performing institutions; further develop the **research infrastructure** at the state universities; attract industry and research **anchors**; and **develop ties** to economic partners in neighboring markets. Achieving these steps will require a profound increase in investment, primarily from the private sector but with key public-sector investments playing a necessary and vital role.

Going forward, Arizona should continue its strategy to focus resources and efforts on areas where it excels. This involves the original core competency areas of cancer research, neurosciences, and bioengineering, plus several additional areas that have emerged over the years, including precision medicine.

This report presents the latest data profile of Arizona's bioscience industry and research base as well as performance data on the Roadmap's first decade, gathered by the Battelle Technology Partnership Practice. Metrics will continue to be commissioned and reported publicly by the Flinn Foundation.

Bioscience Roadmap Vision: 2014–2025

"Arizona is globally competitive and a national leader in the biosciences in such fields as precision medicine, cancer, neurosciences, bioengineering, diagnostics, and agricultural biotechnology. It excels in offering a deep talent base, a critical mass of entrepreneurs and enterprises, and clinical excellence to turn discovery into firms, products, and talent."

Bioscience Roadmap Goals

1. **Entrepreneurial Hub:** Form a hub of bioscience entrepreneurs and new enterprises across Arizona
2. **Research into Practice:** Increase the ability of research-performing institutions to turn bench research results into improved disease/illness prevention, detection, and treatment, plus bio-agriculture and industrial biotechnology products
3. **Bio-Talent:** Make Arizona a bio-talent powerhouse where such talent is developed, educated, trained, and retained
4. **Connectivity:** Promote Arizona to economic partners in neighboring states, Canada, and Mexico as a place where bioscience research, health care delivery, and commercialization seamlessly intersect
5. **Collaboration:** Pioneer a new level of commitment to partnerships to sustain and enhance the state's "collaborative gene" reputation

WHAT ARE THE BIOSCIENCES?

The biosciences are lab research. They are manufacturing plants, budding startups, and hospitals. They are disease treatment and prevention, medical devices, and even algae, plants, and agriculture.

The biosciences serve a diverse set of markets, spanning biomedical drugs, diagnostics and devices, and agricultural and bio-based industrial products. In addition, the bioscience industry involves not only high-value, export-oriented manufacturing activities, but specialty commercial research, development, and testing industries to advance bioscience product development as well as specialty distribution to bring products to market.

Together, the biosciences make our world a better place by developing treatments for health afflictions, designing diagnostics to gauge and prevent illness, strengthening our food supply, developing biofuels, and much more. By combining high-tech research, academia, and product commercialization, the biosciences can serve as an economic driver with high-paying jobs and flourishing companies.

As shown in the adjacent graphic, there are six segments that make up the biosciences in Arizona:

- Agricultural feedstock and chemicals
- Drugs, pharmaceuticals, and diagnostics
- Medical devices and equipment
- Research, testing, and medical labs
- Hospitals
- Bioscience-related distribution

The first five were included in the original Bioscience Roadmap, launched in 2002. The sixth category, bioscience-related distribution, is being introduced with this report to align Arizona with the latest national definition of the biosciences by the Biotechnology Industry Organization, the industry's national trade association.

Bio-distribution coordinates the delivery of bioscience-related products. It increasingly involves specialized approaches to cold storage and product monitoring, and new technologies such as automated pharmaceutical distribution systems. Three major components, each relatively distinct in its product focus, comprise the bio-distribution subsector—drugs and sundries; medical, dental, and hospital equipment and supplies; and farm supplies. Battelle has developed methodology that isolates the portions of these components that most closely relate to the biosciences. Medical, dental, and hospital equipment and supplies is the largest individual component, accounting for 43 percent of this segment's jobs nationally.

Revised Battelle/BIO Definition of the Bioscience Industry

Agricultural Feedstock & Chemicals

- Processing of agricultural feedstock for bio-based products
- Organic and agricultural chemicals including biofuels

Drugs, Pharmaceuticals & Diagnostics

- Pharmaceutical preparation and manufacturing
- Diagnostic substances
- Biopharmaceuticals
- Vaccines

Medical Devices & Equipment

- Biomedical instruments
- Electromedical equipment and devices
- Health care products and supplies
- Lab instrumentation

Research, Testing & Medical Labs

- Biotech and other life sciences R&D
- Testing labs
- Medical labs

Hospitals

+

Bioscience-Related Distribution

Distribution of...

- Agricultural chemicals and seeds
- Biomedical equipment and supplies
- Drugs and pharmaceuticals

Bio-distribution includes firms on the leading edge of integrating and delivering health care information technologies to the clinic, physician, and patient. This is an area in which Arizona's universities are also playing increased roles as part of precision medicine. The implementation of health care reform is likely to spur further technology applications as well.

Arizona is well positioned in the bio-distribution subsector, with more than 8,400 high-salary jobs, 771 firms, and an industry concentration level above the national average. McKesson in Scottsdale is a prime example of a large Arizona employer in bio-distribution.

The New Tagline

"Advancing the Biosciences and Improving Health Outcomes"—the new tagline of Arizona's Bioscience Roadmap—not only recognizes the broad spectrum of the biosciences but reflects the central role of health care within the bioscience sector and the importance of hospital research and jobs. The tagline also acknowledges the emerging fields of health informatics and economics, as well as diagnostics. The success of the bioscience industry in Arizona will be judged, in part, by its ability to turn research and trials into improved medicines and treatments for patients that lead to more successful health outcomes.

The new tagline reflects the central role of health care within the bioscience sector and the importance of hospital research and jobs.

While health outcomes are a central focus of the biosciences and Bioscience Roadmap, bio-agricultural efforts are also integral and reflect an area of prominence in Arizona.

ROADMAP ORIGINS

Arizona's bioscience roadmap was launched in 2002 as a long-range plan to bring the state to competitiveness in the biosciences. The envisioned rewards included a stronger, more diversified economy and access by Arizonans to the latest health innovations. The biosciences were viewed as a leading example of a knowledge-based industry that Arizona should foster to help shape its economic future.

This initial Roadmap identified several challenges facing Arizona in building selective fields of the biosciences. First, Arizona had to play "catch up" to other states in building a world-class research base, as well as translating this base into clinical care, treatment, and commercialization of technology. Second, it needed to concurrently build a critical mass of non-hospital private bioscience firms of sufficient size and stature. Finally, it would need to secure public and private investments if its vision was to become a reality.

The original Roadmap suggested specific and unique approaches in order to build the critical mass of research organizations and bioscience firms:

- **Build on Strengths.** The original Roadmap recommended that Arizona focus its research on technology platforms where the state and its research-performing institutions—universities, medical centers, and private research institutes—had existing or emerging strengths. These included neurosciences, cancer therapeutics, bioengineering, infectious diseases, agricultural biotechnology, asthma, and diabetes. This approach reflected the Roadmap assessment that Arizona's research base was too narrow to attempt to replicate Boston, San Diego, or other major bioscience centers with broad research competencies that were built from scratch.

- **Perform Collaboratively.** The Roadmap noted that the state's research-performing institutions must have a collaborative approach to reach sufficient capacities in select fields. The 2002 founding of the Translational Genomics Research Institute (TGen) and International Genomics Consortium (IGC) in Phoenix, establishment of multidisciplinary research institutes at the universities, plus early implementation of Roadmap recommendations demonstrated that Arizona had a "collaborative gene" approach to help differentiate the state from the rest of the country.
- **Jumpstart Discovery to Translation.** The Roadmap also suggested addressing translational research efforts, moving research discoveries to applications and ultimately delivery to the patient. This would help link universities, hospitals, and physicians and speed delivery of quality health care to Arizonans.
- **Nurture and Grow Arizona's Bioscience Industry.** The original Roadmap was developed around a small but rapidly expanding industry base. However, in 2002, none of the bioscience industry segments was more specialized than the nation; in fact, overall, Arizona's bioscience industry was 28 percent less concentrated. To mature the sector, the Roadmap called for "grow-your-own" strategies, learning from the lead of more seasoned bioscience centers. This involved efforts concentrated on growing startup companies, existing firms, and research-performing institutions, and, to a smaller degree, recruiting firms from outside the state.

WHERE DOES ARIZONA STAND?

In the decade that followed the launch of the original Roadmap, Arizona developed into one of the nation's top emerging states in the biosciences. While others have taken 40 years or more to build their research and industry bases, Arizona made significant progress in its initial 10-year span.

During the first decade, Arizona's bioscience sector significantly outperformed the nation in growth of jobs and firms, and made gains in building a more concentrated industry base. The growth in high-wage jobs continued during both good economic times and bad, including through the Great Recession. However, more attention must be paid to academic research performance, venture capital investment, and firm formation and survival to continue these trends in years to come.

High growth rates are critical to developing Arizona's bioscience base. However, they cannot be looked at in isolation. It is to be expected that a smaller industry base will report greater growth rates than a large, established base. For the second decade, it will be equally important to view Arizona's success in building a critical mass of bioscience firms.

What Differentiates Arizona in the Biosciences?

One of fastest-growing bioscience states

Targets its bioscience strengths—cancer research, neurosciences, bioengineering, bio-agriculture, precision medicine, diagnostics, and emerging areas

Hospitals active in research

Only state with a decade-long, active bioscience strategic plan, plus two customized regional plans

Strategic plan guided by a statewide steering committee with leaders from industry, academia, and government

Third-party performance data released publicly demonstrating progress and gaps to be addressed

Known for its "collaborative gene"—ability for disparate institutions to work together

Every year since the 2002 launch of the original Roadmap, the Flinn Foundation has released the results of performance assessments on Roadmap progress. The Foundation retained the Battelle Technology Partnership Practice, the same consultants used to help develop the Roadmap, to perform the assessments. The results were presented through annual public events, reports, and the Internet. This will continue in the second decade, with metrics expected to be gathered and reported on a biennial basis.

The data below profile Arizona's status at the release of the updated Roadmap in April 2014. All data presented are the latest available. This includes employment data—jobs, firms, wages, and industry concentration measures—across the bioscience industry subsectors.

It should be noted that this data reflect only private industry; research-related jobs at the state universities and private research institutions are not incorporated.

A 2014 Profile of Arizona's Bioscience Sector

INDUSTRY SUBSECTOR[1]	JOBS	ESTABLISHMENTS	AVERAGE WAGES	LOCATION QUOTIENT[2]
Agricultural Feedstock & Chemicals	592	16	$45,003	0.42
Bioscience-Related Distribution	8,429	771	$128,507	1.04
Drugs, Pharmaceuticals & Diagnostics	1,822	41	$51,491	0.35
Medical Devices & Equipment	5,475	91	$64,569	0.85
Research, Testing & Medical Labs	7,227	347	$63,316	0.82
Hospitals	83,301	116	$56,331	0.95
Total Non-Hospital Biosciences	**23,545**	**1,266**	**$85,571**	**0.79**
TOTAL BIOSCIENCES	**106,846**	**1,382**	**$62,775**	**0.91**

National Institutes of Health Funding:
$182 million, 0.82% of U.S. total
(2013)

Bioscience-Related Academic Research & Development:
$463 million, 1.13% of U.S. total
(2012)

Bioscience Venture Capital:
$37 million, 0.38% of U.S. total
(2013)

University Tech Transfer:
4 bioscience startups, 25 licenses, $1.8 million in adjusted gross license income
(2013)

[1] Industry data are from 2012.

[2] Location quotient is the level of industry concentration relative to the nation; 1.0 represents the national average.

Note: the bioscience-distribution subsector is not included in the 10-year data presented on pages 7–8.

SOURCES:
Industry: Battelle analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC
NIH: NIH RePORT database and Battelle calculations
R&D: National Science Foundation Higher Education R&D Expenditures and Battelle calculations
Venture Capital: Thomson Reuters Thomson One Database with Battelle calculations
Tech Transfer: Arizona university tech transfer offices

The data also include measures of Arizona's current standing in generating research grants from the National Institutes of Health—the gold standard for biomedical research—plus total academic research revenues from all sources as reported by the National Science Foundation, as well as the state's standing in generating venture capital investment.

The definition of the biosciences evolves, reflecting the dynamic nature of the sector.

New Definitions

The definition of the biosciences evolves, reflecting the dynamic nature of the sector. Specific industries are added to the definition as they become more specialized and innovative. They can be removed once their products or services become standardized in the marketplace and their focus turns from innovation to consumer needs.

As definitions change, the makeup of the data can change as well. Throughout the first decade of the Bioscience Roadmap, Battelle and the Flinn Foundation have incorporated these national-level industry changes. Each time, the data was standardized historically to ensure consistent analysis over the decade.

To begin the second decade of the Bioscience Roadmap, the data reflect several changes in the national definition of the biosciences. The addition of the bioscience-related distribution subsector, as noted earlier, is the most prominent change. Compared to Arizona's other subsectors, bio-distribution has the most jobs and establishments, pays the highest wages, and is the only Arizona subsector with concentration levels greater than the nation. The growth of this subsector has slowed in recent years, so its inclusion is likely to lessen Arizona's rapid rate of industry growth, although it is anticipated that this subsector will continue to produce jobs. A 2012 Battelle study for the Biotechnology Industry Organization showed that Arizona and Texas were the only states to add more than 500 bio-distribution jobs during 2007–10.

In addition, the definition no longer includes several industry segments that are less connected with bioscience innovation today, such as eyeglass and contact lens providers, dental laboratories, and imaging centers. These changes subtracted from the number of jobs and firms that were previously counted as part of Arizona's industry metrics. These firms, however, continue to contribute to Arizona's health sector and economic base.

First Decade in the Books

At the end of the original Roadmap, Arizona achieved the following marks across the performance metrics that were tracked on an annual basis throughout the decade. (Note: The industry data do not correlate directly to those presented in the 2014 Profile table on page 6, given the industry definition changes.)

Roadmap Implementation Progress, 2002–2012: Of the 19 actions recommended in 2002, progress was made on all 19, including substantial progress on 10.

Jobs, 2002–2011: Bioscience jobs increased by 45 percent, nearly four times the national growth rate, adding more than 30,700 positions (including hospitals), to reach a total of 99,018. During the Great Recession, jobs grew by 6 percent while the private sector lost 11 percent of its positions.

Firms, 2002–2011: The number of bioscience establishments in Arizona increased by 31 percent, from 682 to 892, exceeding the national growth rate of 23 percent.

Wages, 2002–2011: Average bioscience wages increased 44 percent (not adjusted for inflation) to $56,328, 28 percent higher than the average private-sector salary.

NIH Funding, 2002–2012: Funding from the National Institutes of Health was $174 million in 2012, or 19 percent greater than in 2002 (U.S. average: 18 percent). For much of the decade, Arizona achieved its goal of growing its NIH funding faster than the nation's top-10 funded states. However, this status was lost during the final year of the decade. Arizona's proportion of the national funding pool remains nearly the same as it was in 2002; this represents an improvement from pre-Roadmap years, when Arizona was losing market share.

Academic Research Expenditures, 2002–2011: Bioscience-related research expenditures at Arizona's universities and private research institutions from all sources reached a record $452 million in 2011, a 55 percent gain from 2002. Arizona's growth had outpaced the nation until 2009 but trailed the U.S. growth rate of 74 percent by the end of the decade.

Venture Capital Investment, 2002–2012: Mirroring a substantial national decline, venture capital received by Arizona bioscience firms dropped precipitously over the decade. Whereas Arizona had received $111 million during the banner year of 2002, only $22 million was generated in 2012. Arizona's industry gains throughout the decade were achieved despite the dearth of risk capital.

University Tech Transfer, 2002–2012: Arizona's public universities spun off 67 bioscience startups, generated about $19 million in adjusted gross license income, received 1,417 invention disclosures, filed 926 patents, received 180 issued patents, and executed 304 licenses and options.

It is noteworthy that the research and investment totals on page 6 reflect a boost in the year following the first decade. As a result, in NIH funding, Arizona's growth rate once again outpaces the United States and the top-10 funded states. In research revenues, Arizona outperformed the nation in the most recent year. And Arizona's bioscience venture capital in 2013 jumped by about 60 percent over 2012, though the state's share of the national pool remains a modest 0.38 percent.

The strategies and actions are designed to leverage Arizona's distinctive assets and significantly boost its competitiveness in the biosciences.

UPDATING THE ROADMAP

As the first decade came to a close, the Flinn Foundation committed to update the Roadmap to reflect changes in the industry, nation, and world. The new Roadmap would guide the bioscience sector in Arizona through 2025.

To do so, the Foundation engaged the Battelle Technology Partnership Practice to perform research, conduct in-depth interviews with state and national bioscience leaders, and lead focus groups with key constituencies. Extensive work was done with Arizona's Bioscience Roadmap Steering Committee, a group of more than 100 high-ranking individuals from organizations involved in the biosciences. In all, input was received from more than 150 individuals. This led to the updated goals and strategies detailed in this report, plus potential actions to implement these strategies.

The strategies and potential actions aim to leverage Arizona's distinctive assets and significantly boost its competitiveness in the biosciences. Some of the recommended steps are fundamental in nature; others are tailored to the characteristics that differentiate Arizona from other states pursuing the biosciences.

Arizona is better positioned now than a decade ago to emerge as a national player in the biosciences. However, unless significantly more resources and attention are devoted to the biosciences, Arizona's full potential is unlikely to be realized. This updated strategy demonstrates the need for private and public investments, mobilization of the state's leaders, and renewed commitments needed over the second decade.

Looking back on the original Roadmap, of the 19 actions proposed, progress was made on all and substantial progress on 10. Work will continue on those actions partially completed. In addition, Arizona must consider new opportunities and solutions that have arisen over the past decade, particularly those involving niches where the state can be differentiated from others.

It is important to note that the statewide focus of the Roadmap implementation must continue. The updated Roadmap recognizes a truly emerging bioscience corridor connecting Flagstaff, Phoenix, and Tucson, and the need to address all of Arizona's regions. However, regional solutions and approaches are also critical. Indeed, the original Roadmap was followed by regional roadmaps for northern and southern Arizona that contributed to mobilizing their regions and actions.

What's Different from the 2002 Roadmap?

New Vision Statement: Updated to add global perspective, recognize growing research strengths, and reflect Arizona's changing position in the world

Bioscience-Related Distribution: New addition to Arizona definition of biosciences

Goals and Strategies: 5 overarching goals, 17 strategies to achieve the goals

Potential Actions: 77 potential actions to implement the strategies; actions are optional and meant to evolve as feasibility is determined and priorities set

New Roadmap Tagline: "Advancing the Biosciences and Improving Health Outcomes"—to recognize the broad spectrum of biosciences, the central role of health care, and the importance of hospital research and jobs

Broadening the Vision and Mission

The Roadmap vision has been updated to reflect changing times and refocused ambitions:

> "Arizona is globally competitive and a national leader in the biosciences in such fields as precision medicine, cancer, neurosciences, bioengineering, diagnostics, and agricultural biotechnology. It excels in offering a deep talent base, a critical mass of entrepreneurs and enterprises, and clinical excellence to turn discovery into firms, products, and talent."

This vision describes Arizona's aspiration regarding its biosciences-driven economy, its research base, and the dynamics that would characterize the biosciences in Arizona in 2025. It also calls for the state to increase its bioscience talent base and excel at linking research to clinical practice, patient health, and well-being, while creating new firms, jobs, and products.

To achieve this vision, Arizona will need to increase its support and private/public investments in a number of ways, per the following Roadmap mission:

- Invest in and build Arizona's world-class research, clinical, and product excellence around selective sectors/platforms.
- Put in place mechanisms, programs, and incentives that encourage research to be turned into products, processes, and wealth generation for the state and its residents.

- Mobilize public and private leadership and increase knowledge and understanding among the general public of the biosciences and its impact on health and safety, teaching and research, and economic development.
- Build "trees of talent" by encouraging scientific, technical, and managerial talent to be developed and retained in the state.

Tactics for Success

Patience and a long-term perspective

Champions and leaders

Strategic focus

Strong private-public partnerships

Active federal, state, and local government policy and private/public funding support

Flourishing and deeply embedded partnerships among the state's research-performing institutions

Building a bioscience-driven economy does not happen overnight—it takes time, dedication, focus, and commitment. As shown in the sidebar to the left, this is one of the necessary attributes to implementing the Roadmap over its second decade. If these are lacking or not given full attention and support, the vision and mission stated above are unlikely to come to fruition. In the past decade, Arizona has seen champions emerge and new partnerships, institutions, and organizations develop. But enhanced federal and state government policy, expanded private/public funding support, and stronger partnerships with industry will be needed if Arizona is to achieve the new vision.

The updated Roadmap is framed on three prevailing themes: capital, talent, and connectivity (or partnerships and linkages among investors, academia, industry, and anchor markets). These converge to result in specific outcomes that drive Arizona's position in the biosciences, such as jobs, products, clinical treatment, disease/illness prevention, better health, and an expanded Arizona bioscience economy.

GOALS AND STRATEGIES

The updated roadmap is developed around five main goals and 17 strategies detailing best practices to achieve these goals, as shown in the chart on page 11.

In addition, 77 potential actions have been identified to address the strategies. These actions are designed to be flexible and to evolve as their feasibility is further explored, progress unfolds, and priorities change. Therefore, they are not included in this report but are available online at www.flinn.org. While the goals and strategies provide direction for the Roadmap, the most impactful, urgent, and significant actions will represent the avenues toward accomplishing the goals.

At the launch of this updated Roadmap, the state's bioscience leaders had started to prioritize these detailed actions based on their degree of impact and the feasibility of their implementation. The ongoing prioritization of these actions will not only be influenced by budget realities but by developments in the bioscience industry and state and federal policy.

The five overarching goals focus on the importance of **entrepreneurship**; lab **research translating into illness treatment and prevention**; developing and retaining **talent**; promoting the **connectivity** of research, delivery, and commercialization to key target markets; and renewing the emphasis on **collaborations** and partnerships.

Bioscience Roadmap Goals and Strategies

GOAL 1: ENTREPRENEURIAL HUB ***Form a hub of bioscience entrepreneurs and new enterprises across Arizona***	**STRATEGY 1A:** Address capital needs of bioscience firms from startup to expansion through pre-seed funds, seed funds, fund of funds, investments by wealthy individuals, crowdfunding, Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants, a resident-based venture industry and out-of-state venture capital, as well as by linking to key target markets outside Arizona **STRATEGY 1B:** Accelerate the commercialization of discoveries and advancements from research-performing institutions to industry **STRATEGY 1C:** Maintain and improve state and local competitive business climate through the implementation of stable and predictable tax and regulatory policies
GOAL 2: RESEARCH INTO PRACTICE ***Increase the ability of research-performing institutions to turn bench research results into improved disease/illness prevention, detection, and treatment, plus bio-agriculture and industrial biotechnology products***	**STRATEGY 2A:** Develop a premier research leadership stature in Arizona and increase the competitiveness of the state and its institutions for R&D funds from industry, government, and philanthropy, with a focus on core niches, unique disease populations, and demographics emphasizing areas that can lead to disease/illness prevention, a holistic approach, and reflect the state's population **STRATEGY 2B:** Scale up and initiate major strategic partnerships among research-performing institutions, industry and foundations, as well as others focused on Arizona's disease/technology platforms **STRATEGY 2C:** Support and fully operationalize Science Foundation Arizona
GOAL 3: BIO-TALENT ***Make Arizona a bio-talent powerhouse where such talent is developed, educated, trained, and retained***	**STRATEGY 3A:** Increase the state's supply of executive-level serial entrepreneurial talent within the bioscience industry **STRATEGY 3B:** Establish Arizona as the national leader in deploying, assessing, and strengthening Science, Technology, Engineering, and Mathematics (STEM) education at both the state and local levels in K–12, community colleges, and the universities; make improvements in science and math in K–12 through the STEM Network, bioscience academies, and statewide career and community-focused technical preparation programs to form lifelong career pathways in the biosciences **STRATEGY 3C:** Dramatically expand student entrepreneurship programs both at the K–12 and college levels, as well as internship opportunities to thousands of enrollees in private businesses and nonprofit organizations **STRATEGY 3D:** Develop the talent base by attracting and retaining top graduate students, doctoral and post-doctoral candidates and trainees, and physician-scientists to research opportunities in Arizona, including clinical research **STRATEGY 3E:** Promote health care delivery reforms that will make Arizona a national leader and overcome the discovery-to-delivery disconnect **STRATEGY 3F:** Develop programs to educate health care providers about delivering precision medicine to the patient
GOAL 4: CONNECTIVITY ***Promote Arizona to economic partners in neighboring states, Canada, and Mexico as a place where bioscience research, health care delivery, and commercialization seamlessly intersect***	**STRATEGY 4A:** Develop a consistent statewide strategy to form linkages of universities, private research institutes, firms, investors, and entrepreneurs in key target markets, such as Utah, Washington, Oregon, Southern California, Mexico, and Canada; these close connections can help Arizona become recognized as the key center to turn research into practice, form firms, develop products, run clinical trials, and seamlessly deliver health prevention and treatment from development to delivery **STRATEGY 4B:** Encourage creative private-public partnerships and financing mechanisms to address needed infrastructure investments such as research facilities, spec multi-tenant facilities, incubators, accelerators, research park developments, additional biomedical anchors, and shared core laboratories and prototyping facilities
GOAL 5: COLLABORATION ***Pioneer a new level of commitment to partnerships to sustain and enhance the state's "collaborative gene" reputation***	**STRATEGY 5A:** Remove growing impediments to collaboration between and within institutions through incentives for collaboration and performance accountability **STRATEGY 5B:** Strengthen bioscience advocacy at the local, state, and national levels **STRATEGY 5C:** Ensure the updated Roadmap has built-in accountability for performance

To address Goal 1, the capital needs of bioscience firms from startup to expansion must be addressed, including pre-seed funds, seed funds, fund of funds, attracting wealthy individuals, crowdfunding, Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants, building a resident-based venture industry, attracting out-of-state venture capital, and linking to key target markets outside Arizona. In addition, their commercialization must be accelerated, and there must be stable and predictable tax and regulatory policies to maintain and enhance state and local competitive business climates.

To address Goal 2, Arizona must develop a premier research leadership status and focus on core R&D niches, unique disease populations, and demographics that can lead to disease/illness prevention, while initiating strategic partnerships and supporting and fully operationalizing Science Foundation Arizona.

To address Goal 3, the state must increase its supply of executive level serial entrepreneurial talent, make Arizona a national leader in Science, Technology, Engineering, and Math (STEM) education at all levels, dramatically expand student entrepreneurship programs and internship opportunities, attract top graduate students and doctoral and post-doctoral candidates, promote health care delivery reforms, and develop a program to educate health care providers on delivering precision medicine to the patient.

To address Goal 4, the Roadmap calls for a strategy to form linkages of universities, private research institutes, firms, investors, and entrepreneurs to neighboring states and countries to help Arizona become recognized for its bioscience capabilities and successes, while also encouraging private-public partnerships and financing mechanisms.

Investment in Arizona biosciences must be scaled up considerably, particularly in private-sector support.

To address Goal 5, it will be important to create incentives for collaboration and remove any impediments both between and within institutions, increase advocacy at the local, state, and national levels, and ensure the Roadmap has accountability for performance.

Potential Actions

The 77 potential actions—developed by Battelle based on research and input from bioscience leaders—represent steps that could make a difference. They embody the work of the entire bioscience community and require many to lead and carry out. They are meant to be flexible and evolve, especially as their feasibility is gauged and priorities are set.

Not all of the potential actions are equal. Some require greater efforts or resources than others. Some call for the identification and securing of additional resources before they can be initiated. Some need predecessor actions first. While the potential actions are not included in this report, here are examples—one for each of the five goals:

- Create a state Bioscience Portfolio Advisor to help firms locate financing and survive the formative stages until revenues are flowing. Create a related Bioscience Catalytic Capital Network to provide information on sources of capital and stage events to link ideas and entrepreneurs with capital.
- Support an independent review of TRIF—the Technology and Research Initiative Fund approved by Arizona voters in 2000 to support university research—to suggest changes in its design and operations. Identify steps to extend TRIF past 2020.

- Use seasoned executives to help mentor startups and increase their survival rate through a broader and larger-structured executive-in-residence program that provides interim to permanent C-level talent.
- Identify the key supplier assets Arizona offers, or needs to offer, to make strategic linkages with target markets stronger and attract investment, firms, and expansions to Arizona.
- Break down institutional barriers to collaboration in the competitive world of the biosciences by creating an honest-broker function with supporting resources.

TRANSFORMATIVE MEASURES

In order to fully achieve the Roadmap vision, investment in Arizona biosciences must be scaled up considerably, particularly in private-sector support. Small, incremental increases will not create the desired base of new enterprises and expanded firms. A significant change in the private-sector investment climate within Arizona is essential. And furthering the research base, from which health care breakthroughs and discoveries lead to innovations and new products, requires more public investments in Arizona's research infrastructure.

The Roadmap aims to be transformational—to enable Arizona to rise to a new stature in the biosciences and be competitive on both the national and international levels. Gradual enhancements, while helpful, will not fully meet the vision.

Over the second decade of the Roadmap, Arizona must strive to meet the following five "transformative measures" identified by Battelle to truly be globally competitive and a national leader in select areas of the biosciences.

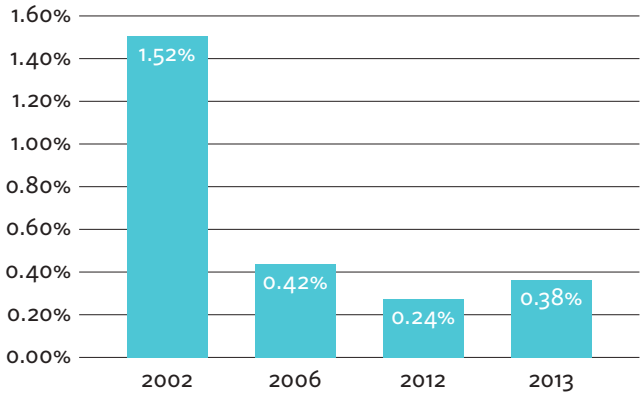
1. **Risk Capital:** Over the decade, Arizona should work to boost existing levels of investment in emerging companies to $25 million–$40 million annually in pre-seed and seed capital from private and public parties, and $100 million–$125 million annually in venture capital. Pre-seed and seed capital support young firms in the formative stages while venture capital supports more established companies that are ready to generate revenue. This Roadmap sets a goal that Arizona reach a market share of national venture capital invested annually in the biosciences equal to its population share by 2025.
2. **Research Revenues:** Arizona research-performing institutions currently generate about $463 million annually from philanthropic, federal, state, and industry sources in grants, contracts, and other support. This should rise to $782 million by 2025. This Roadmap sets a goal to have academic revenues from all sources meet the national performance level by 2025 (see chart on page 15).
3. **Research Infrastructure:** An investment totaling $500 million–$750 million should be made over 10 years to support state-of-the-art academic research infrastructure for the biosciences.
4. **Anchors:** Arizona should attract 5–7 additional bioscience "anchors" involving industry, research, consortia, or related purposes. Examples from the first decade would include the Translational Genomics Research Institute and Critical Path Institute.

5. **Regional Connections:** Drawing from the Roadmap's Goal 4, Arizona should establish business relationships with economic partners in neighboring states, Canada, and Mexico, leveraging its capacity to bring together bioscience research, health care delivery, and commercialization. By 2025, Arizona should have at least two of its five bioscience industry segments with a specialization of at least 1.25, placing Arizona as a national leader in the biosciences.

A large majority of these investments would come from the private sector, with state and local funding accounting for about one-quarter of the total, primarily for research infrastructure. These investments would be phased in and spread out over the decade (and beyond, through debt-servicing) and many would leverage significant dollars from other sources.

Regarding Measure #1, the proposed levels of risk capital are essential for Arizona to take full advantage of spinoffs and startups from its research-performing institutions, including universities, medical centers, private research institutes, and others. Investing in the research enterprise, while not also investing in post-discovery commercialization risk pools, would deprive Arizona of the base of new enterprises that contribute to a critical mass of bioscience firms.

Arizona Bioscience Venture Capital as Share of U.S. Funding



SOURCE: Thomson Reuters Thomson One Database with Battelle Calculations

Arizona will not become a leading bioscience state through a few startups each year. Of these, some will die in the present risk-capital environment, and others that do receive capital may move to already established bioscience centers elsewhere, where capital and other firms congregate. To prevent this, Arizona must continue creating a business climate that rewards and incentivizes risk-capital investing in Arizona bioscience firms.

The adjacent chart illustrates the precipitous decline of Arizona's share of venture investments in bioscience firms over the past decade—from slightly more than 1.5 percent of the national pool in 2002 to 0.38 percent in 2013. While 2002 represented an atypical banner year for Arizona bioscience venture capital, Arizona is nonetheless moving off the national stage of bioscience venture investments.

Strategies presented in this report address this issue, though it should be noted that the size of the investments needed is not small. Other states facing similar issues have stepped in to use limited public funds to spur large, mainly privately managed pools of capital to address these problems.

Measure #2—increasing research revenues—is illustrated by the chart on page 15. To reach the target of $782 million in annual revenues by 2025, Arizona's research-performing institutions must excel in generating additional funding from federal, state, industry, and philanthropic sources. Knowledge increasingly will drive innovation economies in the future, and Arizona's current trend line in the chart does not position the state favorably. While Arizona matched strides with the nation throughout most of the decade by this measure, performance waned over the last four years.

If this trend continues, Arizona will fall far short of this 2025 target; moreover, Arizona will increasingly lag the nation and other states in the amount of bioscience research and development conducted at its

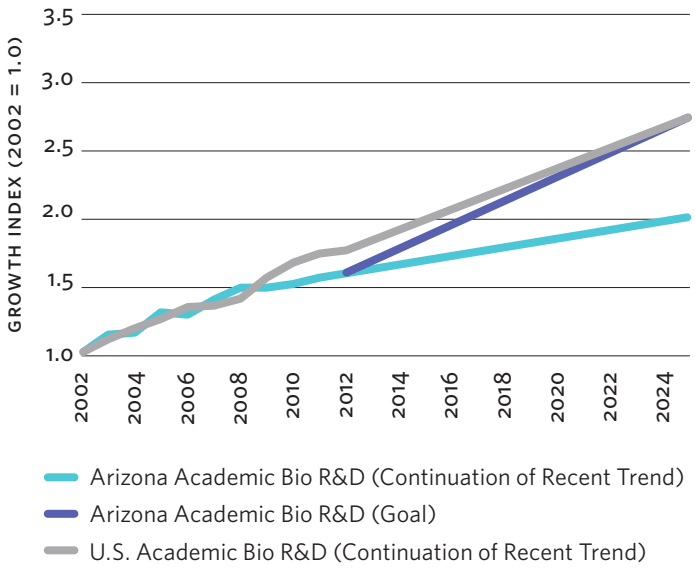
universities and private research institutes. However, if the goals and strategies outlined in this document are implemented, Arizona can be in a position to follow the purple line trajectory in the chart to close the gap against the nation, far above the current trends shown in the light blue line. One effort underway will help—Arizona's universities are focused on doubling their research spending between 2008 and 2020 as part of an initiative of the Arizona Board of Regents.

A Shared Investment

Creating research infrastructure, conducting clinical trials, constructing new buildings, hiring talented researchers, offering lab space for startup entrepreneurs—all of these actions require a significant investment. Given the plethora of opportunities for private investors, and the competing demands facing government, it is indeed a challenge to achieve a substantial boost in investment in the biosciences. But the return can be lucrative. A 2012 Battelle report for the Biotechnology Industry Organization showed that Arizona has a direct economic multiplier of $2.33 for every dollar invested in the biosciences. National studies have historically shown that research investments leverage returns of about 3:1, based on conservative estimates.

There are a number of sources of financing for these endeavors such as private industry, investor venture capital, philanthropic organizations, federal government grants from the National Institutes of Health and other agencies, and other state and local expenditures.

Comparison of Bioscience-Related Academic R&D
Arizona vs. United States



SOURCE: NSF Higher Education R&D Expenditures and Battelle calculations and trend forecasts

As noted above, success in the biosciences, as demonstrated in other states and regions throughout the country, requires a private-public partnership. While most investment comes from the private sector, the public sector plays a vital role.

Determining a bottom-line cost to fully implement the Roadmap is not possible at this time. This will depend on which of the 77 potential actions ultimately are pursued, the methods used to address them, and the degree to which actions devised in the future will be implemented.

Around the country, states diverse in their geography, culture, and political composition, including Arizona, have invested in the development of the biosciences. Examples abound. Research institutes have been created using a combination of state, private industry, and philanthropic dollars. State-driven initiatives and discretionary tax incentives have been used. In some states, voters have approved tax increases with designated funding set aside for bioscience research. As of 2014, some states are planning to invest between $1 billion and $3 billion in public money over the next decade to take advantage of bioscience and health opportunities, recognizing the importance of a leadership position in this sector to their economies and the welfare of their residents. This is in addition to billions more in private, nonprofit, and other resources being leveraged and invested in these areas.

Key Factors in Building a Regional Bioscience Sector

Factors of Success	Best Practice	Arizona's Situation
1. Engaged Research-Performing Institutions with Active Leadership	A focus is placed on cutting-edge tech transfer and economic development	Many are modernizing tech transfer and using cutting-edge commercialization vehicles/strategies
2. Intensive Networking	Academia, industry, and the public are linked through intermediaries	Statewide organizations need further strengthening and regional groups vary in capabilities
3. Available Capital	Programs exist to address company "Valley of Death" stages, including through public and philanthropic sources	Decade-long decline with no new in-state bioscience venture funds available; state has not addressed issue and philanthropic sources are limited
4. Discretionary R&D Funding	Major bioscience regions receive significant federal funding with one or more major federal centers	Retaining federal funding market share but has fallen short of target; establishment of TGen, Critical Path Institute, and others has helped to supplement university grants
5. Talent Pool	Educate and train bioscience workers, from vocational to post-doctoral levels	Considerable expansions in community college, technology prep, and university bioscience programs, plus growth in K–12 STEM programs and specialized academies
6. Specialized Facilities & Equipment	Incubators and accelerators with wet- and dry-lab space, and higher-education institutions that publish and provide low-cost access to equipment to smaller firms	Substantial growth in incubators and accelerators, but universities and private institutes should further make specialized equipment and labs more readily available to small firms
7. Supportive Business Climate	Tax structure reflective of the needs of bioscience firms along with a modern "tool kit" and marketing efforts	Refundable R&D tax credit program one of the nation's best; Arizona Commerce Authority establishing modern "tool kit" with grants and programs/competitions
8. Patience and Long-Term Perspective	Major research bases, such as San Diego, Boston, and Research Triangle Park in North Carolina, took decades to reach a critical mass of firms and research	Some movement in creating a concentrated industry base; less growth in research funding though strengths in non-bioscience research base will be critical in integration of IT and bioscience

DISTINGUISHING ARIZONA

The preceding goals, strategies, and actions were conceived in part based on a review of Arizona's current status in relation to national best practices; an update of its strengths, weaknesses, opportunities, and challenges; and an analysis of the research areas in which Arizona excels.

As shown on page 16, Battelle's benchmarking of regions and states successful in growing bioscience-driven economies has found that there are eight key factors. They must all be concurrently addressed to be successful.

Overall, Arizona has made considerable progress in addressing these factors. The research-performing institutions have been engaged and various educational institutions have stepped up to address the talent pool. Arizona has one of the best refundable research and development tax-credit programs for growing bioscience firms. The stakeholders have mobilized and considerable progress has been made in building the bioscience industry base. Some successes have been achieved in discretionary R&D funding, primarily due to the establishment of TGen and collaborative research-focused bioscience efforts at the three state universities.

However, the growth of Arizona's research base has fallen short of its targets, per its performance on NIH funding. Venture capital funding has been inadequate and remains one of the major unfinished items from the original Roadmap. Efforts to boost advocacy for the biosciences in the public sector must be strengthened.

Venture capital funding has been inadequate and remains one of the major unfinished items from the original Roadmap.

These characteristics of Arizona's bioscience status are further detailed in the analysis of Arizona's strengths, weaknesses, opportunities, and challenges, on page 18.

Technology Platforms

The original Bioscience Roadmap identified key technology platforms upon which to focus efforts in the near-term and mid-term. Arizona's strategy has called for building from strengths, whether existing or emerging. Because Arizona cannot obtain the resources required to build research excellence across the entire bioscience and informational technology spectrum, the state must focus on areas where it excels and rely on heightened collaboration as compared to other states and regions.

In 2002, Battelle identified these areas based on sophisticated quantitative analyses of citations, publications, grant awards, and software clustering. For the latest Roadmap, Battelle updated these platforms through interviews and review of secondary materials and federal funding awards to assess the degree to which these platforms were still relevant, and whether new areas or opportunities had emerged. Battelle has identified the areas listed on page 19 as key technology platforms for the next decade.

These technology platforms and disease areas align well with the industry segments around which Arizona is building its industry critical mass—most particularly research, testing and medical labs; drugs, pharmaceuticals, and diagnostics; and medical devices and equipment. The new bio-distribution industry segment cuts across and services all other industry segments.

These original platforms have continued to grow in strength since 2002, with additional cancer research teams, cancer prevention/treatment programs and centers, and additional collaborations involving medical centers, academic centers, and private research institutes in Arizona. Promising developments by Arizona State University in algae research; Northern Arizona University's efforts in energy harvesting through the

Arizona's Strengths, Weaknesses, Opportunities, and Challenges

Over the past 10 years, a number of Arizona's strengths have emerged and come to light, including the Roadmap itself and the momentum it has created. Arizona is aiming to become a national leader in specific areas of the biosciences in dramatically less time than it took other regions to become biomedical powerhouses. To reach this goal, Arizona must capitalize on its opportunities and address its weaknesses and challenges. At the top of the list is an insufficient amount of venture capital investment and the need to secure sufficient private and public money, as well as have the necessary patience over this multi-decade buildup of the bioscience industry.

Strengths

A formal strategic plan with momentum and proven success

A collaborative culture to leverage efforts and assets

Research-performing institutions that are generally striving to achieve excellence in research, technology transfer, and engagement with external partners

Creation of the Arizona Commerce Authority and its reconstituted programs to assist entrepreneurs in building an innovation economy

Emergence of bioscience champions in key sectors (industry, academia, government)

Accelerated growth in non-hospital bioscience employment during 2009–12

An expanding set of science and technology, biosciences, and STEM initiatives in K–12 education throughout the state

Strong, nationally recognized and growing scientific strengths with funding awards in such areas as Alzheimer's, precision medicine, agricultural biotechnology, and cancer

Engaged philanthropic organizations supporting bioscience-related efforts

Weaknesses

Insufficient risk capital

Not enough executive-level serial entrepreneurs and an insufficient bioscience entrepreneurial culture, despite improvements; uneven and fragmented development efforts across the state

Limited leadership succession planning

Emerging industry base that has not reached critical mass

K–12 education system with inconsistent quality

Research base maintaining national market share but not at the necessary critical mass

Insufficient state government investments in innovation, higher education, and other critical elements necessary to achieve excellence in the biosciences

Failure to continue financial support of Science Foundation Arizona

Lack of sufficient clinical testing facilities and physician-scientists

The need for strong bioscience advocacy efforts

Continued need to recruit out-of-state, experienced talent

Research-performing institutions reticent to provide small firms as much access as needed to their specialized equipment and facilities

Opportunities

Small but agile bioscience community

Safe location away from natural disasters provides security for data storage, manufacturing

Special populations for study and trials including the elderly and groups with disproportionately high disease rates

Southwest location close to growing economic partners in nearby states and countries

Research disease areas are consistent, stronger, and growing since 2002

The merging of IT, biosciences, and health care provides Arizona an advantage due to its historic strengths

Expansion of medical and teaching hospitals with interest in translational research; increased concentration of cancer/oncology centers

Expanded industry base eager for collaborative partnerships with research-performing institutions

A bioscience corridor has emerged from Flagstaff to Phoenix to Tucson, enabling both statewide and local strategic approaches

Building and retaining an entrepreneurial talent base positions Arizona to attract and grow its industry

Challenges

Securing sufficient private and public resources to the scale necessary to achieve Arizona's vision

Maintaining the "collaborative gene" attitude and approach as the bioscience sector expands and new players and organizations emerge

Having the necessary patience and perseverance to build a bioscience base over multiple decades

Lagging federal research investments will require research-performing institutions, industry, and universities to find unique ways to join forces

Ensuring the benefits of the biosciences reach all areas of Arizona

Achieving sufficient education of the general public

Increasing the speed, velocity, and scale of bioscience entrepreneurship

Building mega-scale research infrastructure and talent

merger of engineering and biology; major federal funding awards for the iPlant Collaborative at the University of Arizona; and many other developments have continued to give Arizona opportunities in various agricultural biotechnology niches with exciting opportunities in genomics, bioprocessing, and more. While bioengineering experienced downturns in Arizona in the mid-2000s, it is now recovering well with large, growing student populations and programs at the state's public research universities. Imaging sciences was identified as an area that cut across all other platforms by the scientific working groups that convened after the original Roadmap was released.

The new technology platform areas in the updated Roadmap are:

Biomarkers/Precision Medicine/Bioinformatics: Arizona has taken steps toward positioning itself in precision medicine, starting with the building of its research base at the University of Arizona, establishment of TGen in 2002, and additional focus on bioinformatics across a number of institutions. Precision medicine presents a means to build on discoveries in areas of chronic disease, such as Alzheimer's and cancer. The National Biomarker Development Alliance at Arizona State University could position Arizona nationally and globally in the emerging area of biomarkers, which are key to being able to deliver interventions at the right time to the patient. While few biomarkers have been approved for clinical use today and standards are lacking, Arizona has considerable potential with NBDA and the Critical Path Institute to become a national standards-setting location that could link molecular research, clinical data, and utility with patient care.

Arizona Bioscience Technology Platforms

Continued from 2002 Roadmap

- **Oncology/Cancer Research**
- **Neurosciences/Alzheimer's Disease**
- **Bioengineering/Medical Devices**
- **Agricultural Biotechnology**
- **Imaging Sciences (cuts across all other platforms)**

Added in 2014 Update

- **Biomarkers/Precision Medicine/ Bioinformatics**
- **Diagnostics**
- **Health Information Technologies and Health Economics**

Diagnostics: Diagnostics refer to tests that predict the course or severity of a disease, or tests that predict how a person will respond to a therapy. Diagnostics are playing an increasing role in ongoing monitoring and patient care treatment and prevention. Arizona has an excellent opportunity in molecular diagnostics—which are used to identify the DNA, RNA, and proteins in samples taken from patients to assess their health conditions and evidence or risk of various diseases—with major industry players such as Ventana Medical Systems, HTG Molecular Diagnostics, and Accelerate Diagnostics.

Health Information Technologies and Health Economics: Health information technologies, which include diverse areas such as the remote monitoring of patients, telemedicine, and the monitoring and measuring of health care treatment and outcomes, could become an emerging opportunity for Arizona in part because of the state's historic strengths of information technology and communications.

Health information technologies are growing in stature given escalating health care costs and pressures to contain them, the new Affordable Care Act, and the rise of new technologies to handle and manage large amounts of health data. Increasingly, "Big Data" sets will link clinical research, academic research, and individual data with electronic health records, insurance records, and prescription records; and then apply new economic and health efficacy software tools to assess outcomes, cost-effectiveness, and the ability to target treatments or therapies to the patient.

Bioscience firms will need to show that their innovations will lead to improved health outcomes, and health economics will develop tools to determine this with a focus on cost-effectiveness.

MEASURING FUTURE SUCCESS

Tracking has demonstrated the economic benefits of the industry, while also providing the necessary context for Arizona's progress.

A hallmark of Arizona's bioscience roadmap has been the collection and release of economic data from a neutral, objective source. This tracking has demonstrated the economic benefits of the industry and its challenges, while also providing the necessary context for Arizona's progress by comparing the data against the nation.

The data has been compiled by Battelle Technology Partnership Practice, a leading independent research and development organization, and released on an annual basis by the Flinn Foundation at events throughout the state. The 2002 data was the benchmark to measure the year-to-year developments in the total number of industry jobs, firms, wages, NIH funding, venture capital, and more.

New data gathered by Battelle and presented in this report set the benchmark for the updated Roadmap. For the first time, this includes data on the bioscience-related distribution subsector.

Measures to be used include:

- Measuring the research base: academic research expenditures from all sources and NIH funding
- Attraction of bioscience firms and successful large-scale strategic partnerships achieved from outside the state to Arizona
- Risk capital on two key measures: market share of national venture capital invested in biosciences and calculations in total amounts of investments
- Specialization of industry and its concentration rates; establishments, firms, jobs, and their growth and wages

Going forth, the Flinn Foundation expects to commission Battelle to generate these metrics every other year and continue to release them publicly.

FOR MORE INFORMATION

This report is also available online on the Flinn Foundation website, **www.flinn.org**. In addition, the Roadmap's potential actions will be maintained on this site, enabling them to be changed and updated over the coming decade. New performance data and other announcements specific to Arizona's Bioscience Roadmap will also be posted.

The Flinn website offers additional resources on Arizona biosciences, including progress reports, articles and announcements, news digests, and more. The Foundation can be contacted at **602-744-6800** or **info@flinn.org**.

The Flinn Foundation is a privately endowed, philanthropic grantmaking organization established in 1965 by Dr. Robert S. and Irene P. Flinn to improve the quality of life in Arizona to benefit future generations. The Phoenix-based foundation supports the advancement of the biosciences in Arizona through grants, the convening of Arizona's Bioscience Roadmap Steering Committee, and the commissioning and coordination of the Bioscience Roadmap and its metrics. The Foundation also supports a merit-based college scholarship program, arts and culture, and the Arizona Center for Civic Leadership.

Battelle is the world's largest independent research and development organization, headquartered in Columbus, Ohio. The Battelle Technology Partnership Practice has provided research and facilitation for Arizona's Bioscience Roadmap since its inception.

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FLINN FOUNDATION

1802 North Central Avenue
Phoenix, AZ 85004-1506

602.744.6800
info@flinn.org

www.flinn.org

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