ARIZONA'S BIOSCIENCE ROADMAP

2014-2025
Advancing the Biosciences and Improving Health Outcomes

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TEConomy Partners, LLC
March 29-31, 2016

FLINN FOUNDATION | TECONOMY PARTNERS LLC
Innovating Tommorow's Economic Landscape

WHAT IS THE ROADMAP?

ARIZONA'S BIOSCIENCE ROADMAP

Arizona's Bioscience Roadmap:

- 20-year plan to bring Arizona to competitiveness in bioscience
- Commissioned by the Flinn Foundation; compiled by Battelle, tracked by TEConomy Partners
- Goals: economic strength and diversity, access to health innovations for Arizonans
- Focused on leveraging research strengths, building critical mass of firms

FIRST DECADE: 2002-2012

ARIZONA'S BIOSCIENCE ROADMAP

Outcomes:

- Substantial statewide development
- Industry grew rapidly, even during Great Recession
- Research funding grew, rate slowed in final years
- Risk capital dropped precipitously after 2002
- Progress on all 19 Roadmap actions, substantial progress on 10
- AZ: top emerging bio state with "collaborative gene"

SECOND "DECADE": 2013-2025

ARIZONA'S BIOSCIENCE ROADMAP

Vision:

"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."

SECOND "DECADE": 2013-2025

ARIZONA'S BIOSCIENCE ROADMAP

17 Strategies to Achieve 5 Goals:

- Provide direction for Roadmap implementation
- To be re-examined at midpoint of Second Decade Roadmap

77 Potential Actions to Implement Strategies:

- Prioritized based on feasibility, impact
- Designed to evolve
- Available at www.flinn.org

WHAT ARE THE BIOSCIENCES?

ARIZONA'S BIOSCIENCE ROADMAP

- Agricultural Feedstock and Chemicals
- Bioscience-Related Distribution
- Drugs, Pharmaceuticals and Diagnostics
- Medical Devices and Equipment
- Research, Testing and Medical Labs
- Hospitals

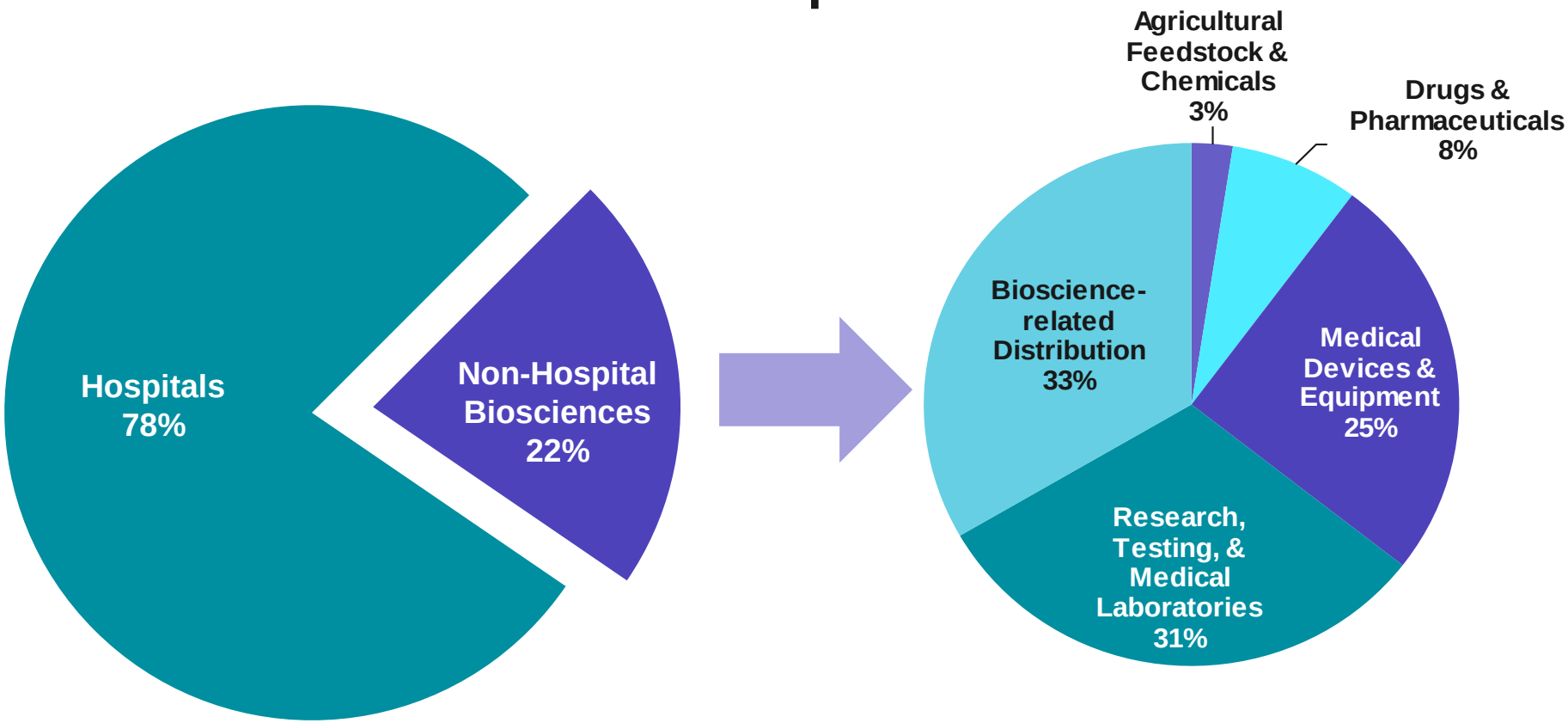





METRIC: JOBS

ARIZONA'S BIOSCIENCE ROADMAP

Arizona Bioscience Jobs Composition

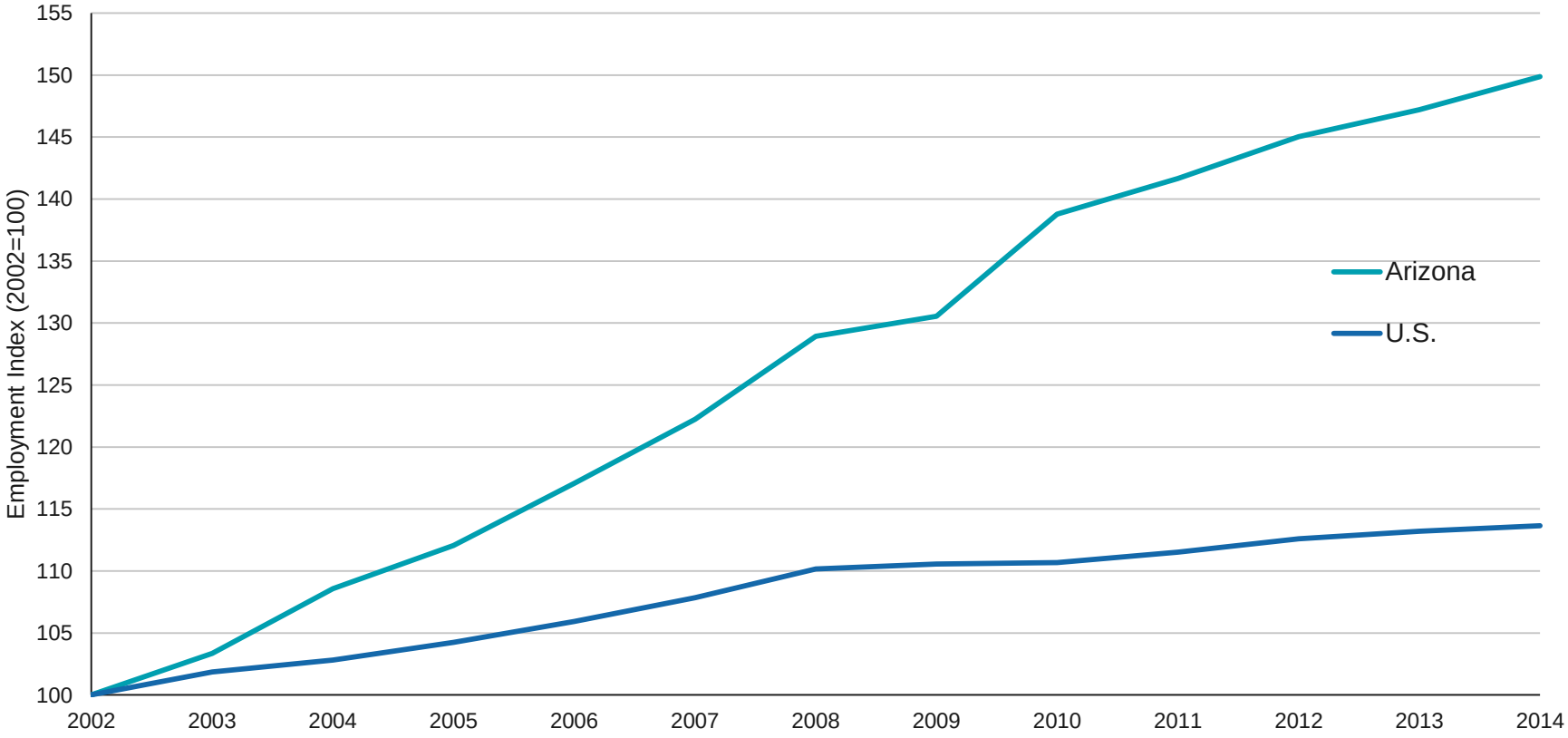


Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: JOBS

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. Bioscience Employment: 2002-14

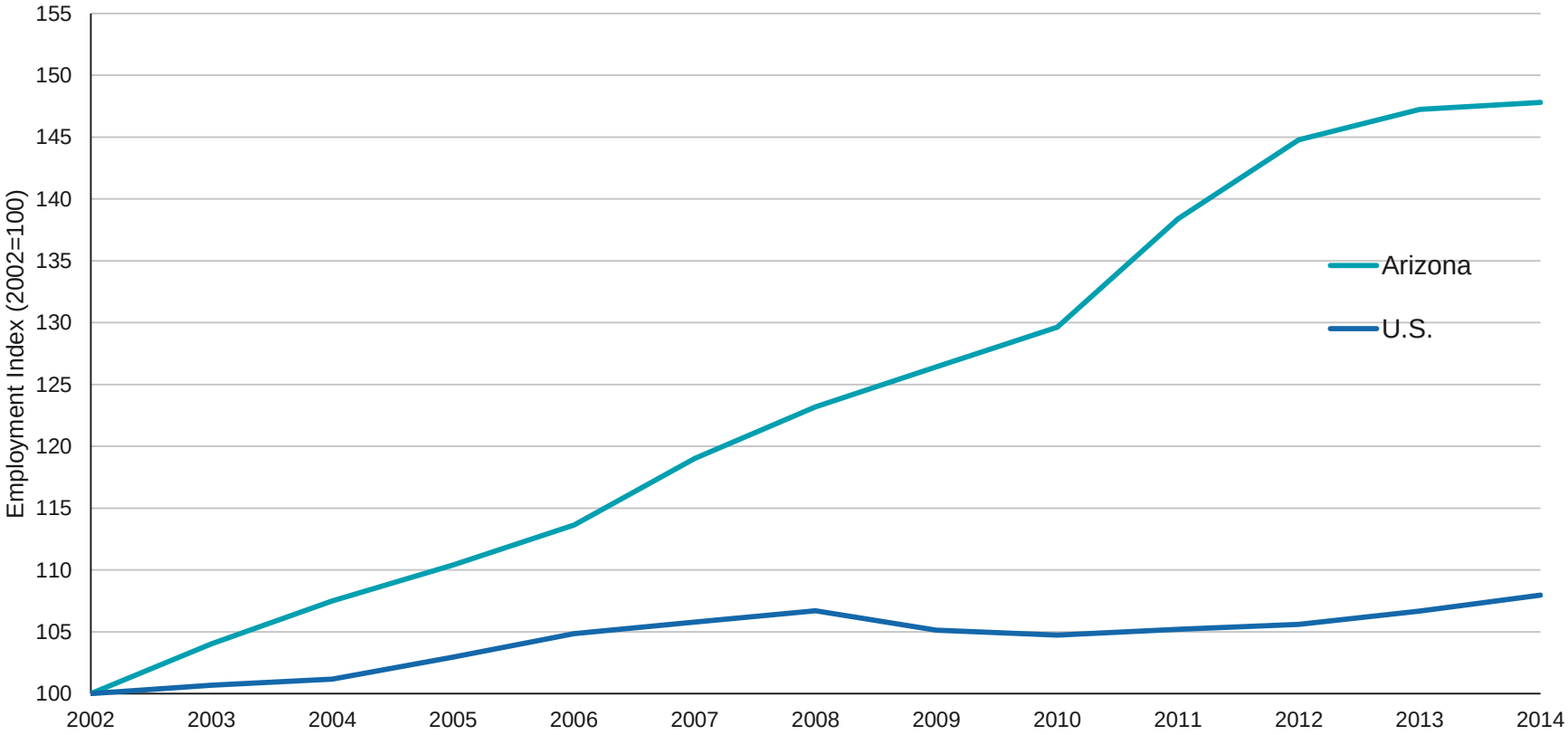


Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: JOBS

ARIZONA'S BIOSCIENCE ROADMAP

Non-Hospital Bioscience Employment: 2002-14



Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: JOBS

ARIZONA'S BIOSCIENCE ROADMAP

Employment Across Business Cycles

Industry Subsector	Economic Expansion		Recession		Recovery/Expansion	
	AZ Change 2002-07	U.S. Change 2002-07	AZ Change 2007-09	U.S. Change 2007-09	AZ Change 2009-14	U.S. Change 2009-14
Total Private Sector	**19.8%**	**6.0%**	**-11.3%**	**-6.2%**	**7.7%**	**7.8%**
Total Biosciences	**22.2%**	**7.8%**	**6.8%**	**2.5%**	**14.8%**	**2.8%**
Total Non-Hospital Biosciences	19.0%	5.8%	6.2%	-0.6%	16.9%	2.7%
Agricultural Feedstock & Chemicals	20.0%	-6.8%	-1.7%	2.1%	9.4%	0.6%
Bioscience-related Distribution	14.4%	7.8%	2.0%	-3.3%	-4.8%	1.8%
Drugs & Pharmaceuticals	17.1%	-0.1%	-8.7%	-4.8%	84.5%	-3.4%
Medical Devices & Equipment	33.4%	1.9%	13.8%	0.6%	36.9%	1.1%
Research, Testing, & Medical Laboratories	17.5%	14.6%	10.9%	3.8%	21.7%	9.3%
Hospitals	23.1%	8.6%	7.0%	3.7%	14.2%	2.8%

Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

INDUSTRY PROFILE

ARIZONA'S BIOSCIENCE ROADMAP

INDUSTRY SUBSECTOR	JOBS	ESTABLISHMENTS	AVERAGE WAGES	LOCATION QUOTIENT
Agricultural Feedstock & Chemicals	595	14	$53,324	0.41
Bioscience-Related Distribution	8,021	755	$94,975	0.95
Drugs & Pharmaceuticals	1,867	47	$54,289	0.34
Medical Devices & Equipment	6,082	107	$67,354	0.94
Research, Testing & Medical Labs	7,475	362	$71,059	0.82
Hospitals	86,370	127	$57,777	0.98
Total Non-Hospital Biosciences	**24,040**	**1,284**	**$76,360**	**0.78**
TOTAL BIOSCIENCES	**110,410**	**1,411**	**$61,823**	**0.92**

1 Industry data are from 2014.
2 Location quotient is the level of industry concentration relative to the nation; 1.0 represents the national average.
Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: WAGES

ARIZONA'S BIOSCIENCE ROADMAP

Bioscience Wage Growth: 2013-14

Major AZ Industries & Subsectors	Avg. Annual Wages, 2013	Avg. Annual Wages, 2014	Change 2013-14
Bioscience-related Distribution	$95,642	$94,975	-1%
Total Non-Hospital Biosciences	**$74,881**	**$76,360**	**2%**
Research, Testing, & Medical Laboratories	$66,094	$71,059	8%
Medical Devices & Equipment	$65,345	$67,354	3%
Total Biosciences	**$60,864**	**$61,823**	**2%**
Hospitals	$56,891	$57,777	2%
Drugs & Pharmaceuticals	$51,873	$54,289	5%
Agricultural Feedstock & Chemicals	$48,503	$53,324	10%
Total Private Sector	**$45,503**	**$46,514**	**2%**

Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

SPOTLIGHT: BIO-DISTRIBUTION

ARIZONA'S BIOSCIENCE ROADMAP

Distribution of:

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

Specializes in:

- Cold storage
- Product monitoring
- Automated pharmaceutical distribution systems

In Arizona:

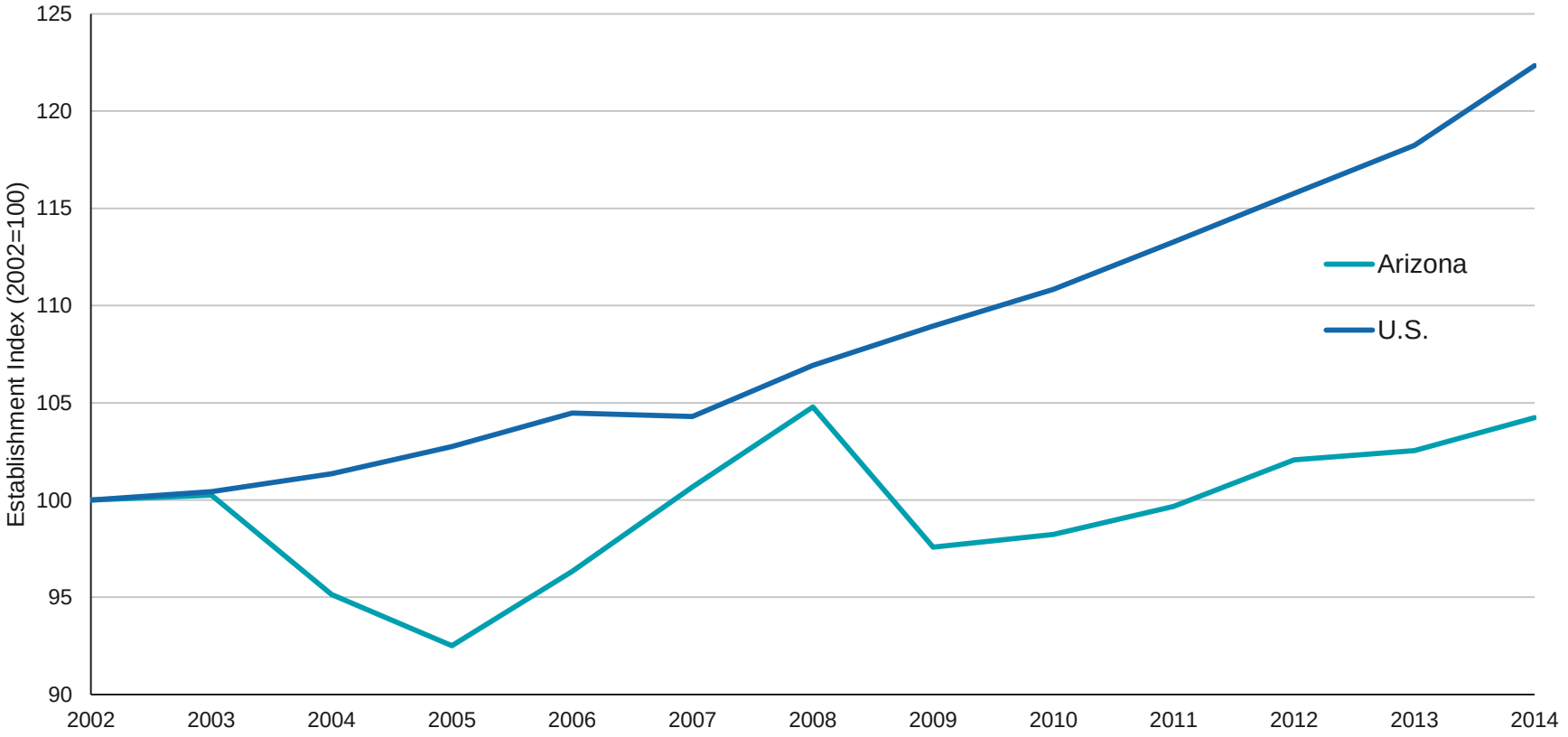
- Jobs: 8,021 (33%)*
- Establishments: 755 (59%)*
- Location quotient: 0.95
- Average Wages: $94,975

** Percentage among non-hospital subsectors*

METRIC: ESTABLISHMENTS

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. Bioscience Establishments: 2002-14

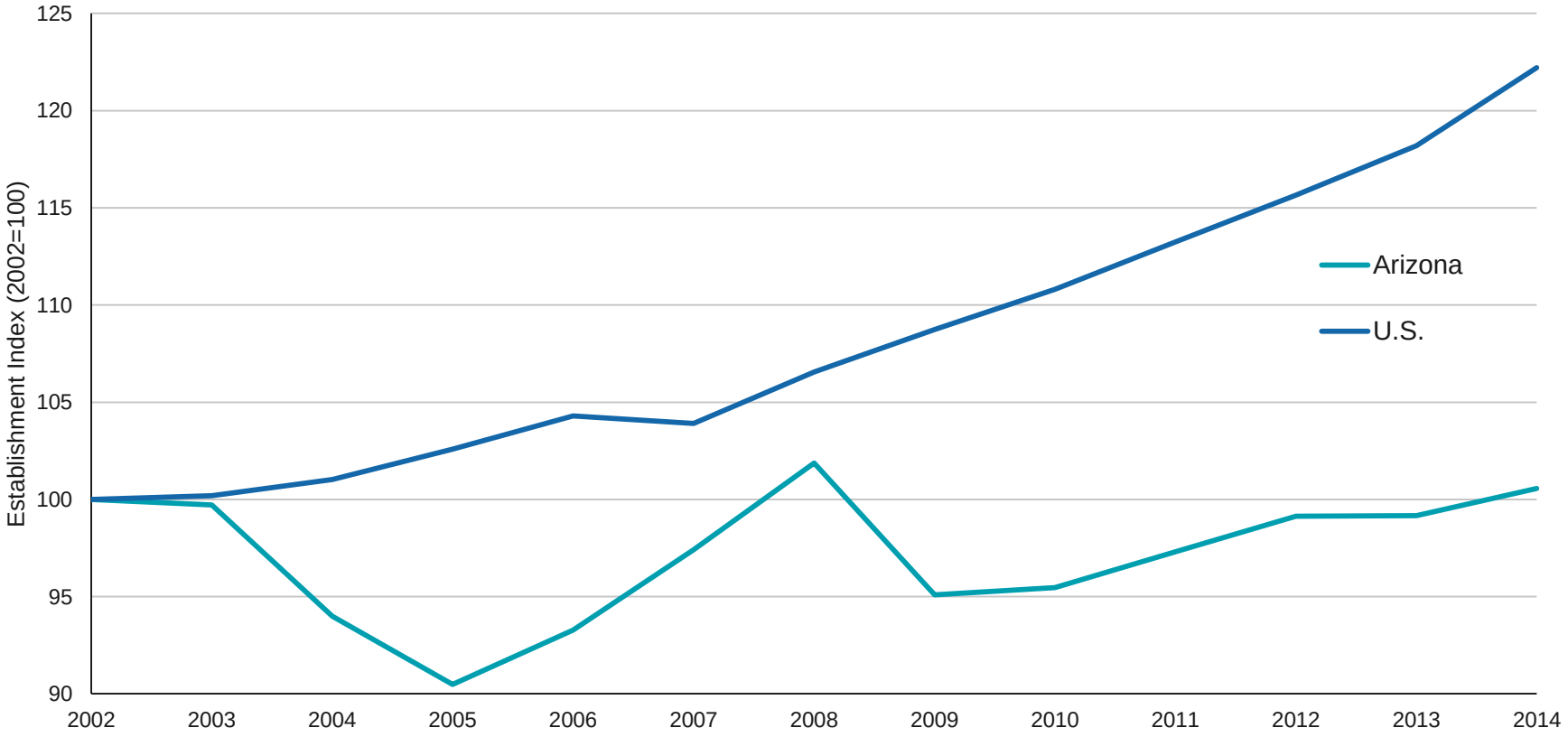


Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: ESTABLISHMENTS

ARIZONA'S BIOSCIENCE ROADMAP

Non-Hospital Bioscience Establishments: 2002-14

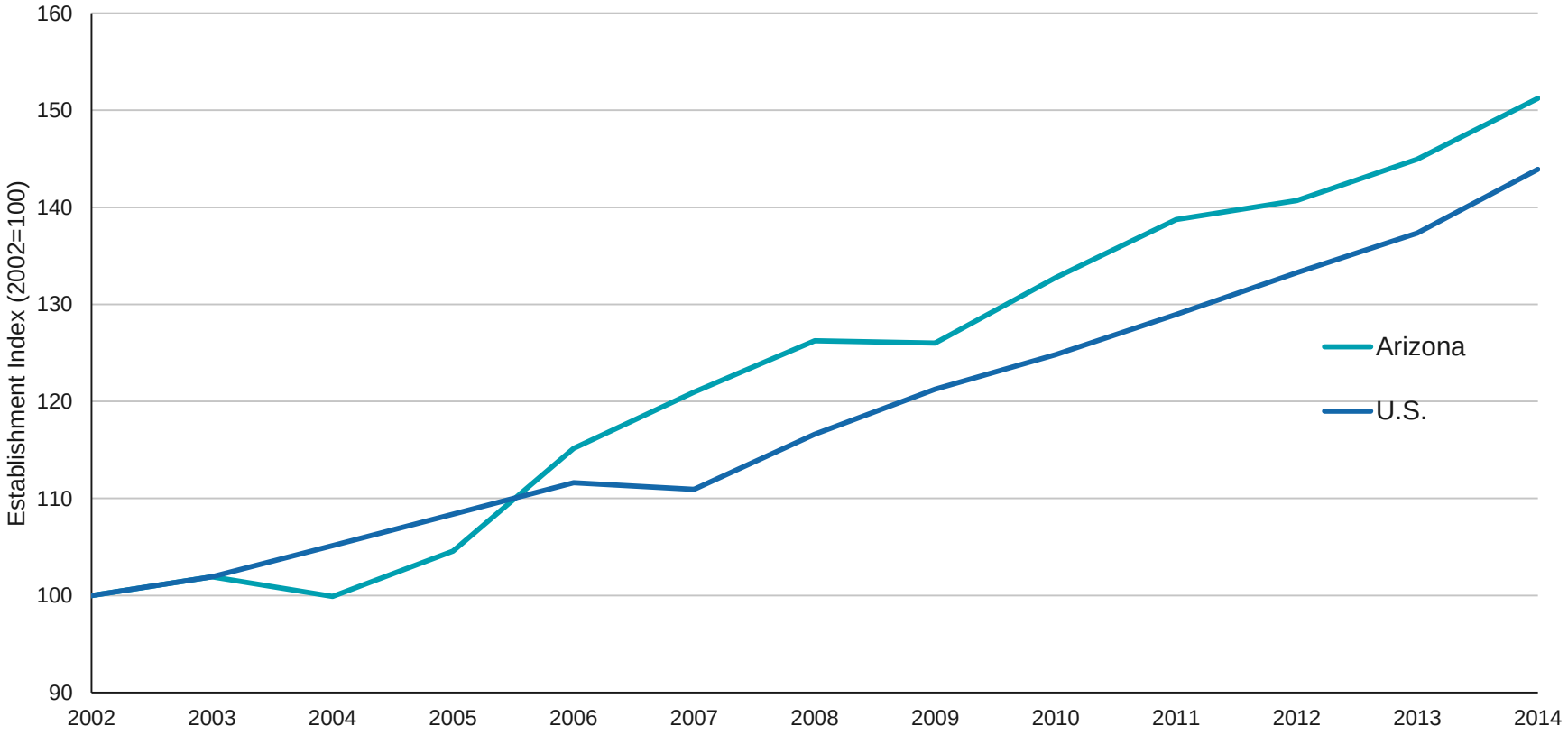


Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: ESTABLISHMENTS

ARIZONA'S BIOSCIENCE ROADMAP

Non-Distribution Bioscience Establishments: 2002-14

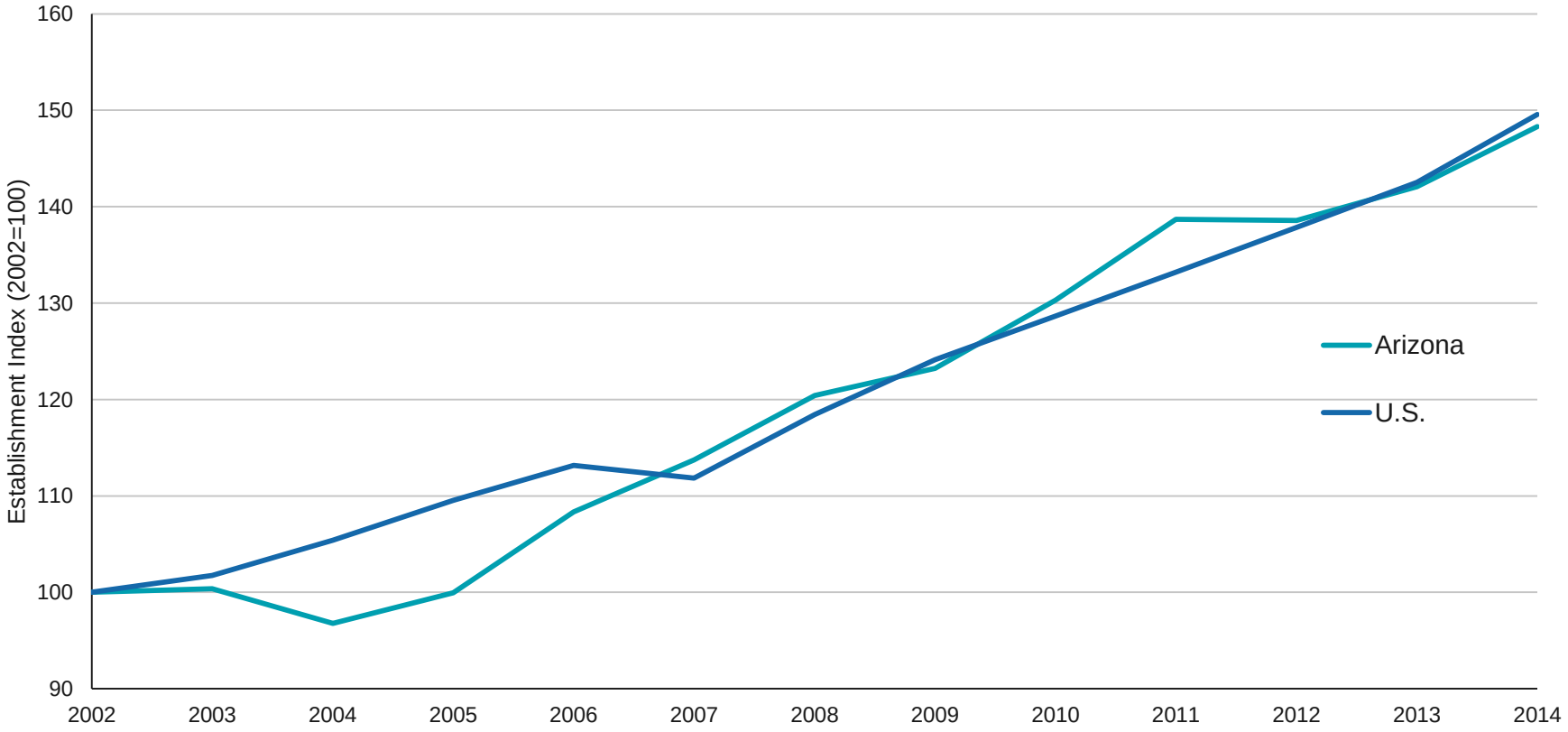


Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

METRIC: ESTABLISHMENTS

ARIZONA'S BIOSCIENCE ROADMAP

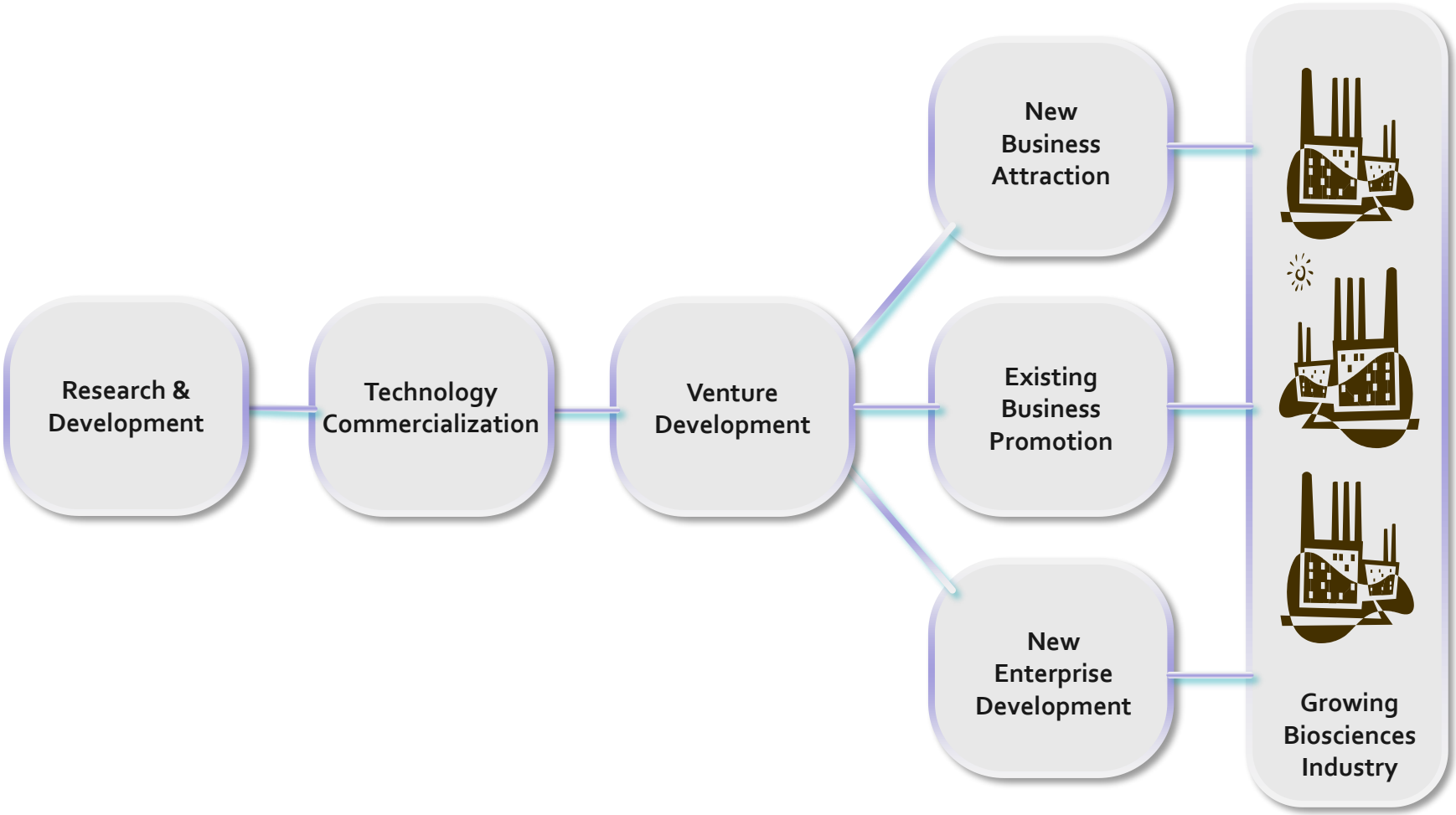
Non-Distribution/Hospital Bio Establishments: 2002-14



Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

INNOVATION ECOSYSTEM

ARIZONA'S BIOSCIENCE ROADMAP



METRIC: BIOSCIENCE R&D

ARIZONA'S BIOSCIENCE ROADMAP

AZ Academic R&D in Bio-Related Fields: FY 2014

- Total bioscience-related R&D: $451M
- Total non-bioscience-related R&D: $536M

U.S. Academic R&D in Bio-Related Fields: FY 2014

- Total bioscience-related R&D: $41.7B
- Total non-bioscience-related R&D: $22B

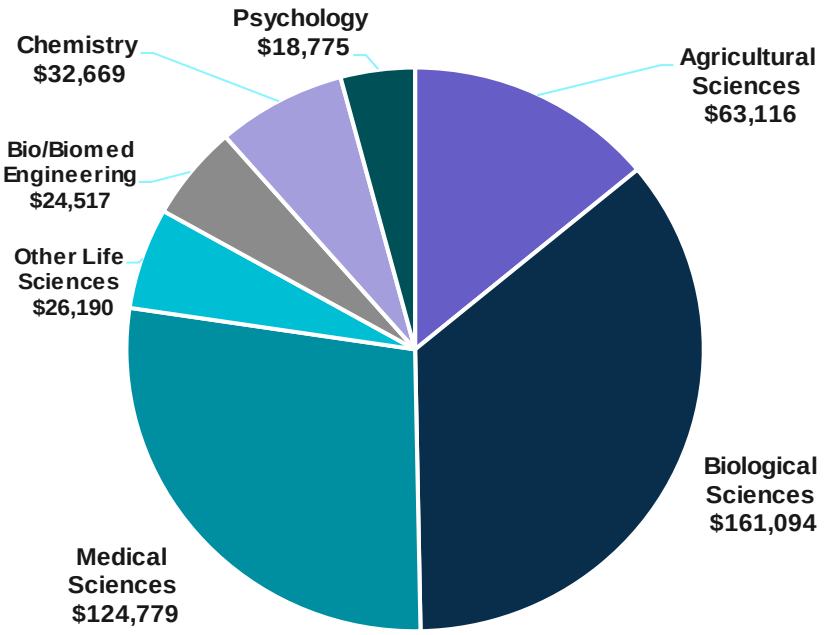
Source: NSF Academic S&E R&D Expenditures and TEConomy Partners calculations

METRIC: BIOSCIENCE R&D

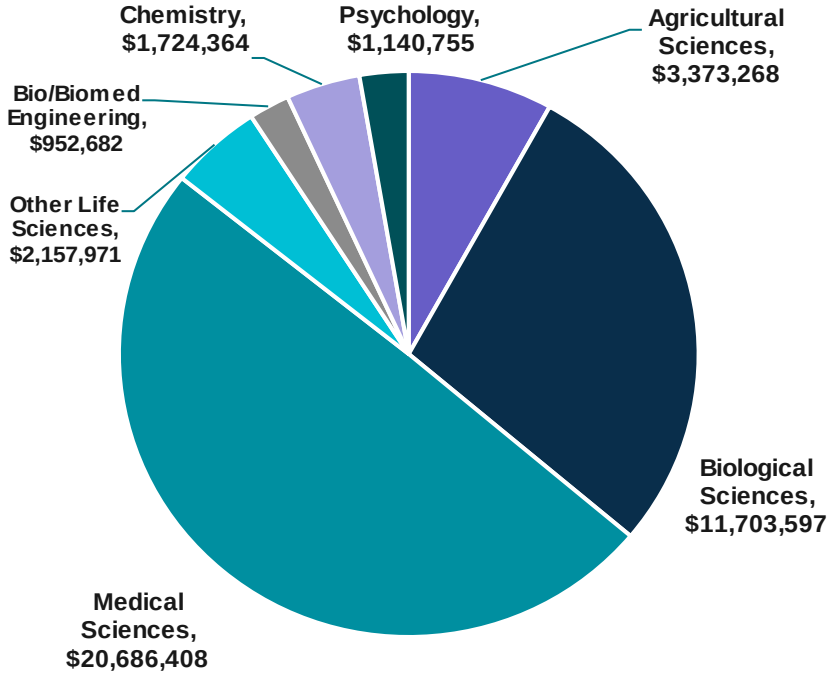
ARIZONA'S BIOSCIENCE ROADMAP

Distribution of Academic R&D in Bio-Related Fields

Arizona



U.S.



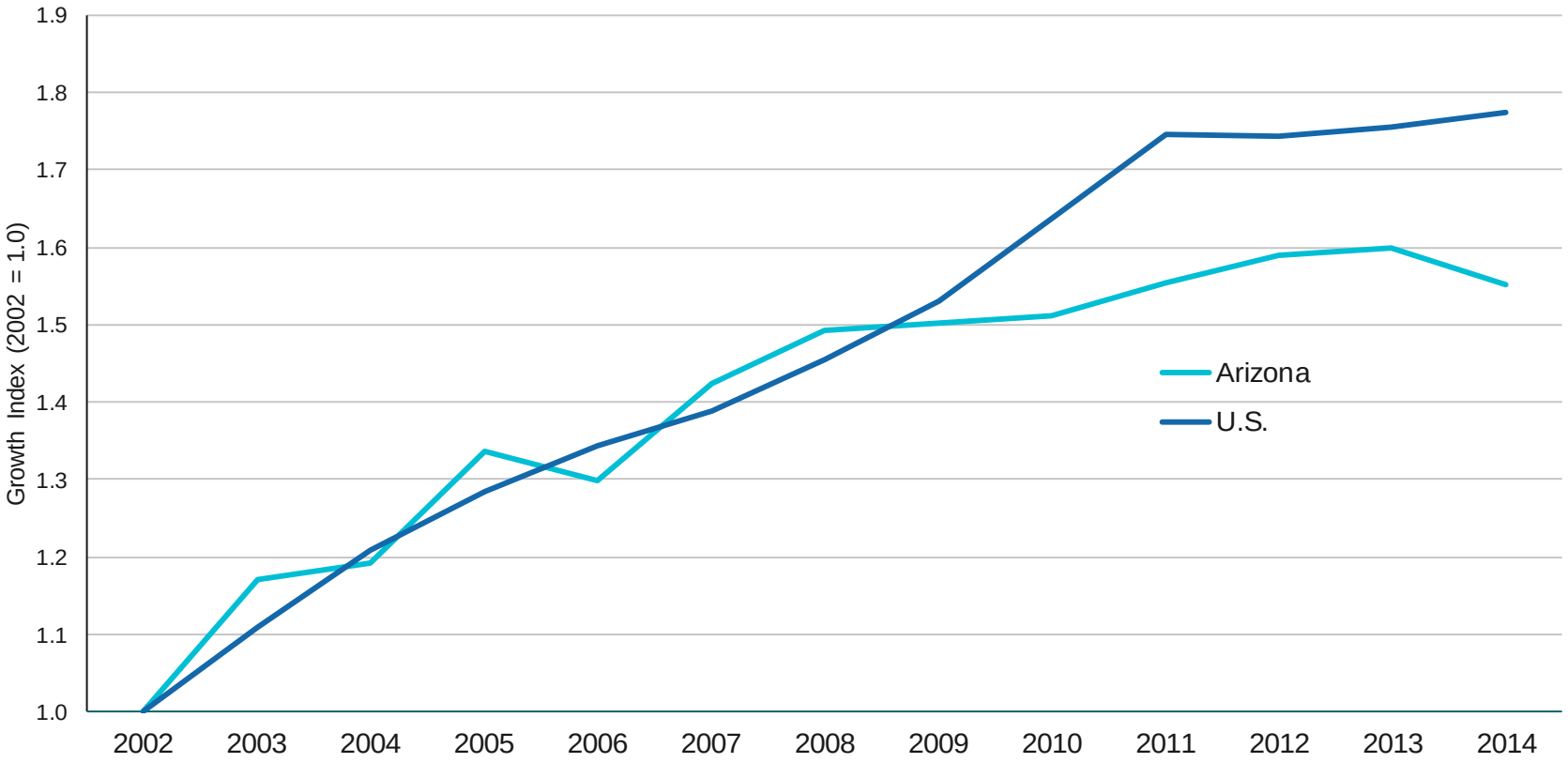
(Figures in $ Millions)

Source: NSF Academic S&E R&D Expenditures and TEConomy Partners calculations

METRIC: BIOSCIENCE R&D

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. Bioscience Academic R&D: 2002-14

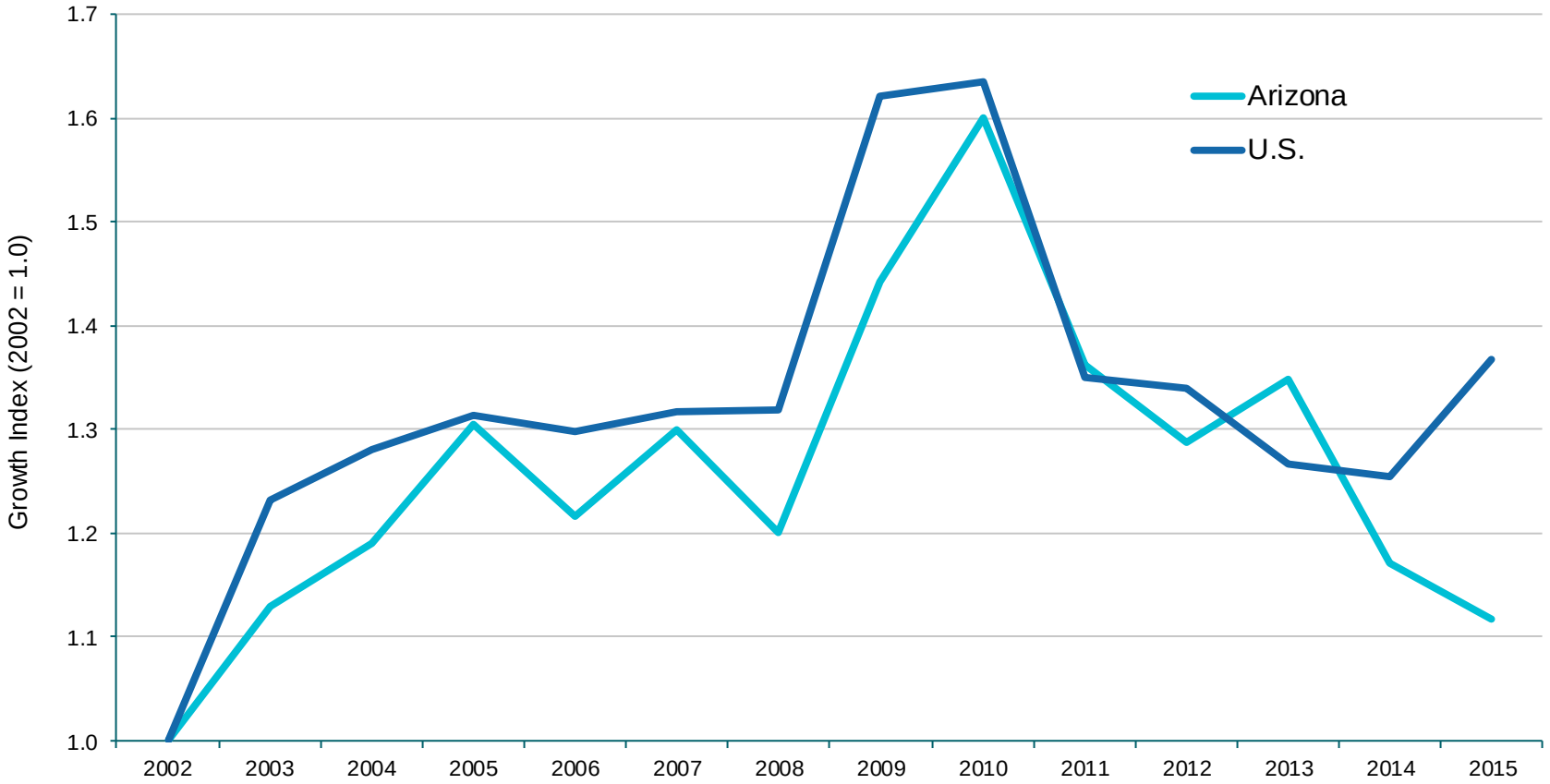


Source: NSF Academic R&D Expenditures and TEConomy Partners calculations

METRIC: NIH

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. NIH Funding: 2002-15

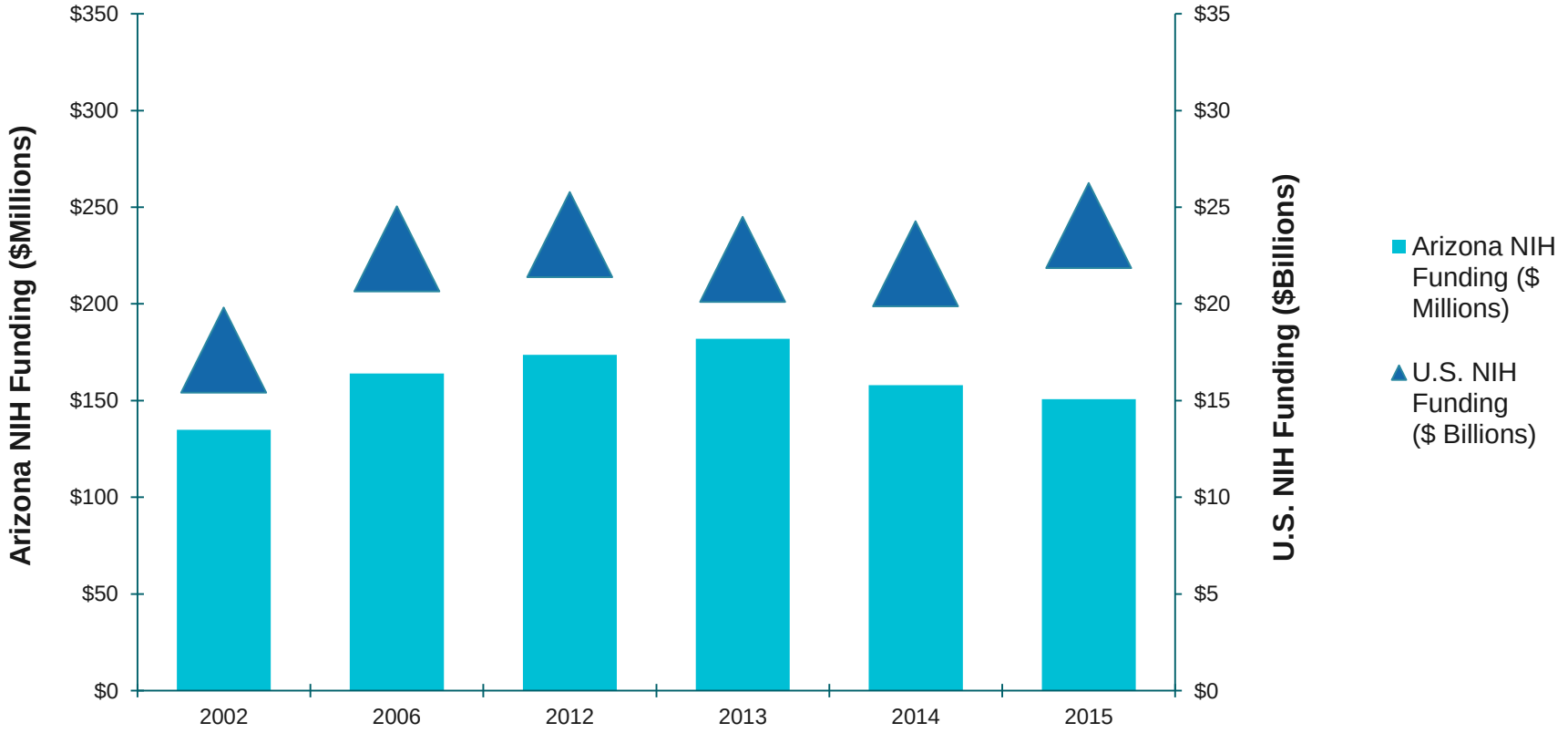


Source: NIH *RePORT* database, and TEConomy Partners calculations

METRIC: NIH

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. NIH Funding: 2002-15

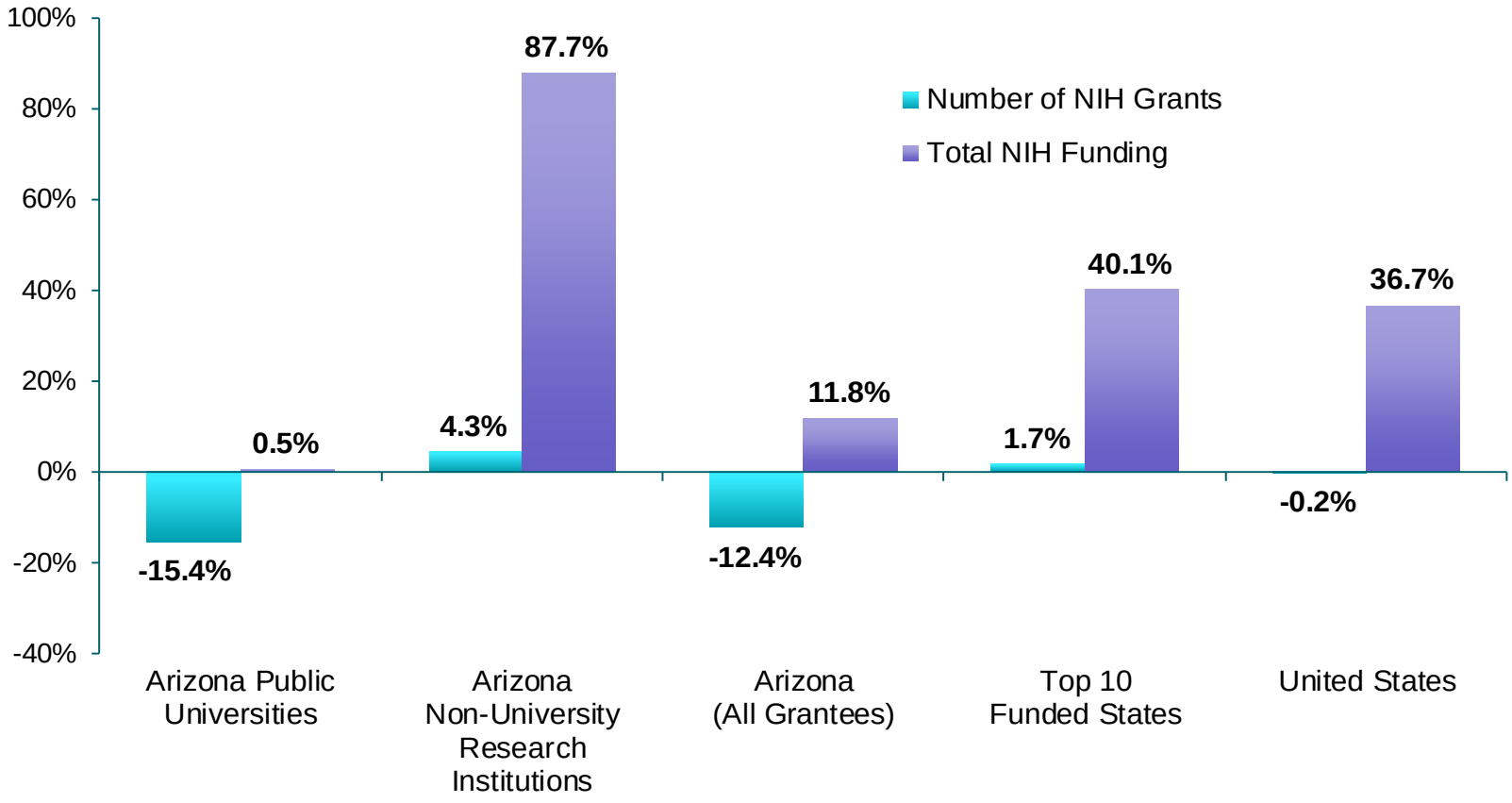


Source: NIH *RePORT* database, and TEConomy Partners calculations

METRIC: NIH

ARIZONA'S BIOSCIENCE ROADMAP

NIH Grants, Funding Growth: 2002-15

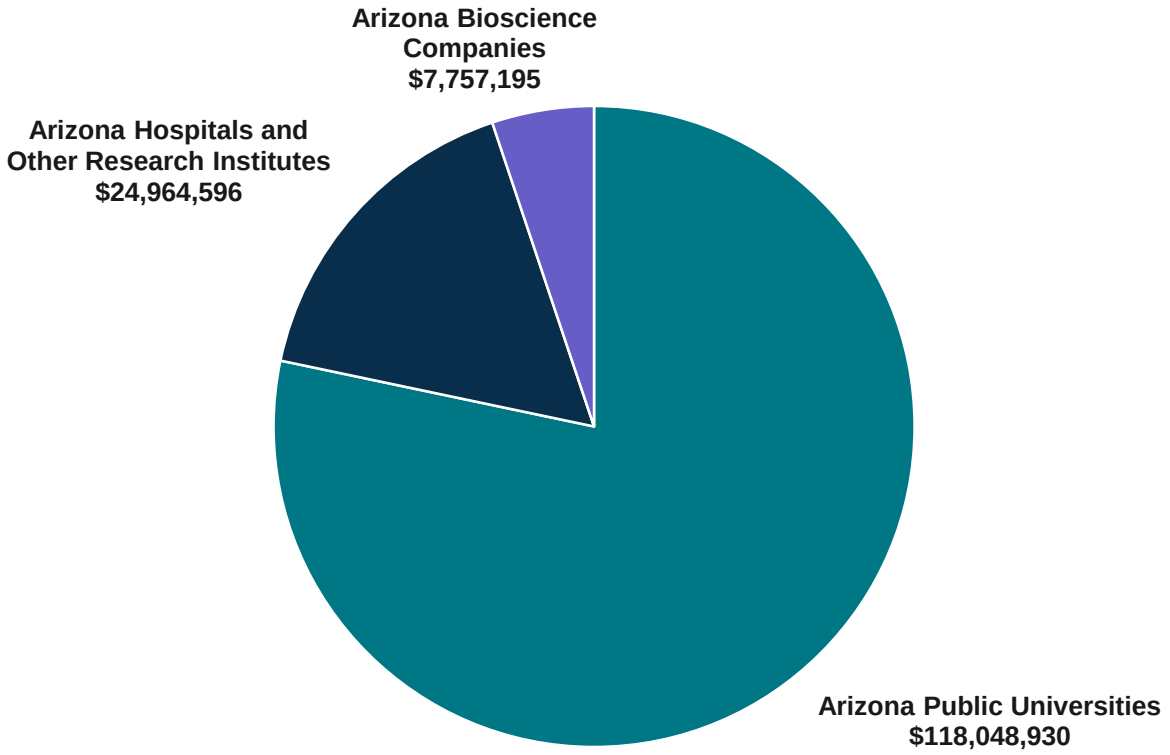


Source: NIH *RePORT* database, and TEConomy Partners calculations

METRIC: NIH

ARIZONA'S BIOSCIENCE ROADMAP

AZ NIH Funding Distribution: FY 2015

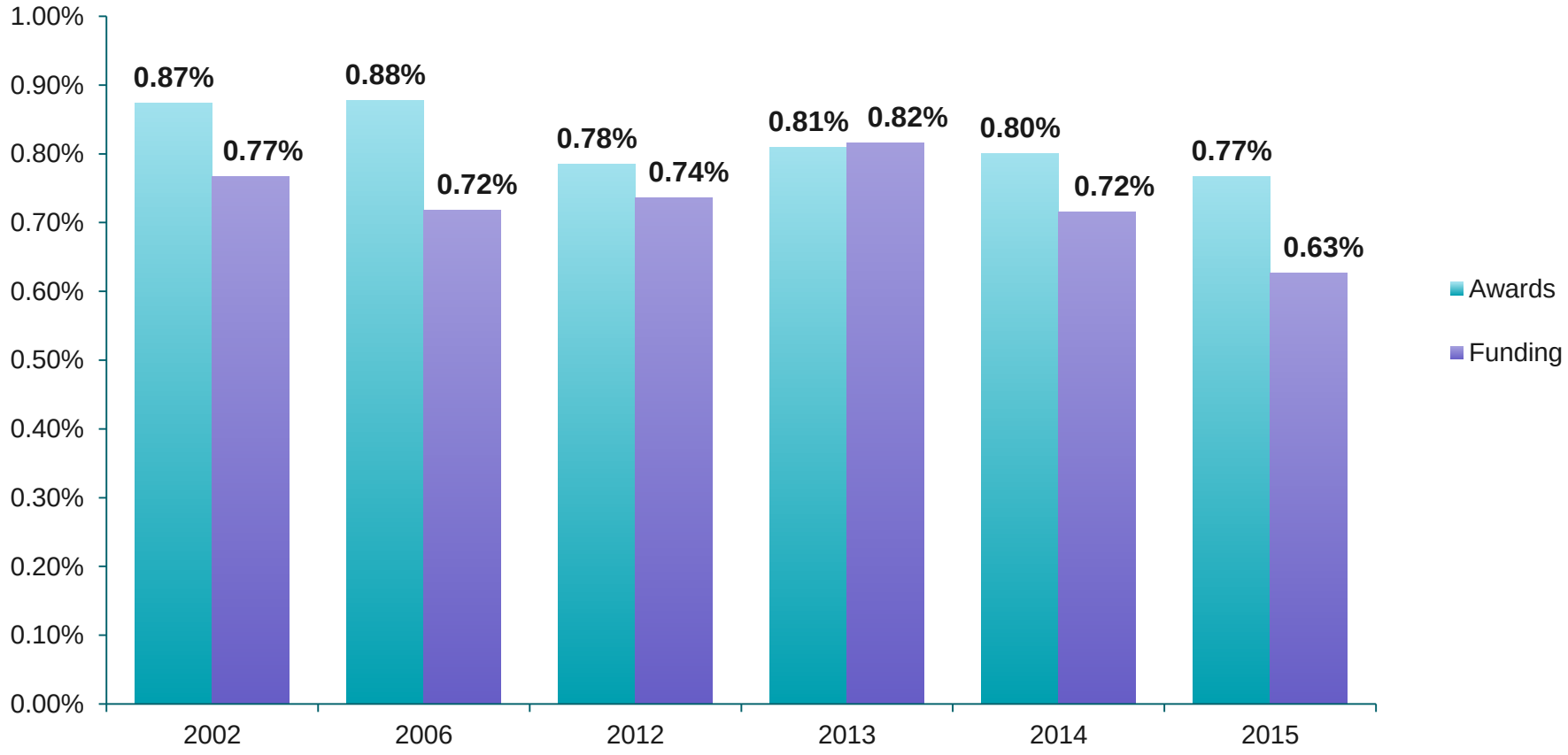


Source: NIH *RePORT* database, and TEConomy Partners calculations

METRIC: NIH

ARIZONA'S BIOSCIENCE ROADMAP

Arizona Share of NIH Support



Source: NIH *RePORT* database, and TEConomy Partners calculations

AZ University Bioscience Tech Transfer: 2014-15

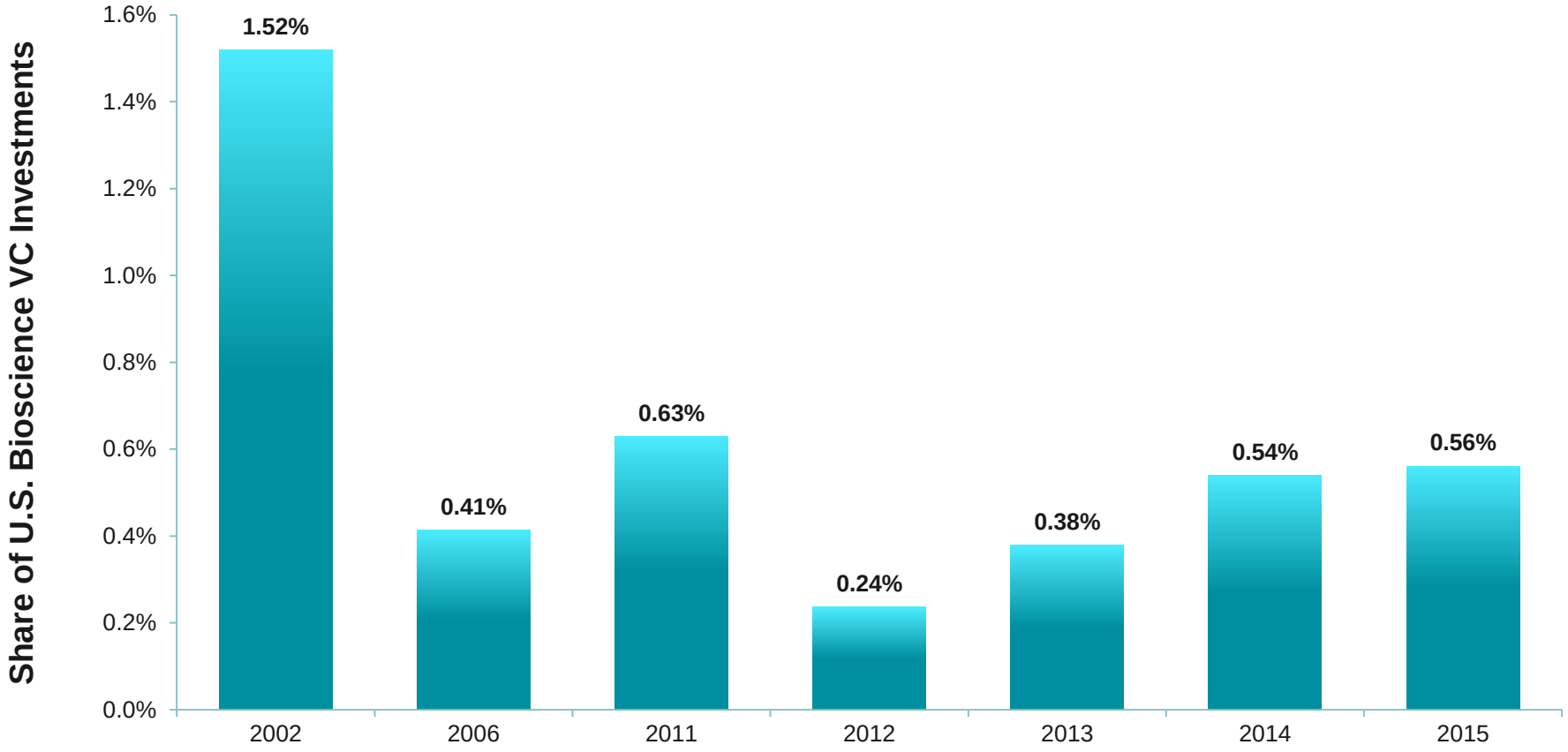
Key Tech-Transfer Metrics	Total 2014-2015	Growth 2012-13 to 2014-15	Bio Share of Tech Transfer 2014-15
Bioscience R&D Expenditures	$736.4M	n/a	34.2%
Invention Disclosures Received	521	54.1%	53.0%
Total U.S. Patent Applications Filed	397	21.0%	54.8%
U.S. Patents Issued	81	72.3%	44.0%
Licenses & Options Executed	121	26.0%	37.0%
Adjusted Gross License Income Received	$7.7M	30.9%	77.2%
Bioscience Startups from University IP	21	23.5%	42.9%

Source: Arizona university technology transfer offices

METRIC: VENTURE CAPITAL

ARIZONA'S BIOSCIENCE ROADMAP

AZ Share of U.S. Bio Venture Capital: 2002-15

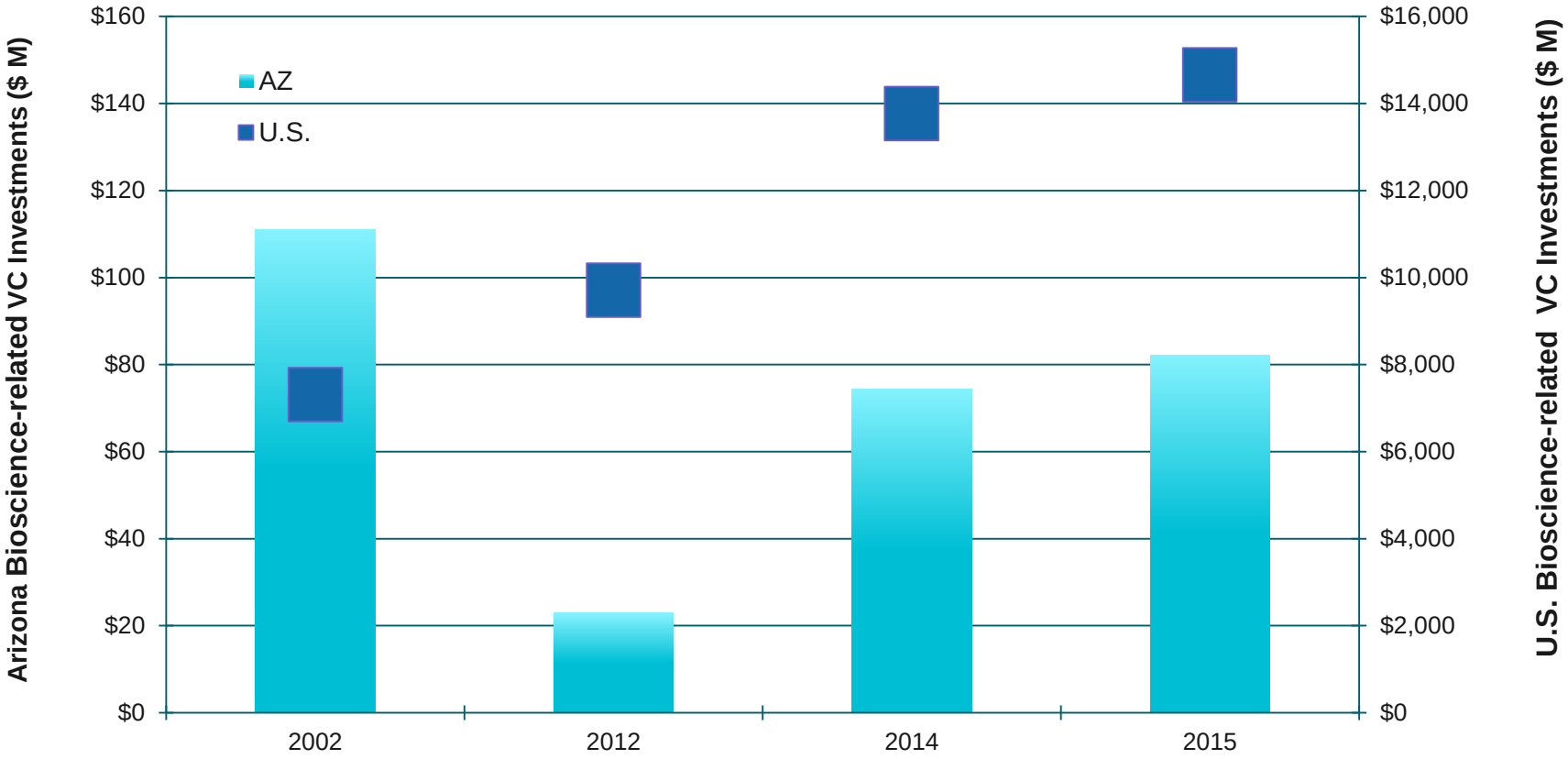


Source: Thomson Reuters Thomson One Database with TEConomy Partners Calculations

METRIC: VENTURE CAPITAL

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. Bio Venture Capital: 2002-15

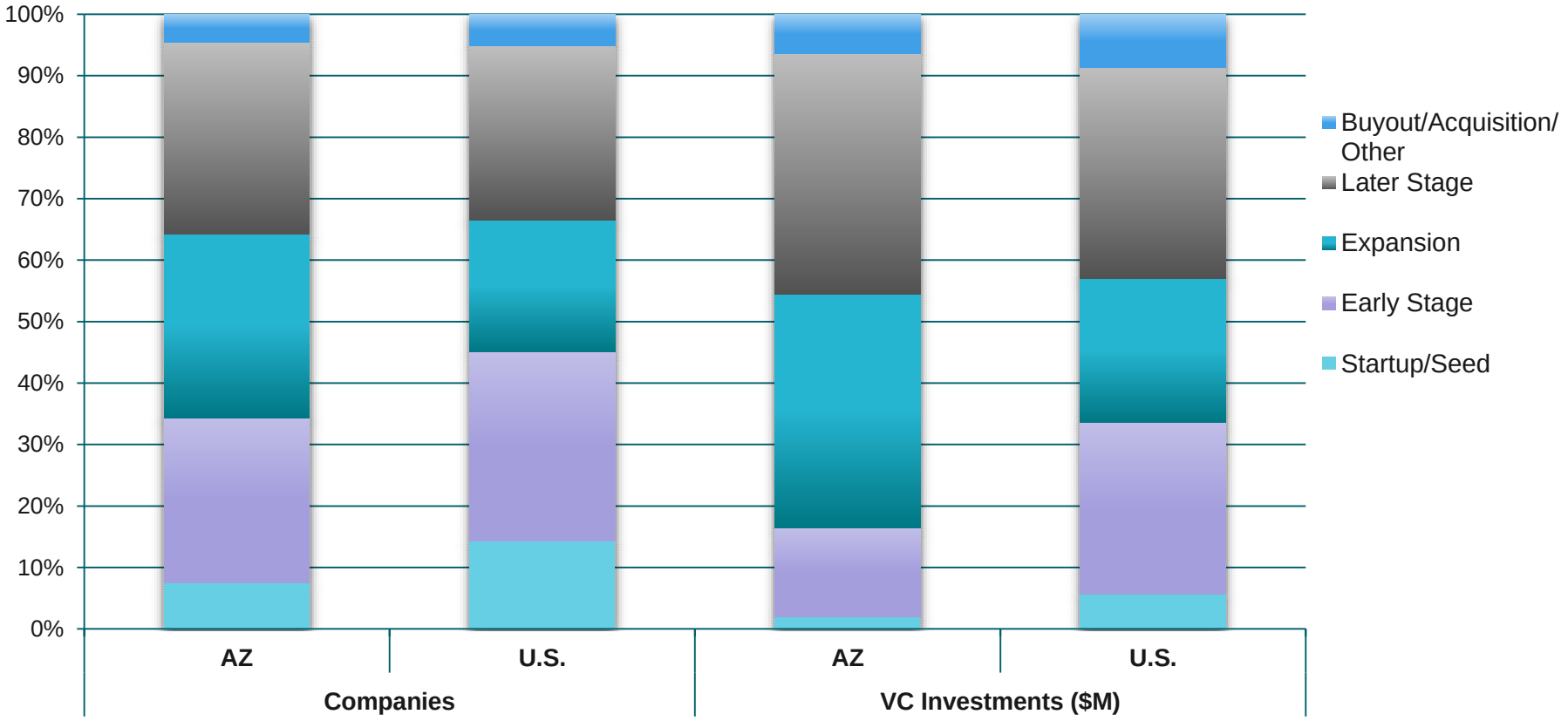


Source: Thomson Reuters Thomson One Database with TEConomy Partners Calculations

METRIC: VENTURE CAPITAL

ARIZONA'S BIOSCIENCE ROADMAP

AZ & U.S. Venture Capital by Stage



Source: Thomson Reuters Thomson One Database with TEConomy Partners Calculations

METRIC: VENTURE CAPITAL

AZ & U.S. Bio Share of Venture Capital, 2002-15*

Metric	ARIZONA				U.S.		
	Bio VC	Total VC	Bio Share of Total AZ VC	AZ Bio Share of U.S. Bio VC	Bio VC	Total VC	Bio Share of Total U.S. VC
Number of Deals	126	479	26%	0.71%	17,833	67,147	27%
Number of Individual Companies Invested in	40	168	24%	0.78%	5,104	23,613	22%
Investment (in $ Millions)	$716	$3,687	19%	0.50%	$142,964	$567,345	25%

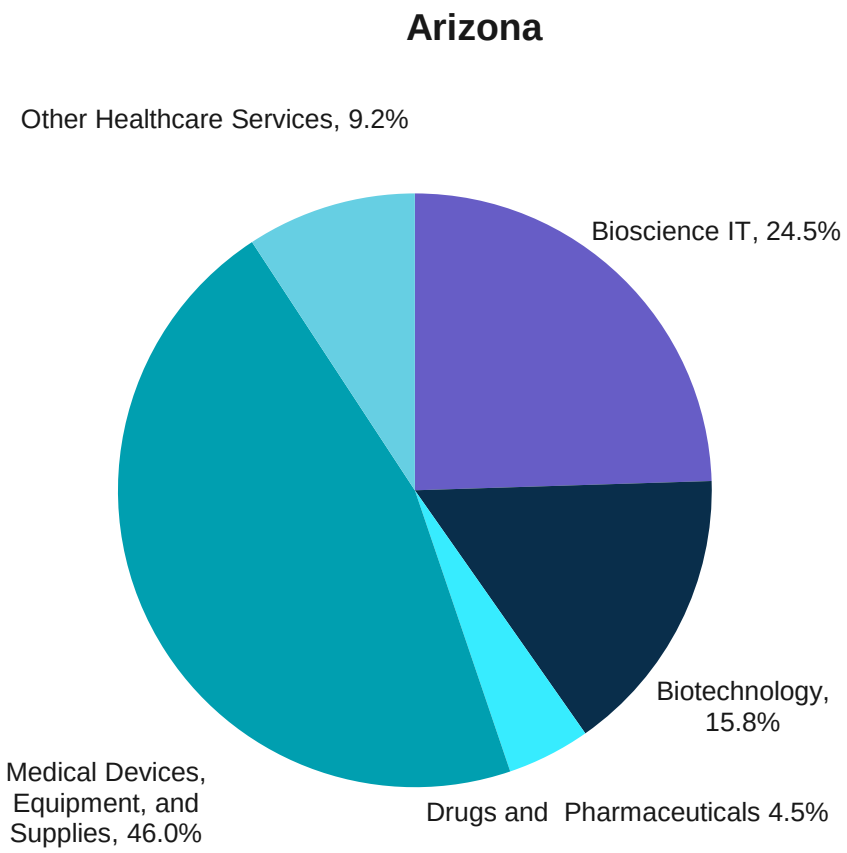
Source: Thomson Reuters Thomson One Database with TEConomy Partners Calculations

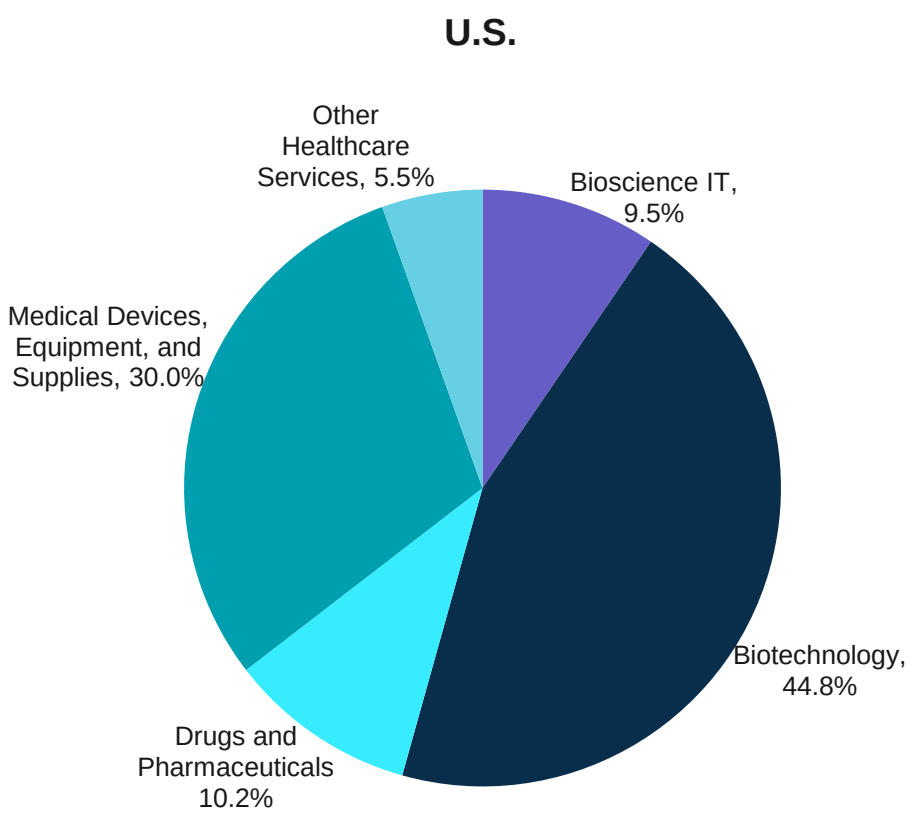
* Because the Thomson One Database is continually updated, VC data presented may not correspond exactly to data in previous iterations of this report.

METRIC: VENTURE CAPITAL

ARIZONA'S BIOSCIENCE ROADMAP

Share of VC Investments by Bio-Related Industry

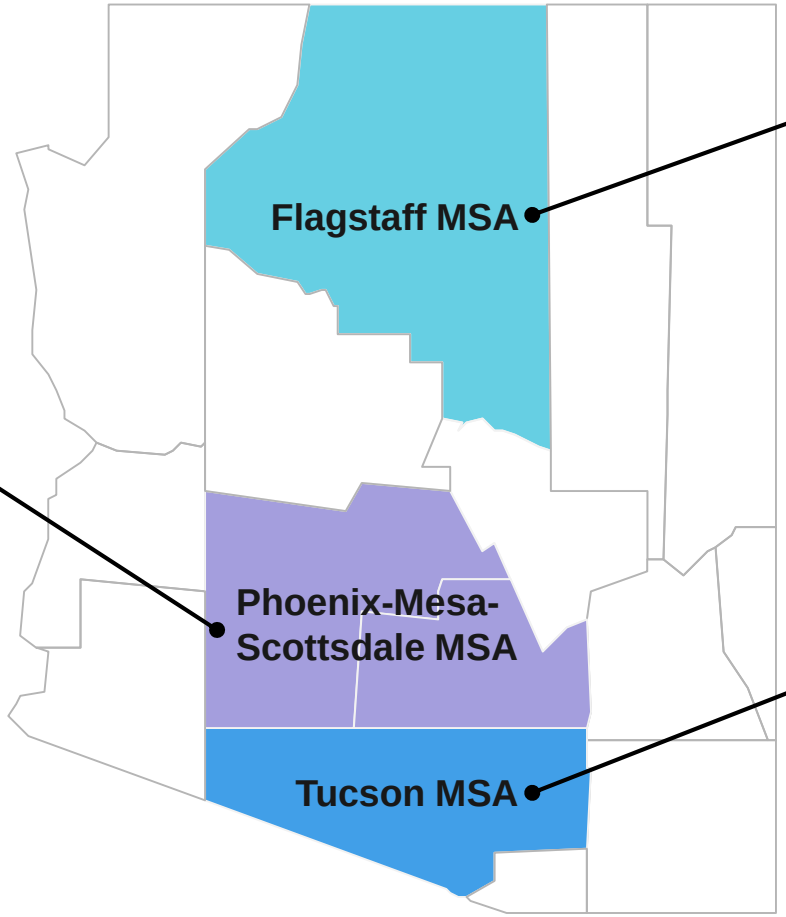




Source: Thomson Reuters Thomson One Database with TEConomy Partners Calculations

REGIONAL BIO STRENGTHS

ARIZONA'S BIOSCIENCE ROADMAP



Medical Devices & Equipment; Hospitals

Research, Testing & Medical Labs; Bioscience-Related Distribution; Hospitals

Research, Testing & Medical Labs; Hospitals; Medical Devices & Equipment

FLAGSTAFF METRO AREA

ARIZONA'S BIOSCIENCE ROADMAP

Key Bioscience Subsector	Establishments, Employment Level & Concentration (2014)	Regional Strengths/ Highlights
Medical Devices & Equipment	Establishments: 2 Employed: 2,321 Employment Growth (02-14): 160% Location Quotient: 17.94	Flagstaff remains highly specialized in medical devices, at almost 18 times the average employment concentration of the nation.
Hospitals	Establishments: 2 Employed: 3,566 Employment Growth (02-14): 44% Location Quotient: 1.96	The hospital subsector is a large employer in Flagstaff, with over 3,500 workers in 2014. It is also growing quickly, with employment increasing by 44% from 2002-14.

Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

PHOENIX-MESA-SCOTTSDALE

ARIZONA'S BIOSCIENCE ROADMAP

Key Bioscience Subsector	Establishments, Employment Level & Concentration (2014)	Regional Strengths/ Highlights
Research, Testing & Medical Laboratories	Establishments: 266 Employed: 5,974 Employment Growth (02-14): 63% Location Quotient: 0.88	Employment in research, testing & medical labs approaching 6,000 in metro Phoenix, with substantial growth of 63% from 2002-14.
Bioscience-related Distribution	Establishments: 616 Employed: 6,913 Employment Growth (02-14): 14% Location Quotient: 1.11	Bioscience-related distribution in the Phoenix area is largest non-hospital subsector in metro Phoenix, 11% more concentrated than the U.S.
Hospitals	Establishments: 84 Employed: 54,801 Employment Growth (02-14): 53% Location Quotient: 0.83	Hospitals remain the predominant subsector for bioscience employment in metro Phoenix, with 53% growth over 2002-14 period.

Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

TUCSON METRO AREA

ARIZONA'S BIOSCIENCE ROADMAP

Key Bioscience Subsector	Establishments, Employment Level & Concentration (2014)	Regional Strengths/ Highlights
Research, Testing & Medical Laboratories	Establishments: 65 Employed: 1,167 Employment Growth (02-14): 36% Location Quotient: 0.97	The research, testing & medical labs subsector in the Tucson area increased employment by 36% over the 2002-14 period.
Hospitals	Establishments: 13 Employed: 16,243 Employment Growth (02-14): 31% Location Quotient: 1.39	Tucson has a large, growing, and specialized hospital subsector with 39% higher employment concentration than the nation.
Medical Devices & Equipment	Establishments: 23 Employed: 1,082 Employment Growth (02-14): 88% Location Quotient: 1.30	Tucson's medical devices & equipment subsector grew by 88% over the 2002-14 period, 30% more highly concentrated than the nation.

Source: TEConomy Partners LLC analysis of Bureau of Labor Statistics, QCEW data from IMPLAN Group LLC

TRANSFORMATIVE MEASURES

ARIZONA'S BIOSCIENCE ROADMAP

Arizona's Targets for 2025:

1. **Risk Capital:** Reach market share equal to population ($100-125M annually in bioscience venture capital, $25-40M in pre-seed/seed).
2. **Research:** Reach national performance level for bioscience research revenue at research-performing institutions ($782M annually).
3. **Infrastructure:** Invest $500-750M over 10 years in academic research infrastructure.
4. **Anchors:** Add 5-7 cornerstone bio institutions.
5. **Regional Connections:** Strengthen ties with economic partners beyond Arizona to support industry maturation and specialization.

TRANSFORMATIVE MEASURES

ARIZONA'S BIOSCIENCE ROADMAP

Arizona's Challenge

To achieve Arizona's targets for 2025, it must **enhance research** that stimulates **new venture formation** and can **attract capital**—increasing the likelihood that **new anchors** will emerge in the state.

EMERGING BEST PRACTICES

ARIZONA'S BIOSCIENCE ROADMAP

Increasing industry/academia collaborations:

Fast pace of basic scientific insights into biological processes informs advances in medical discovery.

Key BIO Report:

Advancing Translational Research for Biomedical Innovation: Measuring Industry-Academic Connections

- 23% increase over 10 years in joint industry-academic publications in biomedical-related fields;
- 81.5% increase over 10 years in industry patents citing academic research informing innovations.

EMERGING BEST PRACTICES

ARIZONA'S BIOSCIENCE ROADMAP

A "Real-World" Context of Developments to Advance Translational Research

Basic & Applied Research	Technology Development	Clinical Trials	New Product Launch
Multi-Institutional/ Multi-Company Collaborations	Partnerships of Clinicians-Engineers-Scientists	Regional Clinical Trials Consortia	Experimental Therapeutics Centers
Open Innovation Collaborations	New Venture Development Organizations	CRO-CTSI Partnerships	Advanced Biomanufacturing Centers
		Centralized Patient Registry	

EMERGING BEST PRACTICES

ARIZONA'S BIOSCIENCE ROADMAP

Building new research anchors with industry:

Indiana Biosciences Research Institute

- New public-private partnership launched in 2013
- $50M initial investment: $25M state investment matched by industry and foundations
- Focus on attracting 8-12 leading research teams to Indiana to collaborate and work alongside industry research-and-development teams
- Initial focus on metabolic health and nutrition
- Industry members include Lilly, Roche, Dow AgroSciences, Cook, and Biomet/Zimmer
- Anchoring new innovation district in Indy – "16 Tech"

EMERGING BEST PRACTICES

ARIZONA'S BIOSCIENCE ROADMAP

Creating a signature shared-use facility to further commercialization:

Oregon Translational Research and Development Institute (OTRADI)

- Launched as a Signature Research Center of Oregon Inc. in 2007
- Focus on high-throughput and high-content new drug discovery
- Significant activities:
  - 35 Oregon company members using facilities
  - Partnerships with 150+ Oregon university researchers to advance medical discovery
- Recently added a wet-lab incubator facility for bio start-ups

EMERGING BEST PRACTICES

ARIZONA'S BIOSCIENCE ROADMAP

Forming mechanism to create new bio ventures:

GRA Ventures

- Started in 2002 to develop companies from university research
- Multi-phased approach: Identify promising technologies, conduct due diligence, support proof-of-concept, and fund venture start-up
- Record of success:
  - 100 university-based companies assisted, generating $500M in private-equity investments and employment of 600
  - New $20M GRA Venture Fund, LLC. focused on Series A early-stage investments in 2009—state commitment of $7.5M in capital investment and income tax credits for investors of 25 percent

CONTACT

ARIZONA'S BIOSCIENCE ROADMAP

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