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A Northern Arizona Bioscience Roadmap

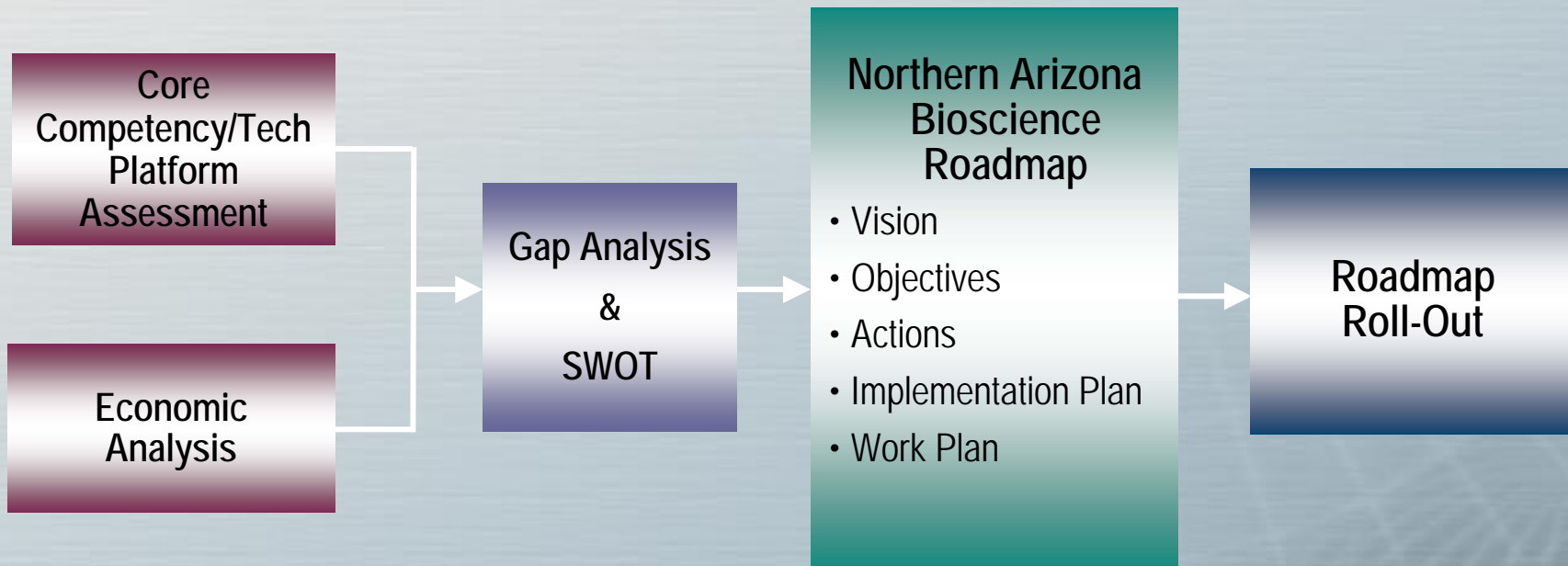
Financial Support Provided by The Flinn Foundation

Walter H. Plosila, Ph.D.
Vice President

October 16, 2007

Methodology to Prepare Northern Arizona's Bioscience Roadmap

Northern Arizona Bioscience Roadmap Steering Committee

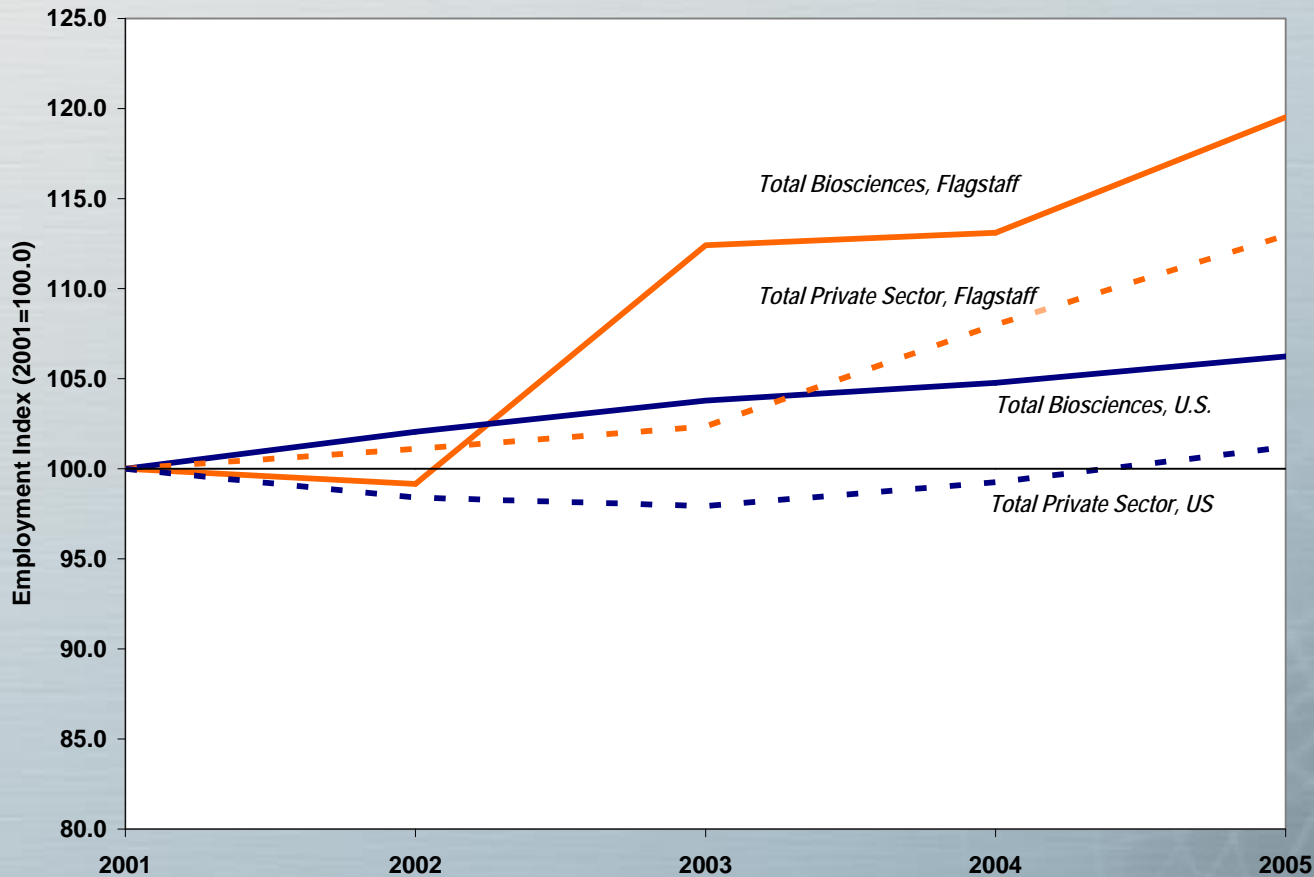


Northern Arizona's Bioscience Sector is Growing

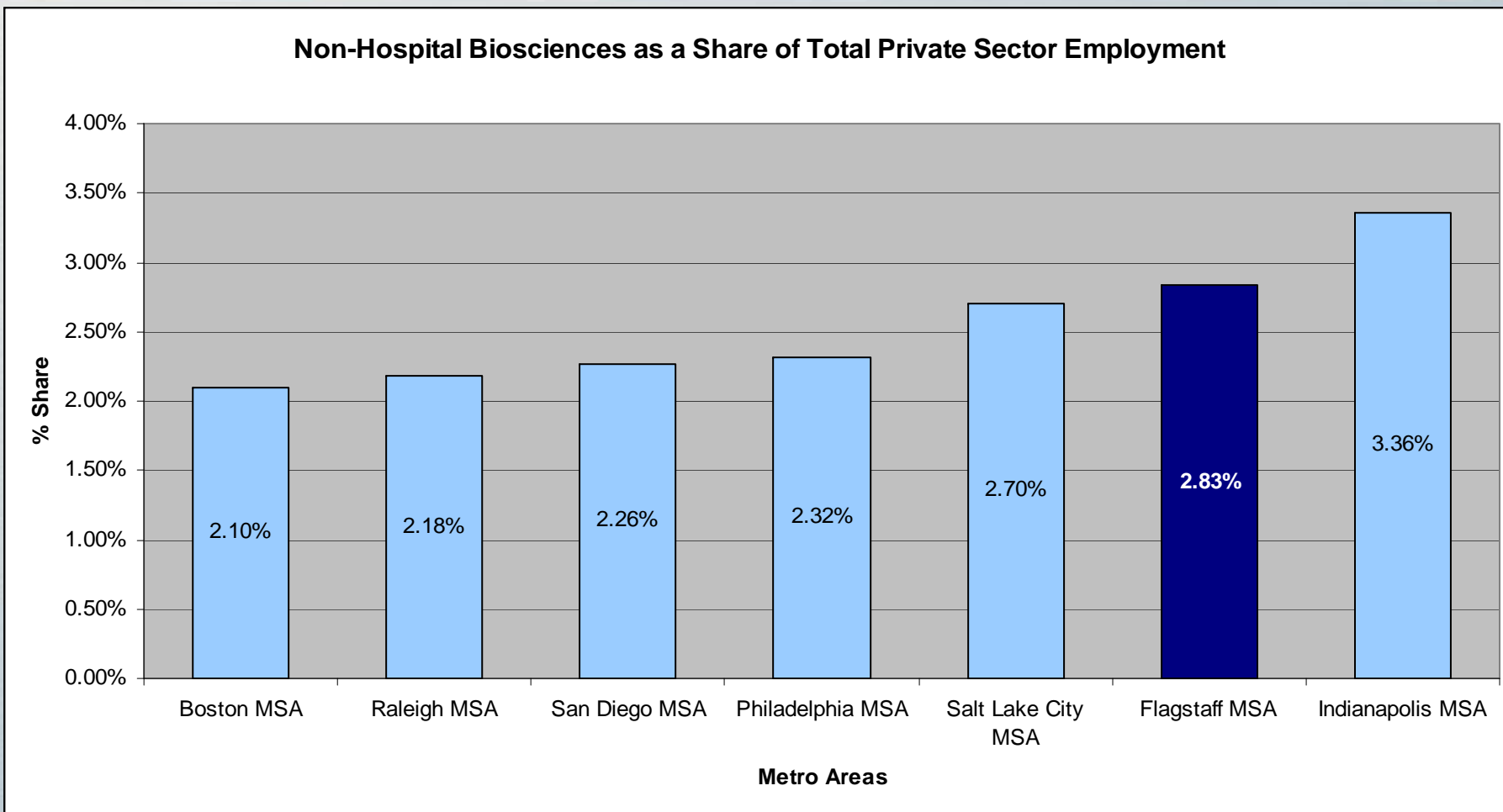
- ***Key Economic Findings:***

- Bioscience employment in the Flagstaff metropolitan area grew three times faster than that of the nation between 2001 and 2005
- The Flagstaff metro area accounts for 5.4 percent of Arizona's bioscience jobs, although the region accounts for only 2.9 percent of total statewide employment
- Medical devices and equipment is the fastest growing bioscience subsector and the most specialized, due to the presence of W.L. Gore
- Hospitals are the largest employer in the region's bioscience sector
- The Prescott MSA has experienced strong job growth in the biosciences, with employment growing 12 percent between 2001 and 2005

Flagstaff bioscience firm employment grew by 19.5% between 2001 and 2005 greatly outpacing the national growth rate of 6.2%

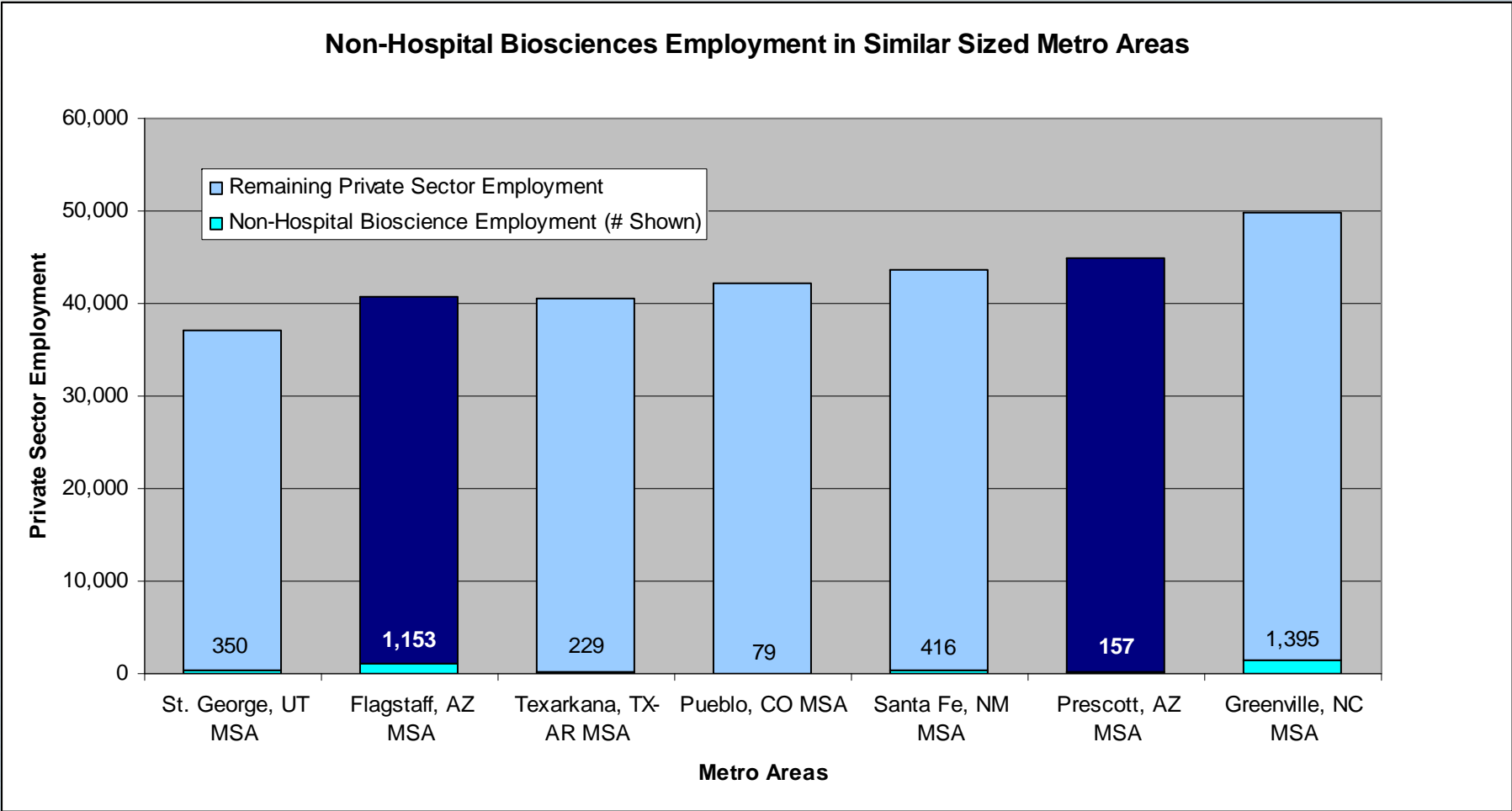


Flagstaff Compares Favorably in its "Share" of Bioscience Employment with Leading National Regions



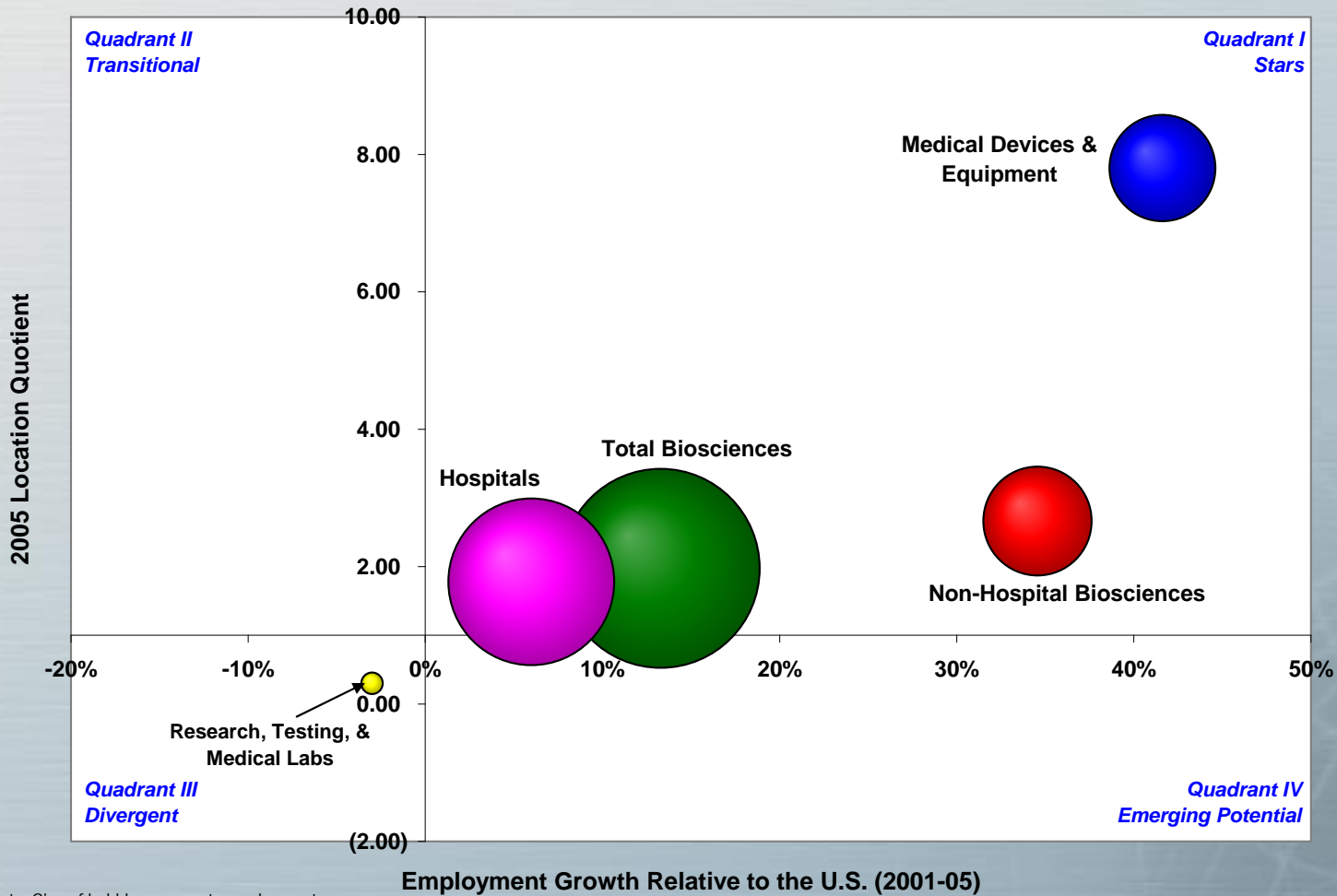
Note: All regional comparison data are from 2004.

Among Similar Sized Metros Flagstaff and Prescott Also Competitive



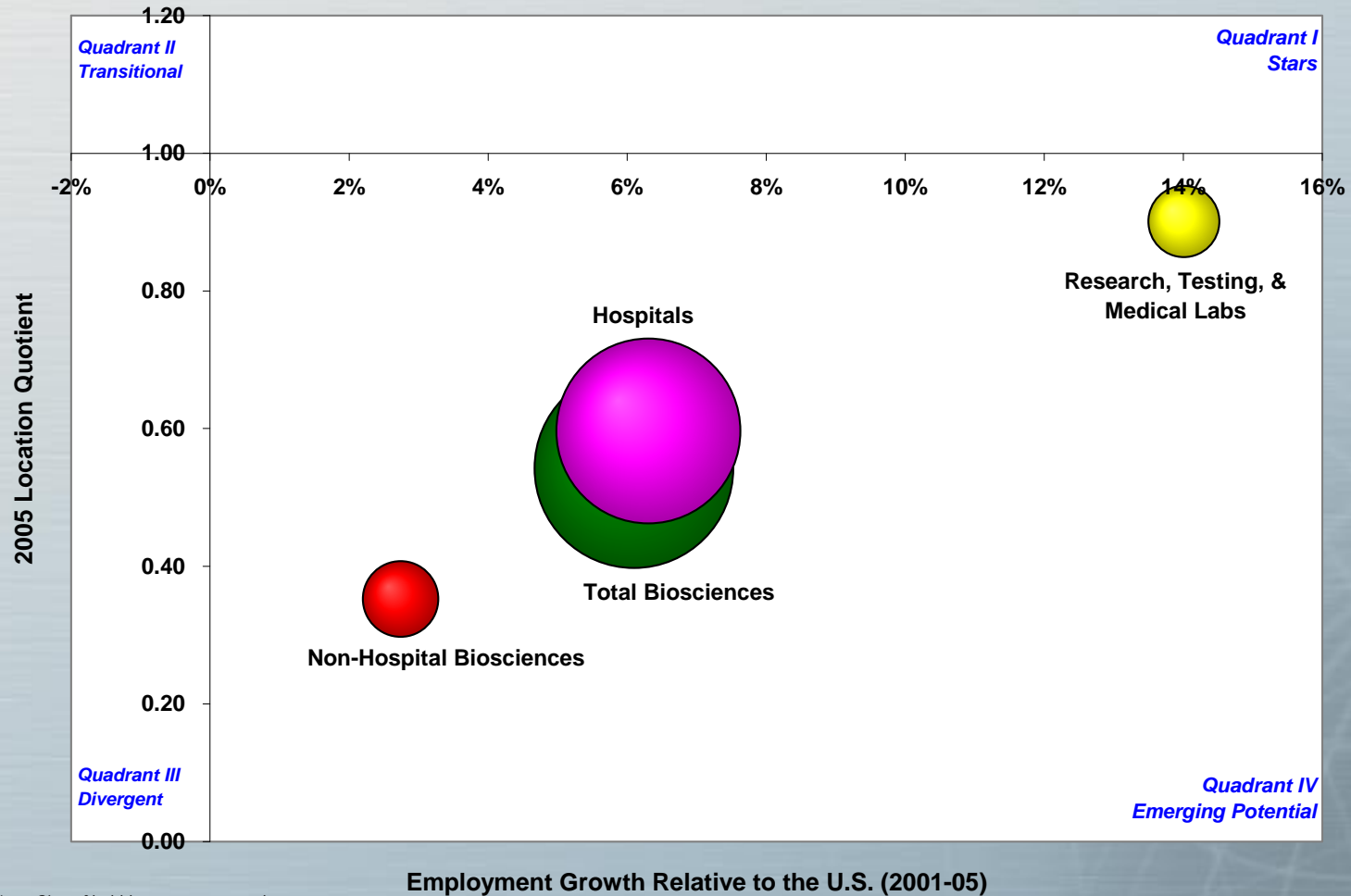
Note: All regional comparison data are from 2004.

Flagstaff Bioscience Subsectors



Note: Size of bubble represents employment.

Prescott Bioscience Subsectors

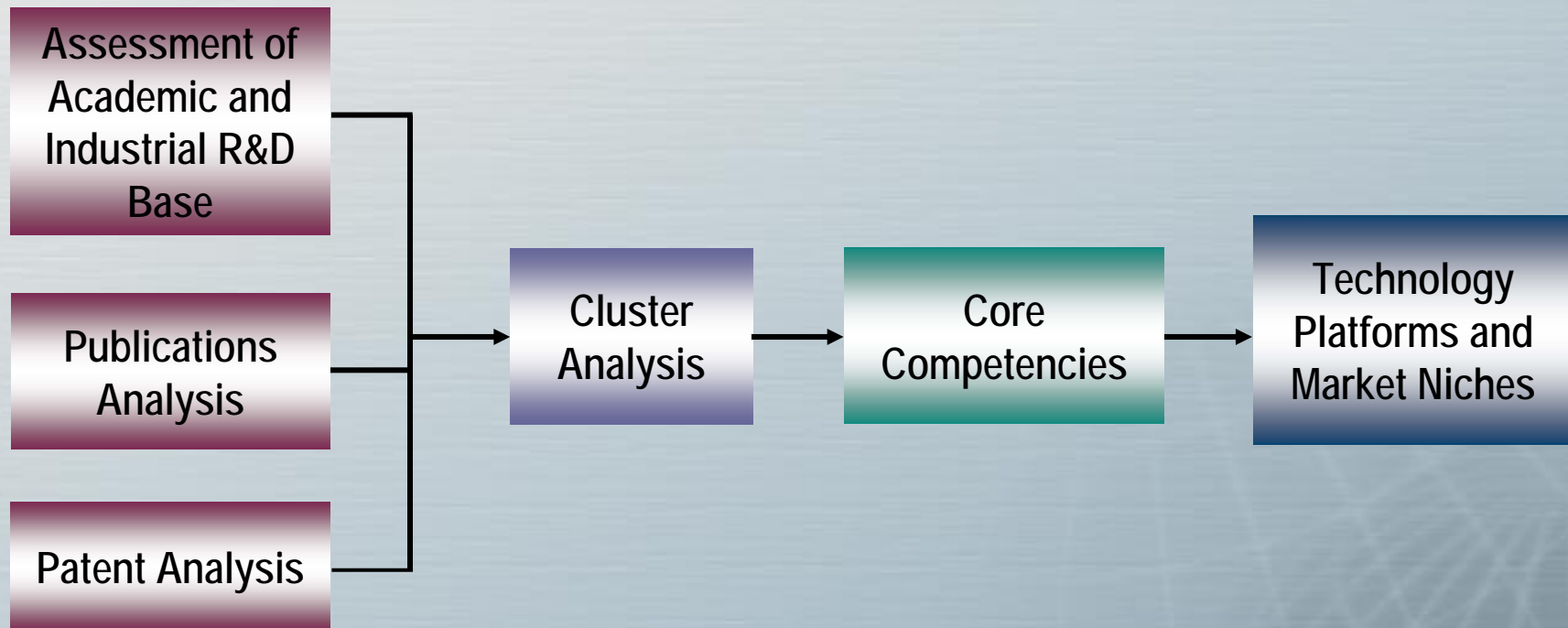


Note: Size of bubble represents employment.

No. Arizona Bioscience Workers Earn Higher Wages than the Overall Private Sector

Northern Arizona: Average Annual Wages by Industry, 2005		
Industry	Flagstaff MSA	Prescott MSA
<i>Medical Devices & Equipment</i>	\$46,466	\$44,806
<i>Total Non-Hospital Biosciences</i>	\$46,041	\$36,405
<i>Total Biosciences</i>	\$45,363	\$45,279
<i>Hospitals</i>	\$45,074	\$46,774
Management of Companies & Enterprises	\$44,920	\$69,120
Wholesale Trade	\$44,733	\$40,090
Manufacturing	\$43,958	\$33,850
Health Care & Social Assistance	\$40,641	\$32,965
Finance & Insurance	\$40,472	\$42,707
Information	\$38,432	\$43,751
<i>Research, Testing, & Medical Labs</i>	\$35,651	\$35,713
Prof., Scientific, & Technical Services	\$35,273	\$35,233
Transportation & Warehousing	\$34,062	\$30,137
Real Estate & Rental & Leasing	\$32,449	\$29,434
Construction	\$28,258	\$30,052
Total Private Sector	\$27,194	\$28,026
Retail Trade	\$22,180	\$23,978
Accommodation & Food Services	\$14,564	\$14,546

Methodology used to identify Northern Arizona specific bioscience platforms



Northern Arizona's Bioscience R&D Base

- Northern Arizona's bioscience R&D base is growing but remains small
 - Bioscience R&D grew from \$6 million in FY 97 to \$16 million in FY 05
- Quality of R&D is high as demonstrated by NIH awards
 - Average increase in NIH funding to NAU researchers of 20% was double the national average
- In addition to biomedical research, Northern Arizona has a research base in environmental biology

Criteria for selecting technology platforms for development

- Builds on existing strengths
- Has a base of emerging or established commercial activity
- Provides opportunities to leverage region's comparative advantages
- Has significant product market potential
- Links to or reinforces other bioscience strengths and core competencies

Linkages to Statewide Arizona Technology Platforms – Biomedical Engineering Needs to Be Addressed

Research Core Competencies

Key Bioscience Strength Areas

Infectious diseases

Environmental & ecological systems

Muscle Physiology

Additional Strength Areas

Engineering (sensors/diagnostics)

Computational modeling of cell signaling

Chemistry

Native American health

Northern Arizona competencies link to four primary statewide bioscience technology platforms.

Cancer

Bioengineering

Bioagriculture

Infectious Diseases

Two areas -- Diagnostics Technology and Environmental Technology -- Hold the Greatest Promise for Development in Northern Arizona

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Diagnostics Technology

Environmental Technology

Applications and Markets for Diagnostics Technology

Applications and Products	<ul style="list-style-type: none">• Biosecurity products• Disease diagnostics technology and tools• Sensors, nanotechnology and MEMS devices
Markets	<ul style="list-style-type: none">• Molecular diagnostics markets overlap with markets for non-molecular diagnostic technologies in the in vitro diagnostic market and are less well defined than those for pharmaceuticals. In the year 2005, the global market for molecular diagnostics was worth \$6.5 billion, representing approximately 3.3% of the total diagnostics market and approximately 14% of the in vitro diagnostic market. (Source: Jain PharmaBiotech 2006)• The molecular diagnostics market will expand to \$12 billion by 2010 and \$35 billion by 2015. A major portion of it can be attributed to advances in genomics and proteomics. Biochip and nanobiotechnology are expected to make a significant contribution to the growth of molecular diagnostics. (Source: Jain PharmaBiotech 2006)• Fuji-Keizei USA specifically examined the biosensor market and estimates that the market size for worldwide biosensors at year end 2003 was about \$7.3 billion. They project a growth rate of 10.4% to \$10.8 billion in 2007.

Applications and Markets for Environmental Technologies

Applications and Products	<ul style="list-style-type: none">• Environmental restoration and remediation technology• Monitoring and sensing systems• Testing and certification tools and services
Markets	<ul style="list-style-type: none">• The global market for environmental products and services is worth about \$520 billion per year. At approximately \$205 billion, the U.S. represents 39 percent of the global revenues and ranks number one in the world. It is almost twice the size of its nearest competitor, Japan. Last year, U.S. exports of environmental technology goods and services topped \$21 billion, producing a positive trade balance of \$10 billion and creating about 170,000 jobs. (Source: National Defense Industry Association)• The \$453 billion global environmental market is growing faster than the global economy and is outpacing growth in the US environmental market. (Source: US National Defense University)• Fuji-Keizei USA specifically examined the biosensor market and estimates that the market size for worldwide biosensors at year end 2003 was about \$7.3 billion. They project a growth rate of 10.4% to \$10.8 billion in 2007.• The world carbon trading emissions market expanded to nearly \$21.5 billion in the first nine months of 2006, up from about \$11 billion for all of 2005 (Source: World Bank)• Phytoremediation is applicable to a number of hazardous waste and other remedial scenarios, which offer sizable potential markets. Markets for remediation of organics, metals and radionuclides from soils and water, combined with municipal and industrial wastewater treatment markets, the treatment of polluted runoff, primarily including landfill leachate, and the market for removing inorganic contaminants such as nitrate from drinking water supplies, offer a total potential market size of U.S. \$33.8-49.7 billion per year. (Source: D. Glass Associates)

Factors for Success: Building a Regional Bioscience Economy

Ingredients for building a critical mass in the biosciences in states and regions include:

- Engaged universities with active leadership
- Building entrepreneurial cultures with intensive networking across sectors and with industry
- Available capital covering all stages of business cycle
- Discretionary federal or other R&D funding
- Workforce and talent pool
- Access to specialized facilities and equipment
- Supportive business, tax and regulatory policies
- Patience and a long-term perspective

Northern Arizona has key bioscience assets and challenges

Competitive Advantages

- Quality of life that appeals to many talented individuals
- Emerging base of bioscience companies that offer high-wage jobs
- Northern Arizona University
 - Tech Platform Strengths
 - Students and Graduates
- Strong talent pool
 - CCC and Yavapai College
- Developing technology infrastructure
 - Science and Tech Park
 - Incubator
 - USGS campus
 - Tech Park at Embry Riddle
 - TGen North

Challenges

- High cost of housing and worker shortages
- Lack of diversified bioscience employment base
- Inability to retain more of the graduates of the region's colleges and universities
- NAU has a small research base and limited interaction with industry
- K-12 schools are not graduating students with sufficient STEM skills and the schools have limited funding to address these needs
- Lack of entrepreneurial support infrastructure
 - Lack of risk capital
- Transportation improvements needed
- Business climate with City perceived as challenging in spite of City's innovative and creative approaches, e.g., USGS, S & T park, etc.

Vision

The biosciences is a key driver of Northern Arizona's economy providing high wage jobs, high quality health care and career opportunities for its citizens. The region is home to a vibrant cluster of bioscience companies and a global leader in medical devices.

Leveraging the Region's Unique Assets

- Growing base of medical device companies and health care institutions and nascent research, testing and medical lab sector
- NAU, USGS and TGen North
- Coconino Community College and Yavapai College
- Proximity to Phoenix
- Image as a tourist destination and region with a very attractive quality of life
- Emerging research strengths at NAU and TGen North to build on

Northern Arizona Bioscience Roadmap

Improve Business Climate for Bioscience Development and Growth

- Continue to invest in technology infrastructure
- Implement initiatives to address housing costs
- Diversify and build the region's bioscience industry sector

Build an Entrepreneurial Culture that Supports Entrepreneurs and Emerging Bioscience Companies

- Address risk capital gaps by reforming Forest Angels and helping companies access SBIR/STTR
- Provide business mentoring for bioscience entrepreneurs and emerging bioscience companies
- Continue and expand networking

Build R&D Base Around Key Platforms

- Grow NAU's research base in identified platforms and facilitate commercialization
- Establish industry liaison and technology transfer capacity at NAU
- Establish tech commercialization function at NAU and provide funding for commercialization activities

Build the Region's Bioscience Talent Pool

- Build a stronger NAU pool of graduate students
- Expand health occupation programs with partnerships with universities, community colleges, and other institutions
- Form the Northern Arizona Science Education Initiative
- Address workforce needs of existing bioscience firms by attracting skilled workers and linking students to companies

Critical actions are listed in black

Six Critical Actions

- Address workforce needs of existing bioscience companies
- Implement creative actions to overcome the differentials in regional housing costs
- Address risk capital gaps
- Continue to invest in technology infrastructure
- Grow NAU's R&D base in the statewide platforms and the Northern Arizona specific platforms
- Form the Northern Arizona Science Education Initiative

Critical Action One: Address workforce needs of existing bioscience companies

Rationale	➤ Northern Arizona employers are facing major shortages of sufficiently qualified applicants to fill hundreds of jobs in the health and medical device industries
Proposal	➤ Create new career paths for non-experienced entry-level workers ➤ Expand employer use of part-time students and expand internships and introduce co-op programs ➤ Actively recruit experienced talent to the region <ul style="list-style-type: none">-- Offer salary differentials-- Undertake campaign to attract back former residents-- Create a web site where companies could list job openings and people looking for work could post resumes
Partners	Economic development organizations, Chambers, bioscience business community, educational institutions

Critical Action Two: Implement creative actions to overcome the differentials in regional housing costs

Rationale	➤ High cost of housing makes it difficult to attract and retain workers
Proposal	<p>A combination of initiatives will most likely need to be undertaken to address housing. Options to be considered include:</p> <ul style="list-style-type: none">➤ Rezone to allow increased density➤ Provide direct or indirect subsidies to renters and/or homebuyers➤ Promote controlled growth in nearby communities➤ Create special programs to increase the availability of workforce housing (land banking, swapping, sharing equity with investors, etc.)
Partners	Local governments, business community, NAU, Chambers

Critical Action Three: Address risk capital gaps

Rationale	<ul style="list-style-type: none">➤ Between 1996 and 2006 no bioscience firms in either the Flagstaff or Prescott MSA received a formal venture capital investment➤ The one angel investor group that did exist, Forest Angels Group, has disappeared
Proposal	<ul style="list-style-type: none">➤ Re-form Forest Angels Group➤ Promote the SBIR/STTR program➤ Work with Phoenix and Tucson to create:<ul style="list-style-type: none">-- Statewide bioscience angel network-- Statewide seed fund
Partners	Economic development organizations, NA Technology Incubator, Chambers

Critical Action Four: Continue to invest in technology infrastructure

Rationale	<ul style="list-style-type: none">➤ To grow start-up and emerging bioscience companies, the region needs to make available space and support services➤ Northern Arizona has transportation issues that need to be addressed including limited public transit, limited air service and Interstate highways that need to be upgraded
Proposal	<ul style="list-style-type: none">➤ Complete incubator building and continue development of S&T park in Flagstaff starting with accelerator➤ Pursue funding for infrastructure and an initial building in the Embry Riddle tech park➤ Complete improvements at Flagstaff airport➤ Expand air service at both Flagstaff and Prescott airports➤ Work with state to obtain improvements in I-17 corridor
Partners	Economic development organizations, Chambers, bioscience business community, local governments

Critical Action Five: Grow NAU's R&D base in the statewide platforms and the Northern Arizona specific platforms

Rationale	<ul style="list-style-type: none">➤ NAU's bioscience R&D base is excellent but small, the university does not have a critical mass of researchers➤ Key R&D strengths are too dependent on a single faculty member
Proposal	<ul style="list-style-type: none">➤ Hire additional faculty in the platform areas➤ Make investments in specialized facilities and equipment➤ Expand graduate science programs aligned to industry such as biomedical engineering
Partners	NAU, Board of Regents

Critical Action Six: Form the Northern Arizona Science Education Initiative

Rationale	<ul style="list-style-type: none">➤ Lack of available talent is hindering the growth of existing firms and discouraging bioscience companies from expanding in Northern Arizona➤ The region's schools are not graduating students with strong STEM skills➤ The region is not retaining sufficient numbers of its college graduates
Proposal	<ul style="list-style-type: none">➤ Work with community colleges to increase focus of career education and workforce programs on the biosciences➤ Develop bioscience training curriculum for high school through community college to NAU➤ Tap NAU's expertise in science and math education to train region's K-12 science teachers
Partners	School districts, community colleges, NAU, bioscience business community

Immediate Work Priorities

- City of Flagstaff, NAU, Flag 40 and others need to reach a consensus on near-, mid- and long-term approaches to addressing housing situation
- Convene angel investors to determine interest in re-constituting Forest Angels Group
- Convene public and charter schools, community colleges and NAU to begin planning to create a Northern Arizona Science Education Initiative
- Continue to implement the S&T Park, including incubator build-out and planning for an accelerator and the NATBI
- Work with the ADOC and the EDA to get funding for the development of the tech park at Embry Riddle
- Work with SFAz to determine what investments they might be willing to make to move this Regional Roadmap forward
- Work with the ABOR and ADOC officials as well as SFAz and private sponsors to secure resources for 1) enhancing technology commercialization capabilities at NAU; 2) creating a technology commercialization fund at NAU; and 3) increasing support for NAU graduate students.
- Work with Arizona's Bioscience Roadmap Steering Committee to address need for BioSeed Fund and other risk capital

Northern Arizona Bioscience Steering Committee Members

- **The Honorable Joe C. Donaldson**
Co-Chair
Mayor, City of Flagstaff
- **John D. Haeger, Ph.D.**
Co-Chair
President
Northern Arizona University
- **Stephanie McKinney**
Co-Chair
Former President & CEO
Greater Flagstaff Economic Council
- **Monica Baker**
Dean of Academics
Coconino Community College
- **Paul Begovac, Ph.D**
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W.L. Gore & Associates, Inc.
- **Bill Bradel**
President
Flagstaff Medical Center
- **W. David Chambers**
President
Grand Canyon Railway
- **Marc Chopin, Ph.D.**
Associate Dean & Associate Professor of
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College of Business Administration
Northern Arizona University
- **Kathleen Corak, Ph.D.**
Vice President of Academic Affairs
Coconino Community College
- **Lee Drickamer, Ph.D.**
Interim Vice President of Research
Northern Arizona University
- **Joseph Engelken**
Chief Executive Officer
Tuba City Regional Health Care Corporation

Northern Arizona Bioscience Steering Committee Members

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TGen North
- **William Grabe, Ph.D.**
Professor of English
Northern Arizona University
*Former Interim Vice Provost for Research
and Dean of Graduate Studies
Northern Arizona University*
- **John Holmes**
Manager
City of Flagstaff
- **Laura Huenneke, Ph.D.**
Dean
College of Engineering and Natural
Sciences
Northern Arizona University
- **Thomas Jordan, Ph.D.**
President
Coconino Community College
- **Paul Keim, Ph.D.**
Cowden Chair & Regent Professor
Biological Sciences Department
Northern Arizona University
- **Michael Kerski**
Community Investment Director
City of Flagstaff
- **Mark Landsiedel**
Community Development Director
City of Flagstaff
- **Ingrid Lee, Ph.D.**
Dean of Arts and Sciences
Coconino Community College
- **Stan Lindstedt, Ph.D.**
Associate Dean
College of Engineering & Natural Sciences
Northern Arizona University

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Representative
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- **Willard Ott**
Lecturer
The W.A. Franke College of Business
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*Former President
Northern Arizona Technology and
Business Incubator*
- **Cecilia Owen**
Superintendent of Schools
Coconino County
- **Julie M. Pastrick**
President and Chief Executive Officer
Flagstaff Chamber of Commerce
- **Tim Porter, Ph.D.**
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