

Presentation 2

The Biological Nexus of Technological Innovation.

Kelvin Willoughby

Australian Centre for Innovation

Addressing the challenges of the future through innovation





For One Baby, Life Begins with Genome Revealed

How a California father made an end run around medicine to decode his son's DNA.

Antonio Regalado, *MIT Technology Review*, June 13, 2014
<http://www.technologyreview.com/news/527936/for-one-baby-life-begins-with-genome-revealed/>

An infant delivered last week in California appears to be the first healthy person ever born in the U.S. with his entire genetic makeup deciphered in advance.

His father, Razib Khan, is a graduate student and professional blogger on genetics who says he worked out a rough draft of his son's genome early this year in a do-it-yourself fashion after managing to obtain a tissue sample from the placenta of the unborn baby during the second trimester.

... The idea of sequencing fetuses is extremely new and sensitive. Khan, who had no real medical reason to learn his son's DNA code, says sequencing his son in utero "was more cool than practical." He did it to show where technology is headed and because he likes "pushing the envelope."



Myriad Genetics Posts Key myPath Melanoma Data - Analyst Blog

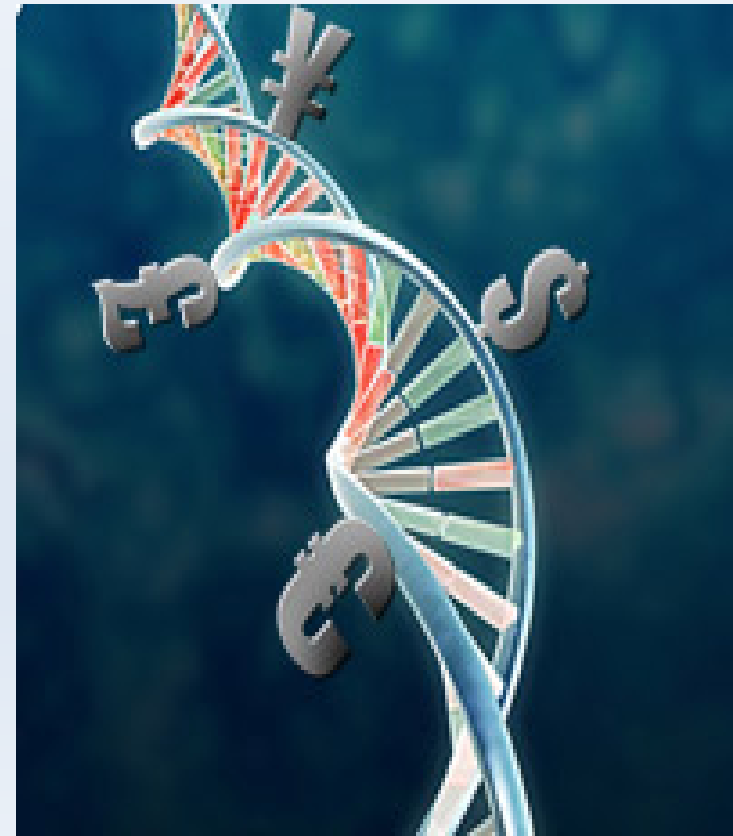
NASDAQ --- Zacks.com, June 03, 2014

<http://www.nasdaq.com/article/-myriad-genetics-posts-key-mypath-melanoma-data-analyst-blog-cm358611/>

Myriad Genetics, Inc. (MYGN) reported results from a crucial clinical validation study of its myPath Melanoma test at the 2014 American Society of Clinical Oncology (ASCO) annual meeting in Chicago. The Myriad myPath Melanoma test is a clinically validated gene expression molecular test that has been designed to differentiate malignant melanoma from benign skin lesions, with a high level of accuracy. With certain melanomas imitating benign skin lesions, it becomes quite difficult for clinicians to diagnose melanoma in patients accurately. In such situations, Myriad myPath Melanoma comes of help as it has the ability to discriminate malignant melanoma from benign skin lesions, as has been observed in the validation study. The test differentiates between the two diseases by using traditional dermatopathology as a gold standard. A quick and accurate diagnosis of potentially fatal melanoma is now possible, thanks to Myriad myPath Melanoma.



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Genentech
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It's ASCO Time!

2014 marks the 50th anniversary of ASCO. This milestone year, we're presenting new data on 9 approved and 18 investigational medicines. Read our latest articles on key ASCO topics.

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Innovative Clinical Science. Improved Patient Care.

Medical Professionals

Our Medicines

Our Pipeline

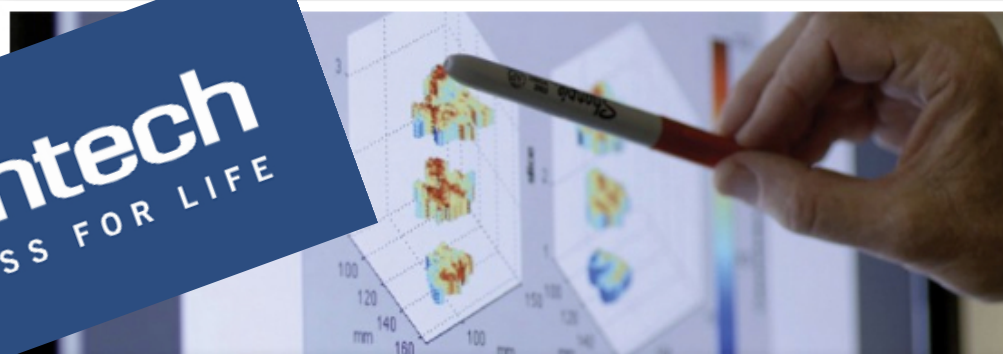
Medical Resources

Sunshine Act Compliance

Anti-Counterfeiting

We focus our research and development practice on discovering and developing new medicines for unmet medical needs. Right now, the Genentech Research and Early Development pipeline has more than 20 new molecular entities in clinical development.

Genentech
IN BUSINESS FOR LIFE



Building a Body of Evidence: Translational Medicine

Sometimes the science in the laboratory doesn't exactly play out as we predicted in clinical trials. So we spend time refining our approach in the lab and in the clinic.



By The Numbers

35

MEDICINES ON THE MARKET

45

MOLECULES IN OUR PIPELINE

785K

SQUARE FEET DEVOTED TO RESEARCH

Most



Gene

Midwest Producer



64°
Broken Clouds
Weekly Forecast

sponsor



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U.S., Australian, Canadian groups commit to wheat biotechnology

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June 11, 2014 12:05 pm

(0) Comments

ARLINGTON, Va. - Sixteen organizations in the Australia, Canada and the United States representing producers and millers publicly confirmed support for innovation in wheat, including the future commercialization of biotechnology. The statement, which lays out shared commitments for the responsible advancement of biotech traits and other breeding advancements in wheat, comes five years after an original document was signed.

This new pledge welcomes the addition of broad-based groups like the American Farm Bureau Federation and the National Farmers Union to a wide coalition of wheat organizations in the three countries.

U.S. organizations signing:
American Farm Bureau Federation; National Association of Wheat Growers; National Farmers Union; North American Millers' Association and U.S. Wheat Associates.

Canadian signatories:
Canadian National Millers Association; Cereals Canada; Grain Farmers of Ontario; Grain Growers of Canada and Western Canadian Wheat Growers Association.

Australian signatories:
AgForce Queensland; Grain Growers Limited; Grain Producers Australia; Grain Producers SA; **Pastoral and Graziers Association of Western Australia** and Victorian Farmers Federations Grains Group.



Center of Excellence for Shrimp Molecular Biology and Biotechnology (CENTEX SHRIMP)



Centex Shrimp, which is an abbreviation for the Center for Excellence for Shrimp Molecular Biology and Biotechnology. It is a multidisciplinary laboratory that was formed in October 2001 by the amalgamation of research laboratories from the Departments of Anatomy, Biochemistry and Biotechnology of the Faculty of Science and It is jointly supported by the Faculty of Science, Mahidol University and the National Center for Genetic Engineering and Biotechnology (BIOTEC).

Vision :

Our vision for the year 2007 is that Thailand will be the world leader in production of healthy & healthful, domesticated shrimp cultivated in biosecure ponds with no negative environmental impact. This could be summarized by the motto, **"Premium shrimp from paradise"**.

Mission:

The mission statement for Centex Shrimp is **"Premier science for premium shrimp"**. This means that its aim is to carry out academically excellent research on molecular biology and biotechnology of shrimp for application in the production of the highest quality of consumer shrimp.

"Premier Science for Premium Shrimp"



Domesticated female brooder

**food, upgraded**

"Aquaculture is currently playing, and will continue to play, a big part in boosting global fish production and in meeting rising demand for fishery products."
– Food and Agriculture Organization of the United Nations

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Who is transgenada?

At TransGenada, we use state-of-the-art biotechnological solutions to create better shrimp broodstock. Our goal is to cultivate superior strains of shrimp that will help farmers be more successful and will promote the growth of aquaculture. Global sustainability, expert personnel, strategic partnerships, cutting-edge integrated product lines, and safety all factor into how we upgrade food. To learn more about TransGenada please click the link below...

[Learn more](#)



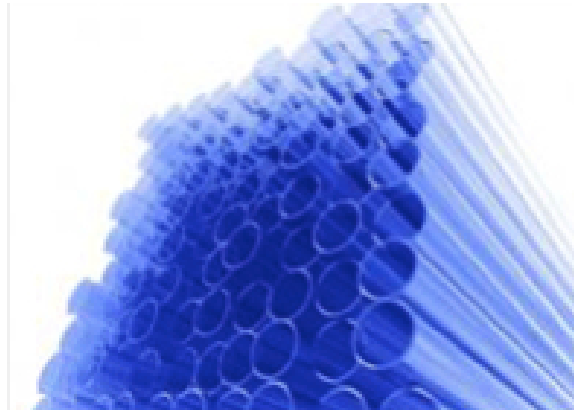
Metabolix, Inc. is an innovation-driven bioscience and engineering company founded in 1992. We focus on providing sustainable solutions to the plastics and chemicals industries.

Metabolix is developing and commercializing a family of high-performance PHA biopolymers targeted to the markets for performance additives, including film and bags, and functional biodegradation. Additionally, Metabolix's biobased chemicals platform utilizes our proprietary "FAST" recovery process to enable the production of cost-effective, high value replacements for petroleum-based industrial chemicals. The Company is also developing a platform for co-producing chemicals and energy from crops.

Metabolix has established an intellectual property portfolio that features more than 500 issued and pending patents across three platforms: biopolymers, biobased chemicals and crops. The Company's industry-leading intellectual property portfolio that, together with our advanced knowledge of industrial practice, is the foundation of our scientific, technological and manufacturing collaborations.

Metabolix biopolymers are based on polyhydroxyalkanoate polymers (PHAs) and are made by fermentation using renewable carbon based feedstocks, making them 100% biobased in neat form. Metabolix has developed leading technology for production of a broad range of PHA biopolymers as evidenced by an industry leading intellectual property portfolio and continues to innovate further to expand the range of performance and production economics of our PHA biopolymers.

Metabolix Performance PHA Biopolymers



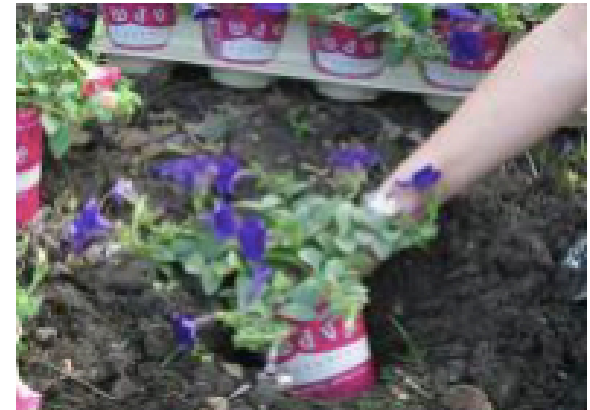
Performance Additives

Metabolix is developing biopolymers as performance additives for conventional and biobased plastics.



Film & Bags

Metabolix performance biopolymers combine performance with sustainability for film and bag applications.



Functional Biodegradation

Metabolix performance biopolymers are a unique biobased material for applications requiring functional biodegradation.

Bottled water, available in US grocery stores



NatureWorks PLA Plant, Blair, Nebraska, USA

\$300 Million Capital Investment

19 months from ground breaking to prime product

10 years to develop technology, know-how, and receptive market

PLA Plant

Blair, Nebraska

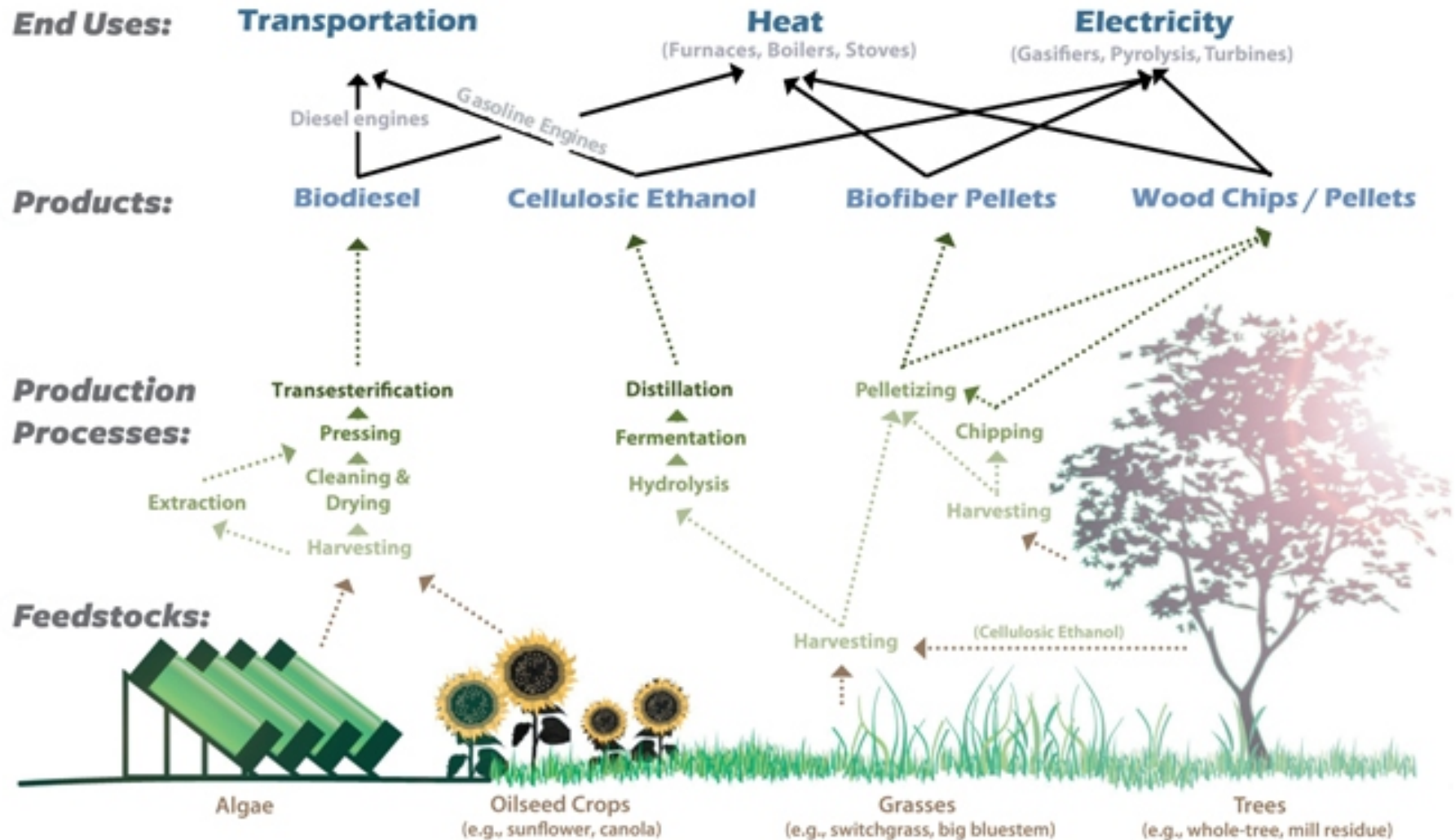
January, 2002



Cargill



Biomass to Biofuels









RNA-Seq misses what

HTA

Delivers!

GeneChip® Human Transcriptome Array 2.0 (HTA) delivers

More transcript isoforms. Higher accuracy and higher precision than 2 full lanes of sequencing data.
From RNA to biology within a week.



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**Human Genotyping
Community**



**Translational Research
Community**



Agrigenomics Community

Educational resources and best practice
for research and commercial

12 June 2014



Medtronic Wants to Implant Sensors in Everyone

In the next few decades, implantable electronics could shift the focus of medical care from reactive, symptom-based diagnosis to early detection or prevention. Heralding that future is the Linq, a new cardiac monitor from medical device giant Medtronic. The company is already envisioning future versions of the implantable gadget, studded with sensors that will give doctors and patients reams of biometric information. The sensors could someday help athletes fine-tune their bodies for improved performance or let an elderly person live independently while his or her vitals are monitored remotely. Medtronic believes that it will eventually be seen as negligent not to have these sensors installed—whether you're elderly and infirm, or young, fit, and healthy.

SEARCH

ADVOCACY

AREAS OF WORK

CONFERENCES & EVENTS

INDUSTRY INTELLIGENCE & ANALYSIS

MEMBER SERVICES

RESOURCES



BIOCENTURY THIS WEEK

CURING THE SYSTEM, PART 2 - Last week House Energy and Commerce Committee Chair Fred Upton (R-Mich.) told BioCentury that it takes too long and costs too much to develop drugs. But what are the solutions?

The second part of BioCentury This Week's look at the Path to 21st Century Cures examines possible solutions and more with:

- Dr. Janet Woodcock, Director of FDA's Center for Drug Evaluation and Research
- Jonathan Leff, Partner at Deerfield Management and Chairman of the Deerfield Institute
- Allan Coukell, Senior Director of Drugs and Medical Devices at The Pew Charitable Trusts

[Watch BioCentury This Week](#)

What is Biotechnology?

At its simplest, biotechnology is technology based on biology - biotechnology harnesses cellular and biomolecular processes to develop technologies and products that help improve our lives and the health of our planet. We have used the biological processes of microorganisms for more than 6,000 years to make useful food products, such as bread and cheese, and to preserve dairy products. [READ MORE](#)



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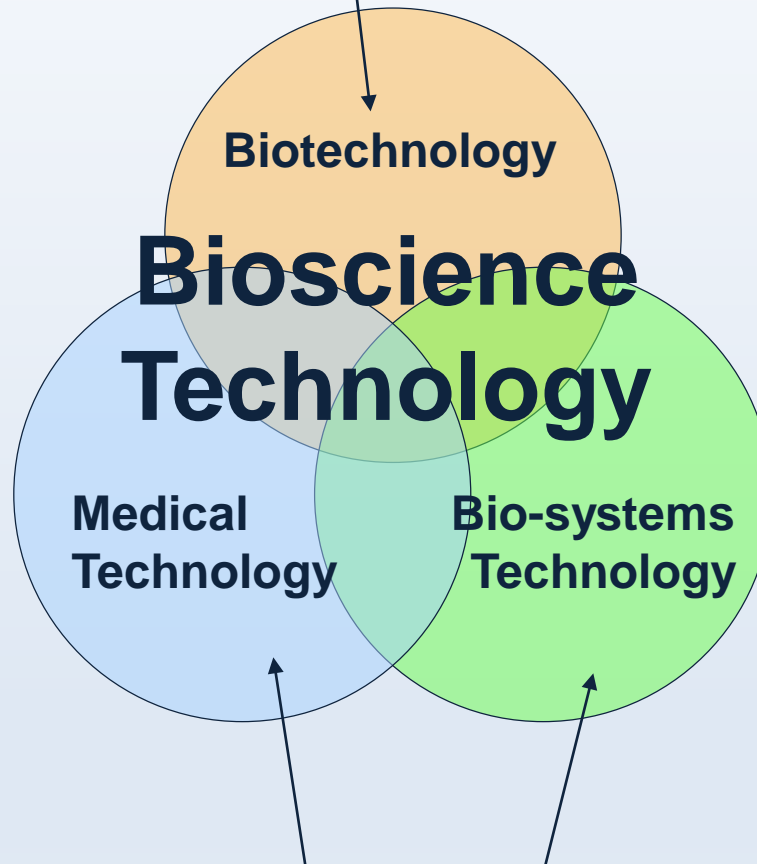
An approach to categorizing biology-related technologies

Technologies categorized by the
types of **MEANS** they incorporate

Technologies categorized by the
types of **ENDS** they serve

Fields of Bioscience Technology

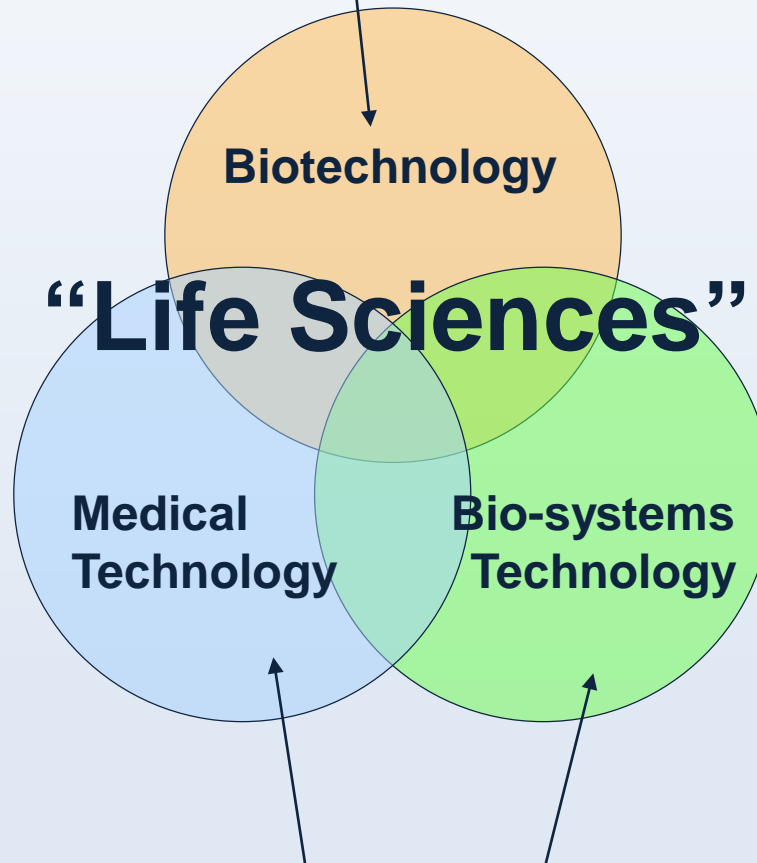
Technologies categorized by the types of bio-related **MEANS** they incorporate



Technologies categorized by the types of bio-related **ENDS** they serve

Fields of Bioscience Technology

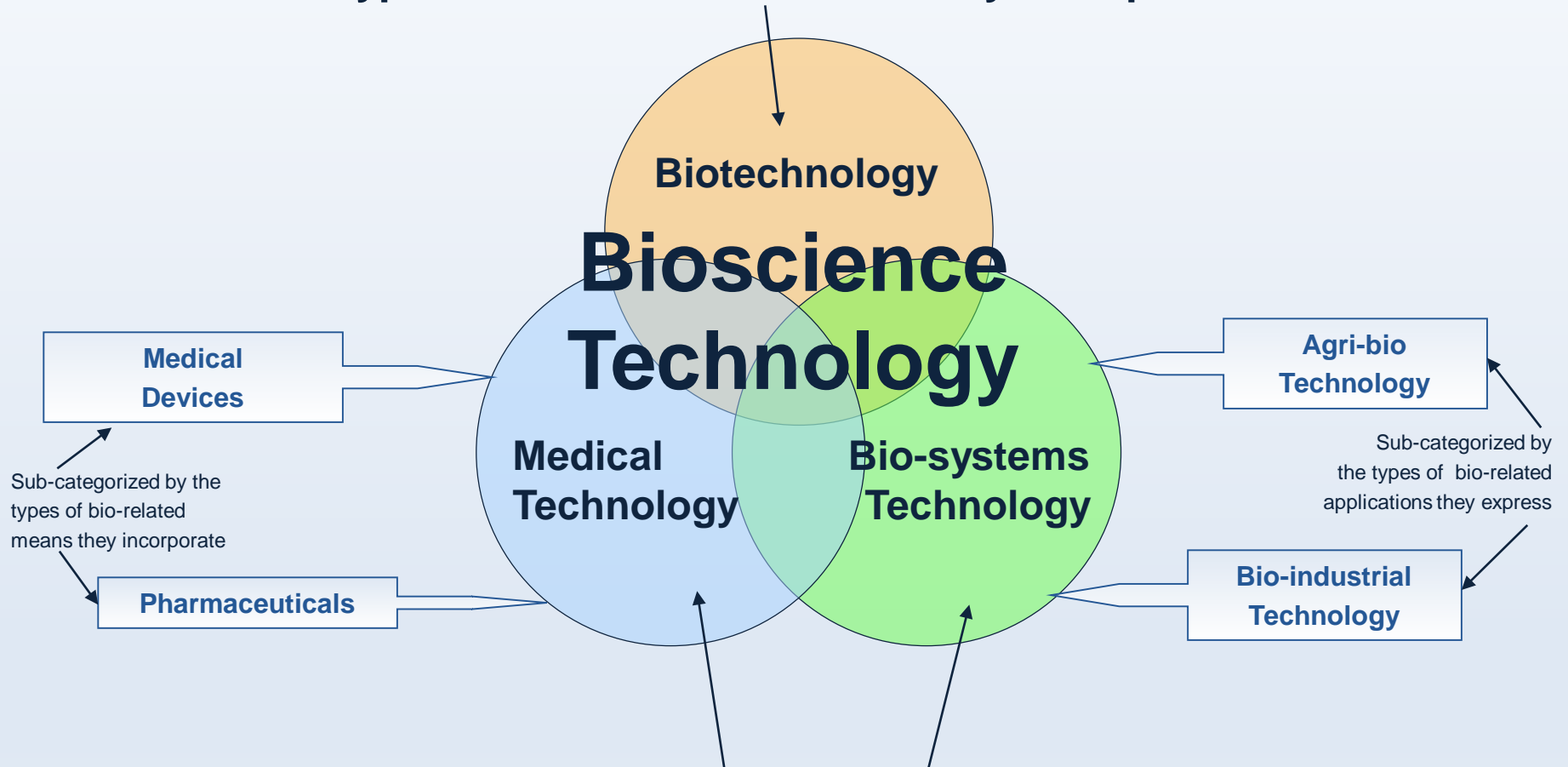
Technologies categorized by the types of bio-related **MEANS** they incorporate



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Technologies categorized by the types of bio-related **MEANS** they incorporate

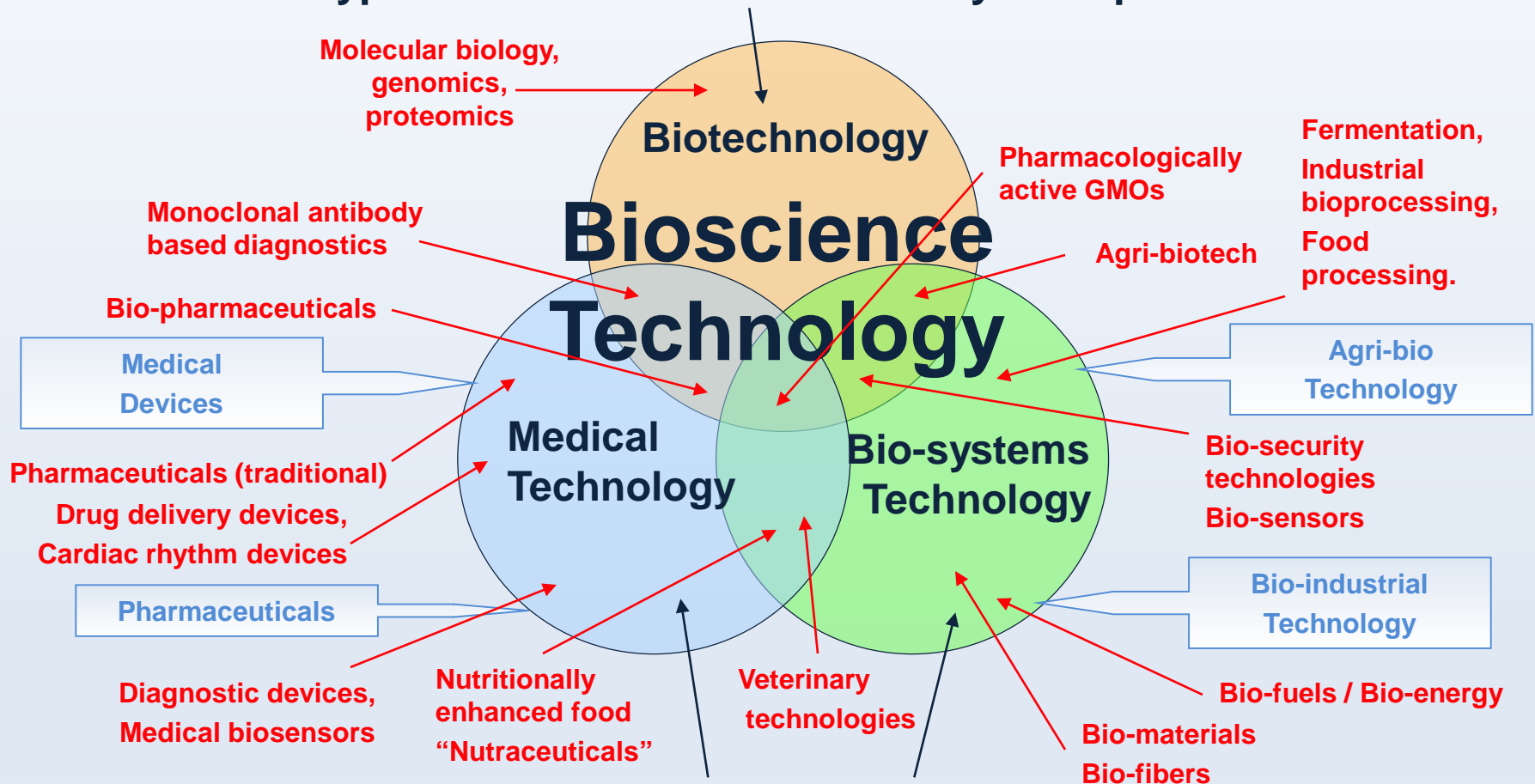


Technologies categorized by the types of bio-related **ENDS** they serve

Fields of Bioscience Technology

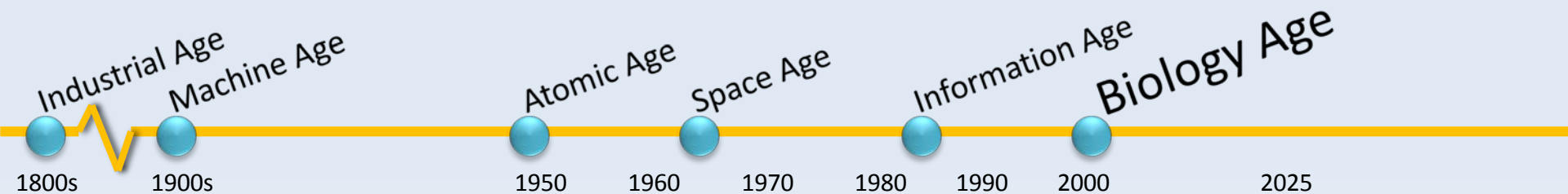
Technologies categorized by the types of bio-related **MEANS** they incorporate

Illustrative Examples
(selections only)



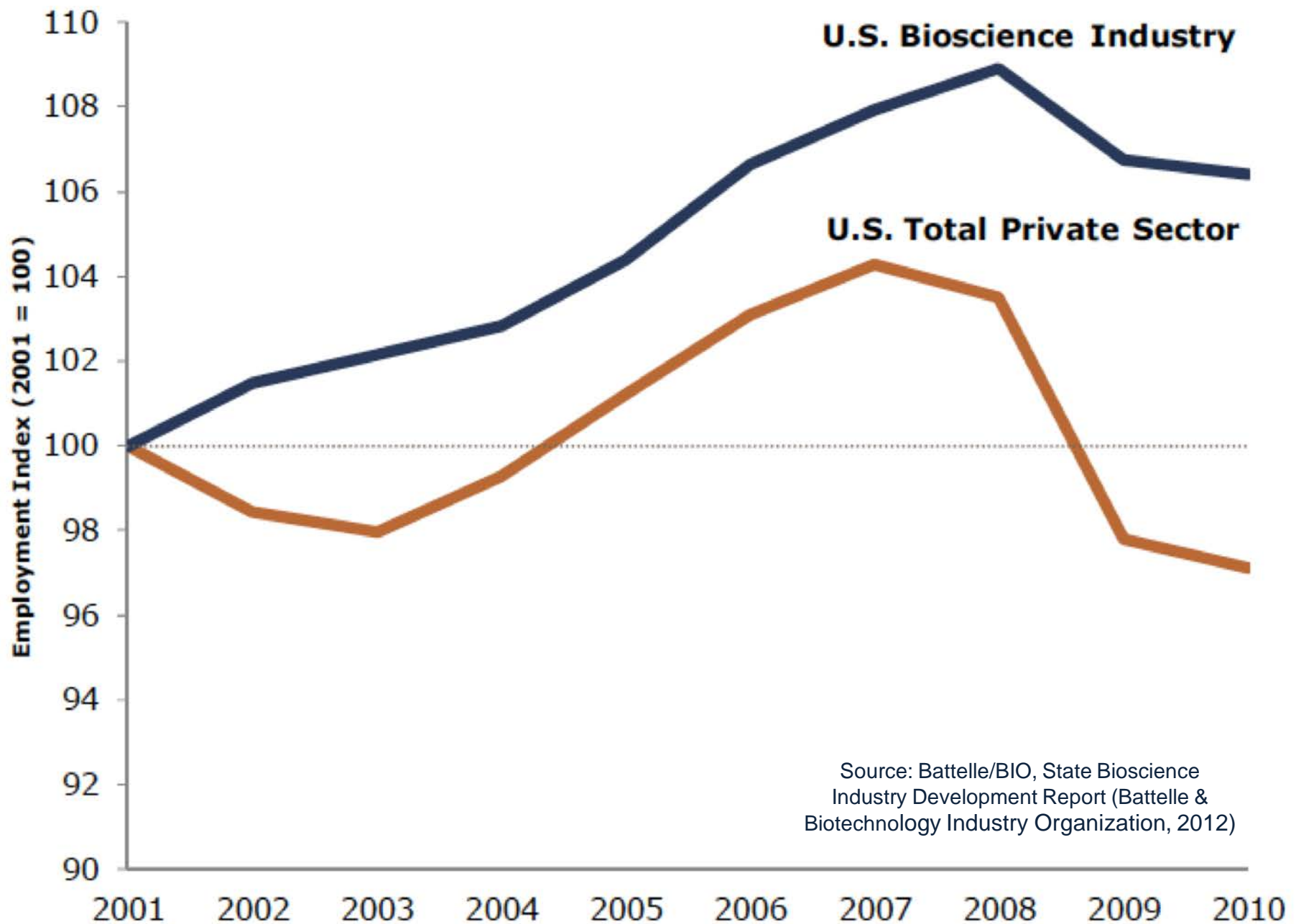
“Bio” business ...

Today’s advances leverage the accomplishments of previous ages, products, and technologies.



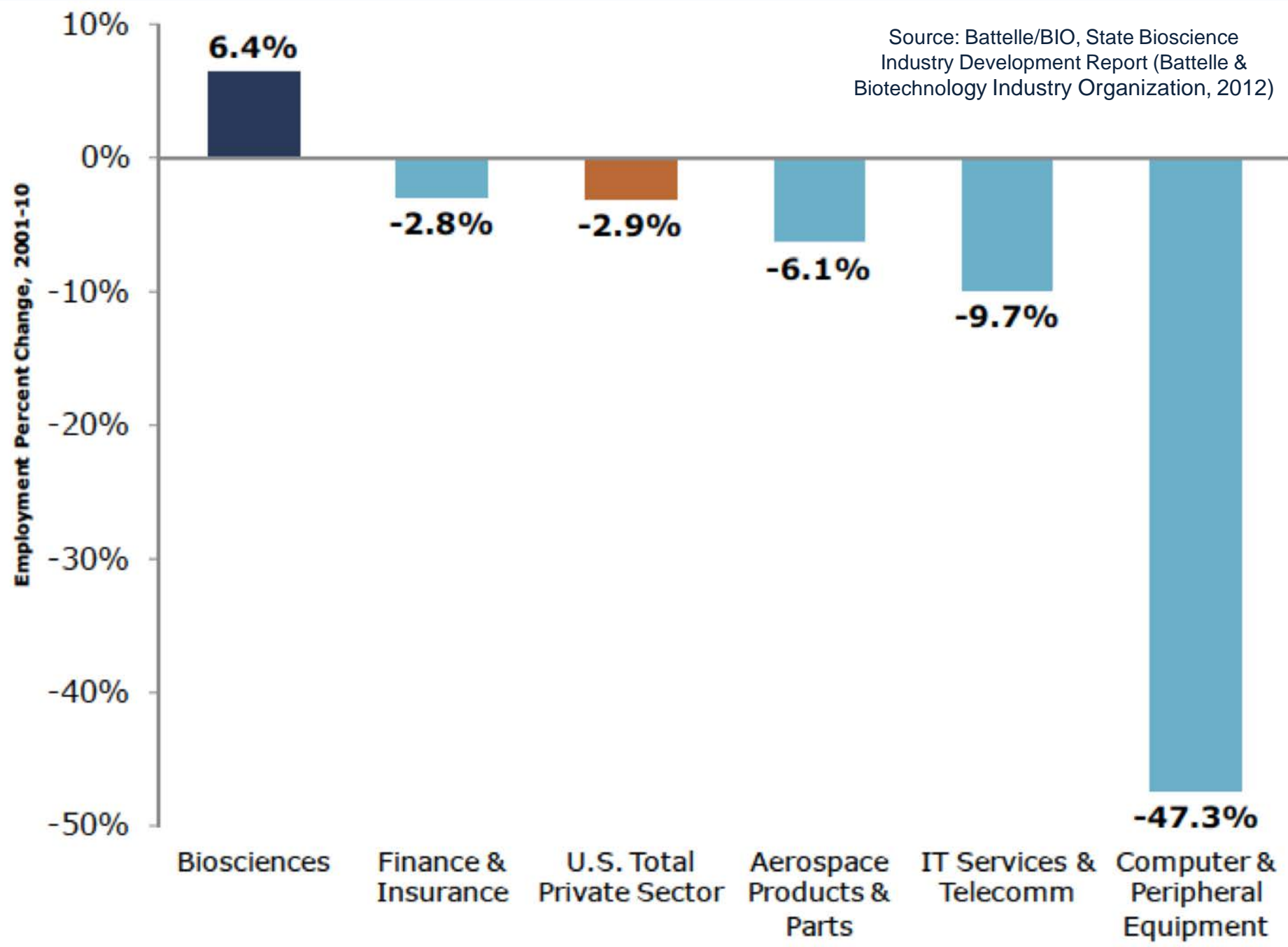


U.S. Bioscience and Total Private Sector Employment, 2001-10, Indexed (2001 = 100)



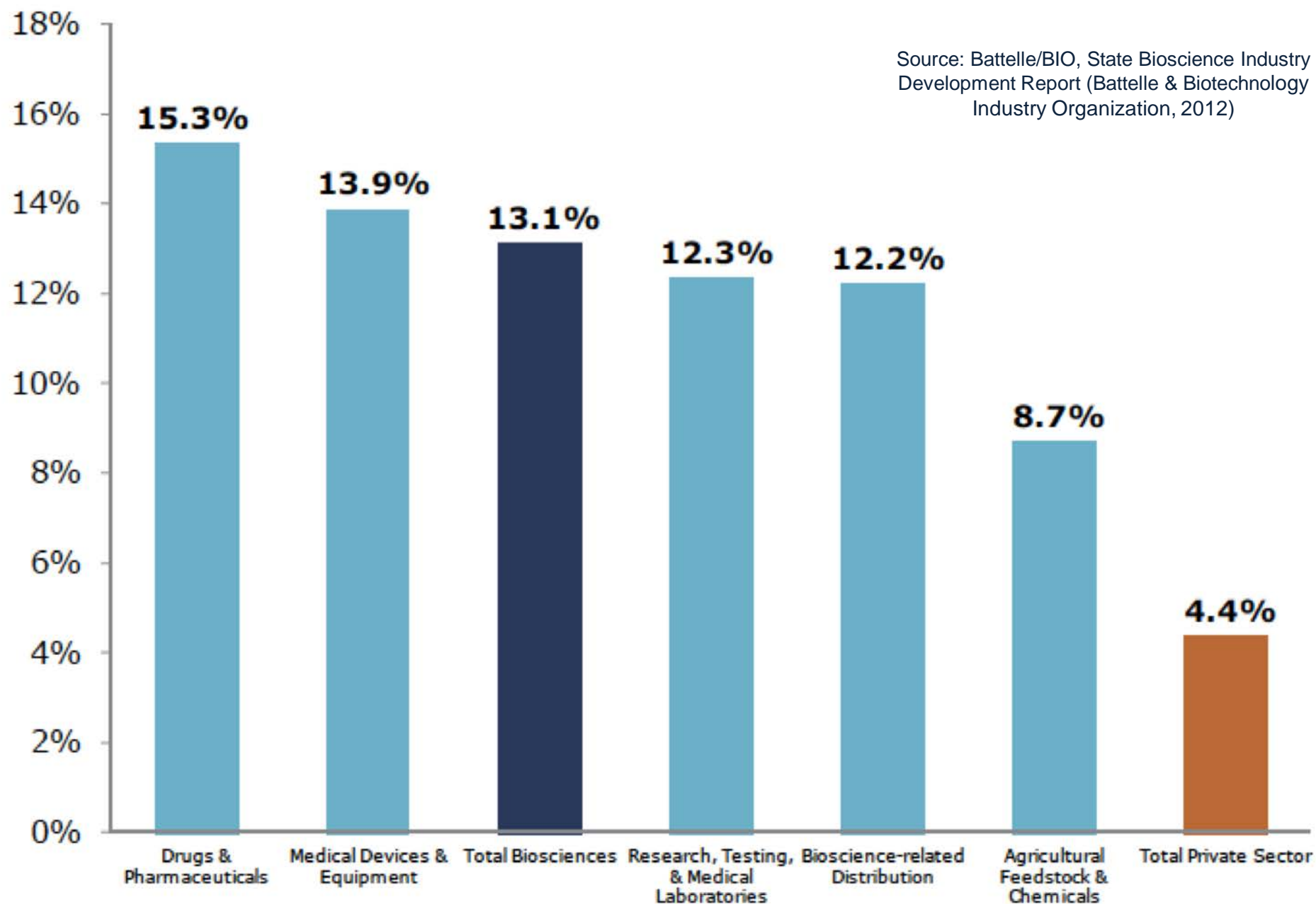
Source: Battelle/BIO, State Bioscience Industry Development Report (Battelle & Biotechnology Industry Organization, 2012)

Employment Trends in the Biosciences and Other Knowledge-intensive Industries, 2001-10



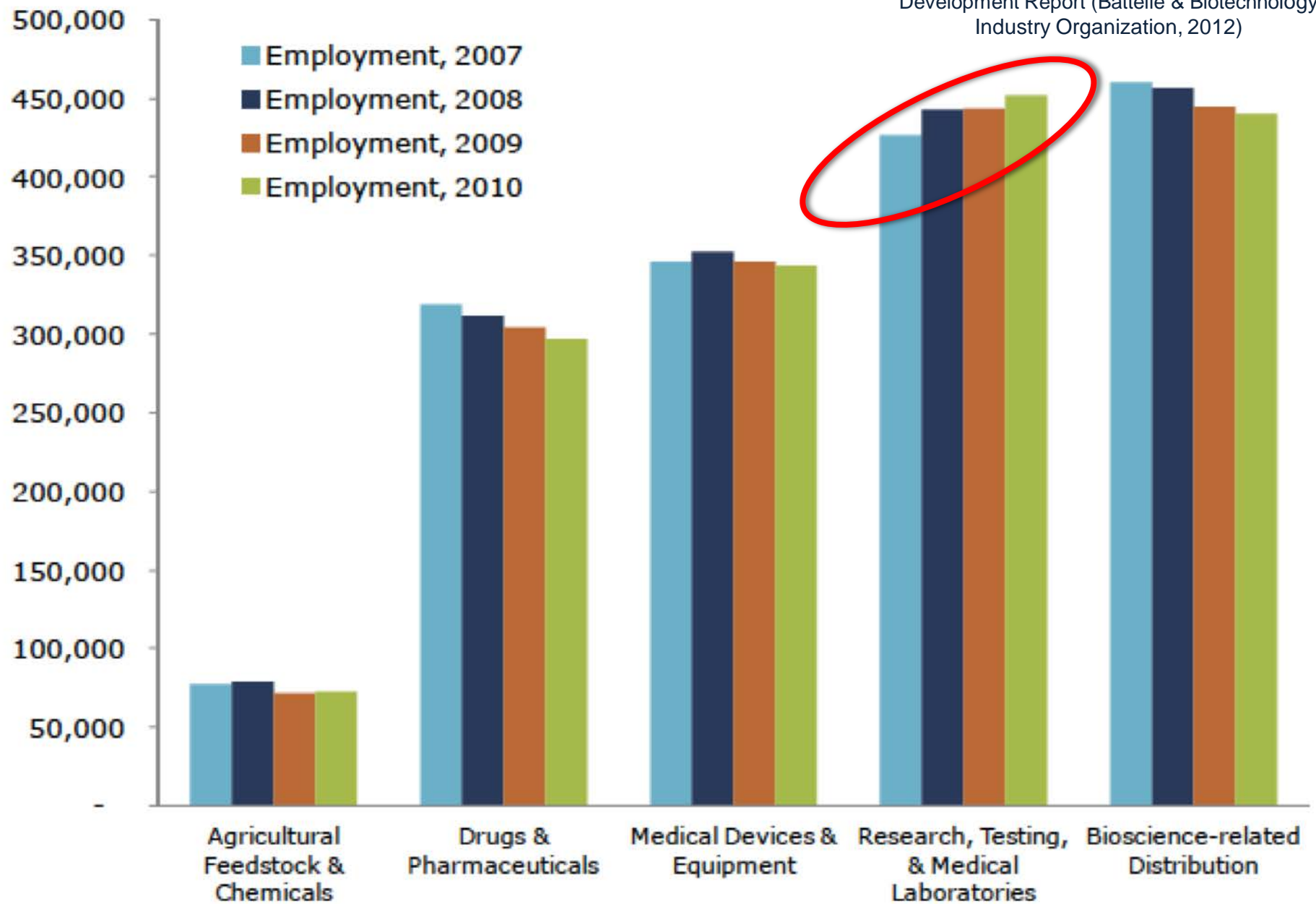
Change in Real Average Annual Wages, United States, 2001-10

Source: Battelle/BIO, State Bioscience Industry Development Report (Battelle & Biotechnology Industry Organization, 2012)



U.S. Employment by Bioscience Subsector, 2007-10

Source: Battelle/BIO, State Bioscience Industry Development Report (Battelle & Biotechnology Industry Organization, 2012)



Minnesota Life Science Community

Minnesota Industries

Medical
Devices

Biologics/
Biopharma

Animal
Health

Food

Renew-
able
Energy

Renew-
able
Materials

Commercialization Catalysts

Leadership Talent

Skilled Workforce

Funding

Academic
Tech Transfer

Acceleration/
Incubation

Int'l Business
Support Center

Component/Service
Suppliers

Enabling Knowledge Clusters

Catalysis &
Synthesis
(Biological &
Chemical)

NanoTech &
Materials
Science

Bioengineering &
Clinical Capabilities

Bioinformatics &
Systems
Biology

Genomics,
Proteomics & High
Throughput
Biology

Imaging /
Navigation

Foundational Capabilities

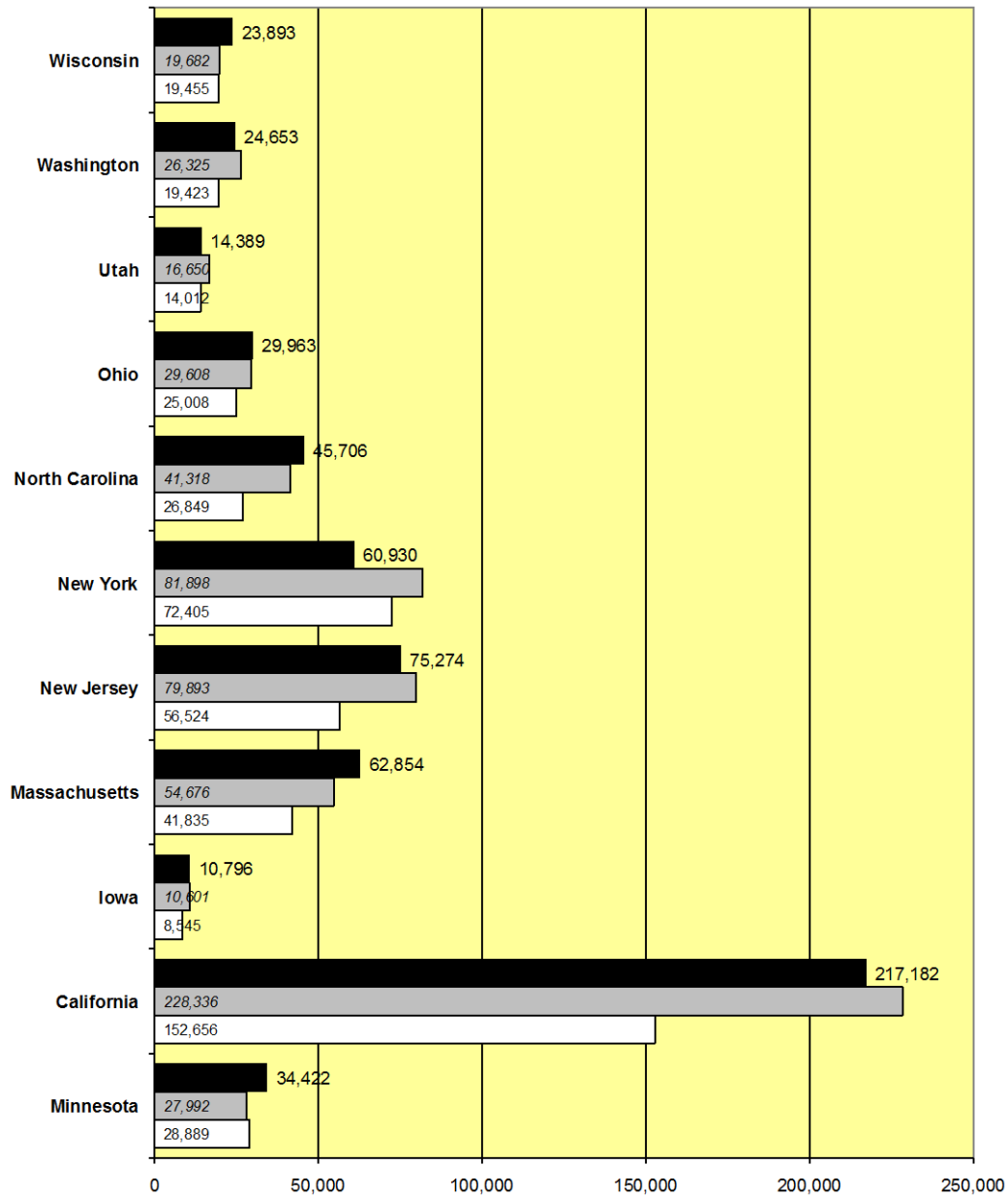
Education

Infrastructure

Policy

Employment, Biobusiness Technology Industries

■ 2007 ■ 2002 □ 1997



Minnesota's
Competitive Position
in the Biobusiness
Technology Industries

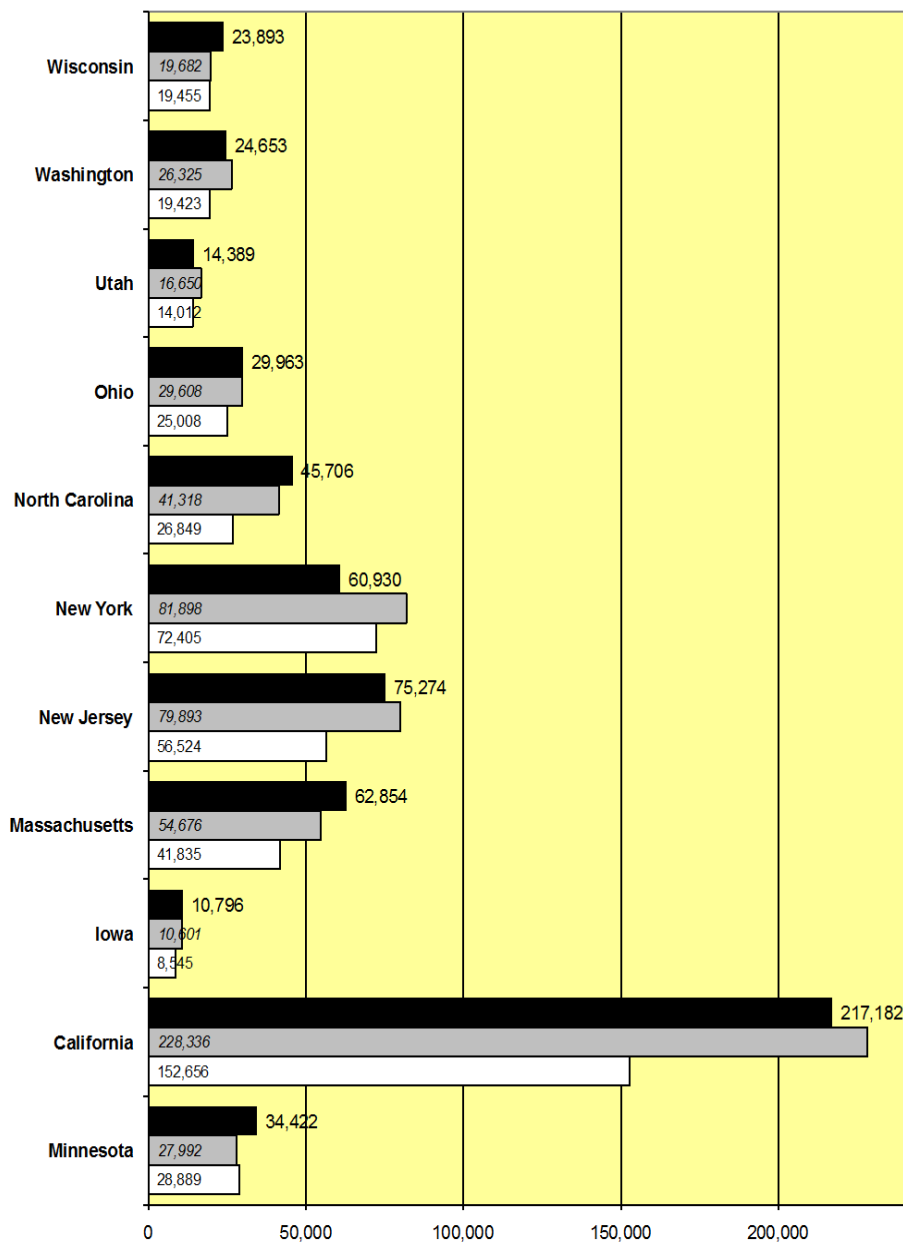
Dr. Kelvin Willoughby
President
Willoughby International LLC

February 2011

 **BioBusiness Alliance**
of Minnesota™

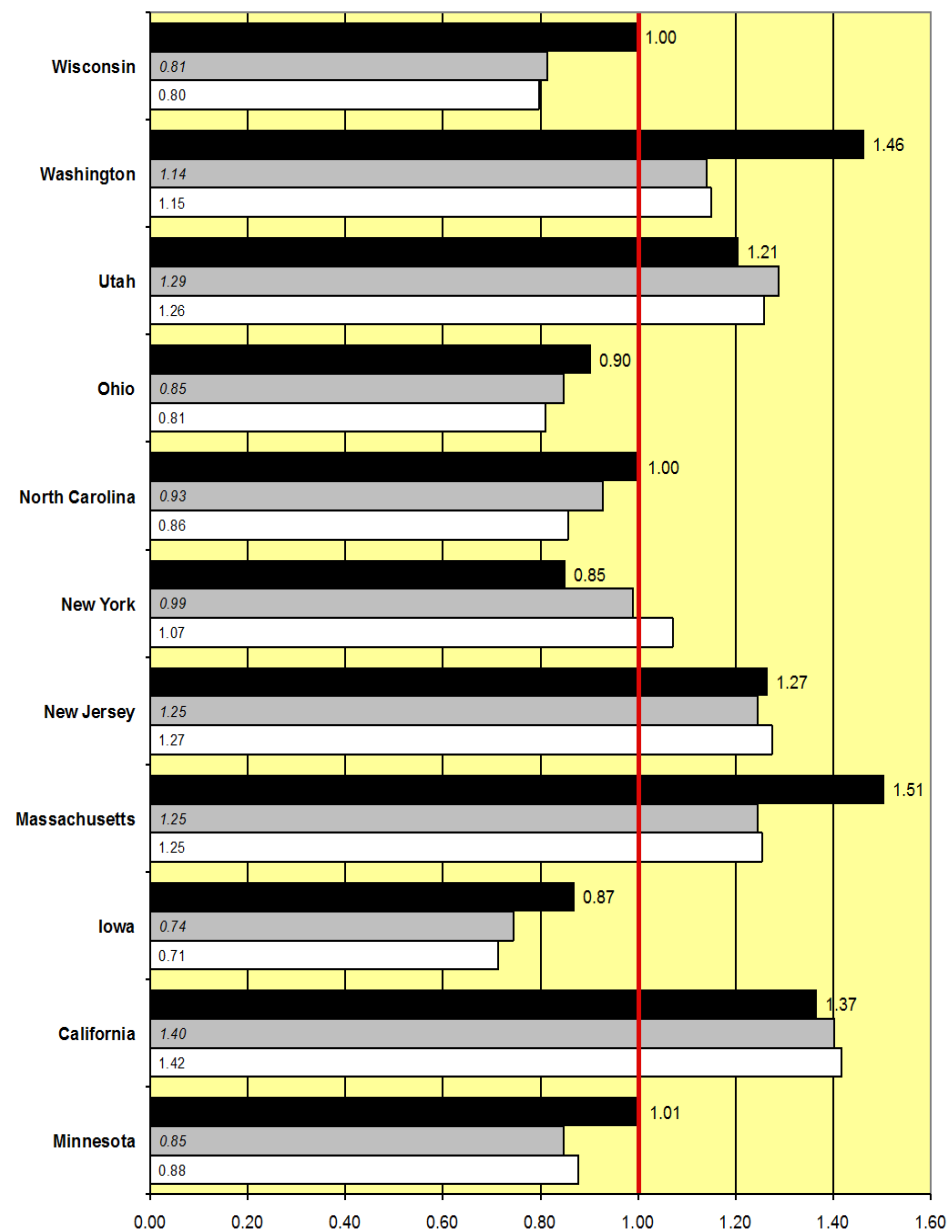
Employment, Biobusiness Technology Industries

■ 2007 ■ 2002 □ 1997

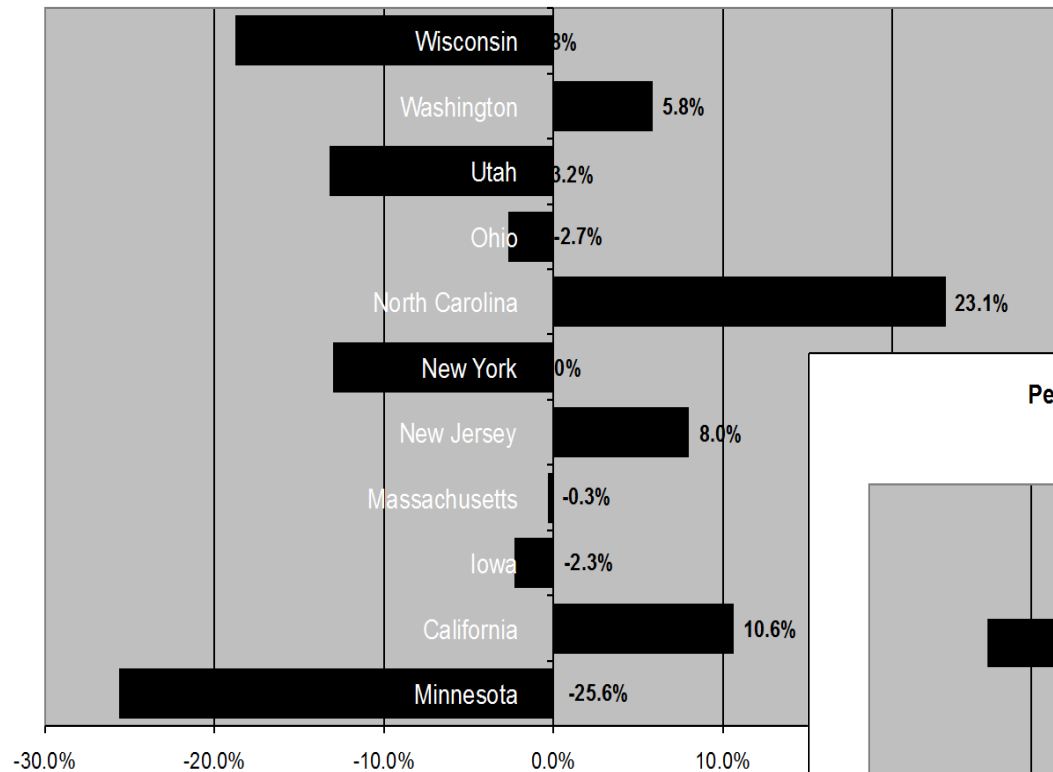


Enterprise Density Indices, Biobusiness Technology Industries

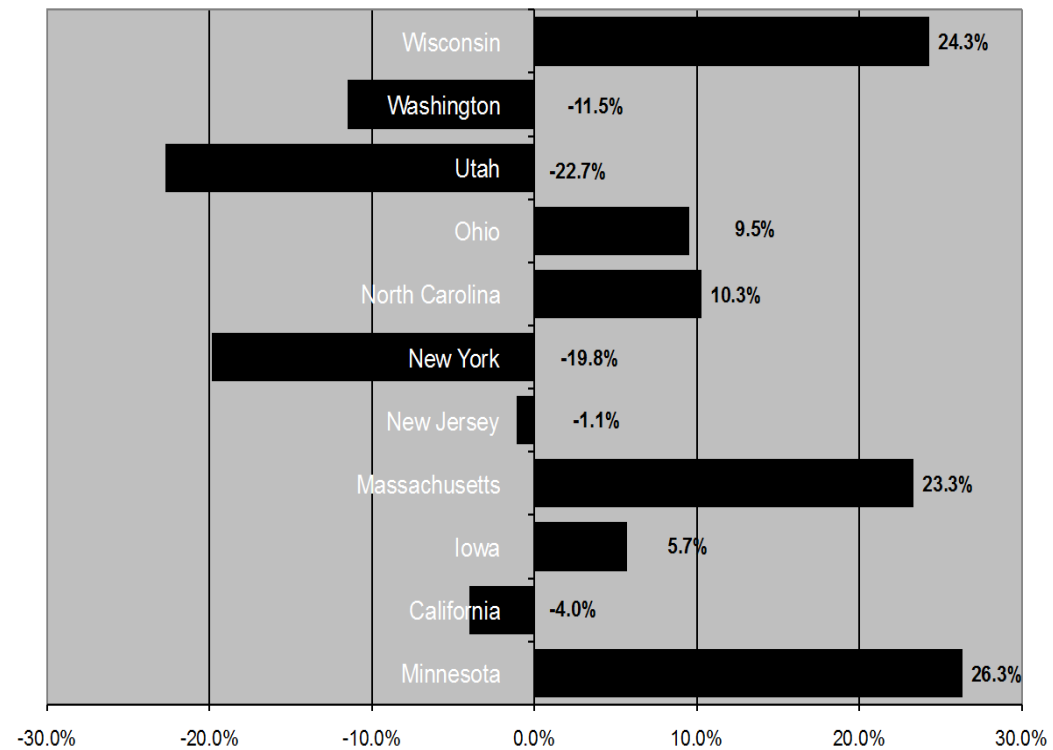
■ 2007 ■ 2002 □ 1997



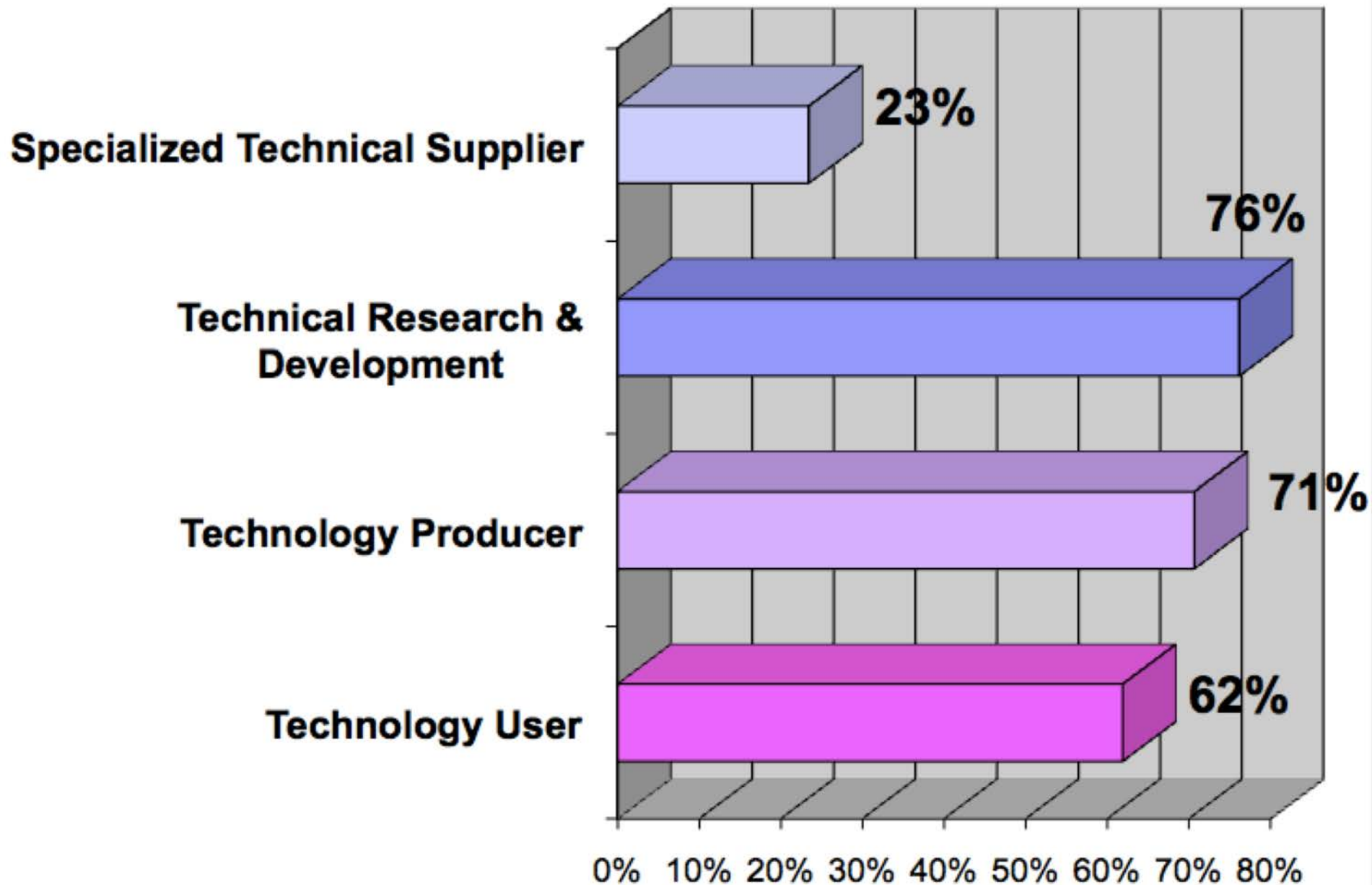
Percentage Change in Employment Density Indices, 1997-2002
Biobusiness Technology Industries



Percentage Change in Employment Density Indices, 2002-2007
Biobusiness Technology Industries



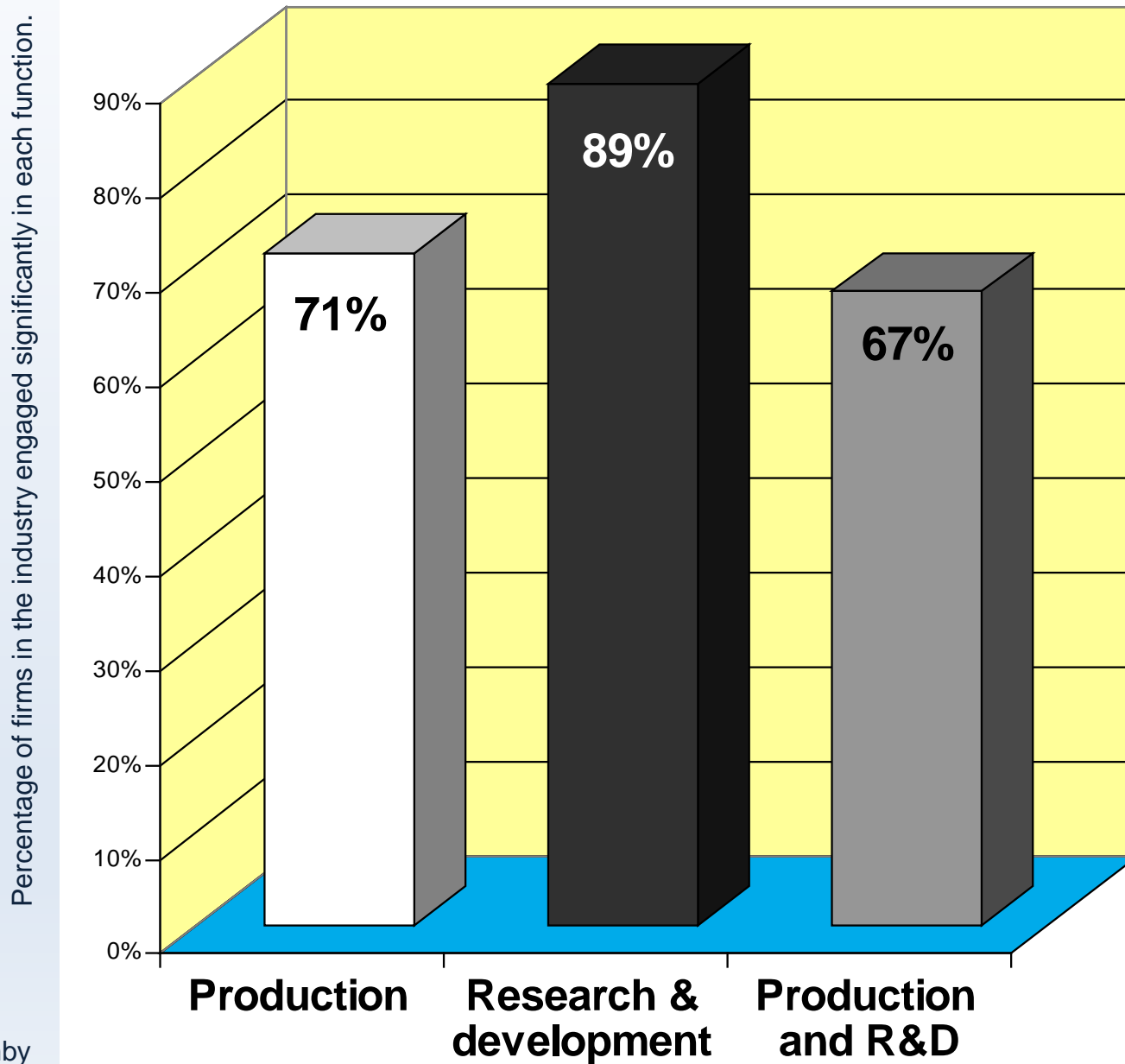
Modes of Activity, Bioscience Technology Firms, New York, Late 1990s



Source: Willoughby

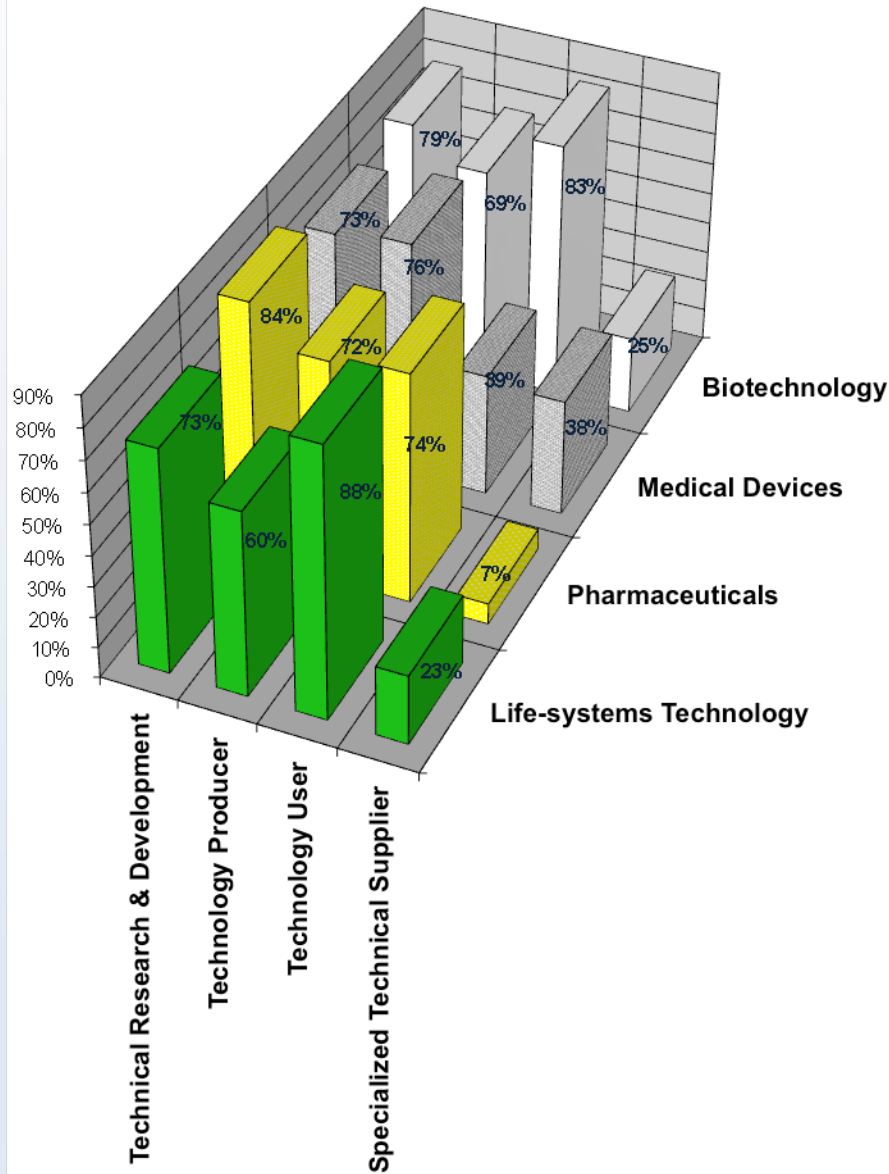
Percentage of firms in the industry engaged significantly in each function.

Modes of Activity, Bioscience Technology Firms, Utah, Late 1990s



Variations in Modes of Activity Between Industry Sectors, Bioscience Technology Firms

Percentage of firms in the industry engaged significantly in each function.



New York, Late 1990s

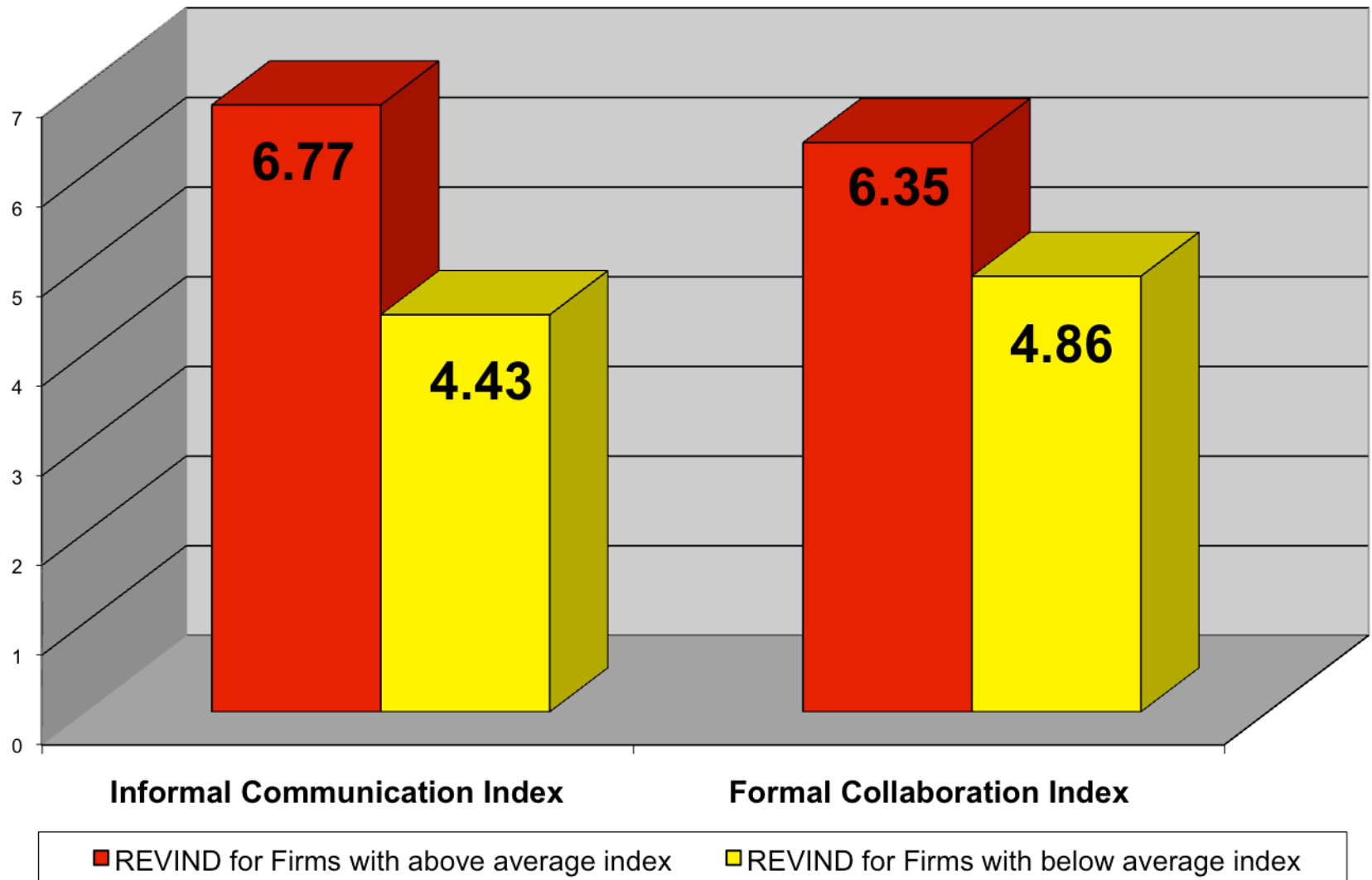
Technological Diversification by Bioscience-Technology Firms New York State, Late 1990s

Primary Field of Technology	Number of Firms in Population	% of Population Active in Other Fields of Bioscience-Technology	% of "C" Active in Biotechnology
Biotechnology	140	57%	100%
Pharmaceuticals	74	55%	85%
Medical Devices	109	21%	91%
Life-Systems Technology	40	88%	80%

Market Orientation of New York Bioscience-technology Businesses, Late 1990s

Market orientations	% of firms ranking each market orientation as one of the three most important areas	Estimated # of firms in population with each market orientation
Human health care (therapeutics)	52%	141
Human health care (diagnostics)	39%	106
Human health care (preventative)	29%	80
Agricultural (animal / veterinary)	15%	40
Agricultural (plant)	12%	32
Food processing / brewing	5%	14
Environmental management & environmental remediation	13%	34
Technical supplies (for bioscience products)	20%	55
Scientific research (in bioscience fields)	45%	124
Other	11%	29

Effect of high levels of inter-organizational interaction on revenue-growth performance, New York, Late 1990s



“Take Away” Themes

- Biology is an emerging nexus zone of technological innovation.
- The business of bioscience-technology plays an increasingly significant role the wider economy and in a range of other industries.
- The business of bioscience-technology may provide great leverage for regional wealth generation.
- Communities compete with one another to become bio-business zones.
- Successful bioscience-technology firms tend to be multi-functional, interdisciplinary, and communicative.