



Accelerating Life Sciences Innovation: a Public-Private Partnership

The Massachusetts Life Sciences Initiative

**Presented to the New Jersey Task Force
April 3, 2018**

BIOMEDICAL GROWTH STRATEGIES LLC

Overview

- **What is the Massachusetts Life Sciences Initiative?** Investing to Create a High-Performance Innovation Ecosystem
- **Has It Worked?** The Massachusetts Life Sciences Initiative's Impact
- **How Did It Work?** The Massachusetts Life Sciences Center's Investment Strategy

The Massachusetts Life Sciences Initiative: Investing to Create a High-Performance Innovation Ecosystem

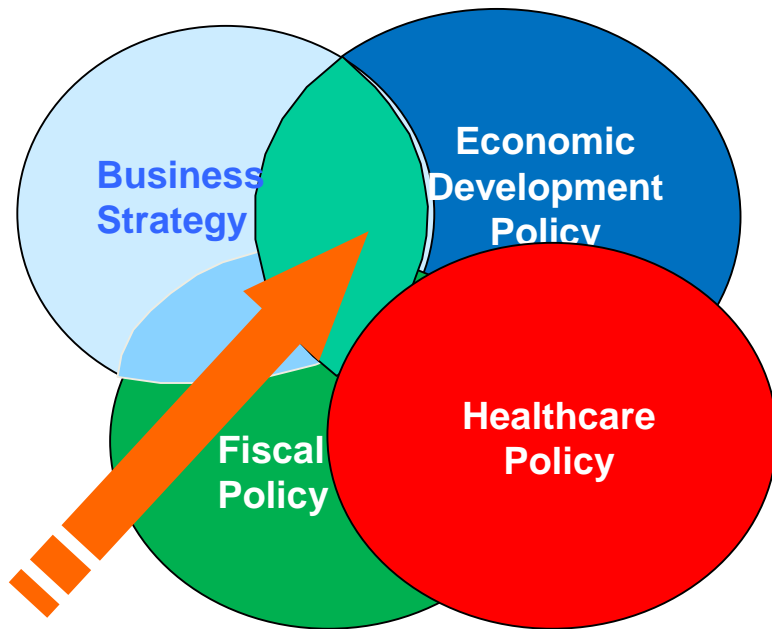
What is the Massachusetts Life Sciences Initiative?

- A **10-year, \$1 billion initiative** (2008-18)
- Envisioned and initiated by **Governor Deval Patrick**
- Commitment by **Governor Charles Baker** to recapitalize
- Administered by the **Massachusetts Life Sciences Center (MLSC)**, a quasi-public authority *funded by the state but governed by a Board of Directors*

The MLSC funds innovation and also is an innovator:

- ✓ New roles for the **public sector** as “strategic investor”
 - ✓ Portfolio of **novel programs and financial tools**
 - ✓ **Unique models of collaboration and partnership** with the private sector

The Massachusetts Life Sciences Initiative: A Strategic Plan of Action



The Initiative “Sits” at the
Intersection of Public Policy and
Business Strategy

Broad Goals:

- ✓ Invest in **good science and good business**
- ✓ Strengthen Massachusetts’ **global leadership in life sciences**
- ✓ Accelerate **commercialization**
- ✓ Create jobs and drive **economic development across the state**

The Massachusetts Life Sciences Initiative: Is Broadly Defined

What Sectors?

Biotechnology



Pharmaceuticals

Medical Devices



Diagnostics



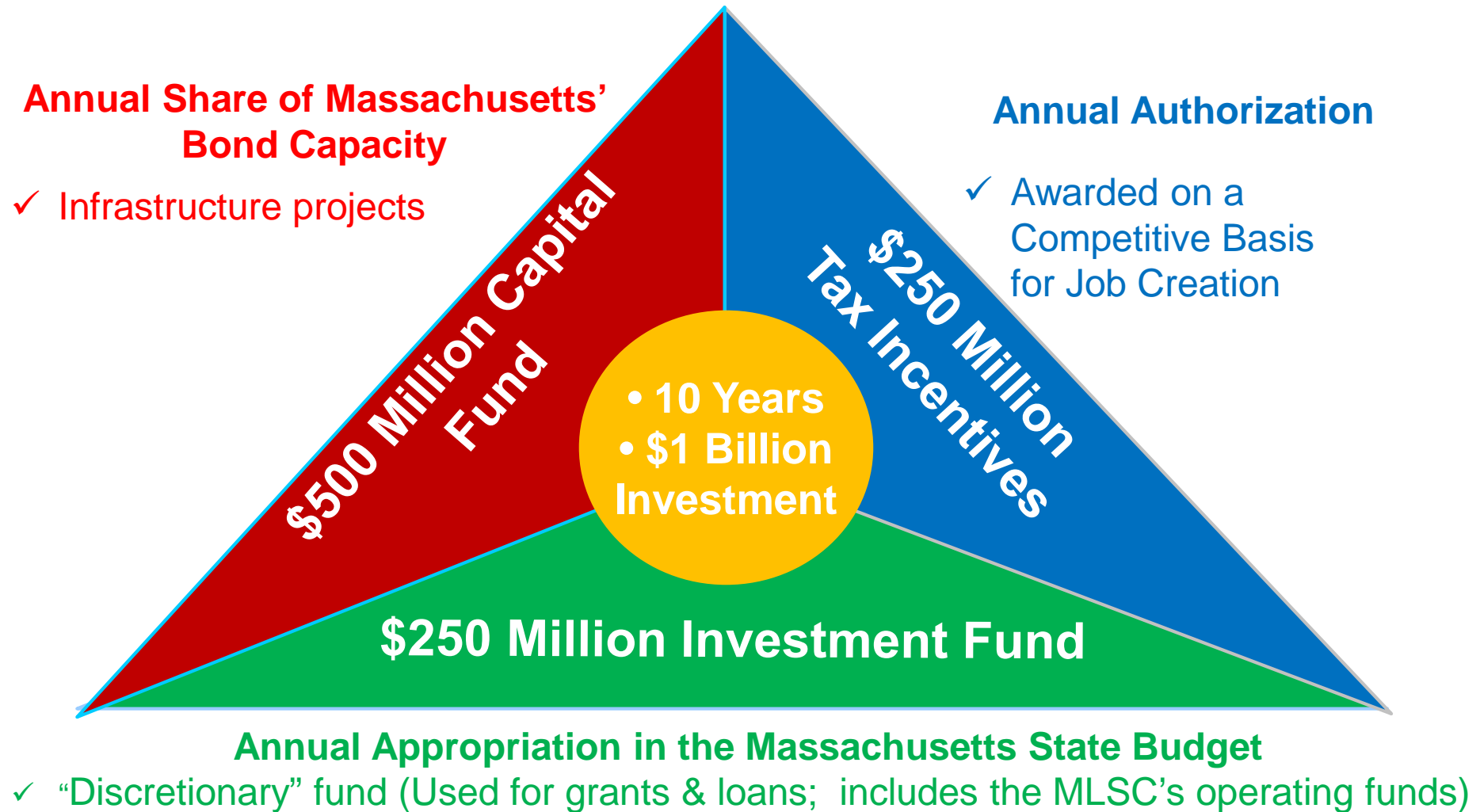
Bioinformatics

What Skills?

**Science, Technology, Engineering, Math (STEM)
AND.....**

- Administration
- Animal Husbandry/Care
- Advertising and Communications
- Computing/IT
- Finance
- Legal and Regulatory
- Logistics Management
- Project Management
- Sales and Marketing
- Skilled Manufacturing

Where Did Massachusetts Find a Billion Dollars?



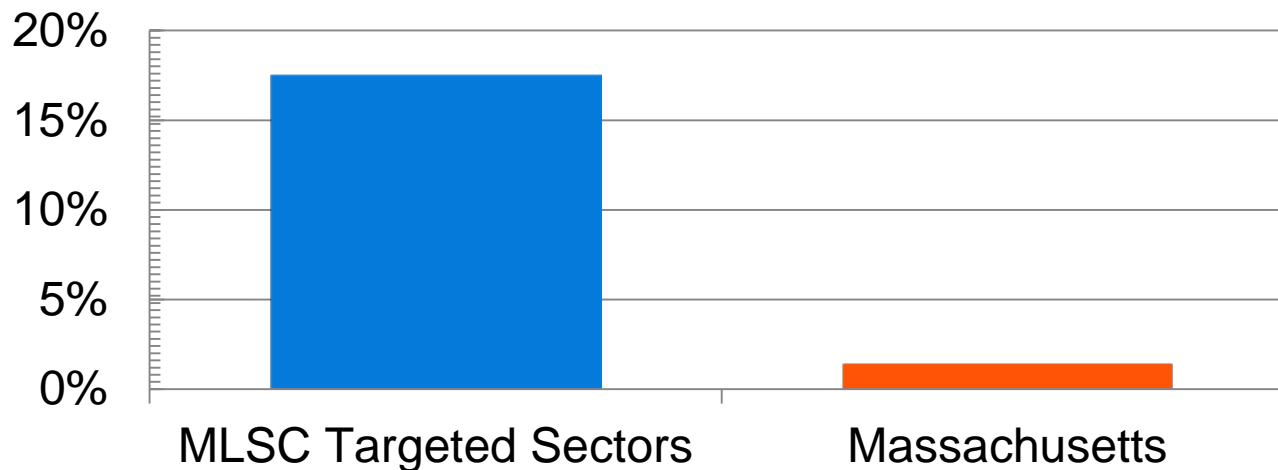
The MLSC is Governed by a Multi-Disciplinary Board Representing the Public and Private Sectors

- Secretary of Housing and Economic Development
- Secretary of Administration and Finance
- President of the University of Massachusetts System
- A researcher involved in the commercialization of biotechnology, pharmaceuticals or medical diagnostic products*
- A physician licensed to practice medicine in the Commonwealth and the President or senior administrator of an academic medical center*
- A person with financial expertise in the life sciences*
- A CEO of a Massachusetts-based life sciences company*

The Massachusetts Life Sciences Initiative: Impact

MLSC Investments Helped Lead Massachusetts Out of the Economic Recession and Build the Economy

Employment Growth in MLSC-Targeted Sectors (2006-2014)



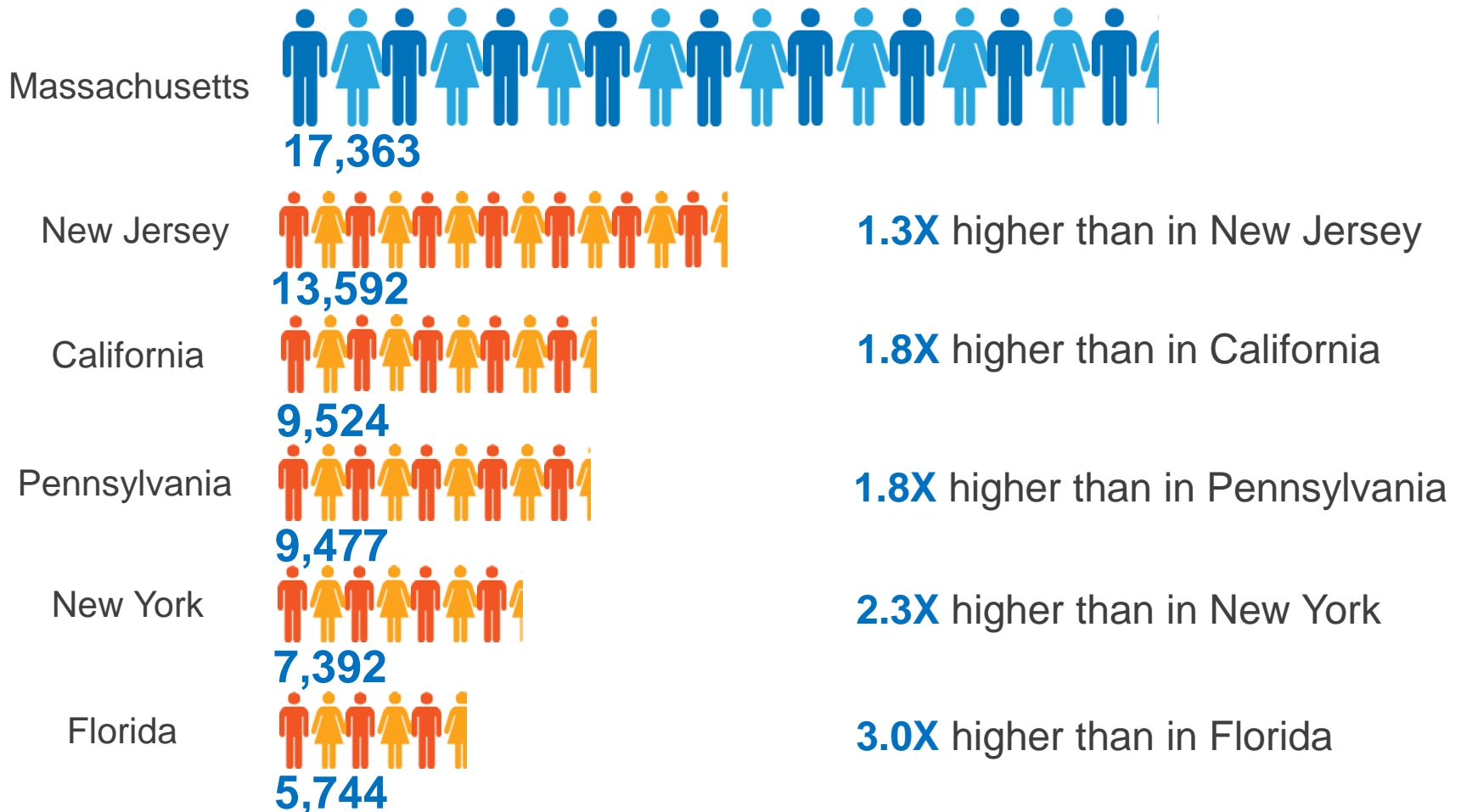
Biopharma Economic Impact in Massachusetts (2016)

- **66,414** employees
- **\$138,768** average annual wage
- **\$9,216,168,893** total MA-based wages

28% growth over 10 years

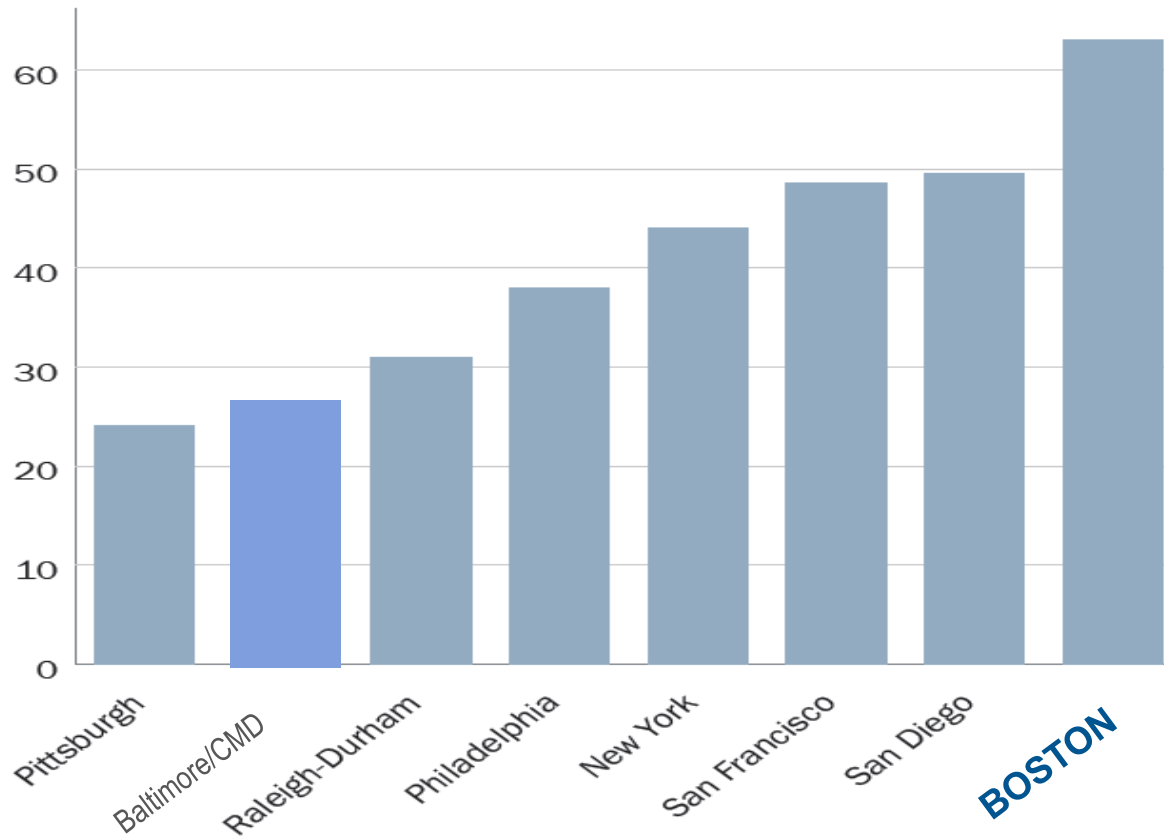
MA Now Ranks #1 in U.S. Life Sciences Employment On a Per Capita Basis

Total Life Sciences Employment, per One Million Population by U.S. State (2016)



Massachusetts Academic Institutions are Now Actively Engaged in Creating Start-up Companies

Startups at Universities
Fiscal Year 2013

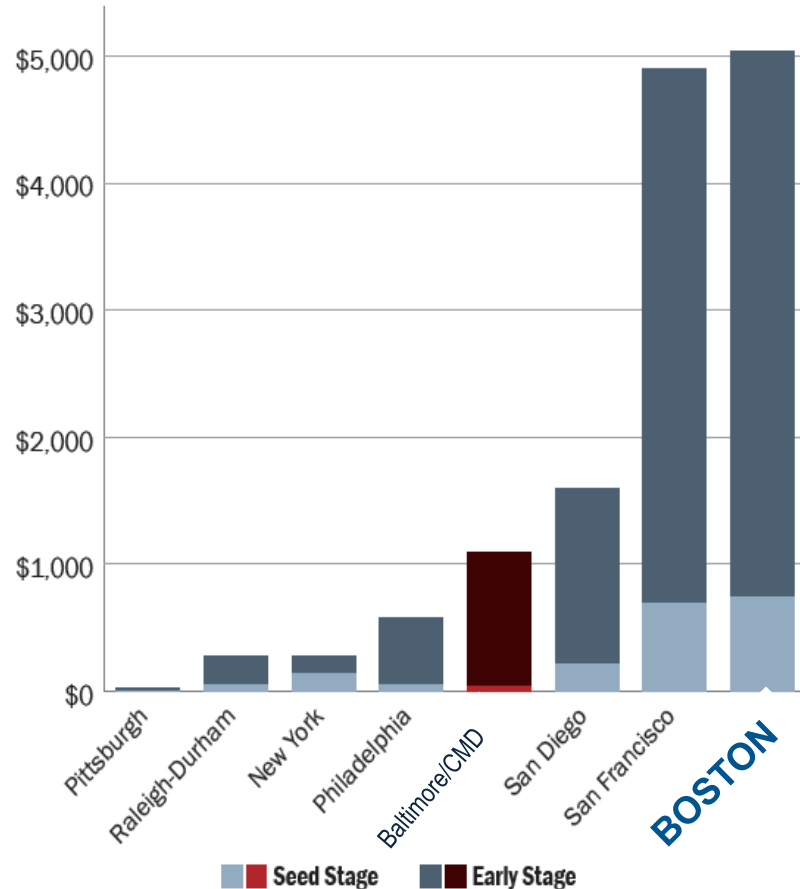


VC and IPO Activity in Massachusetts is High

Seed and Early Stage

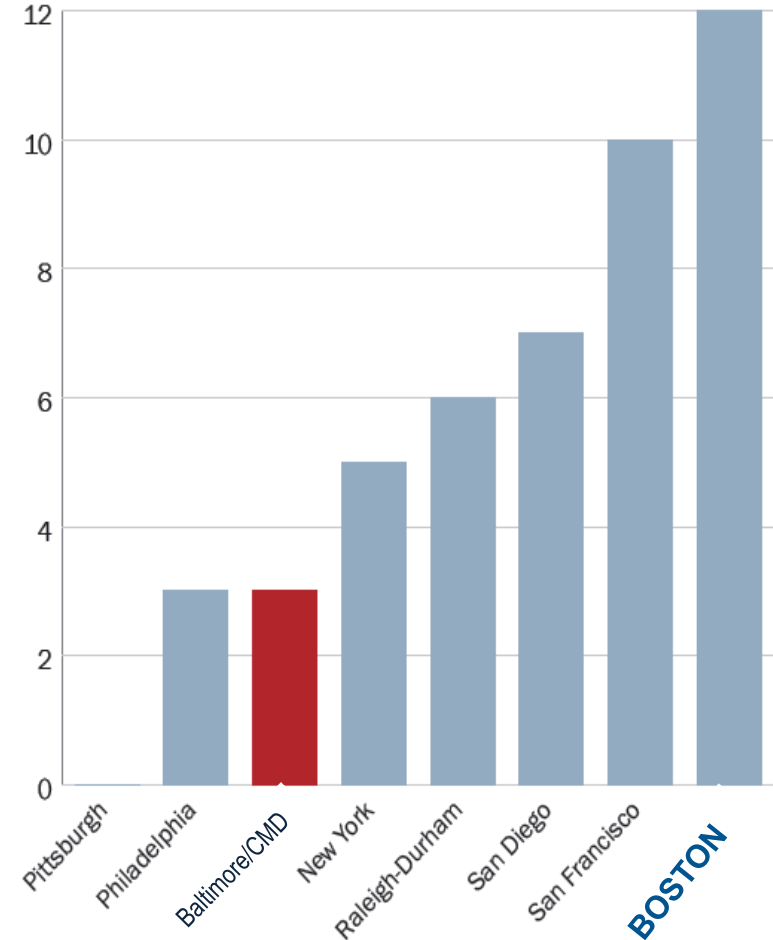
Venture Capital Investment in BioHealth

in Millions of Dollars, 2010-2014



Initial Public Offerings by BioHealth Companies

2012-2013



Massachusetts is Commercializing Its Research...

PwC uses the ratio of VC investment to research dollars as a proxy for commercialization in the state where the research was conducted

Life Sciences VC Investments per NIH dollars by State
Fiscal Year 2014
In dollars

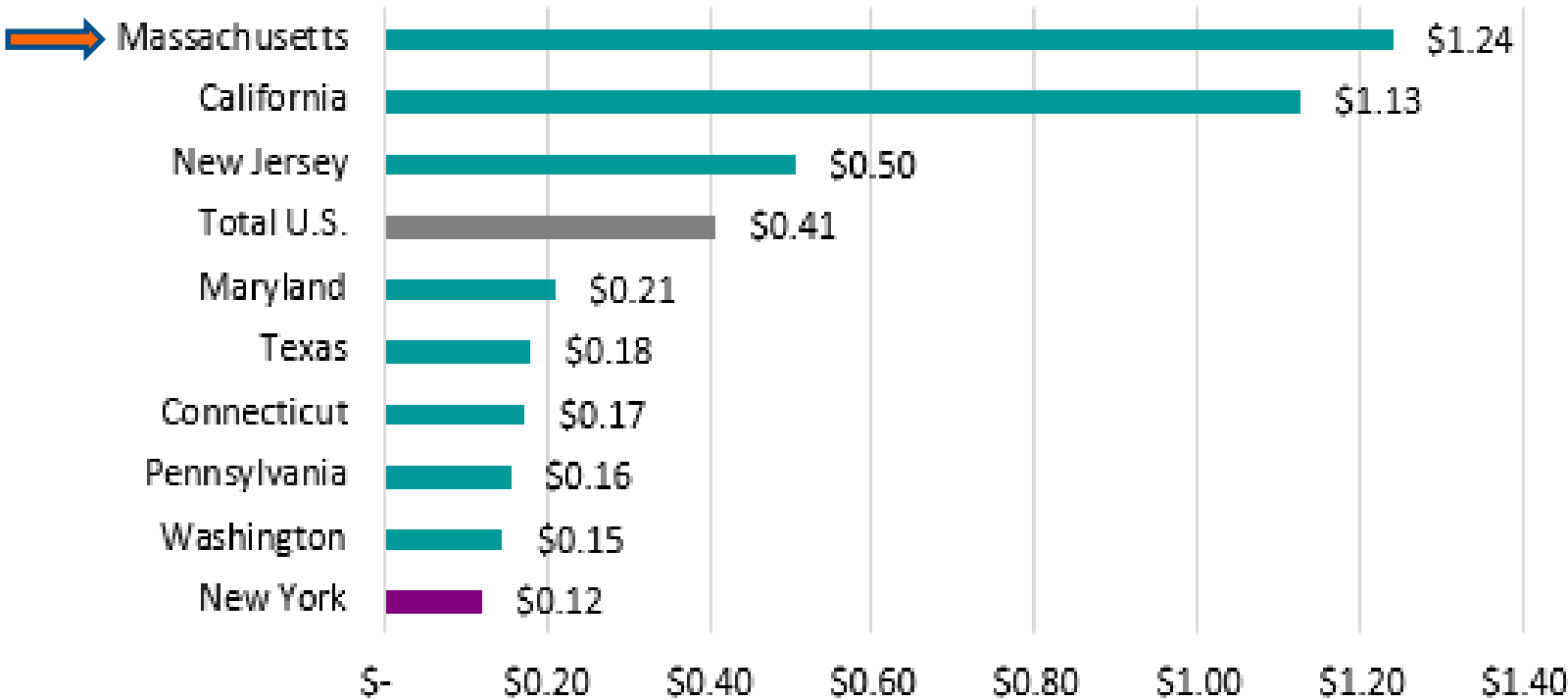
Rank for FY 2014 NIH Dollars	State	FY 2014 NIH Dollars	FY 2014 VC Dollars	VC\$ per NIH\$
1	CA	\$ 3,499,391,307	\$ 3,515,935,800	\$ 1.00
2	MA	\$ 2,404,097,828	\$ 1,567,264,500	\$ 0.65
16	CT	\$ 467,188,982	\$ 260,576,800	\$ 0.56
23	NJ	\$ 246,964,069	\$ 130,704,300	\$ 0.53
8	WA	\$ 906,173,368	\$ 462,317,200	\$ 0.51
Total US		23,014,884,144	\$ 8,092,102,100	\$ 0.35
7	TX	\$ 981,024,135	\$ 344,374,000	\$ 0.35
10	OH	\$ 670,092,509	\$ 129,084,200	\$ 0.19
9	IL	\$ 733,227,259	\$ 134,511,800	\$ 0.18
4	PA	\$ 1,516,874,603	\$ 247,973,900	\$ 0.16
6	NC	\$ 1,067,282,781	\$ 117,321,100	\$ 0.11
5	MD	\$ 1,333,845,959	\$ 93,651,000	\$ 0.07
3	NY	\$ 2,125,150,125	\$ 102,094,800	\$ 0.05

FY 2014 = October 1, 2013 - September 30, 2014

Source: PwC Moneytree, <https://www.pwcmoneytree.com/HistoricTrends/CustomQueryHistoricTrend>
Includes: Biotechnology, Healthcare Services, and Medical Devices and Equipment

...And Has Pulled Ahead of California

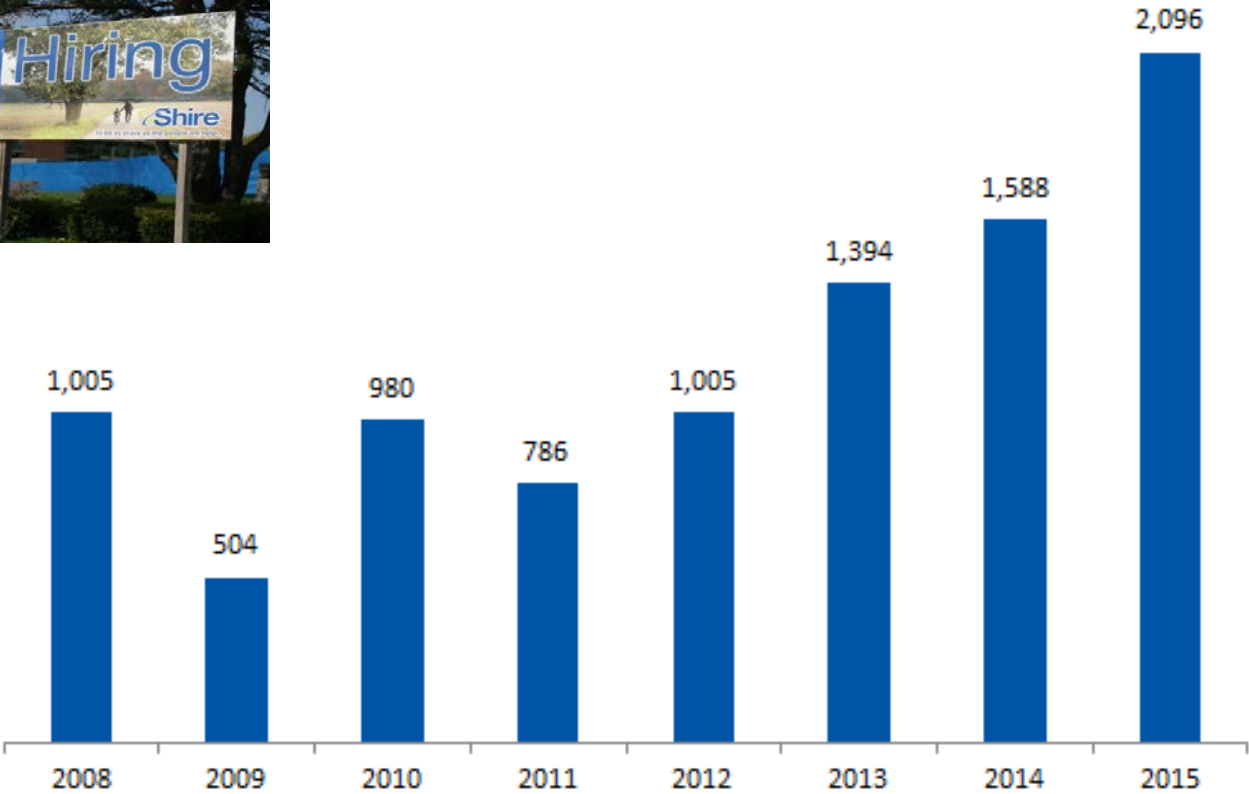
**Ratio of Private (VC) Investments to Public (NIH)
Funding, Federal FY 2016**



Sources: PwCMoneyTree™; National Institutes of Health (NIH)

Demand for Life Sciences Workers is High

Average Daily Number of Job Listings for the Month of May, 2009-2015*

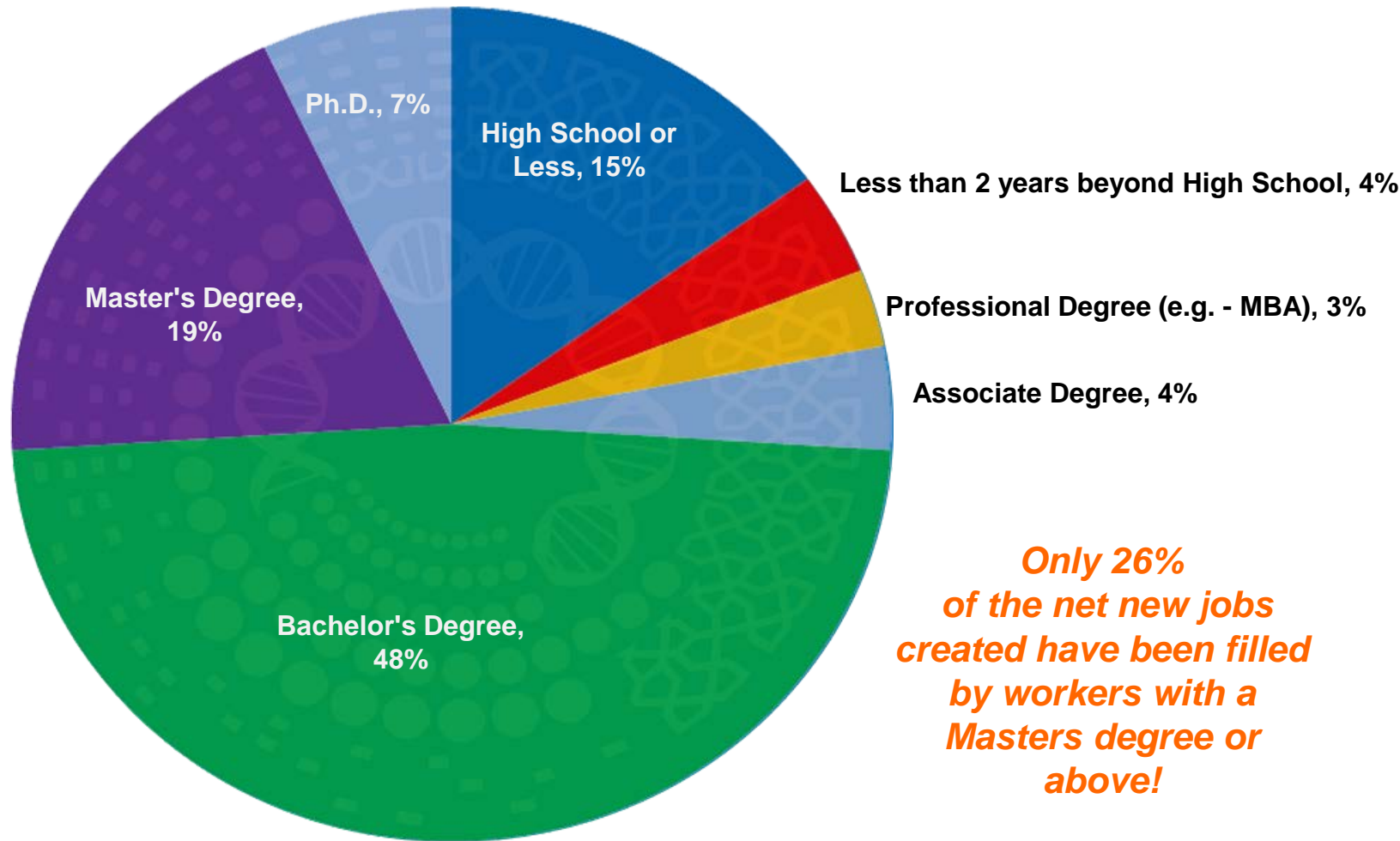


*2015 listing through July.

Source: MassBio

MLSC Tax Incentives Have Created Jobs for a Range of Skills and Educational Levels

Distribution of New Hires by Level of Education Among Companies Receiving MLSC Tax Incentives

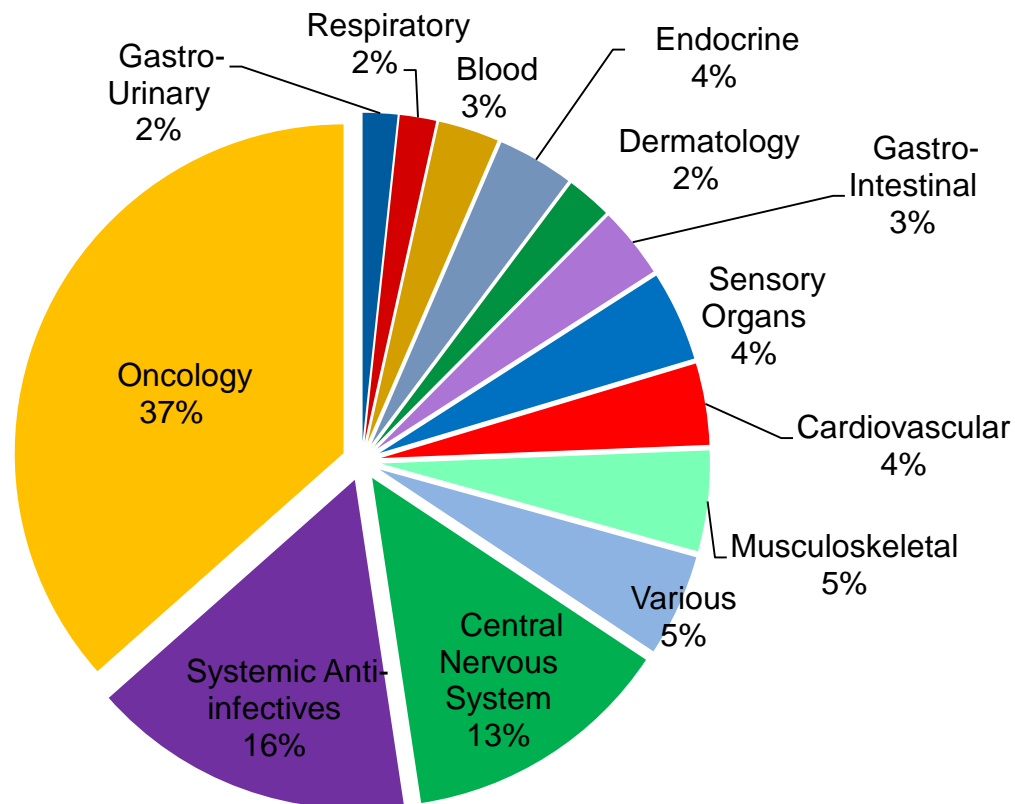


The Massachusetts Drug Pipeline is Extensive

Areas of strength and differentiation have emerged (but were not pre-selected)

Therapeutic Area	Candidates
Oncology	429
Systemic Anti-Infectives	186
Central Nervous System	156
Various	59
Musculoskeletal	58
Sensory Organs	52
Cardiovascular	47
Endocrine	44
Gastro-Intestinal	41
Blood	35
Dermatology	26
Respiratory	21
Gastro-Urinary	20
Total (R&D)	1174

Massachusetts Pipeline, by Therapeutic Area 2013



The Pace of New Company Arrivals and Expansions in MA Has Accelerated Since 2008



Global Leaders are Moving Their U.S. Headquarters to MA



MA Has Become a Target for Investment and Growth by Industry Leaders

- **18 of the top 20 biopharma companies** now have a significant presence in Massachusetts
- Among the largest life sciences employers in MA, **two-thirds employ 500-1,000 workers; one-third employ 1,000+ workers**
- Of these major employers **one-third had little or no presence in MA before 2007!**

The benefits extend FAR beyond job creation:

- Anchor the life sciences ecosystem
- Provide seasoned experts to mentor young companies
- Are sources of spin-outs and investments (venture arms)
- Reduce the # of early stage companies that are acquired and taken out of Massachusetts
- Leverage on public investments
- Train talent that may migrate to start-up companies

Largest Biopharma Employers in Massachusetts (2017)

Rank	Company	# Employees
1	Sanofi Genzyme	5,000
2	Shire	3,040
3	Biogen	2,443
4	Novartis	2,333
5	Pfizer	2,200
6	Takeda	2,000
7	Vertex	1,600
8	Quest Diagnostics	1,550
9	Charles River Laboratories	1,446
10	MilliporeSigma	1,300
11	Parexel International	1,125
12	EMD Serono	1,039
13	AbbVie	911
14	Alkermes	656
15	Sunovion Pharmaceuticals	602
16	Alnylam	608
17	Foundation Medicine	600
18	Merck	600
19	Moderna	550
20	Amgen	500
21	GE Healthcare Life Sciences	471
22	Tesaro	415
23	AstraZeneca	400
24	Bristol-Myers Squibb	400
25	Ironwood	375

BIOMEDICAL GROWTH STRATEGIES LLC

Boston Has Transitioned from an Academic Hub to a “Start-up Hub”

New Report Labels Boston a Better Hub for Startups Than San Francisco

Innovation Matters, U.S. Chamber of Commerce, May 2016



The Initiative Has Received National Recognition

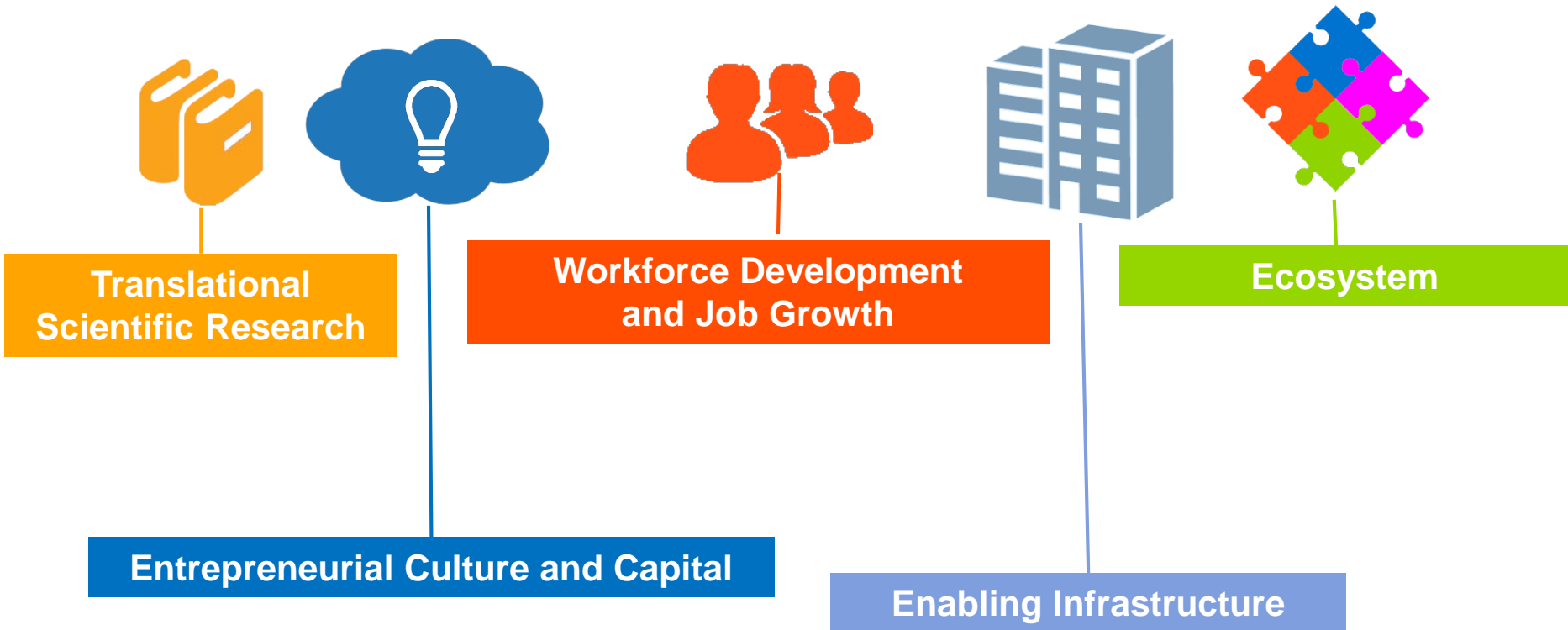
- Received in September 2013, the **State Science and Technology Institute's Award** for Excellence in Technology Based Economic Development for “Improving Competitiveness of Existing Industries”
- Based on a national, judged competition to identify initiatives that represent best practices in innovation-driven, economic development



Life Sciences Investment Strategy

Investing to Build Innovation Capacity: A Framework for Identifying Strategic Priorities and Investment Targets

Target the **Five Key Enablers** of Innovation Capacity

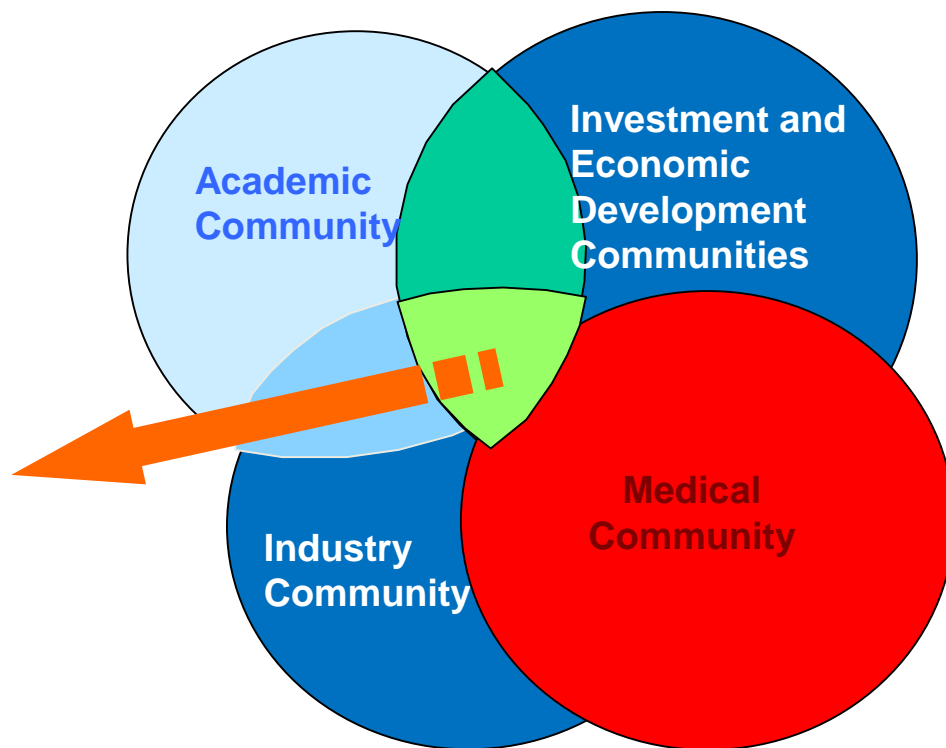


Applying the Framework: Why Wasn't MA Getting Traction?

Areas of Greatest Convergence Across Stakeholders

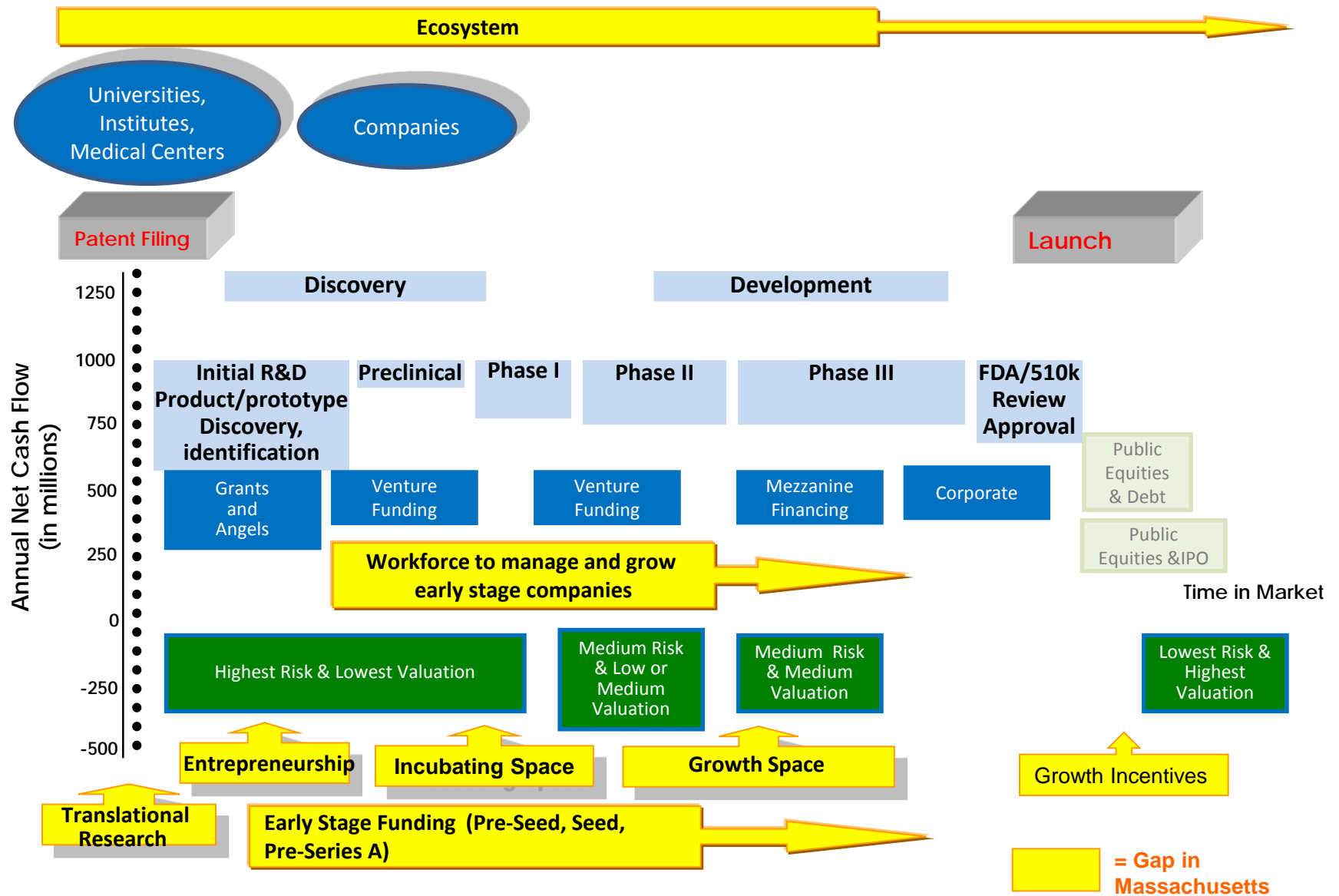
- ✓ **Current Culture at Academic and Medical Research Institutions DOES NOT ENCOURAGE TRANSLATIONAL RESEARCH OR NEWCO FORMATION**
- ✓ **Limited Funding EARLY-STAGE COMPANIES**
- ✓ **Need a WORKFORCE THAT SUPPORTS COMMERCIALIZATION**
- ✓ **Limited infrastructure FOR RESEARCH TRANSLATION AND BUSINESS INCUBATION**
- ✓ **Need investments in CUTTING EDGE RESEARCH INFRASTRUCTURE**
- ✓ **No real ecosystem: NEED A CONVENER AND COORDINATOR TO PROMOTE GREATER COLLABORATION**
- ✓ **Limited incentives to MOTIVATE COMPANIES TO STAY AND GROW IN MA**

Stakeholders Included in the GAP ANALYSIS*



*meetings/interviews with 100+ stakeholders and multiple roundtables at the outset of the Life Sciences Initiative in 2008

Gaps Across the Innovation Life Cycle



A “Hub” for the Massachusetts Life Sciences Community

Stakeholders

- Trade Associations
- Other Massachusetts State and Quasi-Public Agencies
- MA Companies
- U.S. Companies
- International Companies
- Foreign Governments
- International Delegations



MLSC Activities

- Programs and Incentives
- Referrals and Coordination
- Convening and Facilitation
- Outbound Marketing
- Inbound Inquiry Management
- Targeted Outreach
- Tradeshow Participation
- Partnership
- Business Development

Guidelines for MLSC Investment

- Strategic and well-chosen investments by the state **should be highly leveraged** to serve as a magnet for private investment
- **Investment based on a competitive process** promotes the relative best use of public dollars entrusted to the Center
- **Inclusionary decision making** engages the private sector in the life sciences initiative, creates shared ownership and accesses the breadth of expertise needed to optimize the impact of the Center's investments ("wisdom of crowds")
- A **"portfolio" strategy** is the most effective approach for accomplishing the Center's mission and vision
- The best use of MLSC funds is to **"seed, accelerate, match"** (vs. providing operating funds)
- **Funding and Incentivizing new models of partnership and collaboration** are critical to a successful life sciences ecosystem
- Funding priorities should be based on a **"bottoms up"** (market driven) vs. **"top down"** approach

Experts Should Guide Investment Decisions and Help Coalesce the Ecosystem

FOUNDING CHAIR: Harvey F. Lodish, Ph. D.,
Whitehead Institute and Massachusetts Institute of Technology (MIT)

Academia

James J. Collins, Ph.D., Massachusetts Institute of Technology

John M. Collins, Ph.D., Center for Integration of Medicine & Innovative Technology (CIMIT)

Robert D'Amato, M.D., Ph.D., Center for Macular Degeneration Research, Harvard Medical School and Boston Children's Hospital

Glenn R. Gaudette, Ph.D., Worcester Polytechnic Institute (WPI)

Judith Lieberman, Ph.D., Immune Disease Institute, Boston Children's Hospital and Harvard Medical School

Lita L. Nelsen, Massachusetts Institute of Technology

Barbara Osborne, Ph.D., UMass Amherst

Guillermo Tearney, M.D., Ph.D., Harvard Medical School, Harvard-MIT Division of Health Sciences and Technology (HST) and Massachusetts General Hospital

David Walt, Ph.D., Tufts University School of Medicine **CURRENT CHAIR (FOUNDER OF ILLUMINA)**

Frederick J. Schoen, M.D., Ph.D. Professor Harvard Medical School

Industry

James Barry, Ph.D., Inspire MD, Inc.

Dalia Cohen, Ph.D., ALN Associates

José-Carlos Gutiérrez-Ramos, Ph.D., Pfizer

Dale Larson, Draper Laboratory

Alan Smith, Ph.D., CBE, FRS, Genzyme (Retired)

Alison Lawton, Ovascience

Venture Capital

Kevin Bitterman, Ph.D., Polaris Venture Partners

T. (Teo) Dagi, M.D., M.B.A., Queens University Belfast & Broadview Ventures

Andrew Jay, DMD, Siemens Venture Capital

Henry Kay Boston Harbor Angels

Carmichael Roberts, Ph.D., M.B.A., North Bridge Venture Partners

Lauren Silverman, Ph.D., Novartis Option Fund

Frederick Jones, M.D. Broadview Ventures

Entrepreneurs

Alison Taunton-Rigby, Ph.D., RiboNovix, Inc.

Hillel Bachrach, Viztech & UltraSPECT

BIOMEDICAL GROWTH STRATEGIES LLC

*SAB members rotate

The Roadmap: A Strategic Investment Portfolio

Investments Specially Targeted Gaps That Were Weakening Massachusetts' Innovation Capacity

Translational Research Culture



- Faculty/EIR Grants
- Grants to Early Career Scientists for Translational Research
- Co-operative Research Grants

Ecosystem



- Collaborative R&E Partnerships
- Grants for Shared R&D Spaces
- Convening Spaces
- Biomanufacturing Roundtable
- Neuroscience Partnerships
- Partnership Assistance Portal

Entrepreneurship



- Grants for Business Plan Competitions
- Accelerator Loan Program
- Milestone Achievement Program (MAP)
- Small Business Matching Grant (SBMG)
- Mentoring Program
- Incubating, Accelerating and “Maker” Spaces
- Expedited Access by Investors and Industry to New Technologies

Workforce Development and Job Growth



- Internships
- Grants to Community-Based STEM Programs
- Equipment and Supply Grants to Middle, Voc Tech and Public High Schools
- Grants for Programs that Promote Workforce Inclusion and Diversity
- Tax Incentives for Growth and Capital Investments

Infrastructure



- Updates and Renovations
- Cutting Edge Spaces for Research, Training, Biomanufacturing and Computing (“WOW” Projects)

Strengthen the Translational Research Pipeline

Objective: Promote interest by academics in translational research, industry partnerships and entrepreneurship (culture change)

**MLSC investments through end FY 16:
\$15.8 million -- matched dollar for dollar by the private sector**

- 21 early career investigators **(\$5.1 million)**
- Faculty and Entrepreneurs-in-Residence at universities and academic medical centers **(\$3.7 million)**
- 12 translational research collaborations between industry and academic partners **(\$7 million)**
- Funding for the Massachusetts Association of Technology Transfer Offices (MATTO)* Best Practices **(\$100k)**

MATTO's mission: "to promote efficient and effective transfer of knowledge and technology developed at academic institutions in the Commonwealth of Massachusetts to companies that will develop and bring novel products to market for the public good."



Help Life Sciences Companies Grow

Objective: Provide funds and incentives to accelerate the formation, recruitment and growth of life sciences companies in Massachusetts



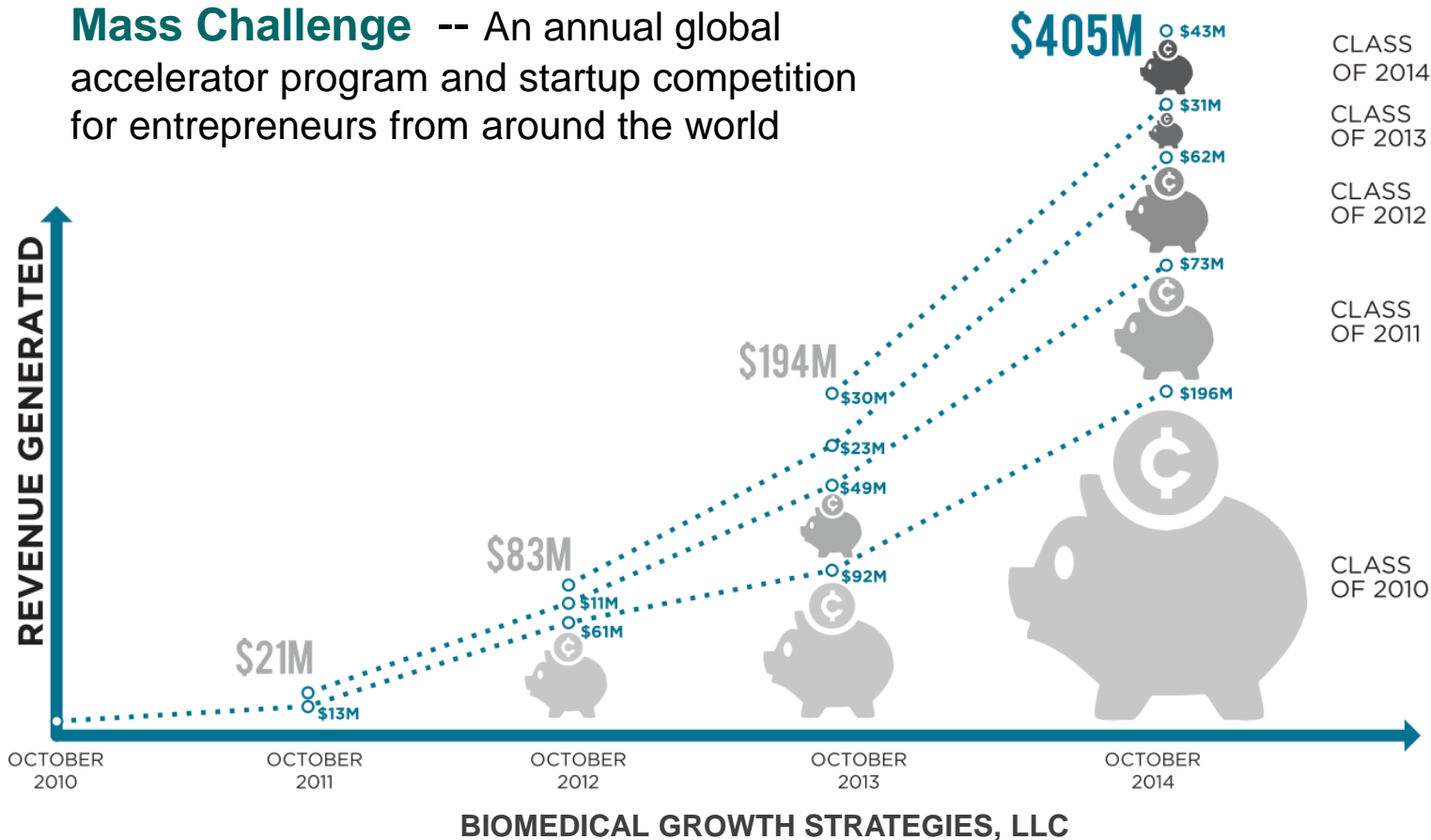
- **Business Plan Competitions:**
 - **Sponsorships**
 - ✓ **Promote Culture of Entrepreneurship**
- **Funding for Early Stage Companies:**
 - **Grants and Loans**
 - ✓ **Share in Risky Investments**
 - ✓ **Support Mentoring and Coaching**
- **Tax Incentives:**
 - **Incentives in Exchange for Job Creation and Capital Investments**
 - ✓ **Support the Business Case for Growing in MA**



Build a “Culture of Entrepreneurship”

Objective: Encourage the formation of start-ups by funding *university based and “free-standing”* business plan competitions across the state

Mass Challenge -- An annual global accelerator program and startup competition for entrepreneurs from around the world



“De-risk” Early Stage Companies

Objective: Provide investment capital to help early-stage companies complete value-creating milestones and compete for private investment

The MLSC Milestone Achievement Program (MAP)

- Grants of **\$50,000- \$200,000** to very early stage companies (seed stage)

The Accelerator Loan Program

- Loans of **up to \$1M** for early stage companies (“Pre-series A”)
 - Supports proof of concept/principle work
 - “De-risks” companies for private investors
 - Non-Dilutive
- **Corporate Consortium** expands the fund



The Mentoring Program

- Funds established programs that provide mentoring and coaching to entrepreneurs



Encourage Gender Parity Among Life Sciences Entrepreneurs

Objective: Increase the number of women-started and led life sciences companies

The Massachusetts Next Generation Initiative (MassNextGen)

- Public-private partnership between the Massachusetts Life Sciences Center and Takeda
- Five year commitment
- Women-led early-stage life science companies awarded a year-long customized package of support
 - Non-dilutive grant funding
 - Access to a network of seasoned Executive Coaches
 - Mentoring to refine business strategies and effectively raise capital



MLSC Accelerator Loan Program: Leverage

Leverage on Public Dollars



Accelerator Awardees have raised **over \$250 million*** in additional funding and acquisition proceeds subsequent to receiving an MLSC loan



\$30.7 million invested or committed by MLSC

*as of 2017



The MLSC Has Helped Young Companies Gain Traction

Nine MA life sciences companies that have filed for or completed IPOs since 2013 received MLSC funding.

The logo for uniQure, featuring the word "uniQure" in orange and blue text.The logo for genocea biosciences, featuring the word "genocea" in green and "BIOSCIENCES" in smaller green text below it.The logo for FOUNDATION MEDICINE, featuring a green hexagonal icon above the word "FOUNDATION" in orange and "MEDICINE" in smaller green text below it.The logo for ACCELERON PHARMA, featuring a blue stylized "A" icon above the word "ACCELERON" in blue and "PHARMA" in smaller blue text below it.The logo for TETRAPHASE PHARMACEUTICALS, featuring a red stylized "T" icon above the word "TETRAPHASE" in red and "PHARMACEUTICALS" in smaller red text below it.The logo for BIND THERAPEUTICS, featuring a blue stylized "B" icon above the word "BIND" in bold black text and "THERAPEUTICS" in smaller black text below it.The logo for Epizyme, featuring a stylized "E" icon above the word "Epizyme" in red and black text.The logo for bluebirdbio, featuring a blue stylized bird icon above the word "bluebirdbio" in blue text.The logo for MEVION medical systems, featuring a red stylized "M" icon above the word "MEVION" in red and "medical systems" in smaller red text below it.

Workforce Development Programs

Objective: Train future life sciences workers – across skill levels, regions of the state and socio-demographics

- Skill development in **Early to Middle School grades (K-8)**
- State-of-the-art training facilities at **public and vocational-technical high schools**
- Infrastructure upgrades in **community colleges and four-year colleges and universities**
- **Career pathways** into the life sciences – “real world experience”



STEM Education:

Grants to Middle Schools & High Schools

- **Targets:**
 - Vocational technical schools
 - Public high schools in “Gateway Cities” (economically challenged communities)
 - Middle Schools
 - Workforce training organizations
- **Grants of up to \$250,000 per institution for equipment and supplies for life sciences-related training**
 - Industry match is required for funding above \$100,000
 - Middle Schools eligible for up to \$50,000
- **Through 2017 awards made to more than 100 institutions across Massachusetts; over \$19 million investment**
 - ✓ Over \$1.3 million in additional “matching” funds provided by industry
 - ✓ MassBio provides discounts of 30% through its purchasing consortium



Preparing the Workforce: Curriculum Development Targeted to Industry Needs

- **Harvard Medical School, Boston - \$4.3M**
 - Using this MLSC grant, Harvard Medical School will partner with the Massachusetts Institute of Technology to establish a new research and education program in regulatory science and precision medicine, focusing on overcoming the most difficult steps in drug development, to address unmet medical needs at lower cost



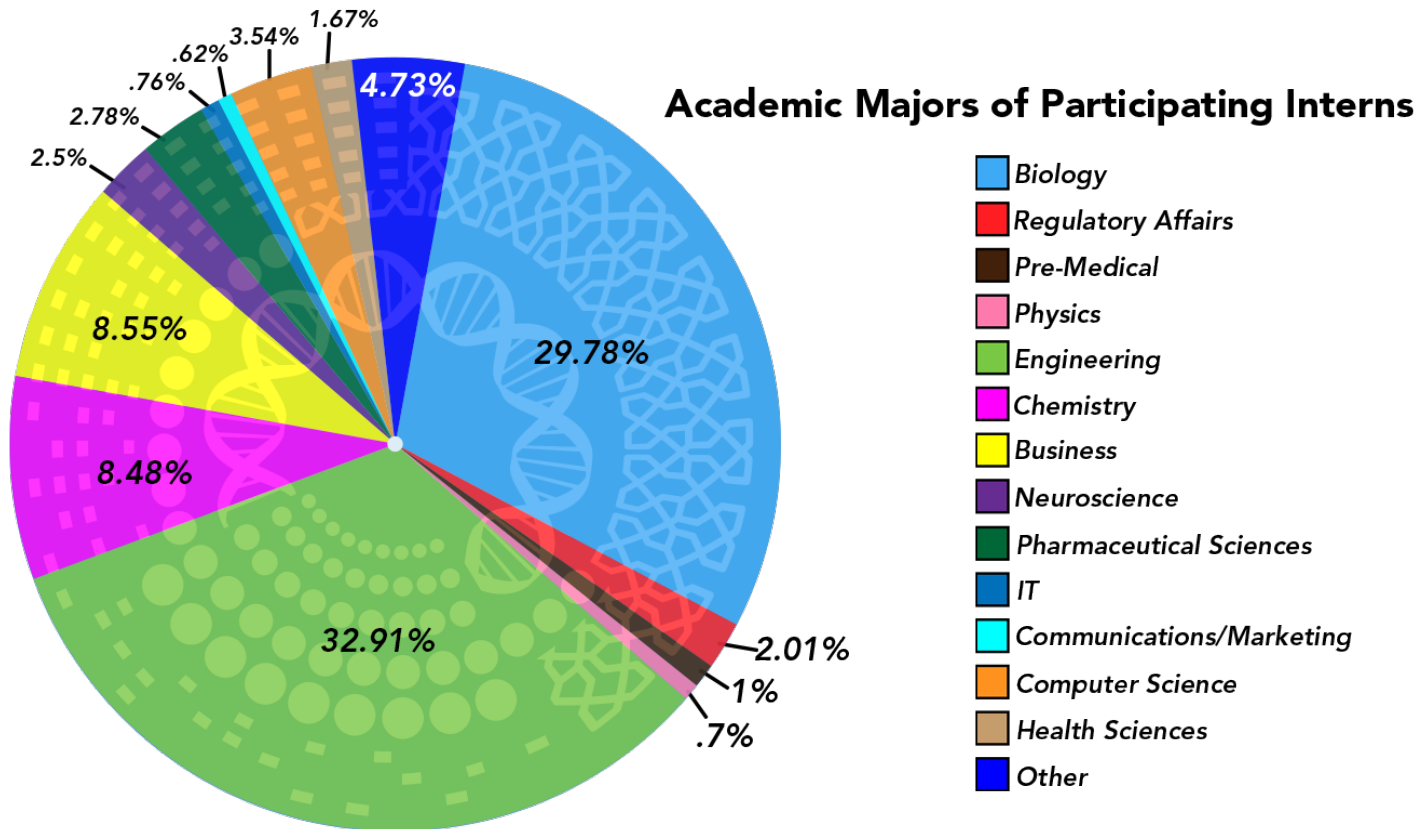
Career Readiness: High School Apprenticeship Program

- Facilitates and funds paid internship opportunities for high school students throughout the Commonwealth
- The program also offers an after-school laboratory training program for select school districts during the spring
 - Aims to better prepare students for summer internships
- Program first launched in 2016; MLSC has supported 106 internships at 49 life sciences companies and research institutions



Career Pathways: Internship Challenge Program

- Nearly **\$16 million** invested since 2009
- **3,000 internships** funded
- **One-quarter** of participating interns who were eligible to work were offered full or part-time employment



Preparing a Diverse and Inclusive Workforce: Grants to Community Programs

Getting Girls and “Kids of Color” Interested.....

- Science Club for Girls
- Just A Start
- Girl Scouts of Eastern Massachusetts – Early Intervention and Prevention
- The Urban League of Springfield, Inc. “Be the STEM”
- Girls Inc. Strong, Smart and Bold Science for Girls Program (Eureka!)

Sustaining Interest and Skill Development.....

- Youth Creating Impact Through Innovation, Entrepreneurship and Sustainability (Youth CITIES)
- Biomedical School Careers Program at Harvard – Project Success:
- The Louis Stoke Alliance for Minority Participation

Supporting Diverse Professionals in the Field.....

- Bentley University’s Center for Women and Business
- The Partnership
- WEST

The MLSC Capital Grant Program

Objective: Expand capital and infrastructure resources across MA, build regional strengths to host industry, support life sciences research, development and commercialization, create collaboration spaces



Life Sciences Laboratories at the University of Massachusetts, Amherst campus: \$95 million to fit out and equip a substantial portion of the university's facilities

Town of Framingham State-of-the-Art Pumping Station:

\$13M grant to upgrade the town's wastewater collection system. The new wastewater system enabled Genzyme Corporation's to build a \$330M manufacturing plant for Fabrazyme® followed by an \$80M million downstream processing facility adjacent to the manufacturing site.



Albert Sherman Center at University of Massachusetts Medical School: \$90M for interdisciplinary research and education facility that fosters inter-disciplinary collaboration and promotes innovation



Upgrade and Renovate Outdated Space



New Life Sciences Institute (LSI) at Roxbury Community College: \$3 million to upgrade outdated facilities for approximately 1,100 students enrolled in its science programs and to build additional science labs, renovate existing lab space. RCC's student body is predominately made up of students of color and immigrant communities, uniquely positioning the College to fill the need for a diverse, well-trained and local life sciences workforce.



Renovation of the Loeb Lab at the Marine Biological Institute: \$10 million grant from the Center that leveraged a \$15 million grant from the Howard Hughes Medical Institute (HHMI), transformed Loeb into a state-of-the-art facility that serves as a national resource for science training and discovery.



Cutting-Edge Shared Training Spaces



WPI Biomanufacturing Education and Training Center (BETC): *\$6.6M grant for an innovative partnership between academia and industry that creates customized workforce development solutions focused on biomanufacturing. Industry matches to date are \$50M*



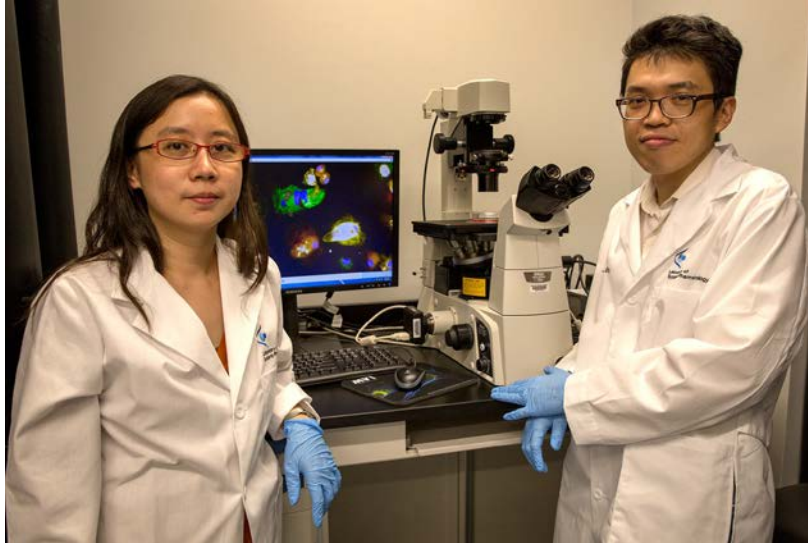
The BETC is the first of its kind in New England: at the 10,000-square-foot pilot-scale Biomanufacturing facility for innovative training. The BETC also offers contract services such as small-scale non-GMP manufacturing, and consulting.



Cutting-Edge Shared Research Spaces

Center for Personalized Cancer

Therapies: **\$10M** in seed funding to the CPCT, a joint initiative of UMass Boston and the Dana-Farber Cancer Institute that helps investigators and clinicians analyze samples, identify genetic variants contributing to disease risk, and reveal complex mechanisms involved in human disease



The Laboratory for Systems Pharmacology at Harvard Medical School:

\$5M to transform drug discovery by convening biologists, chemists, pharmacologists, physicists, computer scientists and clinicians to explore together how drugs work in complex systems



Cutting-Edge Shared Research Spaces (cont'd)

Boston University's Center for Regenerative Medicine (CReM): *\$2M to help build a new lung regeneration facility. The new facility is housed on the Boston University Medical Campus and brings together academic and industry scientists from across the state to apply stem cell biology advances to developing new treatments for cystic fibrosis and other lung diseases.*

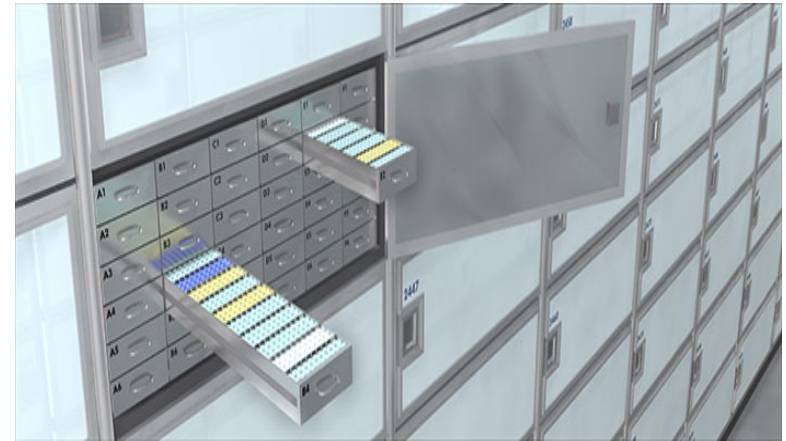


The Joslin Translational Research Center for the Cure of Diabetes: *\$5M for the creation of new labs and new platforms that will lead to the development of translational studies for curing Type 1 and Type 2 diabetes.*



Cutting-Edge Shared Research Spaces (cont'd)

Biobank for Microbiome Research: \$4.8M grant to Brigham and Women's Hospital, the Forsyth Institute, Boston Children's Hospital (BCH) and the Harvard Digestive Disease Center (HDDC) to form the collective "Massachusetts Host-Microbiome Center." Funding will advance clinical trials targeting the microbiota while furthering the development of diagnostic tools.



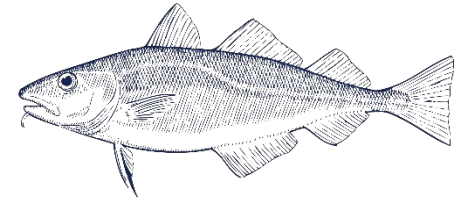
The Advanced Cell Therapy Unit: \$4.6M: MLSC grant funding will support the Dana-Farber Cancer Institute's Advanced Cell Therapy Unit, which will establish partnerships with commercial partners to refine cell therapy manufacturing processes, validate manufacturing procedures, and provide manufactured cellular products for patients enrolled in FDA-approved clinical trials.



Cutting-Edge Shared Research Spaces (cont'd)

Gloucester Marine Genomics Institute, Gloucester - \$2.7M

The Gloucester Marine Genomics Institute will establish a world-class marine genomics research institute on Gloucester Harbor, integrating the dynamic components of scientific discovery, workforce development and investment, and diversifying Gloucester's maritime economy.



GLOUCESTER MARINE GENOMICS INSTITUTE



Institute for **Protein Innovation**

The Institute for Protein Innovation: \$5M.

The IPI will build and operate an open-source antibody discovery platform focused on protein therapies, with the long-term goal of developing antibodies targeting the entire human extracellular proteome.



Shared Computing Resources



Massachusetts Green High Performance Computing Center (MGHPCC)

\$4.5M for the creation of a for a supercomputer system for research in the life sciences. The MGHPCC is a critical piece of infrastructure that promotes cooperative research, education and outreach activities. Computers in the MGHPCC run millions of virtual experiments per month, supporting thousands for researchers in Massachusetts and around the world.



90, 000 square foot, 15 megawatt facility located on an 8.6 acre former industrial site in Western Massachusetts

UNIVERSITY PARTNERS



Northeastern University



HARVARD
UNIVERSITY



IN PARTNERSHIP WITH

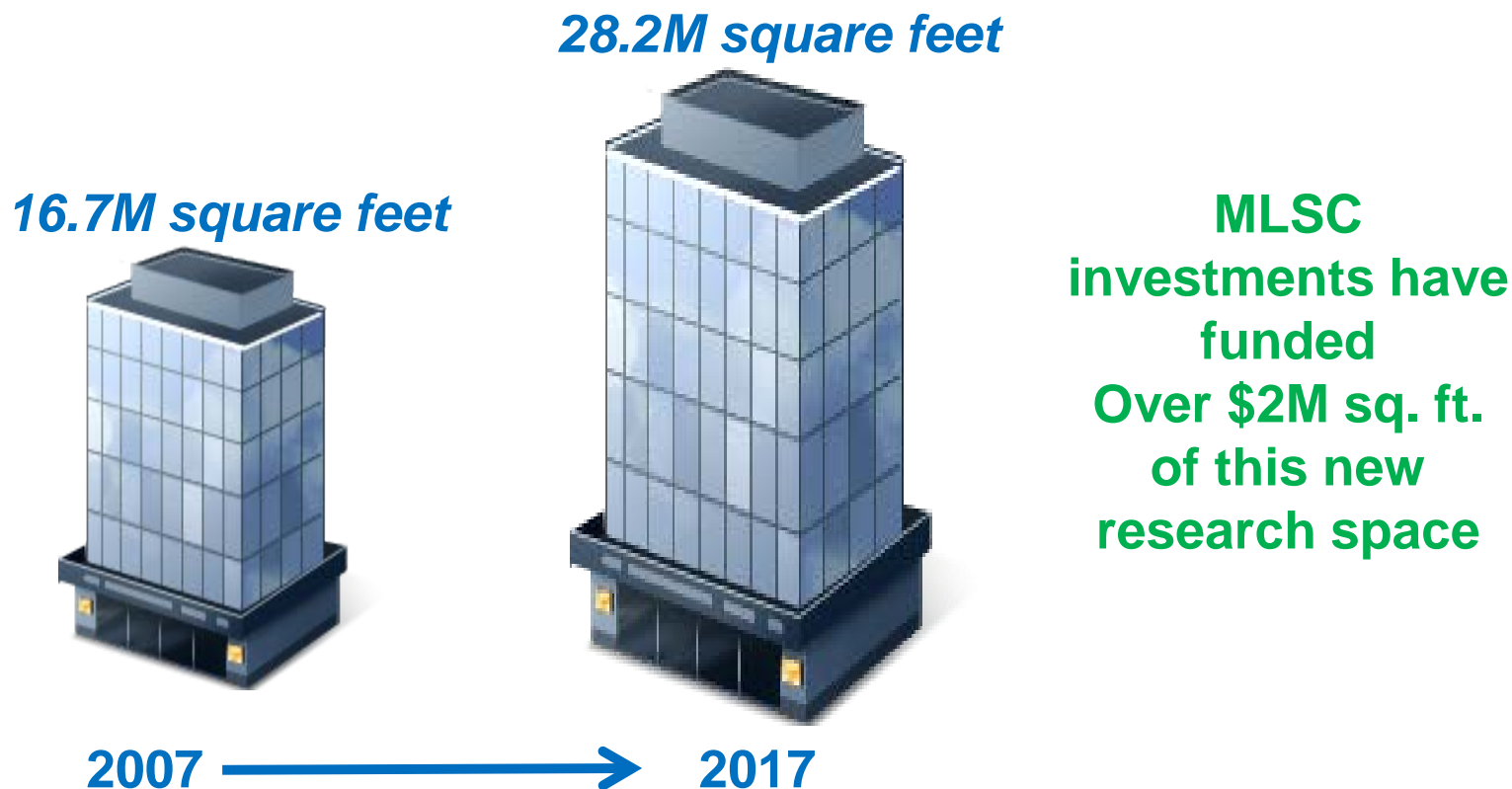
EMC²



BIOMEDICAL GROWTH STRATEGIES LLC

Inventory of Commercial Research Space

Since 2007, **over eleven million square feet of commercial lab space** have been added to the Massachusetts' inventory – an increase of nearly 70%



Source: Colliers Meredith & Grew, Life Science Review, 2007-2015 and 2016-17
Courtesy of MassBio Industry Snapshot 2017

BIOMEDICAL GROWTH STRATEGIES LLC

Business Incubating Spaces



M2D2: the Massachusetts Medical Device Development Center

M2D2 offers inventors and executives of medical device companies easy, affordable, and coordinated access to world-class researchers and resources at the University of Massachusetts Lowell Campus and the University of Massachusetts Medical School and Medical Center



\$10M seed and expansion funding from the MLSC

BIOMEDICAL GROWTH STRATEGIES LLC



Business Incubating Spaces



TechSpring: The Baystate Health Technology Innovation Center

TechSpring is the only healthcare innovation center to empower technology companies with the three conditions needed to advance transformative digital healthcare solutions:

- An authentic healthcare environment to test and prove solutions
- Access to healthcare technology systems and informatics
- A forum for healthcare and technology experts to communicate and collaborate



Investor Office Hours

Springfield • Northampton

Meet with Angels.

Share your ideas.

Get advice.



\$5M seed funding from the MLSC



Business Accelerating Spaces

LabCentral: a first-of-its-kind shared laboratory space



LabCentral is a launch pad for high-potential biopharma start-ups

“Our mission is to help create the next generation of powerhouse biotech companies by providing entrepreneurs and innovative life-sciences startups with the space and resources they need to test out, challenge, and nurture early ideas.”

\$10M seed and expansion funding from the MLSC

BIOMEDICAL GROWTH STRATEGIES LLC



Massachusetts Now Has Incubating and Accelerating Spaces Across the State



UMass Boston



TechSpring - The Baystate Health Technology Innovation Center



Massachusetts Biomedical Initiatives



 = Funded by the MLSC

Biomanufacturing Spaces

Massachusetts Accelerator for Cell and Vector Biomanufacturing (VMC) in Fall River

First-in-Massachusetts cGMP (Current Good Manufacturing Practice) facility to respond to a new era in the use of viral vectors to prevent and treat human diseases



The VMC is a 3,900 sq. ft. commercial/clinical scale facility that includes multi-platform upstream cell culture, downstream purification and dedicated fill capabilities. The facility was built and is operated by MassBiologics and the University of Massachusetts Medical School.

\$20M from the MLSC

The VMC enhances the ability of the Massachusetts life sciences community to translate breakthrough science into viable commercial products. The VMC's unique set of competencies and facilities do not exist in any current commercial facility capable of manufacturing virus based products



Convening Spaces

District Hall: a dedicated civic space where the innovation community can gather and exchange ideas



District Hall has open workspace, classrooms, assembly space, flexible use 'pods', and writable surfaces everywhere



The MLSC was a capstone funder

BIOMEDICAL GROWTH STRATEGIES LLC



Promoting the Public's Interest



Boston Museum of Science Hall of Human Life: \$5 million capstone grant to create a permanent exhibition designed to revolutionize how people view and engage with their own biology

Boston Children's Museum: \$500k grant to create a "maker space" and study how young children develop skills for STEM as well as engage parents in working on STEM projects with their children



Consortia and Collaborations: Neuroscience Consortium



Objective: Accelerate breakthrough treatments in CNS by creating a pioneering new model of collaboration that leverages Massachusetts' rich neuroscience environment

- Accelerates pre-clinical research available to the pharmaceutical industry
- Introduces academic researchers to targeted research
- Facilitates new models of industry-academic partnership
- Provides sponsors with expedited access to Massachusetts' neuroscience cluster – the highest density of neuroscience research in the world

Neuroscience Consortium Charter members:

- | | |
|--|---------------------|
| ➤ AbbieVie | ➤ Merck |
| ➤ Biogen-Idec | ➤ Pfizer |
| ➤ EMD Serono | ➤ Sunovion |
| ➤ Janssen Research (Johnson and Johnson) | (DainipponSumitomo) |

Projects are funded by Consortium members; the MLSC provides staff support and grant administration



Consortia and Collaborations: MLSC and NIIMBL Partnership

Objective: Accelerate innovation in biomanufacturing



- Partnership with NIIMBL (National Institute for Innovation in Manufacturing Biopharmaceuticals) -- the nation's first biomanufacturing innovation institute (launched 2016)
- MLSC is an anchor to NIIMBL's northeastern node
- Regional consortium includes:
 - Small, medium and large biopharmaceutical industry partners
 - MIT, Quincy College, UMass Lowell, UMass Medical School, and the Worcester Polytechnic Institute (WPI).

Center has committed up to \$20 million for five years



Creating the Ecosystem Was a Team Effort

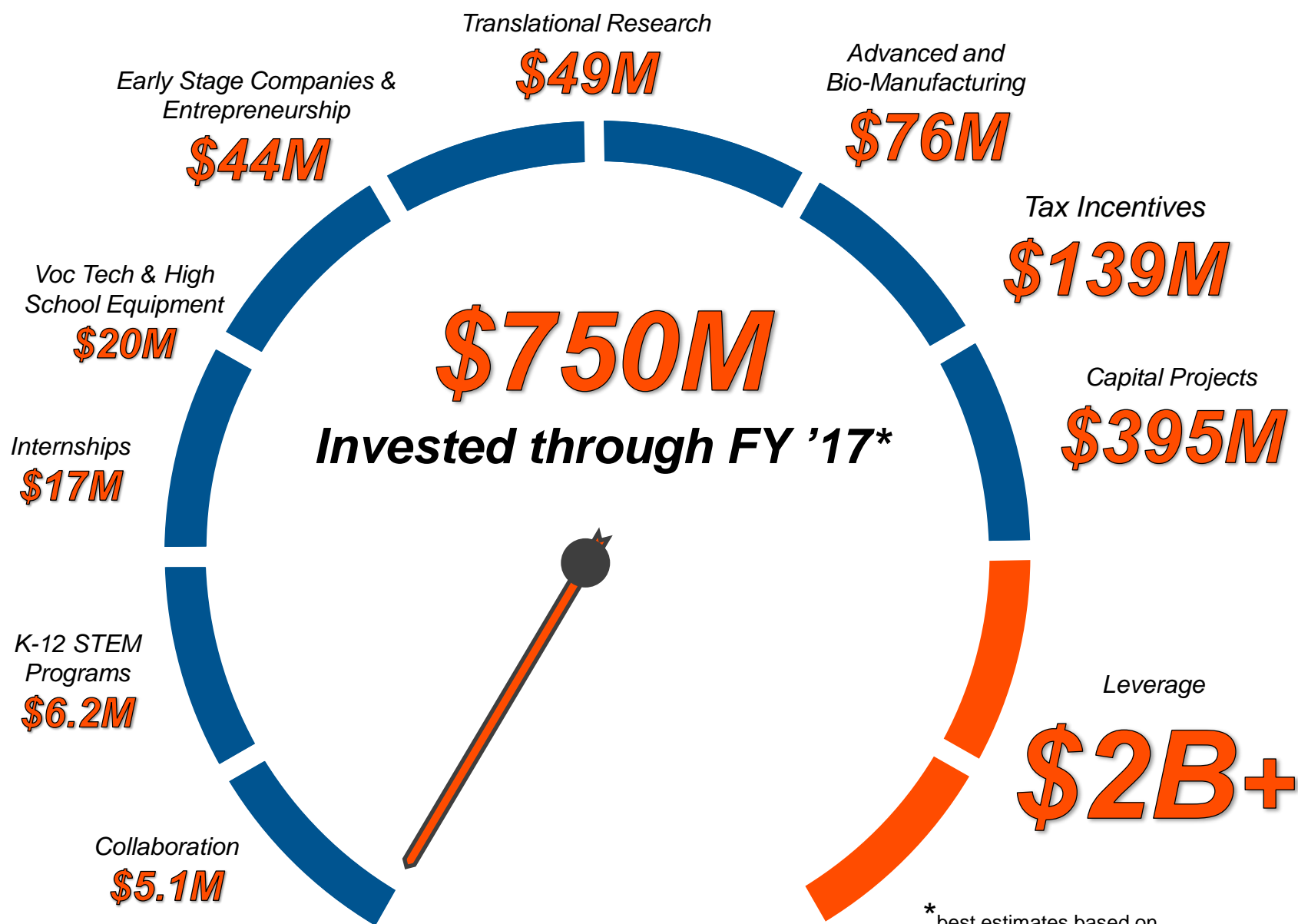
Many constituencies took ownership for the vision and contributed to its realization and helped drive culture change

- “Bioready Communities” rating (MassBio)
- Venture forms and educational sessions for entrepreneurs (Law and Accounting firms)
- “Life Sciences Corridor” (Mayors of 5 cities and towns along the eastern seaboard)
- Tax incentives to life sciences start-ups and mature companies (Local governments)
- Pro bono first class luxury space for the MassChallenge’s business plan competition (The Fallon Company)
- Creation of the Boston **“Innovation District”** – a “new model designed to foster collaboration, especially among start-ups and research-based companies (Mayor, City of Boston)

“Team Massachusetts” creates a unified marketing message and brand



Revving Up the Massachusetts Life Sciences Ecosystem



* best estimates based on available data

Why It Works

- Innovation can be an **outcome of focused, strategic investments***
- Strategic investments by government will be **leveraged** by private investment, especially capital expenditures
- **A rich pipeline of early stage companies** attracts large companies that **anchor the ecosystem**
- **Academic institutions and faculty benefit** from actively participating in translational research, entrepreneurship and industry partnerships
- **Career opportunities** are created for workers with a variety of skills and educational levels
- **“Wisdom of experts”** identifies the relative best investments and creates shared ownership
- Innovation-driven economic development is a **viable goal** for policymakers
- **Collaboration, partnerships, collaboration, partnerships.....**

Other “Best Practice” Initiatives Worth Reviewing

- **Use of Infrastructure for the Creation of Hubs and Districts**
 - ✓ MaRS Discovery District (Toronto)
- **Promoting Entrepreneurship**
 - ✓ Ben Franklin Technology Partners (Philadelphia, PA)
 - ✓ Lab Central (Cambridge, MA)
 - ✓ Cambridge Innovation Center and Venture Café (Cambridge, MA)
 - ✓ MassChallenge and PULSE@MassChallenge (Boston, MA)
 - ✓ Innovation Center of the Rockies (Boulder, CO)
- **Real Estate Development and Use**
 - ✓ Mission Bay Biotech Cluster (San Francisco, CA)
 - ✓ Singapore Jurong Innovation District (Singapore)
 - ✓ Destination Medical Center/Discovery Square (Mayo Clinic, Rochester, MN)
- **Evolving Academic Research Culture**
 - ✓ (CIMIT) Center for the Integration of Medicine and Innovative Technology (Boston, MA)
 - ✓ MIT (Cambridge, MA)
 - ✓ Tri-Institutional Therapeutics Discovery Institute (New York, NY)