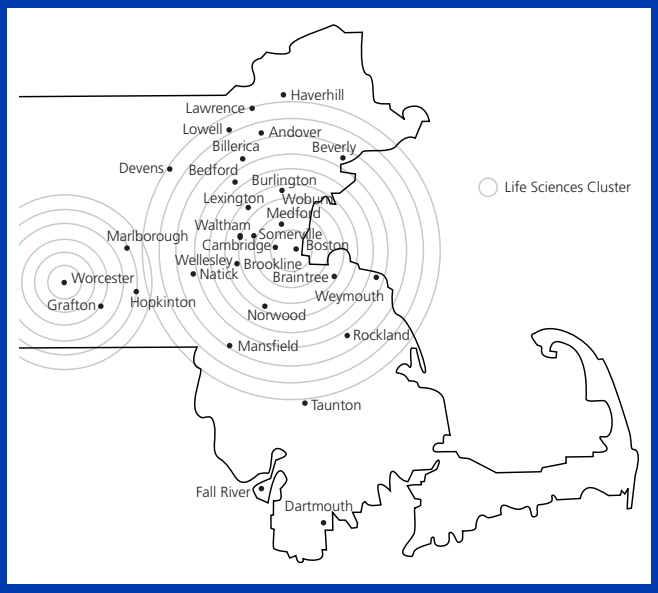
Connecting with our Economic Future

A Transportation Investment Strategy for the Life Sciences Cluster



Executive Summary

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About A Better City

A Better City (ABC) advances infrastructure investments and projects that are vital to sustaining and growing the Boston area's economy and ensuring that Boston remains one of the most dynamic and unique cities in the world. Comprised of leaders from business and major institutions, ABC is focused on solving problems and developing strategies that ensure the continuity and progress of significant transportation, land development, and public realm projects. A Better City is built on the foundation of over fifteen years of success as the Artery Business Committee, widely credited with achieving consensus and keeping Boston open for business during the Central Artery/Tunnel project, the largest and most complex urban infrastructure project ever undertaken in the United States.

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Introduction

A Message from the President & CEO

Metropolitan Boston is home to one of the world's premier life sciences clusters. This mature, broad and diverse life sciences sector combines the strengths of the region's teaching hospitals and medical and academic institutions with a large and growing number of private sector biotechnology, pharmaceutical and medical devices companies. Maintaining and growing this cluster is critical to the health of the Metropolitan Boston and Massachusetts economy.

Boston, Cambridge and cities and towns throughout Massachusetts are hardly alone, however, in their desire or ability to attract, retain and grow a thriving life sciences industry. Competitor cities and regions from across the United States and, increasingly, around the world are eager to capture a share of life sciences jobs and companies. As the Massachusetts Biotechnology Council notes, "While certainly special, our assets and attributes are not necessarily unique, and our competitors both here and abroad are convinced they can replicate the factors that have made our cluster successful." (Massachusetts Biotechnology Council, 2006). Moreover, throughout the United States, cities and regions are investing in infrastructure and in transportation improvements—particularly in transit—to serve the anchor institutions and geographic areas that are most vital to their life sciences clusters.

Having embraced the potential of the life sciences as an engine of growth not just for Boston and Cambridge but for all of Massachusetts, many organizations and elected officials are asking "what can we do to better nurture, retain and grow our life sciences cluster?" To this end, several recent studies have been directed toward understanding the role of the life sciences industry as a generator of jobs and economic development and the types of public policies and investments that can help to expand the region's life sciences sector. A variety of public policies, programs and investments have been identified as important strategies for supporting the life sciences industry in Massachusetts: improving K-12 and higher education, providing workforce training and development, expediting permitting, lowering business costs and creating more affordable housing.

This report focuses on another essential building block for a thriving life sciences sector, one that has received little attention to date: the importance of transportation infrastructure in creating stronger and better connections among the institutions and businesses in the life sciences sector, connections that can provide a critical competitive advantage to Metropolitan Boston's life sciences cluster. It is important to note here that A Better City also recognizes the critical role that infrastructure investment plays in supporting the growth and development of all economic sectors in Metropolitan Boston. While this report highlights the importance of transportation infrastructure investment to the life sciences sector in particular, transportation investment will ultimately enhance the economic competitiveness and position of the Commonwealth overall.

The challenge is how best to construct such a network from the mature but incomplete transportation and transit network that currently serves Metropolitan Boston. The Commonwealth has limited resources to invest in its transportation infrastructure and a myriad of needs, including the need to maintain and enhance existing services as well as the need to expand existing transit and transportation networks. One key question thus becomes how best to make and prioritize transportation operations and investment decisions.

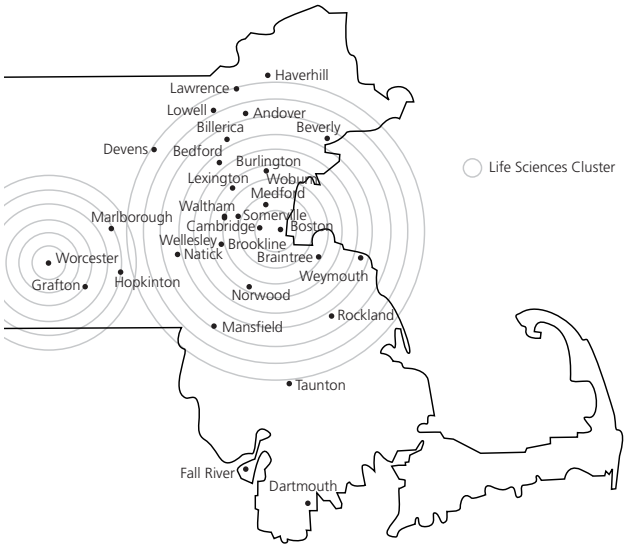
To understand this connection between transportation and life sciences, this report identifies lessons learned from a study of the current competitive advantages of and challenges to Metropolitan Boston's life sciences cluster, as well as case studies of key competitor cities in the United States. These lessons help inform a set of recommendations for operational changes, new transportation policies and planning efforts, and capital investments that A Better City believes can ensure a more successful future for the Commonwealth's life sciences sector.

Richard A. Dimino
President and CEO
A Better City

Overview of the Life Sciences Cluster

Geography of the Cluster

The dense Boston-Cambridge life sciences corridor anchors Metropolitan Boston's life sciences cluster, which extends throughout eastern Massachusetts and includes a smaller but growing cluster around Worcester.



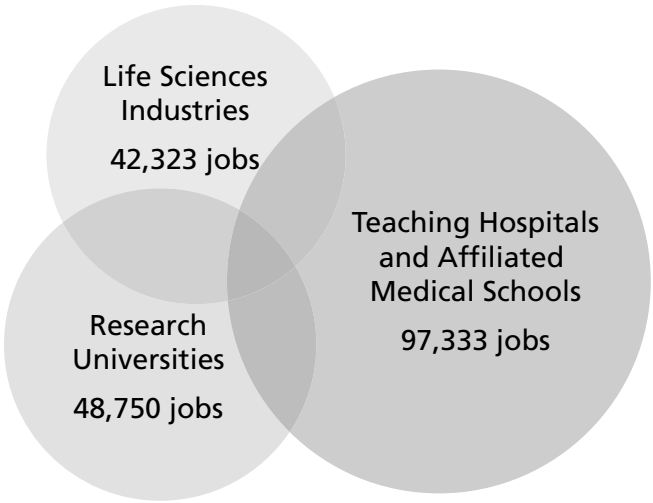
The Metropolitan Boston Life Sciences Cluster

Economic Highlights

Metropolitan Boston's Life Sciences cluster boasts measurable impact on the area economy, as demonstrated by number of employees and jobs, as well as growth projections.

- Recent estimates identify over 42,000 employees in the core life sciences industries in 2004, with an additional 263,000 jobs in the "supporting" life sciences and health care industries. (Milken Institute, 2005)
- The life sciences cluster is characterized by high growth - The Massachusetts Technology Collaborative projects that the number of jobs in the life sciences industry in the Boston area will double by 2010 (Adams, 2004).

The educational and medical institutions or "eds and meds" that are traditionally not counted as life sciences jobs serve both as a source of skilled labor for the private sector and as generators of technological advances from their research and development activities (Breznitz and Anderson, 2006). We know that the "eds and meds" represent a significant share of the life sciences sector, even though there is currently no definitive documentation of their share as illustrated above.



Economic Impact of the Life Sciences Cluster

- A 2007 report by the Conference of Boston Teaching Hospitals found that the medical schools of Harvard, Boston University and Tufts University, along with the 14 teaching hospitals in the Boston area, employ over 97,000 workers in Massachusetts, and generate $24.3 billion in economic activity and more than $839 million in revenue for the Commonwealth. (*Driving Greater Boston & New England: The Impact of Greater Boston's Teaching Hospitals, Conference of Boston Teaching Hospitals, 2007*)
- Four of the ten largest employers in Massachusetts in 2006 were Boston and Cambridge universities and research and teaching hospitals.
- Another recent report that looked at the region's eight research universities, (defined as those that grant doctoral degrees and spend at least $10 million annually on research) found that they employ nearly 50,000 people with a combined 2002 payroll of more than $2.5 billion. These universities received $1.5 billion in research funds and their affiliated hospitals and research centers attracted an additional $1 billion, with 80% of the funds coming from Federal sources. (*Engines of Economic Growth,* Association of Independent Colleges and Universities of Massachusetts, 2003)
- Together the "eds and meds" account for approximately 30% of the jobs in Boston (The Boston Redevelopment Authority).

Known and respected across continents, the "eds and meds" – Greater Boston's universities, colleges, hospitals, research laboratories – are the region's undisputed global marker. They're magnets for billions in research grants. The ideas they generate are constantly spinning off new firms, producing some of the world's most highly sophisticated devices and substances, vastly enriching the local economy. Their very special missions – the industry of the mind and the arts of healing – seem destined to be the Boston region's sustaining force far into the future (Pierce and Johnson, 2004).

Moreover, educational and medical institutions constitute a large and growing share of not just the Metropolitan Boston economy but also that of the Commonwealth of Massachusetts. As summarized in the table below, three research universities and six teaching hospitals in Boston and Cambridge were among the top 25 employers in the Commonwealth of Massachusetts in 2006 (*Boston Business Journal,* 2006).

Rank	Institution	Headquarters	2006 Mass. Employees	% Change in Mass. Employees 2005-2006
2	Massachusetts General Hospital	Boston	22,049	+7.86%
3	Harvard University	Cambridge	19,292	+1.67%
6	Brigham and Women's Hospital	Boston	13,839	-1.42%
7	Massachusetts Institute of Technology	Cambridge	13,451	+3.77%
13	Boston University	Boston	9,210	-1.27%
17	Beth Israel Deaconess Medical Center	Boston	6,788	+2.90%
19	Boston Medical Center	Boston	5,726	+0.72%
20	Tufts/New England Medical Center	Boston	5,605	+3.13%
22	Children's Hospital Boston	Boston	4,745	+3.78%

Eds and Meds among Top 25 Largest Employers in Massachusetts

Competitive Advantages

Anchor institutions: Greater Boston has multiple, world-class universities, medical schools, teaching hospitals and research institutions. The Massachusetts Life Sciences Cluster Survey found that over 50% of companies attributed the proximity to major universities and scientists as lead factors in their decision to locate operations in Boston (*PricewaterhouseCoopers 2007 Massachusetts Life Sciences Cluster Survey*).

Maturity and diversity: The life sciences sector is long-standing and broadly diversified. It is far easier to proceed from a position of strength than to try to grow a life sciences industry from scratch, as many of Greater Boston's competitors are trying to do. As Harvard Business School's Michael E. Porter explained at the 2003 Life Sciences Summit held at Harvard University, "We don't have to claw our way to the top. Our task is to preserve our leadership." (Powell, 2003) A related strength of the cluster is its breadth and diversity. Metropolitan Boston has large and small biotechnology and biopharmaceutical companies, medical devices companies and a variety of institutional, not-for-profit and private sector research and development facilities. While competitor cities are concentrating on only one of the sectors, such as medical devices or biopharmaceuticals, Metropolitan Boston has substantial representation across all life sciences sectors. In addition, knowledge-based industry clusters in related fields such as information technology and nanotechnology are co-located geographically with the life sciences clusters.

Research and development: Metropolitan Boston's life sciences sector attracts both government funding and venture capital and invests these funds in new R&D facilities as well as research activities. The ability of its health care institutions to secure funds from the National Institutes of Health (NIH) is unmatched, with all of the top five hospitals ranked by amount of federal research funding in fiscal year 2006 located in the City

of Boston. The Milken Institute characterizes Boston hospital's prowess in capturing NIH funds as "remarkable," noting that Boston received 78% of the total received by all eleven metropolitan areas studied (Milken Institute, 2005). In terms of research and development facilities, the Conference of Boston Teaching Hospitals identified $1 billion in projects, totaling more than 3.2 million square feet of new space, under construction at teaching hospitals throughout Greater Boston.

Talented workforce: Metropolitan Boston has a highly educated workforce that is critical for the life sciences sector. A recent report by the University of Massachusetts' Donahue Institute noted that "it is difficult to overstate the strength and diversity of talent that exists in Massachusetts' firms and institutions" in the life sciences sector. On account of this workforce, the Commonwealth attracts investment and employment in the most high-skilled and high-wage occupations within the sector and accordingly has the highest average wages in the U.S. for biopharmaceutical workers, with an average 2004 wage of over $98,000 (UMass Donahue Institute, 2007).

Access to downtown international airport: Logan International Airport is a short distance from downtown and is accessible by public transit. Few cities have an international airport located so close to downtown.

Proximity and connections: One of the most striking features of Greater Boston's life sciences cluster—especially when compared to geographically dispersed competitor regions such as Research Triangle Park in North Carolina or Philadelphia/New Jersey—is its geographic compactness that enables strong inter- and intra-institutional connections.

Proximity and Connections

The cities of Boston and Cambridge strongly anchor the dense life sciences cluster, with Boston's cluster heavier on teaching hospitals and Cambridge's cluster heavier on private sector biotechnology companies.

Forty percent (40%) of the membership of the Massachusetts Biotechnology Council (MBC) is located in Boston and Cambridge. Further geographic concentration exists within these two cities, with a substantial proportion of the cluster located along a dense "life sciences corridor" running from Kendall Square in east Cambridge, through the MIT campus to Central Square, then across the Charles River past Boston University, to the Longwood Medical and Academic Area, to the Boston Medical Center/Biosquare Area and then to the South Boston Seaport. This arc passes nearby or contains six of the eight research universities within Route 495: Boston University, Harvard University, Massachusetts Institute of Technology, Northeastern University, Tufts University, and University of Massachusetts Boston. This area also includes many of the region's major teaching hospitals. All three universities with medical campuses—Harvard, Boston University and Tufts University— have their teaching hospitals in this "corridor" but geographically separated from the remainder of their campuses.

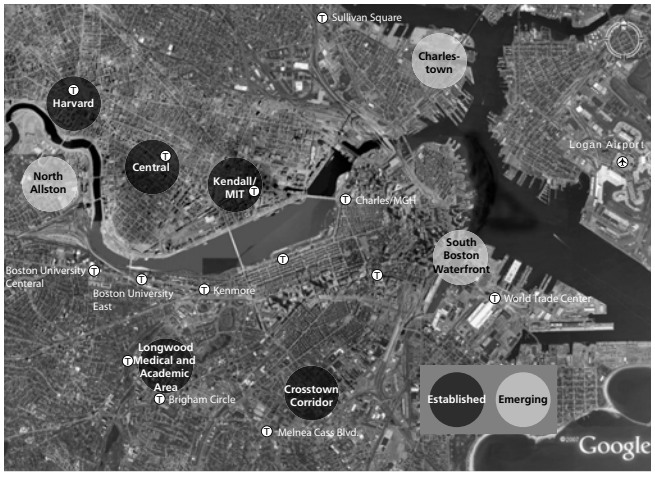
Supporting the core life sciences industry in Boston and Cambridge is an additional cluster in Worcester, in addition to life sciences companies in other cities and towns in Massachusetts.

The Need for Connections

One key to the success of Greater Boston's life sciences cluster—indeed, to the success of any economic cluster—is the complex web of interconnections among the various players in the cluster.

Examining the dynamics of connections and travel within the Boston-Cambridge life sciences corridor establishes the importance of both the proximity of those within the life sciences cluster and their ability to make connections. In other words, there is a reason why life sciences institutions and companies jostle for limited and expensive real estate within a few miles of one another in Cambridge and Boston.

Even in a wired world, those in the life sciences find that there is more rather than less need for physical connections and face-to-face interactions. Those in the life sciences clearly value face-to-face interaction and particularly what Judy Glavin, Director of Basic Science Programs at Harvard Medical School, characterizes as "the kind of creative collaboration that would not have occurred naturally, but only happened because there was



The Boston-Cambridge Life Sciences Corridor

a face-to-face interaction." She is convinced that "there is something that is added by face-to-face time" (Interview, September 6, 2006).

Eric Lander of the Broad Institute similarly believes that scientists—especially young scientists—want to be in a place like Boston or Cambridge where they have frequent opportunities to have spontaneous encounters with other people who share similar interests. He explains that:

> Ideas have a gravitational force. If you get on the bus in Los Angeles, you'll hear people talk about the entertainment industry. In New York, they talk about the financial industry on the subway, and in Washington, it's the government. Here, you get on the "T", and maybe someone [i]s talking about DNA, or biomedicine, or the life of the mind"(Pierce, 2003).

The value of face-to-face interaction has been classified as a key catalyst for innovation and dubbed the "bump rate" by Robert Krim of the Boston History and Innovation Collaborative. Krim explains that "[w]hen people are in a position to meet, whether serendipitously or by design, they are in a position to more readily share their ideas and services, leading to new products, industries and social movements." For the bump rate, Krim argues, "physical proximity matters." Indeed, one of the examples he cites is Novartis' decision to locate its research facilities in Cambridge after evaluating sites as far afield as San Diego and as close to Boston as Burlington, Massachusetts (Krim, 2006).

This report identifies and documents three sets of critical connections that shape the dynamics of the region's life sciences cluster.

Intra-institutional connections link the multiple regional locations of individual institutions and companies, such as a university's main science campus to its medical school and teaching hospital, an institution's core location to its remote locations, and a company's multiple research and development facilities to one another and to pilot production facilities.

The Value of Proximity in the Boston-Cambridge Life Sciences Corridor: The National Emerging Infectious Disease Laboratory

- 1.1 million square foot research facility currently under construction in the growing BioSquare life sciences area adjacent to Boston University Medical Center (BUMC).
- In September 2003, BUMC was awarded $128 million by the National Institute of Allergy and Infectious Diseases, part of the National Institutes of Health, to build this facility.
- Will host basic, clinical and translational research in its secure facilities, including one of only a handful of Level 4 biocontainment laboratories in the United States.
- At the lab, researchers from Boston University and many other universities and institutions throughout Greater Boston will conduct research on infectious agents such as West Nile virus, ebola and bioterrorism agents.
- Boston University and Boston Medical Center were able to win the NIH funding over competitors from other cities in no small part because the National Institutes of Health felt that the facility's location in the City of Boston meant that it would be available to researchers from a variety of disciplines and institutions.

Inter-institutional connections link the institutions and companies in the life sciences sector—and their researchers, employees, faculty, students and others—to each other in order to support the kind of cross-disciplinary, cross-institutional, and academic-industry collaborations that are increasingly crucial to the life sciences sector.

Employer-employee connections play a critical role in ensuring that the growing life sciences sector is served by a well-educated workforce by linking the geographic core of the cluster in Boston and Cambridge to workers and potential workers throughout the region and the Commonwealth.

The Value of Proximity in the Boston-Cambridge Life Sciences Corridor: Novartis

Novartis' decision to move the headquarters for its research operation, the Novartis Institutes for BioMedical Research (NIBR), from Basel, Switzerland to Cambridge in May of 2002 has been described by one industry analyst "as an earthquake in the biotechnology industry" (Pierce, 2003). A tremor from this earthquake was felt in December 2006 when the company announced that it was re-locating the headquarters for its Vaccines and Diagnostics Division from Emeryville California to Cambridge. Combined, the two divisions now occupy close to one million square feet of laboratory and office space and employ approximately 1,400 people in Central Square and a half-mile away in Kendall Square. Robert Krim's interviews with Novartis executives found that the company had chosen to relocate to Cambridge so that "its staff could rub shoulders with scientists from Longwood, Harvard, Boston University, and MIT…even Burlington was too far away from the benefits of tight proximity, they felt" (Krim, 2006). Jeff Lockwood, Executive Director of Communications at NIBR, explained that "We located our sites where cutting-edge science is happening and where it will continue to happen. We knew we would be able to collaborate and tap into the talent base" (NewScientist Jobs, 2006).

The Value of Proximity in the Boston-Cambridge Life Sciences Corridor: The Broad Institute

- Launched in May 2004.
- The Broad Institute results from over a decade of inter-institutional research collaborations among scientists affiliated with MIT, Harvard and several of Harvard's teaching hospitals.
- The Broad Institute's mission is to bring the power of genomics to medicine by empowering creative scientists to construct new powerful tools for genomic medicine, making them accessible to the global scientific community, and applying them to the understanding and treatment of disease.
- Core faculty includes a half-dozen members with their primary laboratories located in the Institute's building, with over 100 associate members whose primary labs are located at one of the affiliated universities or hospitals.
- In February 2006, the Broad Institute relocated to a new, 231,000 square foot building in Kendall Square's Cambridge Center, adjacent to the Whitehead Institute for Biomedical Research.

The Perils of Poor Transportation Infrastructure

While the compact size and geographic proximity of the Boston-Cambridge life sciences cluster enables many positive connections and thus creates many competitive advantages, it also generates serious impacts that affect land use and transportation. One of the most obvious impacts is growing traffic congestion.

The serious traffic congestion currently being experienced in Boston and Cambridge is a significant regional problem affecting the life sciences cluster and can become a constraint to further growth and expansion, limiting the opportunities for the connections that are vital to the life sciences industry.

In a recent survey conducted by the Life Sciences Collaborative, 59% of those surveyed reported that transportation is a major problem and 83% said it was difficult to get to work (*PricewaterhouseCoopers 2007 Massachusetts Life Sciences Cluster Survey*). Similarly, researchers working with Harvard Business School Professor Michael E. Porter in advance of the 2003 Life Sciences Summit identified physical infrastructure, especially transportation infrastructure, as a major weakness for Greater Boston's life science cluster. One senior executive said that "the transportation infrastructure is a significant barrier to future expansion for companies in the area" (Porter, 2003).

The Longwood Medical and Academic Area, and adjacent Kenmore and Fenway neighborhoods, is one of the life sciences areas that needs better transportation infrastructure. Two years ago Porter led an effort to assess the strengths and weaknesses of the Longwood Medical and Academic Area and Fenway and Kenmore neighborhoods. He concluded that "companies agree that the most serious disadvantages they face are related to problems with transportation infrastructure" (Porter et al, 2005). Based in part on this research, the Massachusetts Legislature included funding for both roadway and transit improvements for the area in the 2006 Economic Stimulus Bill. Representative Daniel E. Bosley (D-North Adams), House Chairman of the Economic Development Committee, explained that the funds were included because the area is so critical to the state's economy. "It's such an economic engine that it makes sense to move people around better," Chairman Bosley told *The Boston Globe*. "It has tremendous potential growth, but it's strangled under the current [transportation] system. We have to get the cars out of there." (DePasquale, 2006).

Lessons Learned

To learn how to address the transportation infrastructure challenges that are limiting the growth of Greater Boston's life sciences cluster, ABC asked Northeastern University's Center for Urban and Policy to prepare and analyze case studies of competitor regions that either have or are strategically trying to develop tight-knit life sciences clusters in urban locations and that have mature transit systems or are trying to use transit investment as a strategy for anchoring an urban life sciences cluster (as opposed to regions with less-concentrated and more sprawling life sciences clusters, such as the New York/New Jersey metropolitan area and Greater Los Angeles).

The following areas were studied: San Francisco, CA; Philadelphia, PA; Raleigh-Durham, NC; San Diego, CA; Chicago, IL; Seattle, WA; Denver-Aurora, CO; Indianapolis, IN; and Baltimore, MD.

From these case studies and from the information collected for this report about the structure and dynamics of Metropolitan Boston's own life sciences cluster, there are many lessons to be learned about strategic approaches to investing in this area.

- ***Aim for the bull's eye:*** Public policies and investments around the country are increasingly focused on supporting geographically compact clusters in the immediate vicinity of anchor institutions such as universities and teaching hospitals.
- ***Collaboration is critical:*** The formula for success in retaining and attracting a thriving life sciences cluster involves strong and structured collaboration among state government, local government, academic and medical institutions, and the life sciences industry.
- ***There are many ways to invest:*** There is no single formula for deciding how best to invest and leverage public dollars to promote the life sciences—competitor cities are investing both in research-and-development facilities and in transportation infrastructure.
- ***Traffic is the problem, transit is the solution:*** Both sprawling and compact life sciences clusters generate travel demand, so many competitors are investing in rail, rapid transit, and bus/shuttle services to improve access and reduce congestion.

Perhaps the single most important lesson is this: **throughout the United States, cities and regions are investing in infrastructure and in transportation improvements—particularly in transit—to better serve the anchor institutions and geographic areas that are most vital to their life sciences clusters.**

The table below summarizes the key transit projects and investment strategies that were detailed in the case studies.

City	Target Area	Transit Investment	Project Cost	Other Infrastructure Investments
San Francisco, CA	Mission Bay	Third Street light rail project	$667 million	$4 billion to develop Mission Bay, incl. $200 million in privately-funded infrastructure
Philadelphia, PA	University City and Navy Yard	Expansion of Broad Street subway to serve Navy Yard	Unknown	$600 million expansion of Science Center technology park
Raleigh-Durham, NC	Research Triangle	Regional rail system	$810 million (projected)	
San Diego, CA	Torrey Pines Mesa	Mid-Coast Corridor transit project	$1.2 billion	
Chicago, IL	Illinois Medical District	Pink Line Ogden Ave Transitway	Unknown	$150 million Forest City project in Skokie
Seattle, WA	South Lake Union	South Lake Union Streetcar University Link rail	$50 million $1.7 billion	
Denver-Aurora, CO	Fitzsimmons	T-Rex Southeast rail I-225 FasTracks rail	$1.75 billion $442 million	Total investment in Fitzsimons projected at $4.3 billion
Indianapolis, IN	Downtown Technology Park	People Mover	$40 million	$2 million streetscape improvements on West 16th Street
Baltimore, MD	Science+Technology Park at Johns Hopkins	Subway extension to JHU Station Green Line	$340 million Unknown	Park is $1 billion project; $115 million spent to date

Infrastructure Investments Supportive of Life Sciences Clusters in Competitor Cities/Regions

The case studies illuminate a substantial difference between Metropolitan Boston and many of its competitor cities; one that is particularly important in shaping a strategic state investment strategy for the life sciences. Many of the competitor cities are not as effective as Metropolitan Boston in attracting federal funding (particularly research grants) and also have far fewer private institutions and companies investing in research-and-development facilities. The states in which these competitor cities are located are therefore investing hundreds of millions of state tax dollars directly in R&D facilities and in research grants. These competitor cities have no choice but to "spread around" their public investments to address a wide variety of needs. The table below illustrates this concept.

Life Sciences Investment Strategy: Competitors

Source of Funding	R&D Facilities	Research Grants	Transportation Infrastructure
Federal Government	✓	✓	✓
Private Institutions & Companies	✓	✓	✓
State Government	⊙	⊙	⊙

Key: ✓=existing source, ⊙=target for new investment

Metropolitan Boston's life sciences cluster, by contrast, benefits from $1 billion annually in federal research funding and hundreds of millions of dollars in "bricks and mortar" research and development facilities being built by hospitals, universities and private companies—in most cases with limited or no investment of public funds. This pattern of substantial federal, institutional and private sector investment in life sciences facilities and research substantially narrows the number of "gaps" to be filled in with state funding (although such gaps have been identified and are being addressed, as with proposed state funding for a stem cell bank and gap funding for certain researchers).

Life Sciences Investment Strategy: Metropolitan Boston

Source of Funding	R&D Facilities	Research Grants	Transportation Infrastructure
Federal Government	✓	✓✓✓	⊙
Private Institutions & Companies	✓✓✓	✓	✓
State Government			⊙

Key: ✓=existing source, ⊙=target for new investment

The Commonwealth's public investment strategy can therefore be designed to leverage and maximize the benefits of these other investments by focusing state investments where federal and private/institutional funding is less available: **on improving transportation and transit infrastructure.** Such a funding strategy also has the advantage of improving connectivity, accessibility and mobility for other industries in addition to the life sciences.

Focusing part of the investment strategy on transit makes sense because transit use is well-accepted in the life sciences industry and in many knowledge-based industries. The global real estate firm Jones Lang LaSalle conducted a survey of executives at 350 knowledge-based technology companies to determine the factors they considered when evaluating cities as potential site locations. Over three-quarters of those surveyed said that access to public transportation was a key factor, second only to Internet infrastructure and well ahead of factors such as proximity to clients and support services (Jones Lang LaSalle, 2001).

Recommendations

The continued vitality and growth of the life sciences sector depends upon the Commonwealth's transportation and transit network both to address the growing problem of traffic congestion in the dense life sciences clusters in Boston and Cambridge and to provide the connections that are critical to this industry. Both intra-institutional and inter-institutional connections among life sciences institutions and companies are important, as well as key connections to the communities throughout Massachusetts where the workforce lives.

One particularly promising approach could be the strategic use of public infrastructure investments to support improved access to, and connections among, the life sciences facilities that are largely financed by the private and institutional sectors. Public officials and others in Metropolitan Boston are beginning to realize that transit investment can serve as a tool for retaining and growing the life sciences sector, as evidenced by the $55 million included in the 2006 Economic Stimulus Bill for transportation improvements in Boston's Longwood, Fenway and Kenmore neighborhoods. Similarly, *The Boston Globe* business columnist Steve Bailey recently argued that "if life sciences is the future, Boston has a huge stake in moving forward on the long-discussed Urban Ring to provide a transportation link for the bursting-at-the-seams Longwood Medical and Academic Area, Boston University, and Harvard's Allston campus, the natural home for a new generation of expansion of Boston's medical complex" (Bailey, 2006).

The Patrick Administration has clearly stated that it believes that economic development considerations must be an important factor in making transportation planning and investment decisions, and A Better City supports this approach. We recommend that, in the calculus for making transportation and transit investment decisions, state and local officials weigh the economic development value of such investments, prioritizing the competitive advantage of connecting medical and academic institutions to each other and to life sciences and other knowledge-based companies.

With so many valuable transit projects yet to be implemented and such limited resources, the key to improving the vital transportation and transit connections that serve the life sciences cluster will be to develop a workable, phased approach to improving existing transportation/transit services as well as to planning, designing, constructing and operating new services.

The projects recommended in this report for either construction or more detailed study, are roadway and transit projects that could improve connections among life sciences institutions and companies and/or enhance connections between life sciences jobs clustered in Boston and Cambridge and the regional workforce. The table below provides a brief overview of these key projects and the ways in which those projects help make connections vital to the life sciences cluster.

Recommended Transportation Investments	Intra- and Inter-Institutional Connections	Workforce Connections
Commuter rail station improvements (Ruggles, Sullivan Square and Yawkey)	Yes	Yes
East Boston Haul Road		Yes
Fast Track Rapid Transit Service	Yes	
Green Line extension to Somerville	Yes	Yes
Melnea Cass Boulevard reconstruction	Yes	Yes
North Allston and BU Bridge-Commonwealth Avenue area transportation improvements	Yes	Yes
Rapid transit station improvements (Longwood, Fenway and Kenmore)	Yes	Yes
Red/Blue Connector	Yes	Yes
Rutherford Avenue and Sullivan Square improvements	Yes	Yes
Shuttle bus coordination	Yes	Yes
Urban Ring	Yes	Yes
Framingham / Worcester commuter rail expanded service	Yes	Yes
Acquire rail rights-of-way	Yes	Yes

Short-term Initiatives (2007-2010)

In the short-term transportation agencies should focus on construction and completion of projects that are already fully or partially funded and on advancing planning, design and in some cases engineering of critically-needed, longer-term projects.

Capital Initiatives:

The 2006 Economic Stimulus Bill included not only funds for the creation of an Action Plan and for traffic management changes in the critical Kenmore/Fenway/Longwood portion of the Boston-Cambridge life sciences corridor, but also funds for three sets of capital projects: rapid transit station improvements, Yawkey Station improvements and roadway improvements.

◆ ***Rapid Transit station improvements:*** The 2006 Economic Stimulus Bill appropriated $5 million from the General Fund and also authorized an $11 million bond to improve three of the Green Line rapid transit stations serving the Longwood portion of the Boston-Cambridge life sciences corridor: Kenmore, Fenway and Longwood stations. The package also included funding to provide full-time commuter rail service at Ruggles Station. We recommend that the Commonwealth issue the $11 million in authorized bonds and use these funds along with the $5 million appropriation for physical improvements to the Kenmore, Fenway and Longwood Green Line stations, and Ruggles Commuter Rail Station.

◆ ***Yawkey Station upgrade:*** The Economic Stimulus Bill also appropriated $12 million for improvements to Yawkey Station, a commuter rail station that serves the Longwood-Kenmore-Fenway portion of the Boston-Cambridge life sciences corridor. These physical improvements, along with scheduling changes, are designed to upgrade Yawkey to a full-time, full-service commuter rail station that will link important life sciences employers to the workforce that lives in communities along the Framingham-Worcester commuter rail line. We recommend that the MBTA and City of Boston collaborate to implement the upgrade of Yawkey Station so that it can be operated as a full-time, two-way commuter rail station.

◆ ***Longwood/Kenmore/Fenway roadway improvements:*** The Economic Stimulus Bill also included $12.5 million for roadway design and improvements to important but congested roadways in the Longwood/Kenmore/Fenway portion of the Boston-Cambridge life sciences corridor. These roadways include the Sears Rotary, Ipswich, Maitland, Yawkey Way, Mountfort Street, Carleton Street, Essex Street, BU Bridge, Commonwealth Avenue, Francis Street, Brigham Circle and the Bowker Overpass. Once the City of Boston's Transportation and Pedestrian Action Plan has been completed, we recommend that state and city agencies work together to begin the roadway improvements funded by the Economic Stimulus Bill.

◆ ***East Boston Haul Road:*** This enhanced connection between Logan International Airport and Chelsea that links the East Boston Haul Road to a right-of-way through Chelsea and Everett has the potential to benefit the life sciences industry by directly linking manufacturing sites in Chelsea and Everett with the airport. We recommend that the Executive Office of Transportation & Public Works (EOTPW) include this project as part of the preferred alignment in the Urban Ring environmental document and implement it as expeditiously as possible as an Urban Ring early action item.

◆ ***Framingham/Worcester commuter rail expanded service:*** The Framingham/Worcester commuter rail line provides important connections between Worcester's growing life sciences cluster and the larger Boston-Cambridge life sciences cluster and also connects current and potential workers in MetroWest to life sciences jobs at both ends of the line. Current service is limited to ten daily trips, due to factors including scheduling conflicts with CSX freight services. We recommend that the MBTA take steps to add two additional round trips as expeditiously as possible and develop a plan and timetable for achieving the longer-term goal of doubling the current level of service.

◆ ***Acquire rail rights-of-way:*** In order to support a number of these capital investments and operational enhancements, we support the State's current negotiation efforts to acquire the necessary CSX rail rights-of-way.

Operational Initiatives:

◆ ***Longwood/Fenway/Kenmore Action Plan:*** We recommend implementation of this plan that addresses traffic congestion and less-than-adequate transit service in the area around the Longwood Medical and Academic Area (LMA) through road and sidewalk improvements as well as traffic management improvements.

◆ ***Transportation demand management programs enhancements:*** To evaluate whether there are any additional, near-term, cost-effective measures that could be taken to reduce vehicle trips and improve options for pedestrians, cyclists and transit users, we recommend a

coordinated and strategic review of existing private and institutional transportation demand management programs throughout the Boston-Cambridge life sciences corridor.

◆ ***Improved shuttle bus coordination:*** To create better intra-institutional and inter-institutional connections, as well as better linkages to the public transit network for life sciences employees and visitors we recommend that the MBTA and institutional and private shuttle operators improve coordination of their shuttle services. Such an effort is already underway in Longwood Medical and Academic Area, where MASCO has completed a review of shuttle bus services and consolidated some routes; MASCO is also hoping to undertake a detailed evaluation of existing MBTA bus routes. As an outcome of this, the MBTA and institutional and private shuttle operators can implement scheduling and other changes designed to create an integrated shuttle bus/public transportation network throughout the Boston-Cambridge life sciences corridor.

◆ ***Enhanced transit service plan for the Boston-Cambridge life sciences corridor:*** To identify opportunities for more frequent and better quality bus, rapid transit and commuter rail services throughout the Boston-Cambridge life sciences corridor, we recommend the implementation of an enhanced transit service plan. Priorities could include expanded service to the upgraded Green Line rapid transit and Yawkey Station commuter rail stations, increased Silver Line service frequencies to better serve the BioSquare/South End Medical Center area and the City of Boston's Marine Industrial Park – home of a growing life sciences sector in the South Boston Waterfront, improved and increased MBTA bus service to North Allston as the build out of Harvard's new campus begins. Two other opportunities to increase connections to life sciences are extending the #8 MBTA bus route across Massachusetts Avenue to Kendall Square and increasing the CT2 frequency from MIT via Boston University to the LMA.

Policy and Planning Initiatives:

◆ ***Capital Plan Revisions and Bond Bill Authorization:*** We recommend that future Capital Plans include and the 2007 Bond Bill authorize funding for the evaluation, environmental review, design, engineering and initial construction of a series of roadway and transit enhancements that would improve access for the Boston-Cambridge life sciences corridor. Projects could include improvements to key rapid transit stations (Longwood, Fenway and Kenmore), commuter rail stations (Ruggles, Yawkey and Sullivan Square) and roadways (Melnea Cass Boulevard and Rutherford Avenue), as well as two major expansion projects, the Urban Ring and a new multimodal facility in Allston

◆ ***Enhanced planning function within the Executive Office of Transportation and Public Works (EOTPW):*** To facilitate collaboration across public agencies and with institutional and business partners when planning, designing, constructing and operating transit services designed to improve access along the life sciences corridor, we recommend an enhanced planning function within EOTPW.

◆ ***MBTA-EOTPW DMU feasibility study, including analysis of potential Diesel Multiple Units (DMUs) costs and benefits, routes, and service options:*** To explore the creation of new rapid transit services along existing commuter rail corridors, we recommend a feasibility study of DMUs. DMUs are self-propelled rail cars that can operate as trolleys on commuter rail tracks. At various times, they have been proposed for the Grand Junction line in Cambridge, for a corridor that would connect Newton and Allston to downtown Boston, for the Framingham/Worcester line operating through a new North Allston multi-modal station (often referred to as "West Station"), and Yawkey Station. There are, however, some design and operational constraints to be overcome before DMU service can be considered. Given the availability of commuter rail tracks through the northern portions of the Boston-Cambridge life sciences corridor, DMUs may provide an important tool for creating cost-effective new rapid transit service.

◆ ***North Allston multi-modal station ("West Station") planning study:*** Sometimes called "West Station", this multi-modal facility would connect directly to commuter rail (the Framingham/Worcester line), the Massachusetts Turnpike, MBTA buses and trolleys, the Urban Ring, fast-track services on commuter rail lines, and private shuttles, and would also include parking for motor vehicles. We recommend completion of this study that was funded by the 2006 Economic Stimulus Bill with a $500,000 appropriation.

◆ ***Boston University Bridge transit station ("River Station") feasibility study:*** Boston University as part of its master plan for a transit oriented development has proposed a station at or near the intersection of the Boston University Bridge and Commonwealth Avenue. We recommend that a study of this station be undertaken. The analysis should consider the economic and transportation benefits of a station at this location, including an examination of the station's relationship to the existing transit system, and potential connections to shuttles, MBTA buses, the Green Line and the Urban Ring.

◆ ***Fast Track Rapid Rail Service feasibility study and***

needs assessment: The City of Boston's Access Boston transportation planning project proposed a new "Fast Track" Rapid Rail service that would use existing commuter rail rights of way to create a new set of transit connections and stations in Boston. Such a project would create both inter-institutional connections and better link life sciences institutions to workers living both in the City of Boston and in the southern and western suburbs. The service could connect stations on the Greenbush branch of the Old Colony commuter rail, the upgraded Fairmount Line and the Framingham/Worcester line to each other through key stations in the life sciences corridor, including JFK/UMass Red Line and commuter rail station and going west through Back Bay, Yawkey, and potentially a new River Station and/or North Allston multi-modal station. Such a service could be provided with commuter rail vehicles but might also make use of DMUs. We recommend that the EOTPW, the MBTA and City of Boston collaborate on a feasibility study and needs assessment.

◆ ***Planning, design and engineering of critically-needed, longer-term projects:*** To advance the priority long-term transportation projects that are recommended in the next section, we recommend that the necessary planning, design and engineering efforts occur in the 2008-2010 time frame. Planning efforts are already underway with respect to four of the recommended long-term transportation investments: the Urban Ring, the Red-Blue Connector, the Green Line extension to Somerville, and North Allston transportation improvements. Initial steps can also be taken in the 2008-2010 timeframe to advance the other two recommended long-term projects – Rutherford Avenue and Melnea Cass Boulevard.

Long-term Transportation Investments (2010 and Beyond)

There are major capital investments that can and should be made in the future to improve transit access and connectivity among Metropolitan Boston's life sciences institutions and companies. If the Commonwealth and its municipal, business and institutional partners follow the policy and planning recommendations describe above, stakeholders in Metropolitan Boston will understand which investments should be made and could have the design and engineering completed, and funding in place to advance those projects. We recommend that the Commonwealth, the cities of Boston and Cambridge, and life sciences institutions and companies continue working together to complete design and engineering, secure funding and construct the high priority transportation and transit projects identified in the planning and feasibility studies recommended in this report.

◆ ***Fenway/Kenmore/Longwood improvements:*** By 2010, construction of the three sets of capital improvements for the Fenway/Kenmore/Longwood area in the Boston-Cambridge life sciences corridor should be complete. We recommend the expeditious completion of all of the rapid transit station, Yawkey Station and roadway improvements for the Fenway/Kenmore/Longwood area funded by the 2006 Economic Stimulus Bill.

◆ ***Urban Ring:*** The Urban Ring is perhaps the most important transit investment that can be made to support the Metropolitan Boston life sciences cluster. This project provides the opportunity for high quality, cost-effective and convenient transit options and service.

The EOTPW is currently leading the integrated federal and state environmental review of proposed transit improvements in the Urban Ring corridor. Draft federal and state environmental review documents for the Urban Ring are scheduled for completion in early 2008 and final versions of those documents must be advanced during 2008. Part of the analysis that is being done includes a study of a potential Longwood area transit tunnel; the 2006 Economic Stimulus Bill included $90,000 in state funds to match a federal earmark of $450,000 to fund this important study. In addition to the completion of the environmental reviews and the tunnel study, a third critical part of the Urban Ring planning effort during the 2007-2008 operating time frame will be the identification of a locally preferred alternative that may include "early action" items and "minimum operating segments" that can be advanced more rapidly through design, engineering and construction.

Early action items may include station improvements at key transfer stations, acquisition and protection of critical rights of way for buses, and improved and new services within individual segments of the Ring that can later be aggregated to form a comprehensive set of Urban Ring improvements. Minimum operating segments are portions of the Urban Ring transit projects that have independent value in improving the transit network even before the entire Urban Ring is completed. These early action items and minimum operating segments can and should be funded, permitted and constructed separately and independently from the long-term Urban Ring projects, but of course must be consistent with the overall purpose and need of the larger project in order to be eligible for federal funding.

We recommend that the EOTPW complete the federal and state environmental reviews for the Urban Ring and that, as part of that process, finalizes the Longwood tunnel study and identify a prioritized list of early action items and minimum operating segments.

Once design, engineering, and early construction begin on the high priority early action items and minimum operating segments, a detailed phasing plan needs to be developed for the build-out of the next set of Urban Ring improvements. We recommend the development of a detailed phasing plan for making those improvements, a financial plan to provide the resources to construct the planned projects and improvements, and that the Commonwealth applies for Federal New Starts and/or Small Starts funding.

◆ ***North Allston and BU Bridge-Commonwealth Avenue area transportation improvements:*** Allston—including both Harvard University's planned campus and the surrounding area—is primed to become an important new segment of the Boston-Cambridge life sciences corridor. During this short-term time frame, Harvard University and the Boston Redevelopment Authority will be working to complete and approve a new Institutional Master Plan for the Allston campus. The Institutional Master Plan proposes short-term improvements, including bus lanes on Western Avenue and North Harvard Street, and improvements and expansion of both MBTA bus routes and institutional shuttle services.

A second planning exercise is focused on transportation planning for the area, including the need to connect the new campus to life sciences institutions and facilities located both in Cambridge and in the Longwood Medical and Academic Area. Harvard University is already taking transit into account in its land use planning; for example, a right of way is provided for the proposed Urban Ring from the North Allston multi-modal station through the new campus to Harvard Square.

We also recommend as early items emerge from this planning effort that the EOTPW move forward on the necessary design, right-of-way, and construction–related actions pertaining to this facility.

As Boston University moves forward with its campus master plan and as Harvard University gets underway with the construction of a new Life Sciences Complex in North Allston, it is beneficial that new transportation infrastructure be put in place to serve both the BU Bridge-Commonwealth Avenue area and Allston. We recommend that the City of Boston, Town of Brookline, other neighboring communities, relevant agencies and officials work with Harvard University and Boston University in developing a comprehensive transportation and Urban Ring access plan for this area.

The results of the study of the North Allston multi-modal facility ("West Station"), funded in the 2006 Economic Stimulus Bill, and the recommended study of a transit station at the BU Bridge ("River Station") should be used to inform this area transportation improvement planning effort.

These recommendations should work in concert with advancing the design and engineering of the North Allston multi-modal station, and advance relevant next steps as defined in the River Station Feasibility Study. These transportation investments can provide immediate benefits in terms of economic development, promote transit-oriented development, enhance the public realm, provide service to the greatest number of riders in the regional and immediate area, and optimize intermodal connectivity.

◆ ***Red-Blue Connector:*** The proposed Red-Blue Connector would extend the Blue Line from Bowdoin station to the Red Line at Charles/MGH station, a critical rapid transit project that would allow Massachusetts General Hospital—the single largest employer in the City of Boston—to continue to prosper in its current location. The Connector would improve transit access to Massachusetts General Hospital, Massachusetts Eye and Ear Infirmary and Spaulding Rehabilitation Hospital for employees, patients and visitors coming from East Boston, Revere, Chelsea and Winthrop, address growing traffic congestion in the Charles Circle and Charles River Park areas and provide one-seat service to and from Logan Airport for physicians and scientists. The Commonwealth has committed, in the settlement of a lawsuit over Central Artery transit commitments, to complete final design of the Connector by the end of 2011. We recommend that the EOTPW complete design and engineering of the Red-Blue Connector by 2011 and that the State move to find construction funding for this project.

◆ ***Melnea Cass Boulevard reconstruction:*** A key transportation corridor for the life sciences is Melnea Cass Boulevard, which connects the Longwood Medical and Academic Area both to neighborhoods where potential workers reside and to the Crosstown area near the Boston Medical Center and Boston University's BioSquare. Melnea Cass Boulevard also includes a dedicated bus right of way that can be used for Urban Ring bus rapid transit. A federal earmark of $6 million is available to redesign and rebuild Melnea Cass Boulevard. The goal of this project would be to reduce congestion, create a dedicated bus lane in a center

reservation and accommodate a bicycle facility called the South Bay Harbor Trail. We recommend that the City of Boston and the MBTA cooperate to plan and complete final design and engineering for the reconstruction of Melnea Cass Boulevard to provide for intersection improvements that reduce traffic congestion, a dedicated bus lane in a center reservation for early action Urban Ring bus rapid transit service, and the South Bay Harbor bicycle trail.

◆ ***Rutherford Avenue and Sullivan Square improvements:*** Charlestown's Sullivan Square is an area where life sciences companies could cluster to be near Cambridge's Kendall Square without encountering the high occupancy costs in that area. In order to create development opportunities, the street network would need to be redesigned and reconstructed and better linkages created to the Orange Line station, commuter rail station and major roadways. Federal earmarks of $13 million are available to support the reconstruction of Sullivan Square and the Rutherford Avenue corridor. We recommend that the Metropolitan Planning Organization approve, and the City of Boston undertake the environmental review and design and engineering of Rutherford Avenue and Sullivan Square improvements.

◆ ***Green Line extension to Somerville:*** This project, one of the required transit commitments made as part of the permitting for the Central Artery/Tunnel Project, would extend the Green Line from Lechmere Station in Cambridge through Somerville to Medford with a branch to Union Square in Somerville. The extension to Medford's Hillside neighborhood would be located in the existing right-of-way of the Lowell commuter rail line. The project would provide six new stations, improving transit connections for Somerville residents to jobs in Boston including Longwood Medical and Academic Area. The Green Line extension would also provide a one transfer connection between Tufts University's main campus and its medical campus in Boston. We recommend that EOTPW advance the study of the Green Line extension, including the preparation of draft environmental documentation, and then preliminary engineering and development of the final EIS/EIR.

Summary of Recommendations

	Capital Initiatives	Operational Initiatives	Policy and Planning Initiatives
Short and Medium-Term (2007-2010)	Rapid transit station improvements (Kenmore, Fenway, and Longwood Green stations, and Ruggles commuter rail station)	Longwood/Kenmore/ Fenway Action Plan	Capital Plan revisions and Bond Bill authorization
	Yawkey Station upgrade	Transportation demand management program enhancements	Enhanced planning function within EOTPW
	Longwood/Kenmore/Fenway roadway improvements	Improved shuttle bus coordination	MBTA-EOTPW DMU feasibility study
	East Boston Haul Road, linking to a right-of-way through Chelsea and Everett	Enhanced transit service plan for the Boston-Cambridge life sciences corridor	North Allston multi-modal station ("West Station") planning study
			BU Bridge transit station ("River Station") feasibility study Fast Track Rapid Rail Service feasibility study and needs assessment.
	Framingham/Worcester commuter rail expanded service		Planning, design and engineering of critically-needed, longer-term projects, including: • Urban Ring • Red-Blue Connector • Green Line extension to Somerville • North Allston transportation improvements • Rutherford Avenue • Melnea Cass Boulevard
	Acquire rail rights-of-way		
Long-Term Transportation Investment (2010 and Beyond)	Completion of all of the rapid transit station, Yawkey Station and roadway improvements for the Fenway/Kenmore/Longwood area funded by the 2006 Economic Stimulus Bill.		
	Urban Ring: • Federal and state environmental reviews, including the Longwood tunnel study and a prioritized list of early action items and minimum operating segments • Financial plan for the Urban Ring, and application for Federal New Starts and/or Small Starts funding • Design, engineering and beginning construction of high priority early action items and minimum operating segments • Construction of a clearly-defined series of transit improvements		
	North Allston and BU Bridge-Commonwealth Avenue area transportation investments, including North Allston multi-modal station and relevant interventions associated with River Station		
	Red-Blue Connector, final design, engineering, and construction		
	Melnea Cass Boulevard reconstruction, final design and engineering		
	Rutherford Avenue and Sullivan Square improvements, environmental review and design and engineering		
	Green Line extension to Somerville, preparation of draft environmental documentation, preliminary engineering, final EIS/EIR		

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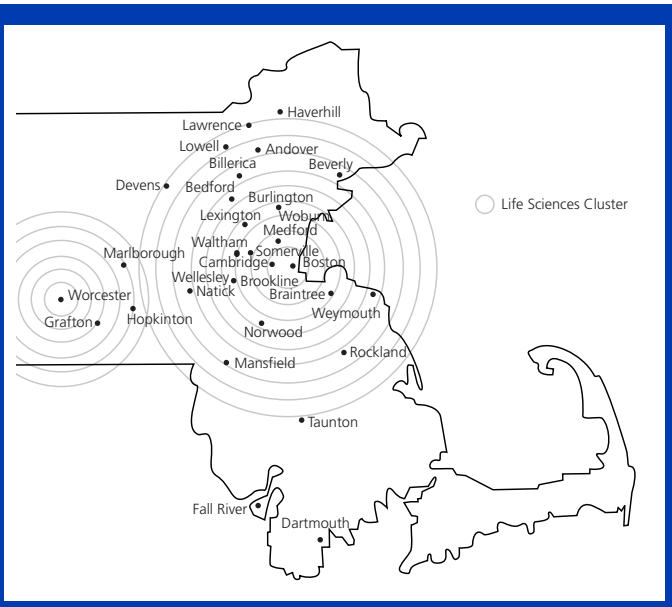

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