



Investing in a Better Massachusetts

An Analysis of Job Creation
and Community Benefits from
Green Investments





ABOUT CLIMATE XCHANGE

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Climate XChange is a 501(c)3 non-profit, non-partisan organization with a mission to achieve a durable, just transition away from polluting fossil fuels in the United States. With a three-pronged strategy of direct advocacy, research, and communications, we work to advance climate policy at the state level. We also host the State Climate Policy Network, which brings together changemakers, to learn from each other and increase the ambition, equity and durability of state and local climate policy. Learn more at climate-xchange.org.

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Executive Summary

ABSTRACT

This report analyzes the potential job creation and quality of life benefits from investing in clean transportation, sustainable development, clean energy, energy efficiency, and natural resource conservation in Massachusetts. **These investments are found to create significantly more jobs per dollar than the state's overall economy, as well as the state's ten largest industries. Additionally, the investments return over two dollars in cost savings, time savings, and health benefits for every dollar invested.** These findings can be re-weighted to project the potential jobs and community benefits from future spending packages in the Commonwealth.

BUILDING A GREEN INVESTMENT PORTFOLIO

This study is motivated by the urgent need to create new economic prosperity and community well-being in Massachusetts. To meet this challenge, Climate XChange Education and Research, Inc. analyzed the economic and health impacts of 18 different conceptual investment programs. The programs were analyzed for their job creation, wage and salary levels, and occupational characteristics using IMPLAN economic modeling. They were subsequently evaluated for cost savings, public health improvements, and climate benefits using peer-reviewed and open source modeling tools.¹

Based on this analysis, an effective strategy for economic and community development in Massachusetts prioritizes public programs in clean transportation, sustainable development, renewable energy, energy efficiency, grid modernization, conservation, and natural resources. These programs, which this report collectively refers to as *Green Investments*, provide robust job creation, as well as significant economic and social benefits that outweigh any upfront costs. The programs will also support the jobs, services, and industries that will help Massachusetts prosper in the transition towards a net zero emissions future.²

TABLE 1.1 The Green Investment Portfolio

INVESTMENT AREA	PROGRAM
Clean Transportation and Sustainable Development  <p>Photo: MassDOT</p>	Light and Commuter Rail Clean Vehicles Low Carbon Buses Transit-Oriented Development Active Mobility Ferry Expansion and Electrification East-West Rail
Renewables, Energy Efficiency, and Grid Modernization  <p>Photo: Team Massachusetts 4D Home</p>	Energy Efficiency and Building Retrofits Residential Solar Offshore Wind Battery Storage Transmission Infrastructure Upgrades Community Microgrids Broadband Connectivity
Conservation and Natural Resources  <p>Photo: Robert Laliberte</p>	Clean Water Infrastructure Urban Greening Aquatic Ecosystem Restoration Sustainable Agriculture

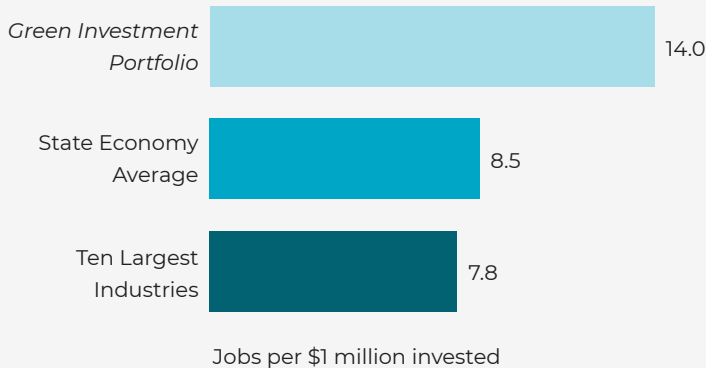
1 | More details on the models used in this study can be found in the Technical Appendix.

2 | As required by SB.9, *An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy*.

KEY FINDINGS

The Green Investment Portfolio supports nearly twice as many jobs per dollar than the state's ten largest industries.³ The investments also support 65 percent more jobs per dollar than the state's overall economy.

FIGURE 1.1 Job creation from the *Green Investment Portfolio* compared to economy benchmarks



The job potential of all 18 *Green Investments* ranges from 5.7 to 28.8 jobs created per million dollars invested. These jobs cut across many different industries and occupations, with particularly strong job creation in construction, architecture and engineering services, and health and family services.

Green Investments outperform other benchmarks on job creation because they support labor-intensive productive businesses that keep dollars local and in the hands of working residents. Upfront jobs created from the *Green Investment Portfolio* pay an average median salary of \$73,174, but span a vast range of pay and benefits.

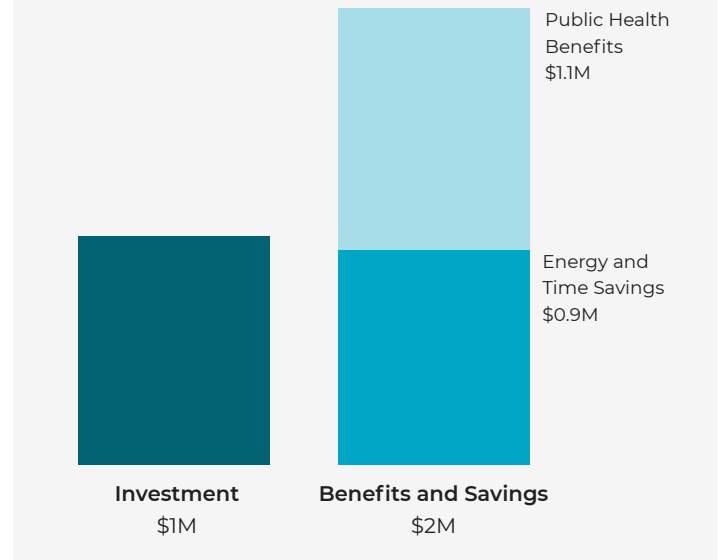
The portfolio outperforms the state average for job creation on direct impacts alone. In addition, these investments also create long-term cost savings for households, businesses, and institutions by reducing reliance on out-of-state

energy. Massachusetts currently spends over \$17 billion per year importing fossil fuels, and a dollar saved on fossil fuel consumption is more likely to be spent locally.⁴ When these energy savings are captured in the model, the jobs potential of the *Green Investment Portfolio* increases to nearly twice that of the state's ten largest industries.

Beyond job creation, *Green Investments* result in significant cost savings and public health benefits. These investments reduce fossil fuel imports and make the state's infrastructure systems more efficient, while removing harmful pollutants from the air residents breathe.

Every dollar invested in the *Green Investment Portfolio* returns over two dollars in cost savings and public health benefits. These benefits include consumer and business savings on utilities, reduced traffic congestion, public health benefits from cleaner air, and safer and healthier transportation systems.

FIGURE 1.2 Benefits per \$1 million invested in the *Green Investment Portfolio*



3 | Industry size is defined as the sum of the industry's economic output. In order of size, the ten largest industries in Massachusetts are Scientific research and development services; Hospitals; Other real estate; Other financial investment activities; Monetary authorities and depository credit intermediation; Insurance carriers; Management of companies and enterprises; Tenant-occupied housing; Software publishers; and Custom computer programming services.

4 | U.S. Energy Information Administration, "State Energy Profile: Massachusetts." April 2021 <https://www.eia.gov/state/data.php?sid=MA#ConsumptionExpenditures>

NEXT STEPS FOR POLICYMAKERS

The findings in this report are presented as comparative “multipliers,” which normalize all benefits to a million dollar investment. To complement these findings, two additional factors are layered in: investment scale and deployment speed (see Table 1.2). Investment scale refers to the size of funding required to exhaust available investment opportunities from the *Green Investment Portfolio*, whereas deployment speed refers to the pace at which projects can reasonably be scoped, planned, and implemented.

This report and the *Green Investment Portfolio* are intended to provide a quantifiable starting point for discussions about a community-aligned public investment strategy. Additional analysis is needed to complement these findings with emphasis on:

- Social justice, community engagement, and the distributional economic and health outcomes of selected investment measures.
- Job quality, career advancement opportunities, local and diverse access, industry unionization, and other occupation-specific components of jobs supported.
- Expansion of the *Green Investment Portfolio* to additional programs that have the potential to deliver community benefits at the nexus of quality job creation and well-being.
- Measurable contributions of public investments towards long-term climate goals, and the net benefits of achieving those goals.
- Further work to bridge this portfolio to workable policies, assess optimal investment scale, and identify possible financing mechanisms.

TABLE 1.2 Overview of Findings in the *Green Investment Portfolio*

INVESTMENT AREA	INVESTMENT SCALE	DEPLOYMENT SPEED	JOBS PER \$M	ENERGY AND TIME SAVINGS	HEALTH AND CLIMATE BENEFITS
Clean Transportation and Sustainable Development	\$\$\$	Mixed	11.7	⚡⚡⚡	+++
Renewables, Energy Efficiency, and Grid Modernization	\$\$\$	Moderate to Fast	17.5	⚡⚡⚡	+++
Conservation and Natural Resources	\$\$\$	Fast	13.2	⚡⚡⚡	+++
<div> <div>Investment Scale</div> <div> <div>Lower opportunity</div> <div>Moderate opportunity</div> <div>Higher opportunity</div> </div> <div> <div>\$\$\$</div> <div>\$\$\$</div> <div>\$\$\$</div> </div> </div> <div> <div>Deployment Speed</div> <div> <div>Slow: 5+ years</div> <div>Moderate: within 5 years</div> <div>Fast: within 2 years</div> </div> </div> <div> <div>Savings and Benefits</div> <div> <div>Low</div> <div>Moderate</div> <div>High</div> </div> <div> <div>⚡⚡⚡</div> <div>⚡⚡⚡</div> <div>⚡⚡⚡</div> </div> <div> <div>Low</div> <div>Moderate</div> <div>High</div> </div> <div> <div>+++</div> <div>+++</div> <div>+++</div> </div> </div>					

Introduction

SETTING THE SCENE IN MASSACHUSETTS

Overall, Massachusetts' existing infrastructure is aging, inefficient, and fossil fuel-intensive, earning a C- grade from the Biden Administration.⁵ Vehicle-based infrastructure maintenance is underinvested, with 472 bridges and 1,194 miles of highway in poor condition. Driving on roads in need of repair costs drivers in the state an average extra \$620 per year, and commute times have increased by 11 percent since 2011.⁶

Public transportation services are also deficient, with 23 percent of the state's trains and transit vehicles currently operating past useful life. Those who take public transit spend an extra 53 percent of their time commuting, and non-White households are twice as likely to commute via public transportation.⁷ Water infrastructure requires significant new investment — 328 dams in the state are considered to be "high-hazard" potential,⁸ and the state's drinking water needs are estimated at an additional \$12 billion.⁹

The state's housing and energy needs are also pressing. Nearly half a million renters in Massachusetts are cost burdened, meaning they spend more than 30 percent of their income on rent.¹⁰ Low-income families spend an average of six to eight percent of their income on home energy

costs alone, and over ten percent of the population does not have an internet subscription.¹¹

At the same time, communities have long been victims of the catastrophic impact that air pollution has on public health.¹² Long-term exposure to air pollution increases the risk of premature death, as well as cardiovascular and respiratory disease.¹³ A recent analysis from Harvard University found that fossil fuel pollution causes more than 7,600 deaths in Massachusetts every year, and close to one in five total deaths globally.¹⁴ Similarly, a 2018 study found that low-level increases in particulate matter are associated with a measurably higher risk of asthma attacks among children in the state.¹⁵

Long-term exposure to air pollution has also devastatingly impacted communities during the COVID-19 pandemic. Individuals experiencing the worst air pollution are the most at risk of fatality from COVID-19. Researchers from the Harvard T.H. Chan School of Public Health measured this correlation, and found that a one microgram per cubic meter increase in long-term exposure to PM2.5 leads to an 11 percent increase in mortality from COVID-19.¹⁶ Communities with greater populations of people of color, such as

5 | Office of the White House, "American Jobs Plan: The Need for Action in Massachusetts." 2021, is.gd/jDU8eX

6 | Ibid.

7 | Ibid.

8 | A "high hazard potential" rating means that if dam failure were to occur, it would result in direct loss of human life and extensive property damage.

9 | 2021 Report Card for America's Infrastructure, "Infrastructure in Massachusetts." 2021, t.ly/Ka3e8

10 | Office of the White House, "American Jobs Plan: The Need for Action in Massachusetts." 2021, is.gd/jDU8eX

11 | 2021 Report Card for America's Infrastructure, "Infrastructure in Massachusetts." 2021, t.ly/Ka3e8

12 | Rosofsky, Anna, Jonathan I. Levy, et al., "Temporal Trends In Air Pollution Exposure Inequality In Massachusetts," *Environ Res.* 2018 February; 161: 76–86. <https://doi.org/10.1016/j.envres.2017.10.028>

13 | Long-term exposure to air pollution increases the risk of lower respiratory infection (LRI), chronic obstructive pulmonary disease (COPD), lung cancer, heart disease, stroke, asthma, and diabetes, and can lead to premature death. Infants and young children are more susceptible to the adverse health effects of air pollution than adults.

14 | Karn Vohra et al., "Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem." *Environmental Research* (2021). <https://doi.org/10.1016/j.envres.2021.110754>

15 | Early-life exposure to PM2.5 and risk of acute asthma clinical encounters among children in Massachusetts: a case-crossover analysis, February 2018, <https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0361-6>

16 | Wu, X. et al., "Air Pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis." *Science Advances*, November 2020, 10.1126/sciadv.abd4049 <https://advances.sciencemag.org/content/6/45/eabd4049>

Chelsea, Brockton, and Lawrence, experience the highest rates of air pollution exposure, and have experienced higher COVID-19 infection and mortality rates across nearly 40 of the largest cities in Massachusetts.¹⁷

At the peak of the COVID-19 pandemic, unemployment reached a historic high of 16.4 percent in April 2020 and was the highest in the country in July 2020.^{18,19} As of October 2020, around 160,000 renter households owed back rent, of which 60,000 households feared imminent eviction, and another 235,000 renters and homeowners anticipated having trouble paying their rent or mortgage.²⁰ More than a year into the pandemic and economic crisis, unemployment remains high, making it difficult for individuals and families to pay for food, housing, medical care, and other necessities.²¹

NEED FOR GREEN INVESTMENT IN MASSACHUSETTS

These circumstances have increased the sense of urgency to invest in a way that delivers new family livelihoods, positive health outcomes, and improved quality of life. In addition, An Act Creating a Next Generation Roadmap for Massachusetts Climate Policy passed into law in 2021, legally requiring the state to cut greenhouse gas emissions in half relative to 1990 emissions levels by 2030, and to achieve net zero emissions by 2050.²² Clean energy and climate infrastructure investments present an opportunity to jointly address the compounding economic and public health crises, and to set the Commonwealth on a path to achieve its required emissions reductions.

In order for the state's transportation, energy, and water infrastructure to reach a "state of good repair," the state needs to make up for an



investment gap of at least \$117 billion by 2030, according to Synapse Energy Economics.²³ These necessary infrastructure projects support jobs in fields such as construction, clean energy, and public transit, which can offer vital economic relief for workers. They provide higher rates of family-supporting wages, access to health insurance, unionization, and opportunities to build long-term wealth and make career advancements compared to the state average.^{24,25} Infrastructure projects also offer widespread, tangible benefits for individuals and communities in the form of lower energy costs, faster and more accessible transportation, cleaner air, and better quality of life.

A successful public investment strategy for the Commonwealth requires analytical tools to investigate, scope, and prioritize these opportunities. Decision-makers can best allocate public investments when they deeply understand the solutions on the table, the scale of funding needed, and the economic, social, and environmental benefits.

17 | Office of Massachusetts Attorney General Maura Healey, "COVID-19's Unequal Effects in Massachusetts." 2020, <https://www.mass.gov/doc/covid-19s-unequal-effects-in-massachusetts/download>

18 | U.S. Bureau of Labor Statistics, "Current Unemployment Rates for States and Historical Highs/Lows." <https://www.bls.gov/web/laus/lausth1.htm>

19 | U.S. Bureau of Labor Statistics, "State Employment and Unemployment — August 2020." September 2020, https://www.bls.gov/news.release/archives/laus_09182020.htm

20 | Metropolitan Area Planning Council, "COVID-19 Layoff Housing Gap Update: The Crisis Continues." October 2020, <https://www.mapc.org/resource-library/covid-19-layoffs-october/>

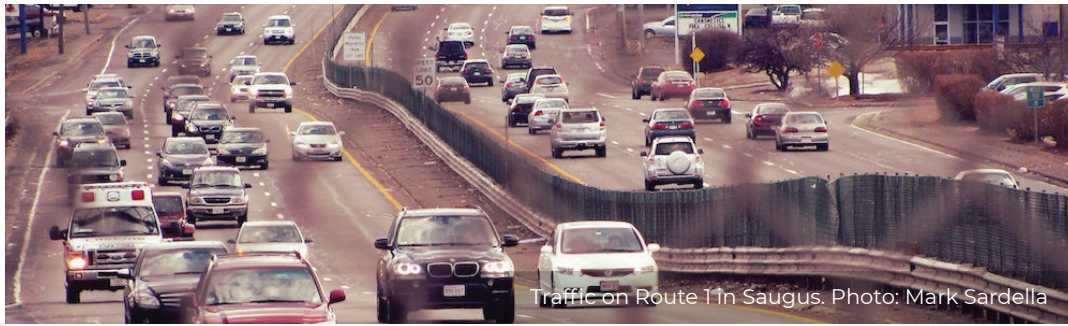
21 | U.S. Department of Labor, Bureau of Labor Statistics, "State Employment and Unemployment," March 2021, <https://www.bls.gov/news.release/pdf/laus.pdf>

22 | Massachusetts State Legislature, Chapter 8 of the Acts of 2021, "An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy." <https://malegislature.gov/Laws/SessionLaws/Acts/2021/Chapter8>

23 | Camp, Erin et al., "Investing in Public Infrastructure in Massachusetts" Synapse Energy Economics, October 2019.

24 | Demos, Public-Sector Jobs Increase the Economic Well-Being of Massachusetts Families, November 2018, <https://www.demos.org/research/public-sector-jobs-increase-economic-well-being-massachusetts-families>

25 | E2, Clean Jobs, Better Jobs, October 2020, is.gd/qDY39G



Traffic on Route 1 in Saugus. Photo: Mark Sardella

GREEN INVESTMENT ACROSS THE UNITED STATES

Massachusetts' need for a green recovery is not unique. Public investments, particularly those aligned with climate goals, are well situated to give the U.S. economy a short- and long-term boost and unlock a higher return on investment compared to traditional recovery measures.

A global survey of climate-focused economists revealed an overwhelming consensus that the costs of inaction on the climate crisis are far higher than the costs of action.²⁶ Inaction will lead to national GDP losses, economic hardship, displacement, and worsened inequality. Conversely, taking action on climate presents an opportunity to strengthen the economy, improve air quality, and enhance individual and community well-being.

Existing literature on economic recovery strategies can help inform this unique moment. According to a global survey of economists, clean energy-focused investments deliver higher short- and long-term cost savings compared to traditional stimulus measures relating to continued reliance on fossil fuels.²⁷ The benefits of these investments are cited as key drivers of long-term economic and social prosperity, with benefits including reduced solid waste, reduced

transportation congestion and inefficiencies, improved health outcomes, preserved biodiversity, and ecosystem sustainability.²⁸

In the U.S., the Rocky Mountain Institute identifies building retrofit programs, transportation expansion and electrification, sustainability-tied debt forgiveness, and new finance mechanisms for clean energy and transportation as key programs for an adequate and equitable federal recovery strategy. For example, a national low-carbon financing bank capitalized at \$5 billion would create 388,000 jobs and reduce energy costs for nearly 800,000 homes. However, the success of these programs hinges on how policymakers prioritize job creation potential, cleaner air, and economic, energy, and climate resilience.²⁹

The *American Recovery and Reinvestment Act of 2009 (ARRA)*, the largest single investment in clean energy in U.S. history,³⁰ provides key lessons for using clean energy and ecosystem restoration investments as tools for efficient economic recovery. Investments enabled by ARRA laid the groundwork for unprecedented growth in clean energy and energy efficiency in the decade following.^{31,32}

26 | Howard, Peter and Derek Sylvan, "Gauging Economic Consensus on Climate Change." Institute for Policy Integrity, March 2021. https://policyintegrity.org/files/publications/Economic_Consensus_on_Climate.pdf

27 | Jennifer Allan et al., "Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?" May 2020. <https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper20-02.pdf>

28 | Other top ranked "non-climate" measures for economic recovery include liquidity support for households and small and medium enterprises, healthcare investment, direct provision of basic needs, and targeted direct cash transfers or temporary wage increases.

29 | Ben Holland et al., Rocky Mountain Institute, 2020. t.ly/xLgr

30 | The ARRA allocated more than \$90 billion in clean energy investments and tax incentives, and leveraged an additional \$150 billion in private and other non-federal capital for these investments.

31 | Executive Office of the President of the United States, 2016. t.ly/piZQ

32 | Solar electricity generation increased by more than 30 times between 2008 and 2016, adding workers at a pace 12 times faster than the overall economy, and wind generation more than tripled during that time period. The Department of Energy estimates that more than 1.6 million homes have benefitted from energy efficiency improvements between 2009 and 2015 as part of the Weatherization Assistance Program.

Notable investments and job creation from the *American Recovery and Reinvestment Act of 2009* (ARRA):

- Clean energy related programs supported 900,000 job-years between 2009 and 2015, and were some of the most cost-effective job creators across all ARRA measures.³³
- Approximately \$122 million for weatherizing homes in Massachusetts, leading to money-saving improvements for 17,000 low-income homes and hundreds of new jobs.³⁴
- Every dollar spent on clean energy and climate-related infrastructure returned an economic benefit of \$2.20.³⁵
- Each dollar invested in public transit supported nearly twice as many jobs as each dollar invested in new roads.^{36,37} However, most states prioritized building new roads instead of repairing deteriorating infrastructure and building out public transit.^{38,39}
- In Massachusetts, more than 75 percent of flexible transportation funding was spent on highways and roads, as opposed to 14.5 percent spent on public transit and nine percent spent on active mobility infrastructure.⁴⁰

The ARRA prioritized “shovel ready” projects, which could start soon after receiving funding and be completed within a few years, to support rapid job creation. Massachusetts took advantage of the immediate job creation potential from the Energy Efficiency and Conservation Block Grant (EECBG), using nearly \$15 million in ARRA funding to provide grants and technical assistance for energy efficiency projects throughout the state and create nearly 1,100 jobs.⁴¹

The federal response to the Great Recession has been criticized for excessive fiscal austerity, which resulted in an economic recovery that was slower than necessary.⁴² In contrast, several federal rescue packages to address the COVID-19 economic crisis have been much larger than ARRA, and the U.S. Federal Reserve maintains an interest rate of zero to 0.25 percent.⁴³ These indicators point to greater ‘fiscal space’ for government borrowing and short-term public debt to inject the capital necessary for recovery.⁴⁴

States, however, are unable to deficit-spend and have limited tools to raise additional public capital, and thus will require creative financing mechanisms that leverage capital from other sources. For example, every dollar spent on green investments in the U.S. attracts an average of \$2.50 additional from private sources.^{45,46} Whether from additional federal stimulus packages or other revenue sources, Massachusetts will soon need to implement recovery investments at a scale far beyond previous stimulus measures and build a comprehensive vision for what a climate-aligned recovery could look like.

33 | Executive Office of the President of the United States, 2016. t.ly/piZQ

34 | U.S. Department of Energy, “Recovery Act State Memos: Massachusetts.” June 2010, t.ly/GHpM

35 | Congressional Budget Office, Estimated impact of the American Recovery and Reinvestment Act on employment and economic output in 2014, February 2015, [cbo.gov](https://www.cbo.gov).

36 | The White House Office of the Press Secretary, 2016. t.ly/CFsG

37 | Smart Growth America, 2020. <https://smartgrowthamerica.org/resources/learning-from-the-2009-recovery-act/>

38 | U.S. Department of Transportation, “DOT & The Recovery Act.” <https://www.transportation.gov/recovery>

39 | Smart Growth America, 2020. <https://smartgrowthamerica.org/resources/learning-from-the-2009-recovery-act/>

40 | Smart Growth America, 2011. <https://smartgrowthamerica.org/app/legacy/documents/lessons-from-the-stimulus.pdf>

41 | Massachusetts Department of Energy Resources, “EECBG Impact Evaluation.” Fall 2013

42 | Josh Bivens, 2016. <https://www.epi.org/publication/why-is-recovery-taking-so-long-and-who-is-to-blame/>

43 | U.S. Federal Reserve Board, March 2021. t.ly/Hym6

44 | Jennifer Allan et al., 2020. <https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper20-01.pdf>

45 | Rocky Mountain Institute, Green Banks, <https://rmi.org/green-banks-101/>

46 | Leveraging ratios for green investments have even reached as high as between \$6.50 to \$8 in private investment for every public dollar spent. Connecticut Green Bank, 2020 Annual Report, is.gd/Qxw0aM

MEETING THE CHALLENGE

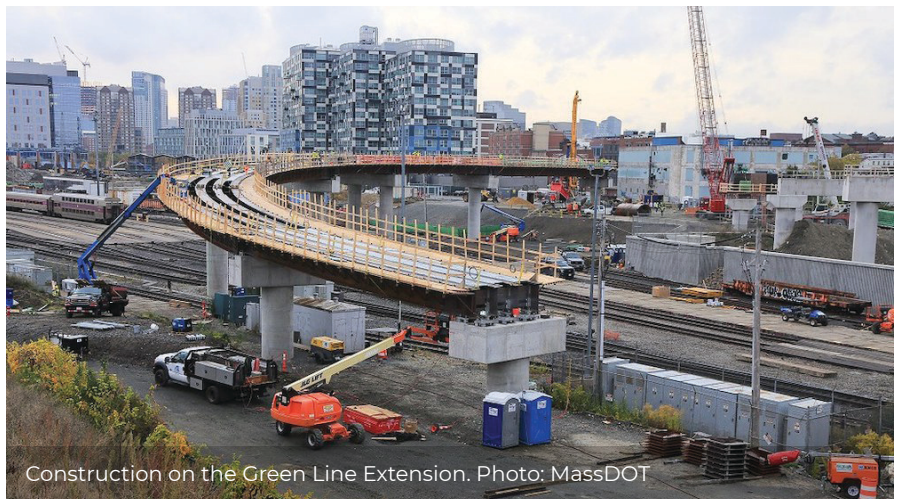
This report analyzes these principles by modeling what a *Green Investment Portfolio* would mean in terms of job creation and community well-being for decades to come in Massachusetts. Climate XChange constructed and modeled the job creation, cost savings, health improvements, and climate benefits of 18 public investment programs spanning transportation, housing, clean energy, grid modernization, and natural resource conservation. This data can be weighted to project the jobs and community benefits from future spending packages in the Commonwealth.

The central thesis of this benefit framework is simple: governments must expand beyond antiquated metrics such as gross domestic product when evaluating the cost-benefits of budgets and policy decisions. Representing the public interest requires measuring many aspects of community well-being, including job opportunities, income levels, cost and time savings, public health improvements, and ecosystem and climate benefits.

When these benefits are captured and expressed in dollar terms, this analysis reveals that public investment in a green transition is immensely beneficial to the Commonwealth's job market, economic vitality, and community well-being, even beyond the pressing needs to address the climate crisis.



Solar farm built on a landfill in Dover. Photo: U.S. Department of Energy



Construction on the Green Line Extension. Photo: MassDOT



Public charging station in New Bedford. Photo: Massachusetts Dept. of Environmental Protection

Overview of the Modeling Approach

This report presents 18 conceptual “programs” for public investment in transportation, buildings, electricity, conservation, and natural resources. Each of these 18 programs is rooted in existing investment proposals in Massachusetts whenever possible, and was individually modeled for its job creation, fuel savings, health benefits, traffic reductions, and climate benefits.

The study consists of three main stages:

1. Data Collection and Jobs: 29 individual projects in Massachusetts were deconstructed into line-item expenditures using existing budget documents, and coded into IMPLAN. IMPLAN is an economic input-output model that maps the flow of dollars, commodities, and labor between 546 sectors in the state. Each dollar invested in IMPLAN ripples throughout the state economy and measures resulting employment, output, labor income, and other fiscal impacts.⁴⁷

2. Fuel Reductions: 20 out of 29 projects had sufficient data to estimate their greenhouse gas emissions reductions and/or fossil fuel savings, using a combination of project-specific literature and peer-reviewed energy models.⁴⁸ These fuel savings were coded into IMPLAN to calculate long-term economic benefits and added to the job creation estimates from initial investment.

3. Health and Time Savings: An air quality model was constructed, using county-level air pollution data and reduced-complexity models (RCMs), to calculate the down-wind public health benefits of 17 projects that reduce fossil fuel consumption.⁴⁹ An additional benefit module was constructed to estimate the physical activity, traffic fatality prevention, and traffic congestion savings of seven transportation projects.

The 29 individual projects were combined thematically to form 18 investment “programs.” Some programs consist of only one individual project. The 18 programs were then further grouped into three major “investment areas”:

1. *Clean Transportation and Sustainable Development,*
2. *Renewables, Energy Efficiency, and Grid Modernization, and*
3. *Conservation and Natural Resources.*

This study has two primary uses. First, each investment area and program can be individually examined for job creation potential, public health benefits, and other merits. These detailed results are featured in the Program Profiles section of this report.

Second, the program results can be weighted and combined to project the jobs and benefits of any future funding package under consideration in Massachusetts. To illustrate this exercise, this report includes a *Green Investment Portfolio* that aligns with the Governor’s 2030 Clean Energy and Climate Plan (CECP).⁵⁰ This portfolio is not prescriptive for Massachusetts policymakers, but rather illustrates what an investment approach aligned with the state’s 2030 climate goal could achieve. This study’s data can be re-weighted to calculate the jobs and benefit potential of any investment plan under consideration, be it from federal, state, local, or private sources.

TABLE 3.1 The *Green Investment Portfolio*

Clean Transportation and Sustainable Development

Light and Commuter Rail
Clean Vehicles
Low Carbon Buses
Transit-Oriented Development
Active Mobility
Ferry Expansion and Electrification
East-West Rail

Renewables, Energy Efficiency, and Grid Modernization

Energy Efficiency and Building Retrofits
Residential Solar
Offshore Wind
Battery Storage
Transmission Infrastructure Upgrades
Community Microgrids
Broadband Connectivity

Conservation and Natural Resources

Clean Water Infrastructure
Urban Greening
Aquatic Ecosystem Restoration
Sustainable Agriculture

⁴⁷ | See the Technical Appendix for details on the job impact methodology and IMPLAN.

⁴⁸ | Nine projects either lack sufficient information to make a reasonable estimate, or do not directly reduce greenhouse gas emissions and/or fossil fuel consumption. For example, the greenhouse gas emissions reductions from the *Clean Water Infrastructure* are not quantifiable due to a lack of data.

⁴⁹ | Of the 20 projects that have measurable greenhouse gas emissions reductions, three do not have measurable air pollution benefits. For example, *Aquatic Ecosystem Restoration* projects absorb and sequester carbon, but do not reduce local air pollution.

⁵⁰ | The *Green Investment Portfolio* directs 50 percent of funds to *Clean Transportation and Sustainable Development*, 35 percent towards *Renewables, Energy Efficiency, and Grid Modernization*, and 15 percent towards *Conservation and Natural Resources*. For more details on the *Green Investment Portfolio*’s weighting, see the Technical Appendix.

Jobs Potential from *Green Investments*

Findings show that every million dollars invested in the *Green Investment Portfolio* supports 14 full-time equivalent (FTE) jobs either directly or indirectly.⁵¹ About 9.3 of these 14 jobs are supported directly through investment as a stimulus measure, and an additional 4.7 jobs are supported in the long-run by reducing the state's reliance on fossil fuel imports.

Benchmark investments were created to better understand these findings, both broadly and targeted at certain sets of industries. Running a million-dollar "investment," which is treated in IMPLAN as a million dollar increase in economic output, across all 546 economic sectors represents the jobs created by general spending in Massachusetts. A diffuse million dollar investment across the state's entire economy supports only 8.5 jobs in IMPLAN, which is significantly lower than the job creation potential of the *Green Investment Portfolio*.

Isolating the ten largest industries in Massachusetts, which together generated 28

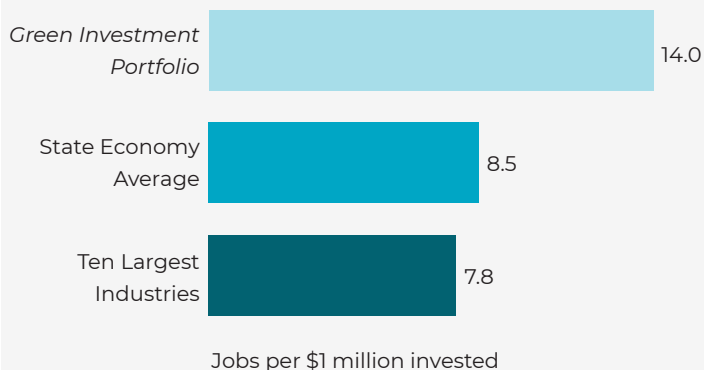
percent of the state's economic output in 2019, provides a more targeted benchmark.⁵² Together, an output-weighted million dollar investment into the ten largest industries in IMPLAN supports 7.8 jobs. Therefore, the *Green Investment Portfolio* is an 80 percent more effective job creator per dollar than an investment into the ten largest industries. In addition, none of the ten largest industries individually generate as many jobs per dollar as the *Green Investment Portfolio*.

Green Investments outperform broader state benchmarks because they support labor-intensive businesses, meaning businesses that spend a greater share of revenue on compensating employees and conduct more business locally. As a result, a dollar spent on a *Green Investment* is more likely to stay in the local economy and end up in the hands of employees rather than out-of-state proprietors. Even without considering the long-term economic benefits, the initial investment into these projects creates more jobs per million dollars (9.7) than the average of the state economy, or top ten industry benchmark (8.5 and 7.8 respectively.)

However, the long-term economic savings of *Green Investments* are a crucial contributor to analyzing job creation. Sixteen out of 18 programs in the portfolio either replace fossil fuel demand with clean alternatives, or reduce energy consumption. As a state that lacks natural reserves of fossil fuels, Massachusetts must import all petroleum and natural gas from out-of-state producers. Therefore, every dollar avoided in fossil fuel expenditures is more likely to be spent locally.

This study quantifies the energy savings from 13 out of 18 programs. These cost savings are run back through IMPLAN as an increase in spending power for households, businesses, and

FIGURE 4.1 Comparison of FTE Jobs Created per Million Dollars Invested



51 | This study measures job creation by full-time-equivalent (FTE) job-years, in order to normalize across occupations that may have variable part-time or seasonal jobs. Throughout this report, "jobs" is used as a shorthand term for FTE job-years.

52 | Industry size is defined as the sum of the industry's economic output. In order of size, the ten largest industries in Massachusetts are: Scientific research and development services; Hospitals; Other real estate; Other financial investment activities; Monetary authorities and depository credit intermediation; Insurance carriers; Management of companies and enterprises; Tenant-occupied housing; Software publishers; and Custom computer programming services.

institutions.⁵³ As a result, the *Green Investment Portfolio* creates an additional 4.7 jobs per million dollars invested. These jobs span the essential goods and services that households spend income on, with the greatest employment gains in real estate, the food service industry, hospitals, and transportation services. In other words, when families increase their spending power, these service industries in Massachusetts experience the greatest employment gains.⁵⁴

TYPES OF JOBS CREATED

The employment impacts of *Green Investments* are stronger in certain industries. This methodology can differentiate between what jobs are created in the near-term from initial investment, versus what jobs are created long-term from a more efficient and productive state economy.

The top industries for near-term job creation include multiple construction industries, architectural and engineering fields, real estate, hospitals, and family services.

TABLE 4.1 Top Ten Industries Supported by *Green Investments*, By Jobs Created

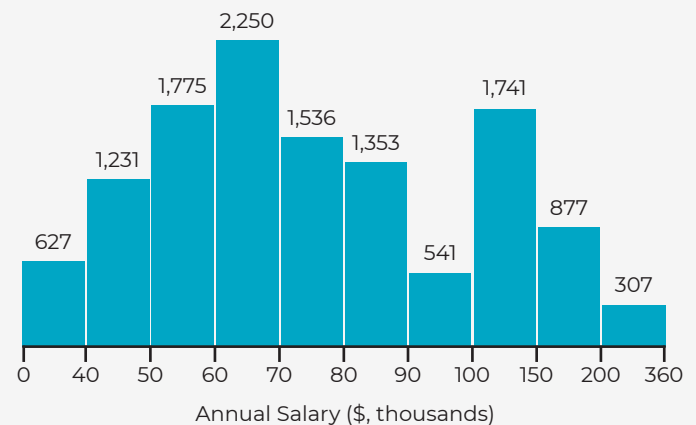
INDUSTRY
Construction of other new nonresidential structures
Other real estate
Maintenance and repair construction of nonresidential structures
Architectural, engineering, and related services
Hospitals
Construction of new power and communication structures
Support activities for agriculture and forestry
Individual and family services
Construction of new multifamily residential structures
Full-service restaurants

Construction was the strongest industry for job creation, constituting nearly one quarter of all jobs created by the *Green Investment Portfolio*. Other top-performing industries include a mixture of technical fields (architectural and engineering services) and broader services that experience a boost in demand as stimulus dollars ripple throughout the state (hospitals, individual and family services, and restaurants.)

However, there are many different types of jobs with various levels of pay, benefits, and working conditions within a given industry. IMPLAN also offers occupational analysis, which measures the hours of new labor opportunity (labor-hours) created by an investment for 802 unique occupations. This allows for a closer analysis of the potential job quality of *Green Investments*, regardless of industry.

All labor-hours generated by the *Green Investment Portfolio* support an average wage/salary of \$85,000 per year.⁵⁵ However, this number is skewed upward due to outlier high-paying occupations. Less than ten percent of total labor-hours created by the *Green Investment Portfolio* support high-paying fields that pay more than \$150,000 in annual salary, yet constitute over 21 percent of all income generated by the portfolio.

FIGURE 4.2 Hours of Work Created Per \$1M of *Green Investment Portfolio*, By Income Level

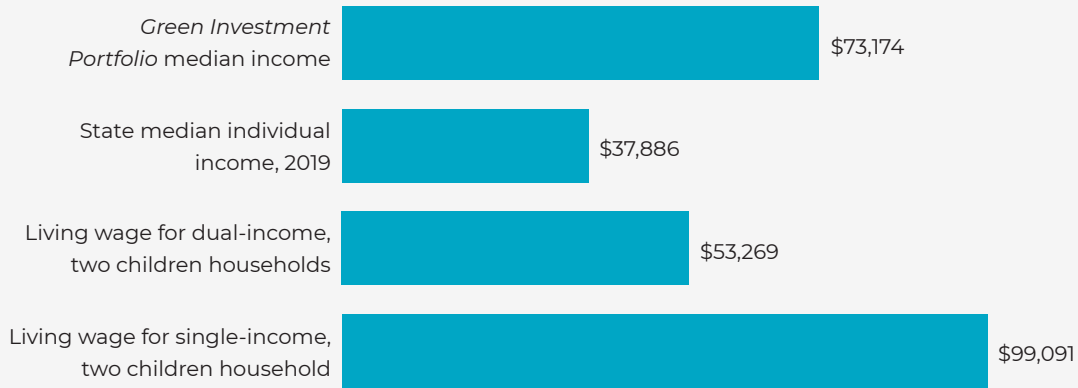


53 | These fuel savings can be on a timeline between five and 30 years, depending on the project. Discounted future cost savings are run in IMPLAN to ensure they are comparable in value to current-day job creation from stimulus.

54 | The top industries to gain employment from fuel savings in IMPLAN were, in descending order: 1) Real estate; 2) Support for agriculture and forestry; 3) Full-service restaurants; 4) Hospitals; 5) Services to buildings; 6) Employment services; 7) Transit and ground passenger transportation; 8) Nursing and community care facilities; 9) All other food and drinking places; 10) Limited-service restaurants.

55 | Labor-hours are defined as one hour of labor for a given occupation.

FIGURE 4.3 Income Comparison across *Green Investments*, State Median Income, Living Wage



Adjusting for this skew, the portfolio supports a labor-hour weighted median salary of \$73,174 per year. However, whether a job pays sufficiently is based on cost of living, which varies widely depending on location and family composition. Researchers at MIT find that a family-supporting wage for two working adults and two children is \$53,269 per adult in Massachusetts. However, a family-supporting wage for a single adult supporting two children is \$99,091 per year.⁵⁶

The top ten occupations created by the *Green Investment Portfolio* span construction workers, contractor positions, transportation drivers and operators, and general services such as office clerks, retail workers, and family service providers. Six out of the ten top occupations supported by the portfolio typically pay near or above the state's median household income of \$81,215 per year.⁵⁷

IMPLAN's analysis of occupational pay is a reflection of the current economy, not that of the future. The analysis reveals that the potential employee compensation with *Green Investments* is substantial, though not guaranteed for all jobs, and likely won't be sufficient without provisions to protect and empower workers as the primary beneficiaries. The actual pay, benefits, and job quality of occupations supported by *Green Investments* is a product of many factors beyond what this study can project.

These workforces will be required for the state to achieve its 2030 and 2050 legally-binding greenhouse gas emissions reductions goals, regardless of where funding comes from. This occupational analysis can and should still be used by policymakers to inform what workforces the Commonwealth will need to support in order to achieve a rapid, equitable, and prosperous transition to the clean economy of the future.

TABLE 4.2 Top Ten Occupations Supported by *Green Investments*, by Hours of Work

OCCUPATION	AVERAGE ANNUAL WAGES/SALARY
Construction Laborer	\$61,974
General and Operations Manager	\$166,665
Carpenter	\$75,475
Transit and Intercity Passenger Vehicle Driver	\$86,346
Electrician	\$79,441
First-Line Supervisor of Construction Trades and Extraction Workers	\$87,759
Individual and Family Service Worker	\$32,332
General Office Clerk	\$59,339
Retail Salesperson	\$46,000
Plumber, Pipefitter, or Steamfitter	\$80,177

⁵⁶ | Massachusetts Institute of Technology, "Living Wage Calculation for Massachusetts." <https://livingwage.mit.edu/states/25>

⁵⁷ | U.S. Census Bureau, "Quick Facts: Massachusetts." <https://www.census.gov/quickfacts/fact/table/MA/INC110219>

Benefits of *Green Investments*

In addition to jobs, the social and economic benefits generated by these programs are critical to understanding their value. **When weighted according to the *Green Investments Portfolio*, these 18 programs provide \$2.2 million in measured benefits for every million dollars invested.**

This analysis measures six distinct benefits in dollar terms:

MEASURED BENEFITS OF GREEN INVESTMENTS⁵⁸



Energy Cost Savings

The gasoline, diesel, and natural gas costs avoided by reducing energy use or switching away from fossil fuel sources



Congestion Time Savings

The travel time savings from lower traffic congestion and/or switching to other modes of transportation



Air Quality Health Benefits

The saved lives and avoided illnesses from reducing air pollution



Physical Activity Health Benefits

The saved lives and avoided illnesses from increased walking, cycling, and other forms of active mobility



Traffic Accidents Avoided

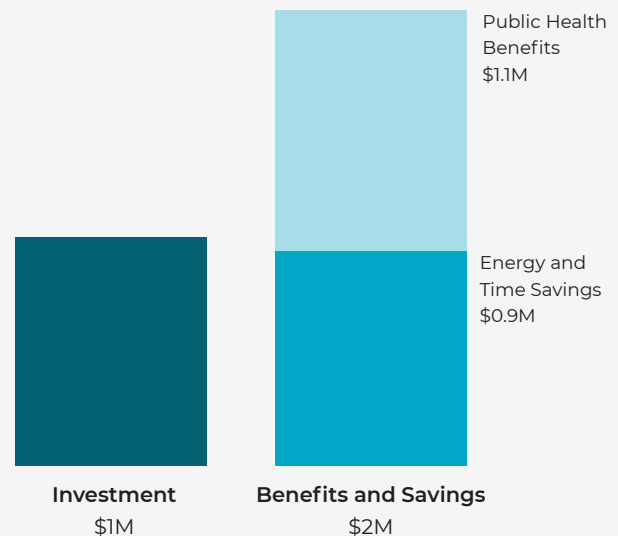
Avoided traffic accident fatalities or injuries from reduced personal vehicle use



Climate Benefits

The avoided future damages of climate change from greenhouse gas pollution

FIGURE 5.1 *Green Investment Portfolio* Benefits per million dollars invested



Not every program has all six of these benefits; some programs either lack sufficient information to make a reasonable estimate, or do not provide the given benefit. In all, 13 out of 18 programs lack sufficient data to quantify some or all of the benefits listed above. There are also many additional benefits that are either beyond the scope of this study or lack precedent in how to quantify. Therefore, the expected total benefits from the *Green Investment Portfolio* in dollar terms, are significantly higher than the \$2.2 million that this study indicates.

This study uses county-level pollution data, but most project analysis remains generalized to the state level. There is important local context that may determine where co-benefits occur and who receives them. As these investments transition from conceptual programs to concrete, location-specific proposals, more granular analysis can be applied to where these benefits occur.

⁵⁸ | The methodology for how each benefit is quantified can be found in the Technical Appendix.

ENERGY AND TIME SAVINGS

Massachusetts' existing infrastructure incurs high energy costs and wastes time and productivity for its residents and businesses. *Green Investments* provide measurable cost and time savings for the state by building a more efficient energy and transportation system.

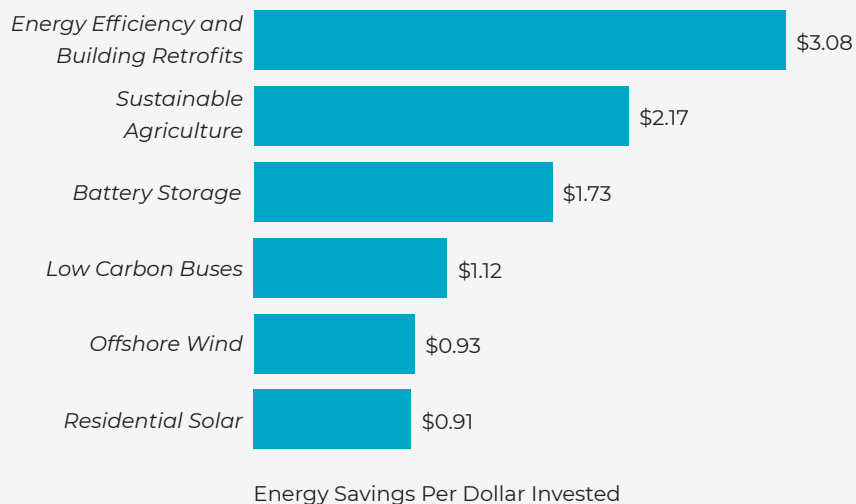
Every dollar invested in the *Green Investment Portfolio* avoids 94 cents in energy costs and travel time, of which 75 cents come from fuel savings and 19 cents come from reduced traffic congestion.

ENERGY SAVINGS

As a non-extractive state, Massachusetts currently imports all fossil fuels from out-of-state producers, thus every dollar avoided in fossil fuel expenditures is a dollar kept in-state. *Green Investments* reduce consumption of fossil fuels, either by reducing energy use or by switching to cheaper and cleaner renewable sources. This leads to significant savings on transportation and utility costs for families, businesses, and institutions.

Energy savings for 13 out of 18 programs ranged from six cents to \$3.08 in fuel savings per dollar invested. *Renewables, Energy Efficiency, and Grid Modernization* was the highest performing investment area in reducing energy costs. *Energy Efficiency and Building Retrofits* saved \$3.08 on energy costs per dollar invested, followed by *Sustainable Agriculture* (\$2.17 per dollar), *Battery Storage* (\$1.73 per dollar), and *Low Carbon Buses* (\$1.12 per dollar) programs.

FIGURE 5.2 Top Performing *Green Investments* for Energy Savings

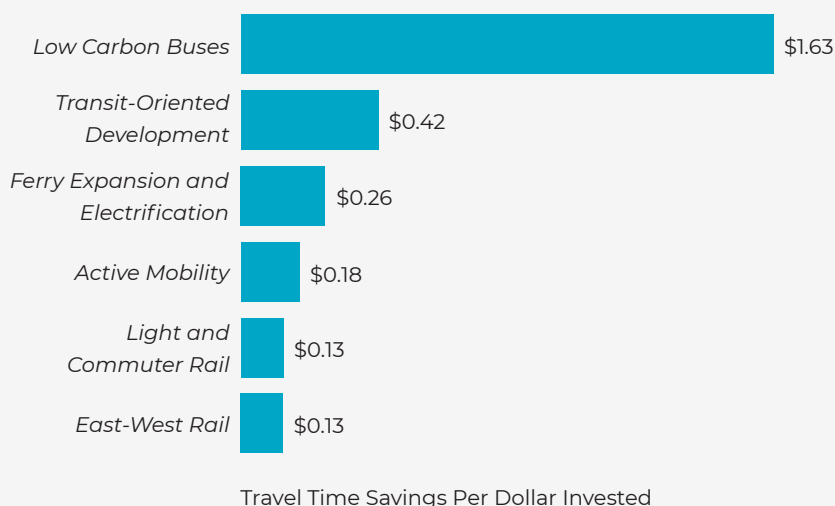


CONGESTION REDUCTION

High-traffic congestion leads to productivity losses and economic costs to the state, as well as reduced quality of life. *Green Investments* reduce congestion by expanding alternative modes of transportation. This leads to significant time savings, both for drivers who remain on the road as well as the direct users of a cleaner, faster, more affordable public transportation system.

Time savings for six out of 18 programs, all of which were in the *Clean Transportation and Sustainable Development* investment area, ranged from 13 cents to \$1.63 in congestion savings per dollar invested. The *Low Carbon Buses* program saved \$1.62 in time savings per dollar invested, followed by the *Transit-Oriented Development* (42 cents per dollar), *Ferry Expansion and Electrification* (26 cents per dollar), and *Active Mobility* (18 cents per dollar) programs.

FIGURE 5.3 Top Performing *Green Investments* for Congestion Reduction



PUBLIC HEALTH SAVINGS

Existing fossil fuel use and personal vehicle infrastructure result in negative health outcomes through air pollution, physical inactivity, and traffic accidents. *Green Investments* deliver measurable health benefits by reducing local pollution from fossil fuels, as well as providing residents with alternative, efficient modes of transportation that are healthier and safer than those with internal combustion engines.

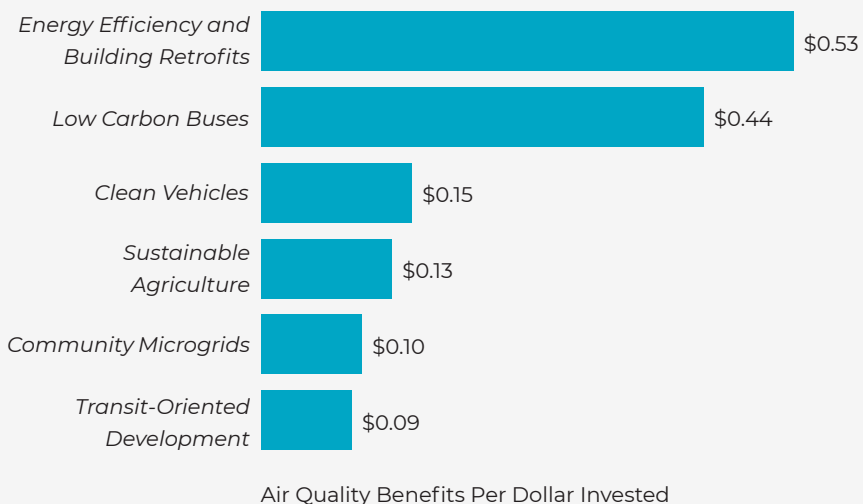
Every dollar invested in the *Green Investment Portfolio* creates \$1.06 in public health benefits, of which 13 cents are benefits from reduced air pollution, 88 cents are physical activity benefits, and five cents are from avoided traffic fatality and injuries.

AIR POLLUTION

Premature mortality and disease due to air pollution from fossil fuels is a pressing issue in the state. *Green Investments* reduce air pollution by cutting energy use or switching to cleaner sources of energy. This leads to air quality benefits in the surrounding community, resulting in reduced mortality and disease.

Air pollution benefits for 13 out of 18 programs ranged from one cent to 53 cents in air pollution benefits per dollar invested. The *Energy Efficiency and Building Retrofits* program saved the most on air pollution per dollar invested (53 cents), followed by the *Low Carbon Buses* (44 cents per dollar), *Clean Vehicles* (15 cents per dollar), and *Sustainable Agriculture* (13 cents per dollar) programs.

FIGURE 5.4 Top Performing *Green Investments* for Air Pollution Reduction

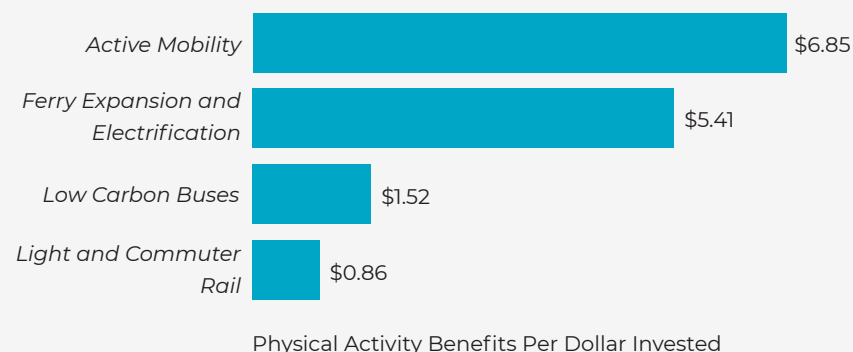


PHYSICAL ACTIVITY

Current infrastructure fosters a physical reliance on personal vehicles and discourages walking, biking, and public transit use. *Green Investments* increase access to new walking and cycling opportunities, both through active mobility infrastructure and increased walking to and from public transit, while reducing personal vehicle use. This leads to health benefits for the surrounding community that can better access walking, biking, and public transit in their everyday lives.

Physical activity benefits were measured for five out of 18 programs, all of which were in the *Clean Transportation and Sustainable Development* investment area, and ranged from two cents to \$6.85 in physical activity benefits per dollar invested. The *Active Mobility* program created \$6.85 in physical activity benefits per dollar invested, followed by the *Ferry Expansion and Electrification* (\$5.41 per dollar), *Low Carbon Buses* (\$1.52 per dollar), and *Light and Commuter Rail* (86 cents per dollar) programs.

FIGURE 5.5 Top Performing *Green Investments* for Physical Activity Benefits

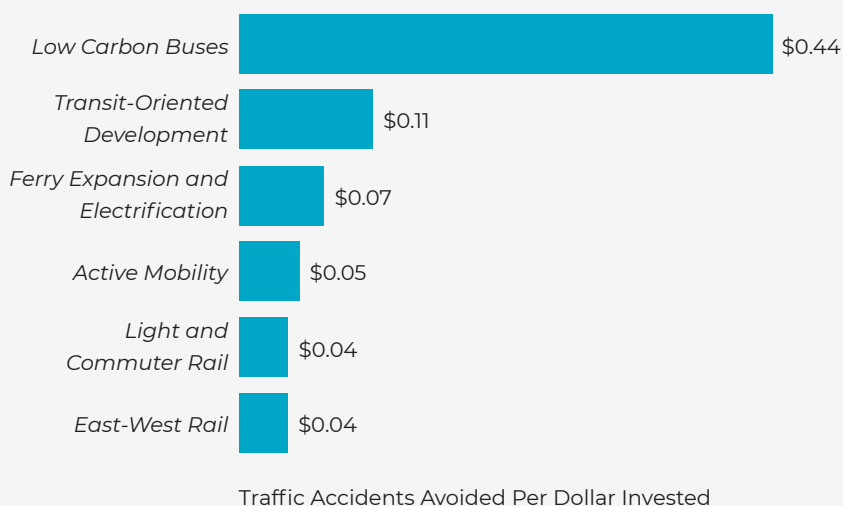


AVOIDED TRAFFIC FATALITIES AND INJURIES

Frequent traffic accident fatalities and injuries result in part from a high density of personal vehicles. *Green investments* reduce the need for personal vehicles and build a safer streetscape. This reduces the risk of vehicle-on-vehicle, vehicle-on-bicycle, and vehicle-on-pedestrian accidents.

Avoided traffic fatalities and injuries for six out of 18 programs, all of which were in the *Clean Transportation and Sustainable Development* investment area, ranged from four to 44 cents per dollar invested. The *Low Carbon Buses* program saved the most on traffic fatalities and injuries per dollar invested (44 cents), followed by the *Transit-Oriented Development* (11 cents per dollar), *Ferry Expansion and Electrification* (seven cents per dollar), and *Active Mobility* (five cents per dollar) programs.

FIGURE 5.6 Top Performing *Green Investments* for Avoided Traffic Accidents

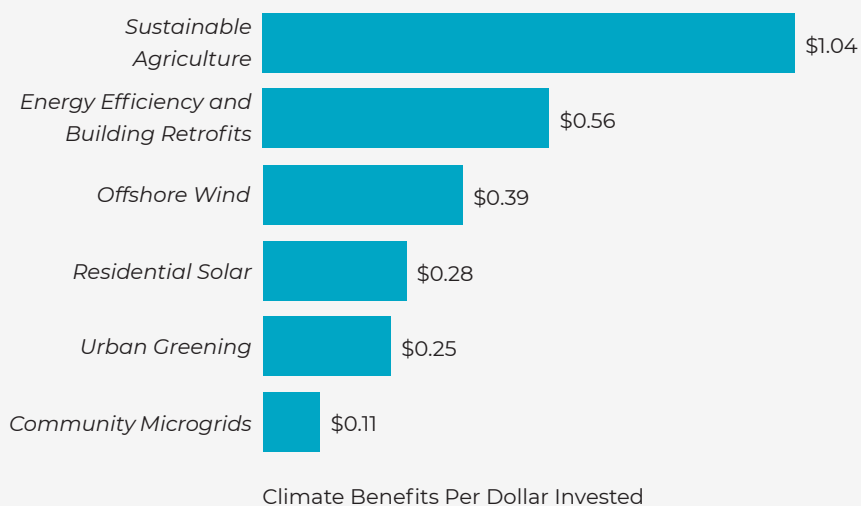


CLIMATE BENEFITS

Greenhouse gases create climate damages by contributing to global atmospheric warming and impacting ecosystem processes. *Green Investments* contribute to worldwide climate benefits by reducing greenhouse gas emissions.

Climate benefits for 15 out of 18 programs ranged from 0.1 cents to \$1.04 on climate benefits per dollar invested. *Conservation and Natural Resources* was the highest-performing investment area in reducing greenhouse gas emissions. The *Sustainable Agriculture* program created the most significant climate benefits per dollar invested (\$1.04), followed by the *Energy Efficiency and Building Retrofits* (56 cents per dollar), *Offshore Wind* (39 cents per dollar), and *Residential Solar* (28 cents per dollar) programs.

FIGURE 5.7 Top Performing *Green Investments* for Climate Benefits



Summary and Next Steps

DEPLOYMENT SPEED AND INVESTMENT SCALE

The *Green Investment Portfolio* offers an investment template for Massachusetts to build back better, delivering compelling results and benefits. These include enhanced well-being for communities and families through lower costs of living, cleaner air, and above-average job creation. Below are two additional pieces of analysis that synthesize previous findings with added components for the consideration of policymakers and stakeholders.

This report presents findings as comparative “multipliers,” which normalize all benefits to a million dollar investment. However, in reality, the various investment areas identified as part of the *Green Investment Portfolio* require different scales of funding. Additionally, not all programs can be deployed immediately — some programs require years of upfront planning and scoping work prior to implementation, others may not

require such drawn-out steps, while some may be shovel-ready. The speed at which programs can be deployed and benefits generated is an important consideration for an effective, rapid investment strategy.

As a result, Climate XChange incorporated two additional considerations to accompany these findings: investment scale and deployment speed (see Table 6.1). Investment scale refers to the size of funding required to exhaust available investment opportunities considered in the *Green Investment Portfolio*, and deployment speed refers to the anticipated pace at which projects can be feasibly implemented to facilitate rapid deployment.

An evaluation of these two criteria remains qualitative, as concrete program details are required for all programs to quantitatively assess both investment scale and deployment speed.

TABLE 6.1 Overview of Findings by Investment Area

INVESTMENT AREA	INVESTMENT SCALE	DEPLOYMENT SPEED	JOBS PER \$M	ENERGY AND TIME SAVINGS	HEALTH AND CLIMATE BENEFITS
<i>Clean Transportation and Sustainable Development</i>	\$\$\$	Mixed	11.7	⚡ ⚡ ⚡	+++
<i>Renewables, Energy Efficiency, and Grid Modernization</i>	\$\$\$	Moderate to Fast	17.5	⚡ ⚡ ⚡	+++
<i>Conservation and Natural Resources</i>	\$\$\$	Fast	13.2	⚡ ⚡ ⚡	+++
<div> <div> Investment Scale <div> Lower opportunity \$\$\$ </div> <div> Moderate opportunity \$\$\$ </div> <div> Higher opportunity \$\$\$ </div> </div> <div> Deployment Speed <div> Slow: 5+ years </div> <div> Moderate: within 5 years </div> <div> Fast: within 2 years </div> </div> <div> Savings and Benefits <div> Low ⚡ ⚡ ⚡ Low +++ </div> <div> Moderate ⚡ ⚡ ⚡ Moderate +++ </div> <div> High ⚡ ⚡ ⚡ High +++ </div> </div> </div>					

Notably, *Clean Transportation and Sustainable Development* has a wide array of deployment speeds depending on the project in question. Large infrastructure projects, such as *Light and Commuter Rail*, require years of planning and scoping work prior to beginning construction. On the other hand, *Clean Vehicles* qualifies as a “fast” potential deployment speed, since Massachusetts has existing programs and funding sources that can be expanded to deploy more electric vehicles (EVs) and their charging infrastructure.

Renewables, Energy Efficiency, and Grid Modernization programs have a mix of moderate and fast deployment speeds. Some investments, such as energy efficiency upgrades or rooftop solar installation, may only take a few months to complete, while larger grid and renewable energy projects can take years of planning before construction begins. *Conservation and Natural Resources* has a fast deployment speed, since many projects are shovel-ready, but funding remains the predominant limitation for this investment area.

Another key factor to consider for infrastructure investments is their scale. This can determine their impact because in many cases, the more capital invested, the better the return on investment. Many of the programs in the *Green Investment Portfolio* presented in this report will require significant, long-term funding sources to effectively function as intended.

Government funding leverages significant private investment in climate infrastructure, effectively multiplying the impact of every public dollar invested. Every government dollar spent on green projects attracts approximately \$2.50 in additional private investment.^{59,60} Therefore, higher government investment in infrastructure can not only provide necessary funds, but also influence expectations of future growth and private investment decisions.

NEXT STEPS

Future work should build on this report and add critical dimensions of analysis to take the *Green Investment Portfolio* from a conceptual investment strategy to actionable, equitable policy. Recovery measures and investment strategies should:

1. Include diverse workforce development policies, job quality and safety standards, and local hiring provisions



Research highlights that clean energy jobs are overwhelmingly held by White men, and that workers who are currently underrepresented in the clean energy workforce are often not reaping some of the benefits discussed in this report. Therefore, hiring practices should prioritize historically marginalized workers, including people of color, women, people living with disabilities, formerly incarcerated people, and veterans.⁶¹ Workforce development should also support reskilling and training for workers in industries impacted by decarbonization.

Many *Green Investments* support construction-heavy projects, which must pay prevailing wages and be covered by project labor agreements. To ensure high job quality across all occupations, jobs must provide family-sustaining wages and benefits, which need to be higher than the current minimum wage in Massachusetts, and have health and safety standards.

⁵⁹ | Rocky Mountain Institute, Green Banks, <https://rmi.org/green-banks-101/>

⁶⁰ | Leveraging ratios for green investments have even reached as high as between \$6.50 to \$8 in private investment for every public dollar spent. Connecticut Green Bank, 2020 Annual Report, <https://flowpaper.com/online-pdf-viewer/?theme=dark&pdf=https://www.ctgreenbank.com/wp-content/uploads/2020/12/Annual-Report-FY20-final.pdf>

2. Center equity and frontline communities in infrastructure investments

Targeted investments in frontline communities can improve public health, make housing, transportation, and energy more affordable, and create good jobs in underinvested communities. In April 2021, the Biden administration promised that 40 percent of federal energy investments will be allocated to frontline and environmental justice communities. Similarly, an analysis of an early draft of Massachusetts' 2030 Clean Energy and Climate Plan (CECP) recommends that the state prioritize climate investments in environmental justice neighborhoods, setting either a percentage minimum or a relative standard for funding in environmental justice populations.⁶²

In addition, policymakers must ensure that environmental justice and vulnerable communities are included and can effectively participate in decision making about climate and energy investments.

3. Incorporate direct air pollution reduction into decarbonization and investment strategies to maximize health benefits

According to a Political Economy Research Institute (PERI) report, decarbonization policies focused too narrowly on greenhouse gas emissions can sacrifice significant health gains from improved air quality.⁶³ Alternatively, explicitly including air quality standards into climate mitigation policies can amplify health and air quality benefits.

Policymakers should adopt a multi-benefit framework to assess and prioritize climate investments and decarbonization strategies that focus on air quality, public health, and quality of life, in addition to job creation and emissions reductions. Since air quality co-benefits immediately improve conditions for communities, the PERI report highlights that this may provide more momentum for decarbonization efforts than traditional one-dimensional frameworks.⁶⁴



⁶² | Applied Economics Clinic, "Initial Assessment of the Clean Justice Working Group's Recommended Policy Priorities — Tracking Equity and Justice," March 2021. t.ly/OdkH

⁶³ | Diana, Bridget, Michael Ash, and James K. Boyce, "Green for All: Integrating Air Quality and Environmental Justice into the Clean Energy Transition." PERI, March 2021, t.ly/AHsk

⁶⁴ | Ibid.

4. Ensure transparency and public access to investment information

An Applied Economics Clinic report recommends that Massachusetts track government dollars spent on climate and clean energy efforts by the location of the project and make that data publicly available.⁶⁵ This can ensure government accountability and give the public access to information and resources needed to engage in decision making processes.

Past efforts to make investment information accessible have been beneficial. For example, transparency on stimulus projects funded through the American Recovery and Reinvestment Act (ARRA) increased collaboration and information sharing between different levels of government.⁶⁶

5. Examine additional investments beyond projects in this report

This report presents a wide range of climate investment options in the *Green Investment Portfolio*, but it does not include every type of program to consider to quickly recover from economic crises and meet the state's infrastructure needs in the coming decade

Further, infrastructure investments to support other community needs, such as affordable housing, food security, health care, and education, should be incorporated in investment measures to foster as holistic a transition to a clean economy as possible.

TABLE 6.2 Additional Investment Programs to Consider

INVESTMENT AREA	ADDITIONAL PROGRAMS TO CONSIDER
<i>Clean Transportation and Sustainable Development</i>	<i>Light and commuter rail electrification</i> <i>Low- and zero-emission trucks and school buses</i> <i>Freight train electrification</i> <i>Road and highway repair</i>
<i>Renewables, Energy Efficiency, and Grid Modernization</i>	<i>Utility-scale solar</i> <i>Smart meters</i> <i>Zero-emission hydrogen fuel cells</i> <i>Local renewable energy research & development</i>
<i>Conservation and Natural Resources</i>	<i>Forest resilience and sequestration</i> <i>Soil management</i> <i>Environmental remediation</i> <i>Waste reduction</i> <i>Community gardens and green roofs</i>
Other Investment Areas	<i>Flood resilience infrastructure</i> <i>Air monitoring stations</i> <i>Green banking and clean energy public finance</i> <i>Green job education and training</i> <i>Methane gas pipeline leakage repair</i>

⁶⁵ | Applied Economics Clinic, "Initial Assessment of the Clean Justice Working Group's Recommended Policy Priorities — Tracking Equity and Justice," March 2021. t.ly/OdkH

⁶⁶ | Yee, Raymond et al., "Improving Federal Spending Transparency: Lessons Drawn from Recovery.gov", 2010, <https://escholarship.org/uc/item/7tw2w9wx>

Program Profiles

This study's data is packaged into three "investment areas", each of which contains four to seven individual programs, as seen on the right. The programs are grouped into investment areas based on which sector of the economy the program predominantly focuses on: transportation and housing, buildings and electricity, and natural resources.

This section provides more detailed model results for each program and investment area in a standard one-page template. Each one-pager includes:

- An explanation of the investment area or program
- The investment scale and deployment speed
- Job creation potential, in comparison to the state's ten largest industries
- The top five occupations supported by the investment area or program
- The measurable energy cost savings, travel time savings, air quality benefits, physical activity benefits, traffic accidents avoided, and climate benefits

The program profile findings are presented as a one million dollar multiplier, which can be scaled linearly. For example, a two million dollar investment into a given program would create twice the jobs and community benefits as listed on its program profile page. These multipliers can be used to project the jobs and community benefits of any future public investment scenarios, including combinations of multiple programs or investment areas.

TABLE 7.1 The Green Investment Portfolio

INVESTMENT AREA	PROGRAM
Clean Transportation and Sustainable Development  <p>Photo: MassDOT</p>	<i>Light and Commuter Rail</i> <i>Clean Vehicles</i> <i>Low Carbon Buses</i> <i>Transit-Oriented Development</i> <i>Active Mobility</i> <i>Ferry Expansion and Electrification</i> <i>East-West Rail</i>
Renewables, Energy Efficiency, and Grid Modernization  <p>Photo: Team Massachusetts 4D Home</p>	<i>Energy Efficiency and Building Retrofits</i> <i>Residential Solar</i> <i>Offshore Wind</i> <i>Battery Storage</i> <i>Transmission Infrastructure Upgrades</i> <i>Community Microgrids</i> <i>Broadband Connectivity</i>
Conservation and Natural Resources  <p>Photo: Robert Laliberte</p>	<i>Clean Water Infrastructure</i> <i>Urban Greening</i> <i>Aquatic Ecosystem Restoration</i> <i>Sustainable Agriculture</i>



Clean Transportation and Sustainable Development

PROGRAMS INCLUDED

- 1 Light and Commuter Rail
- 2 Clean Vehicles
- 3 Low Carbon Buses
- 4 Transit-Oriented Development
- 5 Active Mobility
- 6 Ferry Expansion and Electrification
- 7 East-West Rail

DESCRIPTION

Clean Transportation and Sustainable Development investments expand and improve Massachusetts' transit infrastructure and housing stock in order to reduce transportation emissions. This includes light and commuter rail expansion, transit-oriented housing development, and a buildout of the state's electric car, bus, and ferry fleets and their charging infrastructure.

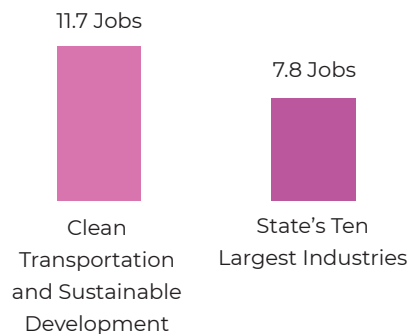
BENEFITS

The initial investment into clean transportation and housing creates a significant number of construction, architecture, and operations jobs to build and run the infrastructure. As the transportation system electrifies and expands public transit, it also provides significant benefits to the public in the form of fuel savings, congestion reduction, cleaner air, safer roads, and healthier lifestyles.

RESULTS

Supports **50 percent more jobs per dollar than the state's ten largest industries**. Additionally, **every dollar invested saves the Commonwealth \$2.61** in fuel savings, reduced traffic, and improved public health.

JOBS PER MILLION INVESTED



INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Mixed

BENEFITS PER MILLION INVESTED



Total
\$2,609,100





Light and Commuter Rail



Construction on the Green Line Extension. Photo: MassDOT

INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Slow

DESCRIPTION

Light and Commuter Rail extends existing light and commuter rail service, builds new rail lines, and connects existing service lines at strategic locations in the state. Light and Commuter Rail projects increase rail system coverage, capacity, and ridership in Massachusetts.

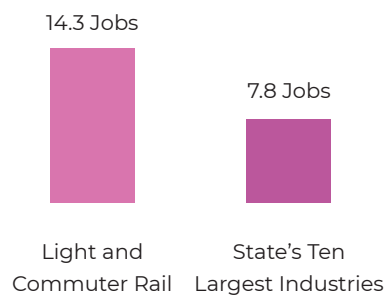
BENEFITS

The initial investment in light rail creates substantial construction and engineering work. As the state's public transportation systems expand and become more efficient, they also provide significant benefits to the public in the form of fuel savings, congestion reduction, cleaner air, safer roads, and healthier lifestyles.

RESULTS

Each dollar invested **supports nearly twice as many jobs as a dollar invested in the state's ten largest industries.** Additionally, every dollar invested in Light and Commuter Rail saves the Commonwealth \$1.10 in fuel savings, travel time savings, and public health benefits.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Carpenters
- 3 Electricians
- 4 First-Line Construction Supervisors
- 5 General and Operations Managers

BENEFITS PER MILLION INVESTED



Fuel Cost Savings
\$62,800

Gasoline and diesel costs avoided by reducing vehicle reliance



Physical Activity Health Benefits
\$861,300

Saved lives and avoided illnesses from increased walking and cycling



Travel Time Savings
\$132,200

Travel time savings from lower traffic congestion and faster public transit



Traffic Accidents Avoided
\$36,000

Avoided traffic accident fatalities or injuries



Air Pollution Health Benefits
\$12,600

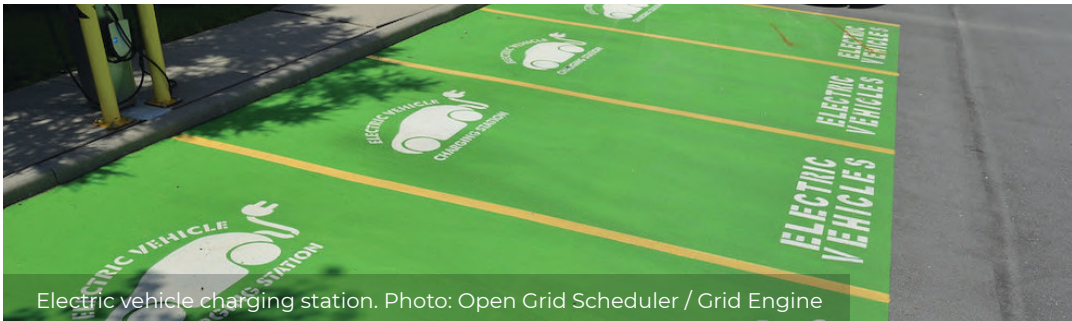
Saved lives and avoided illnesses from improved air quality

Total
\$1,104,800





Clean Vehicles



Electric vehicle charging station. Photo: Open Grid Scheduler / Grid Engine

INVESTMENT SCALE

Moderate \$\$\$

DEPLOYMENT SPEED

Fast

DESCRIPTION

Clean Vehicles provides financial assistance to increase the adoption of zero-emission vehicles (ZEV) and low-emission vehicles (LEV) in the state for low-income individuals. *Clean Vehicles* also installs workplace and public electric vehicle charging stations to expand Massachusetts' public charging network.

BENEFITS

This program spurs the electric vehicle industry in Massachusetts, creating jobs in EV manufacturing, retail, and maintenance. The program also provides cost savings for households in the form of avoided fuel and maintenance costs associated with internal combustion engines, as well as public health benefits for the community through cleaner air.

RESULTS

Supports 7.7 jobs per million dollars invested, compared to 7.8 jobs per million dollars invested in the state's top ten industries. Adopting zero- and low-emission vehicles results in \$288,000 in fuel savings and improved public health per million dollars invested.

JOBS PER MILLION INVESTED

7.7 Jobs



Clean Vehicles

7.8 Jobs



State's Ten Largest Industries

TOP OCCUPATIONS

- 1 Individual and Family Services
- 2 Retail Salespersons
- 3 General and Operations Managers
- 4 Auto Technicians and Mechanics
- 5 Office Administrators

BENEFITS PER MILLION INVESTED



Fuel Cost Savings

\$134,500

Gasoline and diesel costs avoided by using hybrid or electric personal vehicles



Air Pollution Health Benefits

\$153,600

Saved lives and avoided illnesses from improved air quality

Total
\$288,000





Low Carbon Buses



INVESTMENT SCALE

Moderate \$\$\$

DEPLOYMENT SPEED

Fast

DESCRIPTION

Low Carbon Buses provides funding for local and state transit agencies to establish new or expanded bus service and to replace or expand their existing fleets with battery-electric buses (BEBs) to increase low- and zero-emission heavy-duty use in public transit. Low Carbon Buses also installs battery electric bus (BEB) charging stations at bus depots.

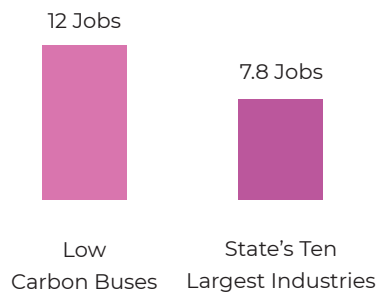
BENEFITS

Expanding and electrifying bus service in the Commonwealth unlocks quality workforce opportunities in the fields of construction, engineering, and public transportation. These investments also create long-term job benefits by providing transportation and fuel cost savings for transit operators and new transit riders. Electrified buses deliver significant public health measures when they replace polluting diesel-powered buses, create convenient healthy alternatives to personal vehicles, and reduce overall traffic.

RESULTS

Each dollar invested **supports 55 percent more jobs than a dollar invested in the state's ten largest industries.** Additionally, every dollar invested in Low Carbon Buses **saves \$5.16 in fuel savings, congestion reduction, and improved public health.**

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Transit and Intercity Vehicle Drivers
- 2 General and Operations Managers
- 3 Bus and Truck Mechanics
- 4 Office Administrators
- 5 Customer Service Representatives

BENEFITS PER MILLION INVESTED



Fuel Cost Savings
\$1,119,500

Gasoline and diesel costs avoided by reducing vehicle reliance



Physical Activity Health Benefits
\$1,521,000

Saved lives and avoided illnesses from increased walking and cycling



Travel Time Savings
\$1,626,800

Travel time savings from lower traffic congestion and improved bus service



Traffic Accidents Avoided
\$443,000

Avoided traffic accident fatalities or injuries



Air Pollution Health Benefits
\$444,500

Saved lives and avoided illnesses from improved air quality

Total
\$5,155,100





Transit-Oriented Development



Broadway Bridge construction. Photo: MassDOT

INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Slow

DESCRIPTION

Transit-Oriented Development provides funding for development and land-use projects that increase the supply of affordable housing near jobs, retail centers, transportation options, and other key amenities. This includes transit-oriented development of affordable housing and transportation-related infrastructure, as well as connectivity projects that increase transit access to existing affordable housing.

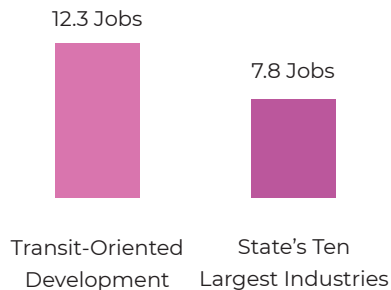
BENEFITS

Affordable housing must be near convenient transportation options in order to allow families to thrive in place. Investing in transit-oriented development creates significant construction and contractor work opportunities, and provides long-term fuel cost savings for the state by increasing the viability of transit rather than personal vehicles, which reduces road pollution, reduces traffic accidents, and encourages healthy lifestyles.

RESULTS

Each dollar invested **supports 60 percent more jobs** than a dollar invested in Massachusetts' ten largest industries. Further decreases personal vehicle use, **creating \$802,000 in cost savings, congestion reduction, and public health benefits** per million dollars invested.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Carpenters
- 3 Electricians
- 4 First-Line Construction Supervisors
- 5 Plumbers, Pipefitters, Steamfitters

BENEFITS PER MILLION INVESTED



Fuel Cost Savings
\$185,800

Gasoline and diesel costs avoided by reducing vehicle reliance



Air Pollution Health Benefits
\$85,900

Saved lives and avoided illnesses from improved air quality



Travel Time Savings
\$416,700

Travel time savings from lower traffic congestion and improved public transit access



Traffic Accidents Avoided
\$113,500

Avoided traffic accident fatalities or injuries

Total
\$801,900





Active Mobility



INVESTMENT SCALE

Low \$\$\$

DEPLOYMENT SPEED

Moderate

DESCRIPTION

Active Mobility supports the construction of new or improved pedestrian and bicycle infrastructure, such as sidewalks, complete streets, bike lanes, and shared-use paths.

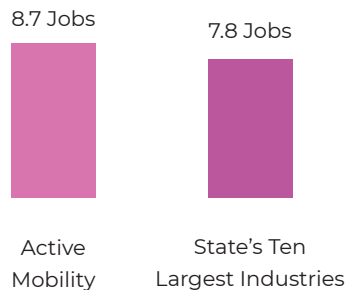
BENEFITS

Makes it safer, easier, and more attractive for residents to walk and bike in Massachusetts. Investing in active mobility infrastructure creates significant construction and contractor work opportunities, and provides long-term fuel cost savings. By increasing the viability of biking and walking rather than personal vehicles, Active Mobility alleviates road congestion, reduces traffic accidents, and encourages healthy lifestyles.

RESULTS

Supports 8.7 jobs per million dollars invested, compared to 7.8 jobs per million dollars invested in the state's ten largest industries. Additionally, **every dollar invested saves the Commonwealth \$7.20 in fuel costs, congestion, and public health costs.**

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Carpenters
- 3 Electricians
- 4 First-Line Construction Supervisors
- 5 Retail Salespersons

BENEFITS PER MILLION INVESTED





Ferry Expansion and Electrification



Boston Harbor Ferry. Photo: Martin Beecroft

INVESTMENT SCALE

Low \$\$\$

DEPLOYMENT SPEED

Moderate to Fast

DESCRIPTION

Ferry Expansion and Electrification expands ferry service in Boston Harbor and between the Cape and Islands and builds out the state's fleet with hybrid-electric ferries. The program also makes upgrades to docks and ferry terminals along these routes.

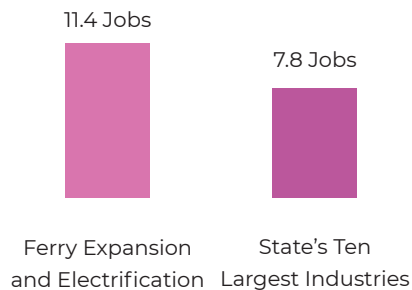
BENEFITS

Expanding and electrifying ferry service unlocks quality workforce opportunities in the fields of construction, carpentry, and metal fabrication. These investments also create long-term job benefits by lowering transportation-related costs for users of the new ferry service and fuel costs for transit operators. Electrified ferries deliver significant public health benefits when they replace polluting diesel-powered ferries, create convenient healthy alternatives to personal vehicles, and reduce overall traffic.

RESULTS

Each dollar invested **supports 50 percent more jobs than a dollar invested in the state's ten largest industries.** Additionally, every dollar invested **saves \$5.92 in fuel, traffic congestion, and public health costs.**

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Electricians
- 3 Carpenters
- 4 First-Line Construction Supervisors
- 5 Plumbers, Pipefitters, Steamfitters

BENEFITS PER MILLION INVESTED





East-West Rail (High Speed Rail)



INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Slow

DESCRIPTION

The East-West Rail connects Western Massachusetts communities with central and eastern cities via fast, frequent, and affordable passenger rail service. This rail service would increase transit connectivity across the state, enhance mobility, and reduce highway congestion.

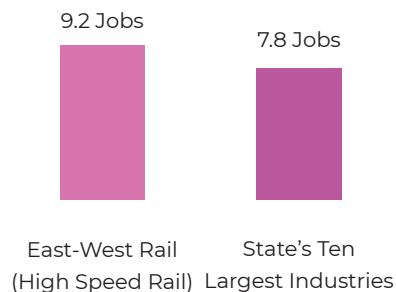
BENEFITS

An efficient, reliable high speed rail service connecting Springfield and Pittsfield with Worcester through to Boston would create substantial social and economic benefits. Investing in this long-anticipated rail service will create workforce opportunities in construction, engineering, and public transportation. The program also provides significant benefits to the public in the form of congestion reduction, cleaner air, safer roads, and healthier lifestyles.

RESULTS

Supports 9.2 jobs per million dollars invested, compared to 7.8 jobs per million dollars invested in the state's ten largest industries. Mode switching from driving to using East-West Rail unlocks \$288,300 in cost savings, traffic reduction, and public health benefits per million dollars invested.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Carpenters
- 3 Electricians
- 4 First-Line Construction Supervisors
- 5 General and Operations Managers

BENEFITS PER MILLION INVESTED





Renewables, Energy Efficiency, and Grid Modernization

PROGRAMS INCLUDED

- 1 Energy Efficiency and Building Retrofits
- 2 Residential Solar
- 3 Offshore Wind
- 4 Battery Storage
- 5 Transmission Infrastructure Upgrades
- 6 Community Microgrids
- 7 Broadband Connectivity

DESCRIPTION

Renewables, Energy Efficiency, and Grid Modernization investments reduce energy consumption in buildings, increase renewable energy generation, and make vital upgrades to the energy grid and transmission infrastructure.

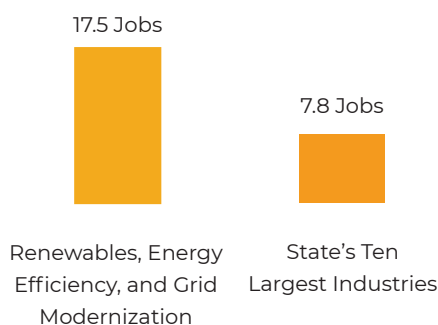
BENEFITS

Public spending on renewable energy and energy efficiency spurs new workforce opportunities for contractors and engineers, and it creates an even greater number of jobs in the broader economy by reducing utility costs for households and businesses. The transition away from natural gas heating and power plants also reduces significant sources of indoor and outdoor air pollution.

RESULTS

Each dollar invested supports more than **twice as many jobs per dollar than the state's ten largest industries**. Additionally, **every dollar invested returns double the benefits** in the form of fuel savings, improved public health, and climate benefits.

JOBS PER MILLION INVESTED



INVESTMENT SCALE

Moderate \$\$\$

DEPLOYMENT SPEED

Moderate to Fast

BENEFITS PER MILLION INVESTED



Energy Cost Savings

\$1,538,900

Costs avoided by reducing energy use or switching to renewable sources



Climate Benefits

\$299,800

Avoided future damages of climate change from greenhouse gas pollution



Air Pollution Health Benefits

\$191,900

Saved lives and avoided illnesses from improved air quality

Total

\$2,030,600





Energy Efficiency and Building Retrofits



Spray foam insulation installation. Photo: dunktanktechnician

INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Fast

DESCRIPTION

Energy Efficiency and Building Retrofits offers financial assistance, technical support, and education services to reduce energy use in residential, commercial, and industrial buildings. Energy Efficiency and Retrofits also provides building energy assessments, funds workforce development and training, and supports research and development programs.

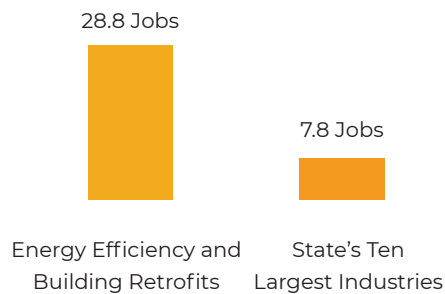
BENEFITS

Electrifying buildings and installing energy efficient appliances has the potential to unlock major new employment opportunities and savings for the Commonwealth. Investments in Energy Efficiency and Building Retrofits develop new workforce opportunities for construction workers, electricians, and engineers, and creates an even greater number of jobs in the broader economy by reducing household and business utility costs. The transition away from natural gas, propane, and oil heating also significantly reduces indoor and outdoor air pollution.

RESULTS

Supports 3.5 times as many jobs per dollar as the state's ten largest industries. Additionally, every dollar invested **saves \$4.18 in fuel costs, improved public health, and climate benefits.**

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Sales Representatives of Services
- 2 Construction Laborers
- 3 General and Operations Managers
- 4 Carpenters
- 5 Electricians

BENEFITS PER MILLION INVESTED



Energy Cost Savings

\$3,084,000

Utility costs avoided by reducing energy use and electrifying homes



Climate Benefits

\$564,800

Avoided future damages of climate change from greenhouse gas pollution



Air Pollution Health Benefits

\$532,000

Saved lives and avoided illnesses from improved air quality

Total
\$4,181,000





Residential Solar



PV panel installation. Photo: Team Massachusetts 4D Home

INVESTMENT SCALE

Moderate \$\$\$

DEPLOYMENT SPEED

Moderate to Fast

DESCRIPTION

Residential Solar provides technical assistance and funding for the installation of solar photovoltaic (PV) panels on single family homes and multi-family residential buildings in Massachusetts.

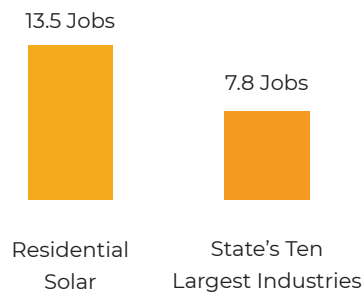
BENEFITS

Rooftop or other residential solar PV panels will make electricity more affordable and has the potential to unlock major new employment opportunities. Investments in Residential Solar develop new workforce opportunities for construction workers, electricians, and engineers, and also create a significant number of jobs long-term in the broader economy by reducing household utility costs. The transition away from fossil fuel-intensive electricity also reduces outdoor air pollution.

RESULTS

Each dollar invested **supports 75 percent more jobs than a dollar invested in the state's ten largest industries**. Additionally, every dollar invested **saves \$1.23 in household energy savings, improved public health, and climate benefits**.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 General and Operations Managers
- 2 Management Analysts
- 3 Electrical, Electronic, and Electromechanical Assemblers
- 4 Customer Service Representatives
- 5 Office Administrators

BENEFITS PER MILLION INVESTED



Energy Cost Savings

\$907,000

Utility costs avoided by reducing grid reliance



Climate Benefits

\$279,700

Avoided future damages of climate change from greenhouse gas pollution



Air Pollution Health Benefits

\$45,900

Saved lives and avoided illnesses from improved air quality

Total
\$1,233,000





Offshore Wind



First offshore wind farm in the U.S. off Block Island. Photo: Ionna22

INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Slow

DESCRIPTION

Offshore Wind funds the development of large-scale offshore wind projects in Massachusetts. This program focuses specifically on the planning, design, and construction phases of offshore wind expansion.

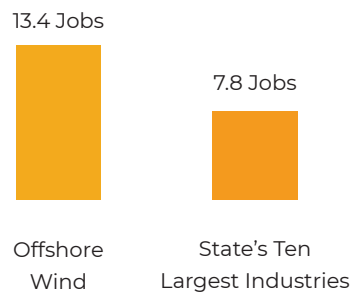
BENEFITS

The development of offshore wind is a crucial component of the Commonwealth's pathway to a decarbonized energy system. Investing in offshore wind infrastructure will create jobs in the construction, engineering, and contracting industries, and long-term savings on electricity costs will support a substantial number of jobs in the broader economy as well.

RESULTS

Each dollar invested **supports 75 percent more jobs than a dollar invested in the state's ten largest industries**. Additionally, every dollar invested **saves \$1.37 in energy cost savings, improved public health, and climate benefits**.

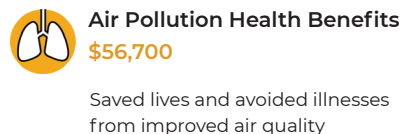
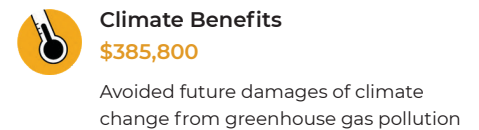
JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 General and Operations Managers
- 2 Construction Laborers
- 3 Freight, Stock, and Material Movers
- 4 Office Administrators
- 5 Customer Service Representatives

BENEFITS PER MILLION INVESTED





Battery Storage



Battery storage facility. Photo: UniEnergy Technologies

INVESTMENT SCALE

Low \$\$\$

DEPLOYMENT SPEED

Slow to Moderate

DESCRIPTION

Battery Storage deploys battery storage technology to store excess energy and facilitate renewable energy growth in Massachusetts. This includes both large-scale battery storage projects for utilities and Municipal Light Plants, as well as small-scale projects for residential, commercial, and industrial buildings.

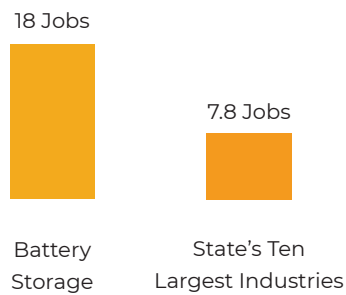
BENEFITS

As Massachusetts builds out its wind and solar energy capacity, battery storage will play a key role in ensuring renewable electricity remains reliable, affordable, and efficient. Investments in Battery Storage develop new workforce opportunities in battery and electrical component manufacturing, construction, and engineering, and create an even greater number of jobs in the broader economy by reducing utility costs for households and businesses.

RESULTS

Each dollar invested **supports more than twice as many jobs as the state's ten largest industries**. Additionally, every dollar invested **saves \$1.80 in energy cost savings, improved public health, and climate benefits**.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Electrical, Electronic, and Electromechanical Assemblers
- 2 Miscellaneous Assemblers and Fabricators
- 3 General and Operations Managers
- 4 Lawyers
- 5 Freight, Stock, and Material Movers

BENEFITS PER MILLION INVESTED



Energy Cost Savings

\$1,734,500

Energy grid costs avoided by storing renewable electricity



Climate Benefits

\$44,500

Avoided future damages of climate change from greenhouse gas pollution



Air Pollution Health Benefits

\$18,100

Saved lives and avoided illnesses from improved air quality

Total
\$1,797,100





Transmission Infrastructure Upgrades



Transmission lines. Photo: Todd Lappin

INVESTMENT SCALE

Moderate \$\$\$

DEPLOYMENT SPEED

Moderate

DESCRIPTION

Transmission Infrastructure Upgrades expands high-voltage transmission lines needed to support increased renewable energy generation in Massachusetts. The program focuses on capital costs of building the new grid infrastructure.

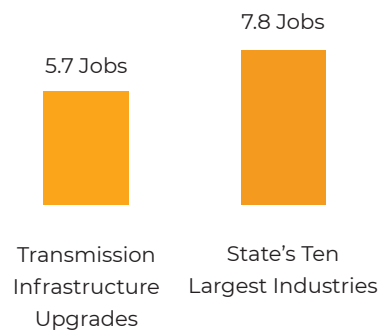
BENEFITS

A significant buildout of high voltage transmission infrastructure is needed to reliably operate and efficiently deliver clean electricity in Massachusetts. Investments in transmission infrastructure can lower energy costs for households and businesses, and facilitate greenhouse gas emissions reductions by providing greater access to low-cost renewable energy in the state.

RESULTS

Supports 5.7 jobs per million dollars invested.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Electrical, Electronic, and Electromechanical Assemblers
- 2 Miscellaneous Assemblers and Fabricators
- 3 General and Operations Managers
- 4 Construction Laborers
- 5 Wholesale Manufacturing Sales Representatives

ADDITIONAL BENEFITS

Transmission Infrastructure Upgrades would increase

- Resiliency
- Efficiency

While reducing

- Energy costs
- Greenhouse gas emissions



Community Microgrids



Solar panels on a small farm. Photo: Christine

INVESTMENT SCALE

Low \$\$\$

DEPLOYMENT SPEED

Moderate

DESCRIPTION

Community Microgrids develops microgrid systems throughout Massachusetts for a mix of residential, commercial, and institutional consumers. These microgrid systems consist of distributed energy generation sources, including solar photovoltaics, battery storage technology, combined heat and power (CHP) plants, hydrogen fuel cells, and backup generators.

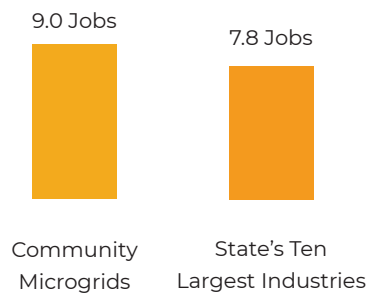
BENEFITS

Microgrids generate clean and reliable energy to households and businesses, make the grid more resilient, and increase energy security. Investments in Community Microgrids develop new workforce opportunities in battery and electrical component manufacturing, construction, and engineering, and support jobs in the broader economy in the long-term by lowering utility costs for households and businesses.

RESULTS

Supports 9.0 jobs per million dollars invested, compared to 7.8 jobs per million dollars in the state's ten largest industries. Lower fossil fuel consumption from Community Microgrids investments creates nearly \$660,000 in energy cost savings, improved public health, and climate benefits per million dollars invested.

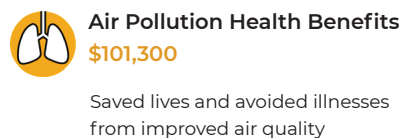
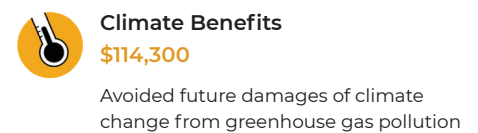
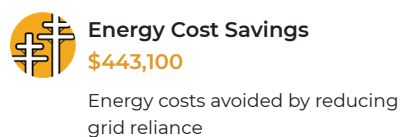
JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Electrical, Electronic, and Electromechanical Assemblers
- 2 General and Operations Managers
- 3 Miscellaneous Assemblers and Fabricators
- 4 Freight, Stock, and Material Movers
- 5 Wholesale Manufacturing Sales Representatives

BENEFITS PER MILLION INVESTED





Broadband Connectivity



Broadband installation. Photo: David Clow

INVESTMENT SCALE

Moderate \$\$\$

DEPLOYMENT SPEED

Moderate

DESCRIPTION

Broadband Connectivity expands access to high-speed broadband through municipal-owned fiber optic networks. This includes networks that serve only municipal buildings, such as government buildings, schools, and libraries, as well as networks that are available to all residents, businesses, and institutions in a municipality.

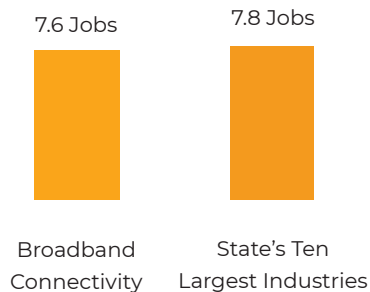
BENEFITS

The COVID-19 pandemic and the transition to remote work and learning has shown that access to high-speed broadband is essential for learning, working, and socializing, yet many households lack adequate access or cannot afford broadband. Investments in *Broadband Connectivity* can ensure entire communities have access to reliable, high-speed, and affordable broadband in Massachusetts. These investments support jobs in construction, engineering, and manufacturing, and may create additional jobs in the broader economy if future telework reduces personal vehicle use.

RESULTS

Supports 7.6 jobs per million dollars invested in fiber optic infrastructure, nearly equal to the number of jobs supported per million dollars invested in the state's ten largest industries.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Carpenters
- 3 Electricians
- 4 First-Line Construction Supervisors
- 5 General and Operations Managers

ADDITIONAL BENEFITS

Broadband Connectivity would increase

- Reliability
- Affordability
- Economic opportunity

While reducing

- Household and business costs



Natural Resources and Conservation

PROGRAMS INCLUDED

- 1 Clean Water Infrastructure
- 2 Urban Greening
- 3 Aquatic Ecosystem Restoration
- 4 Sustainable Agriculture

DESCRIPTION

Natural Resources and Conservation investments upgrade and replace water infrastructure, restore and expand vital ecosystems, expand green spaces, and promote sustainable agriculture in Massachusetts. These investments reduce energy consumption, land deterioration, and waste.

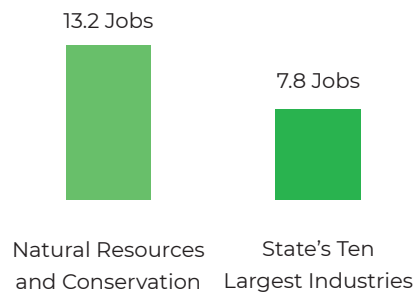
BENEFITS

Protecting natural resources and advancing sustainable agriculture practices in the Commonwealth creates work opportunities in landscaping, construction, and office positions, while reducing agricultural energy use supports a significant number of jobs in the broader economy long-term. These investments also provide significant benefits to the public through cleaner air and water, flood prevention, energy savings.

RESULTS

Each dollar invested supports **70 percent more jobs per dollar than the state's ten largest industries**. Additionally, these investments create \$924,300 in cost savings, improved public health, and climate benefits per million dollars invested.

JOBS PER MILLION INVESTED



INVESTMENT SCALE

Low \$ \$ \$

DEPLOYMENT SPEED

Fast

BENEFITS PER MILLION INVESTED



Energy Cost Savings
\$543,400

Costs avoided by reducing energy use



Climate Benefits
\$349,600

Avoided future damages of climate change from greenhouse gas pollution



Air Pollution Health Benefits
\$31,400

Saved lives and avoided illnesses from improved air quality

Total
\$924,300





Clean Water Infrastructure



Deer Island Waste Water Treatment Plant, Photo: Paul VanDerWerf

INVESTMENT SCALE

High \$\$\$

DEPLOYMENT SPEED

Moderate to Fast

DESCRIPTION

Clean Water Infrastructure provides financial and technical assistance to municipal governments to upgrade or replace drinking water systems, water supply infrastructure, and stormwater management infrastructure. *Water Infrastructure* helps municipalities comply with federal and state water quality standards, improve local water management and distribution, and deliver public health benefits.

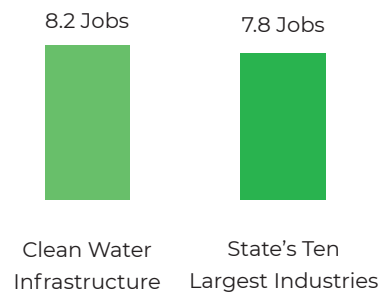
BENEFITS

Access to potable water, and efficient, reliable water systems is an essential need for all households in Massachusetts. Investments in *Clean Water Infrastructure* can work to meet these needs, while also reducing energy use and operation and maintenance costs for local governments. Maintenance, repairs, and upgrades to water infrastructure will support jobs in construction, engineering, and water systems. These investments also provide health and safety benefits from cleaner drinking water supply and cleaner air.

RESULTS

Supports 8.2 jobs per million dollars invested, compared to 7.8 jobs per million dollars invested in the state's ten largest industries. The program's measurable fuel savings, public health benefits, and climate benefits are beyond the scope of this report.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Construction Laborers
- 2 Water Treatment Plant and System Operators
- 3 Carpenters
- 4 General and Operations Managers
- 5 First-Line Construction Supervisors

ADDITIONAL BENEFITS

Clean Water Infrastructure would improve

- Public health
- Water quality
- Stormwater management
- System reliability

While reducing

- Flooding
- Operation and maintenance costs



Urban Greening



Community park in Fitchburg. Photo: Massachusetts Office Of Travel & Tourism

INVESTMENT SCALE

Low \$ \$ \$

DEPLOYMENT SPEED

Fast

DESCRIPTION

Urban Greening improves and expands community green spaces. This includes establishing neighborhood parks and gardens, expanding urban forestry and agriculture, reclaiming and restoring abandoned land, and building green infrastructure.

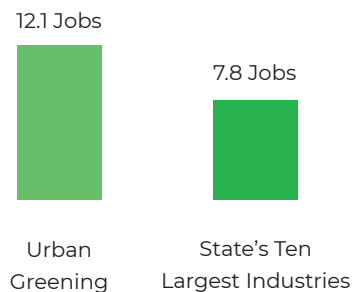
BENEFITS

Revitalizing and building new urban green spaces has the potential to create substantial social and economic benefits in Massachusetts. Investments in Urban Greening will support workforce development opportunities in the landscaping, forestry, and construction fields, while encouraging healthy and active lifestyles, increasing social interactions in communities, and reducing the severe health effects from urban heat islands.

RESULTS

Each dollar invested **supports 60 percent more jobs than a dollar invested in the state's ten largest industries.** Expanded green spaces capture and store carbon dioxide, resulting in \$250,000 in climate benefits per million dollars invested.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Landscaping and Groundskeeping Workers
- 2 General and Operations Managers
- 3 Office Administrators
- 4 First-Line Landscaping Supervisors
- 5 Recreation Workers

BENEFITS PER MILLION INVESTED



Climate Benefits
\$245,200

Avoided future damages of climate change from greenhouse gas pollution

ADDITIONAL BENEFITS

Urban Greening would increase

- Health and safety
- Social interactions
- Property value

While reducing

- Water pollution
- Urban heat island effects



Aquatic Ecosystem Restoration



Marsh and Egrets near Boston's South Shore. Photo: Eugene Kim

INVESTMENT SCALE

Low \$ \$ \$

DEPLOYMENT SPEED

Moderate to Fast

DESCRIPTION

Aquatic Ecosystem Restoration replaces or removes harmful water management infrastructure, such as dams and culverts, to restore tidal flows and revitalize aquatic ecosystems. The program also improves stormwater management and flood control near these bodies of water.

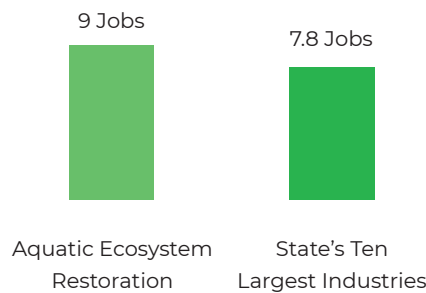
BENEFITS

Protecting and restoring vital ecosystems in the Commonwealth delivers major employment opportunities and social benefits to the public. Investing in *Aquatic Ecosystem Restoration* creates jobs in architecture, engineering, construction, and landscaping, and long-term savings for the state by avoiding costly flood management and infrastructure repairs. Recreation, physical activity, and safety benefits have the potential to unlock significant improvements in public health.

RESULTS

Supports 9.0 jobs per million dollars invested, compared to 7.8 jobs per million dollars invested in the state's ten largest industries. Additionally, healthy wetlands and vegetation capture and store carbon dioxide, creating around \$110,000 in climate benefits per million dollars invested.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Landscaping Workers
- 2 Construction Laborers
- 3 General and Operations Managers
- 4 Retail Salespersons
- 5 Carpenters

BENEFITS PER MILLION INVESTED



Climate Benefits

\$113,600

Avoided future damages of climate change from greenhouse gas pollution

ADDITIONAL BENEFITS

Aquatic Ecosystem Restoration would increase

- Public health and safety benefits
- Recreation and tourism
- Property value

While decreasing

- Storm and flood damages
- Infrastructure maintenance costs



Sustainable Agriculture



Organic farm on Cape Cod. Photo: Massachusetts Office Of Travel & Tourism

INVESTMENT SCALE

Low \$ \$ \$

DEPLOYMENT SPEED

Fast

DESCRIPTION

Sustainable Agriculture provides grants to install more efficient irrigation systems that reduce water usage and greenhouse gas emissions. The program also supports projects that reduce methane emissions from agricultural waste and provides grants to enhance the efficiency and economic viability of anaerobic digester technology.

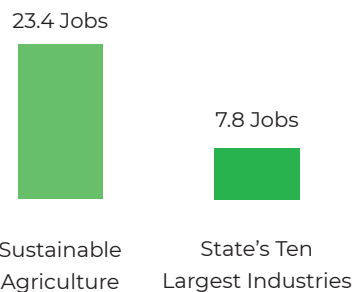
BENEFITS

Investing in low-carbon agriculture has the potential to unlock major new employment opportunities and savings for the Commonwealth. Spending on efficient irrigation systems and agricultural technology supports new workforce opportunities in construction, engineering, and manufacturing, but creates an even greater number of jobs in the broader economy by reducing energy costs for agricultural businesses. The transition away from energy-intensive agriculture and trapping methane emissions also reduces outdoor air pollution.

RESULTS

Each dollar invested supports three times as many jobs as a dollar invested in the state's ten largest industries. Additionally, every dollar invested saves the Commonwealth \$3.34 in energy cost savings, improved public health, and climate benefits.

JOBS PER MILLION INVESTED



TOP OCCUPATIONS

- 1 Electrical, Electronic, and Electromechanical Assemblers
- 2 Miscellaneous Assemblers and Fabricators
- 3 General and Operations Managers
- 4 Semiconductor Processing Technicians
- 5 Retail Salespersons

BENEFITS PER MILLION INVESTED

