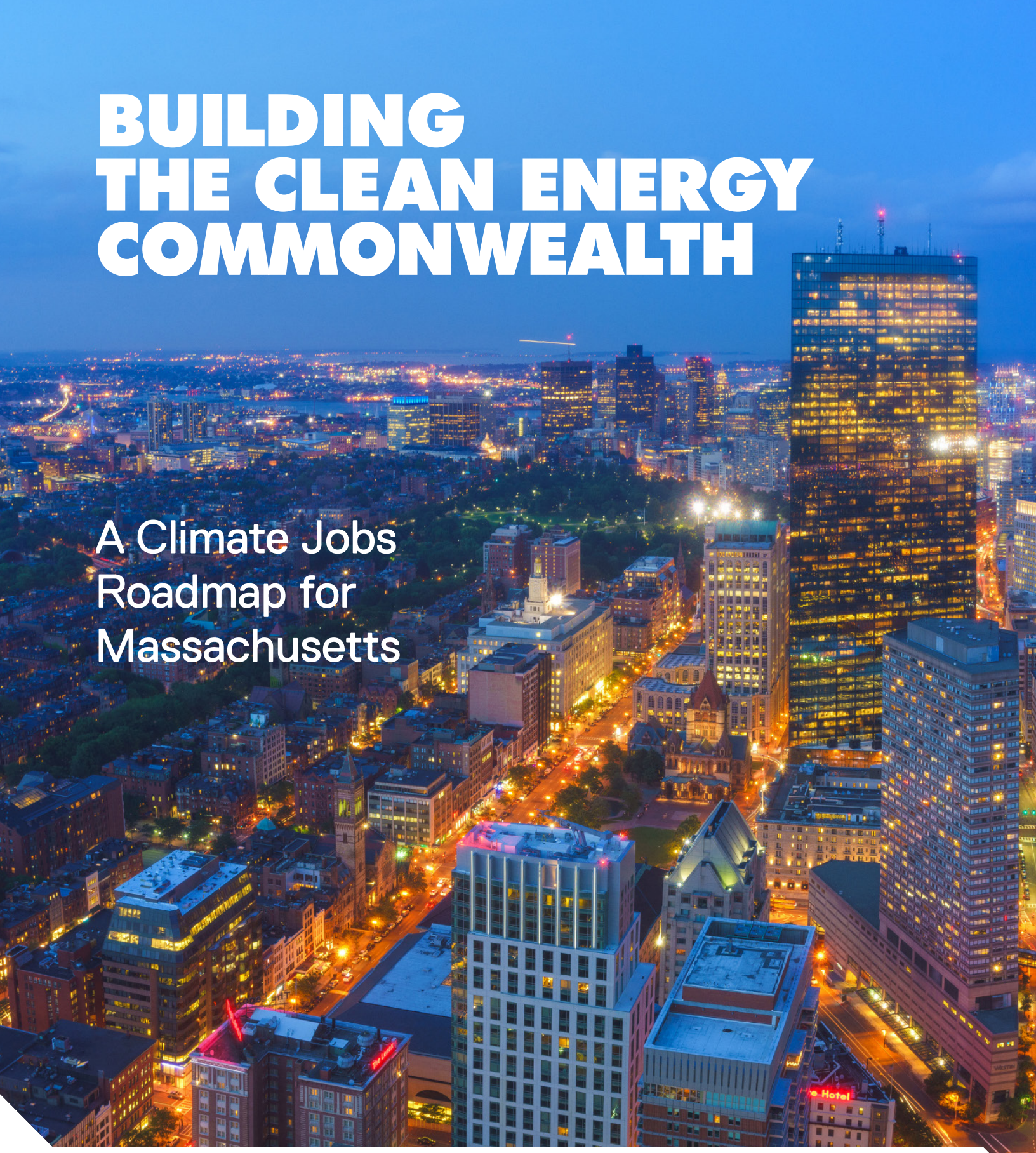
BUILDING THE CLEAN ENERGY COMMONWEALTH

A Climate Jobs Roadmap for Massachusetts



ILR Climate Jobs Institute

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ACKNOWLEDGMENTS

Cornell University's Climate Jobs Institute (CJI) would like to thank the Massachusetts unions and labor federations that participated in our state research and convening process. We appreciate their bold leadership and commitment to tackling climate change and inequality in the state.

CJI would also like to thank all the leaders from local labor, environment groups, academia, government, and industry we interviewed to develop recommendations for this report.

- Massachusetts AFL–CIO
- American Federation of Teachers MA
- Building Pathways
- Community Labor United's Green Justice Coalition
- International Union of Painters and Allied Trades District Council 35
- Foundation for Fair Contracting of Massachusetts
- Greater Boston Labor Council
- Greater Southeastern Massachusetts Labor Council
- Heat and Frost Insulators Local 6
- International Association of Machinists and Aerospace Workers
- International Brotherhood of Electrical Workers
- International Union of Operating Engineers Local 4
- International Union of Electrical Workers – Communications Workers of America Local 201
- Iron Workers Local 7
- Laborers' International Union of North America, New England Region
- Massachusetts Organization of State Engineers and Scientists
- Massachusetts Building Trades Council and Regional Councils
- Massachusetts Teachers Association
- North Atlantic States Regional Council of Carpenters
- North Shore Labor Council
- Plasterers and Cement Masons Local 534
- Professional Fire Fighters of Massachusetts
- Seafarers International Union
- SEIU State Council
- Sheet Metal Air Rail Transportation Union – Northeast Regional Council
- The United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry
- United Food and Commercial Workers Local 1459
- United Steelworkers - New England Gas Workers Alliance
- Utility Workers Union of America

CJI is the academic and educational partner to the Climate Jobs National Resource Center (CJNRC). CJNRC educates workers and the public about policies that will build a clean energy economy at the scale climate science demands, create good union jobs, and create more equitable communities. CJNRC is a labor-led organization that works to combat climate change and reverse racial and economic inequality by building a worker-centered renewable economy.

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DIRECTOR'S MESSAGE

At the beginning of 2022, Cornell ILR's Climate Jobs Institute (CJI), along with our partner the Climate Jobs National Resource Center, began a process with Massachusetts' labor leaders to develop a "climate jobs" plan for the state that would tackle climate change at the pace and scale science demands while protecting and creating high-quality union careers and expanding access to these careers for frontline, underserved communities. After two years of intensive work, CJI is proud to release "Building the Clean Energy Commonwealth: A Climate Jobs Roadmap for Massachusetts."

CJI wants to thank the Massachusetts AFL-CIO and the more than 25 unions, labor federations and labor partners that participated in this multi-dimensional research, policy, training and education process. This collaborative process has led to a cutting-edge, yet practical plan to build an equitable clean energy economy and workforce in MA that implements real climate action while ensuring the state's economy, workers and communities are thriving.

With 19 recommendations, this Climate Jobs Plan for Massachusetts ensures bold action in the state's key sectors: buildings, energy, transportation, and resilience and adaptation. A special section on workforce development also ensures that the Commonwealth's approach to climate action is integrated with a plan to: protect existing high-quality careers so no workers are left behind during this historic transition; apply strong wage, job quality and training standards to ensure new clean energy jobs are high-quality, family and community sustaining careers that truly support Massachusetts' families; and expand pathways for frontline, underserved communities into good careers.

Based on two years of excellent quantitative, qualitative and participatory research, and more than a 100 conversations with labor leaders, climate and industry experts, policymakers and others, this report demonstrates that it is possible for the Commonwealth to prioritize climate protection, high-quality careers and equity. We look forward to Massachusetts implementing these recommendations and leading the nation in creating a path to an equitable, climate-safe economy that improves the lives of working people and builds strong communities.

Lara R. Skinner

Dr. Lara Skinner
Executive Director
Climate Jobs Institute

ILR Climate Jobs Institute

The Climate Jobs Institute (CJI) at Cornell University's ILR School is guiding the nation's transition to a strong, equitable, and resilient clean energy economy by pursuing three aims: to tackle the climate crisis; to create high-quality jobs; and to build a diverse, inclusive workforce.

Through cutting-edge policy studies, deep relationships with on-the-ground partners, and innovative training and education programs, CJI provides information that policymakers, the labor and environmental movements, industry leaders, and others need to navigate this historic transition to a zero-carbon economy.

Core Activities and Objectives

CJI delivers high-quality research, innovative policy solutions, and top-notch educational programming that connects key stakeholders to design and implement climate plans.

The CJI's main areas of work include:

Applied Research and Policy Development for Legislators and Labor, Environmental, and Industry Leaders. CJI crafts equity- and worker-oriented climate policies and analyses indicating how states can address climate change while maximizing high-quality job creation and economic development. The Institute's research and policy efforts result in reports, case studies, policy briefs, and visual tools and maps meant to guide the nation's transition to a clean, equitable economy.

Cornell University, ILR School
New York City office, 570 Lexington Avenue

Technical Assistance. CJI provides rapid response data and policy analysis on the labor, employment, and economic impacts of climate and clean energy issues. The Institute's technical assistance work offers legislators, policymakers, and others real-time support. This work also generates legislative briefings, policy briefs, blog posts, op-eds, and other written materials targeting legislators, local government officials, and leaders in labor, environmental movements, and industry.

Training and Education. CJI organizes a variety of educational convenings that strengthen stakeholders' knowledge, confidence, and motivation to tackle climate change and to build a large, equitable clean energy economy with high-quality jobs. Programs include the Institute's annual Climate Jobs Summit; the design and delivery of member trainings; legislative briefings; educational delegations for legislators, labor leaders, and others; and an online Climate Jobs certificate.

Workforce Development. CJI provides a critical link between the future clean energy workforce we need and workforce development programs that meet these needs. The Institute also provides a pipeline from frontline Black, indigenous, and people of color communities to paid on-the-job training and high-quality careers.

Student Engagement. CJI enriches the ILR and Cornell student experience by engaging undergraduate and graduate students in important aspects of the Institute's core work through fellowships, research assistantships, hands-on clinical experiences, internships, labor-climate undergraduate and graduate courses, and more.

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INTRODUCTION

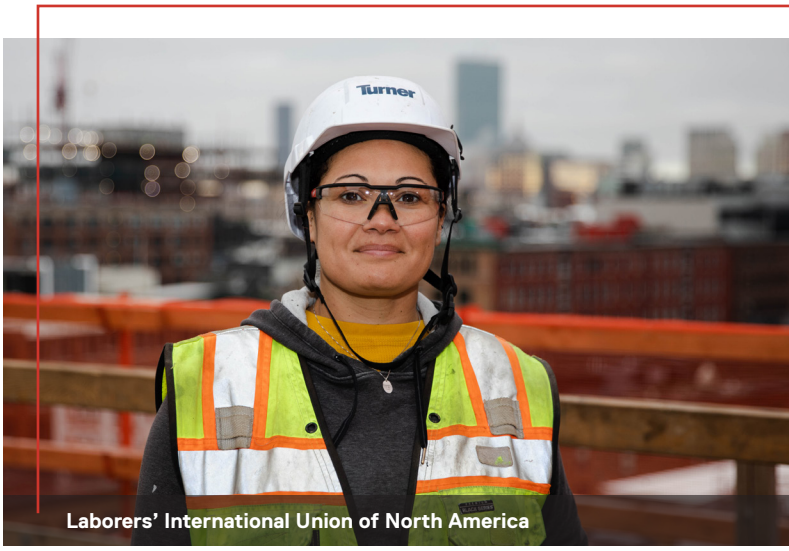
As the climate crisis worsens and the federal government adds approximately $500 billion to clean energy investments in the United States, the Commonwealth of Massachusetts is facing historic opportunities: to address climate change; protect and create high-quality jobs; confront race and gender inequality; and build a robust, equitable clean energy economy that benefits all.

The climate crisis presents major threats to the Commonwealth, including rising sea levels and more powerful storms as well as extreme heat and droughts in the summer (United States Environmental Protection Agency [EPA], 2016). Left unabated, climate change will wreak havoc on the state: people's homes and businesses will flood; key transportation, energy, and water infrastructure will crumble; and deaths from extreme heat, flooding, and air pollution will increase. Women, people of color, low-income communities, and other socially vulnerable populations are hit first and worst. However, if Massachusetts responds to the climate crisis by promoting equality and creating and protecting good jobs, the state can flourish even in the face of these challenges, building the fairer, more just society and economy that it needs.

Massachusetts has been a national leader on climate change for many years. The state passed the Global Warming Solutions Act in 2008 (An Act Establishing the Global Warming Solutions Act, 2008) and the Act Driving Clean Energy and Offshore Wind in 2021 (An Act Driving Clean Energy and Offshore Wind, 2022). It also installed an impressive 3.3 GW of solar power (U.S. Energy Information Administration, n.d.a) and has been a first mover in the development of offshore wind. In addition, Massachusetts has some of the highest union density in the country (U.S. Bureau of Labor Statistics, 2022a); over 40 union apprenticeship programs in the Commonwealth invest more than $60 million annually in workforce training (Callahan, 2023). Massachusetts' unions have also helped establish Building Pathways in Boston, Worcester and Southeast Massachusetts and Community Works in western Massachusetts – direct-entry, pre-apprenticeship programs that recruit and support women and people of color to enter careers in the construction trades (Callahan, 2023).

The Commonwealth's climate leadership and union strength give the state a strong foundation from which to build an equitable clean energy economy that can actualize multiple goals: offer good union jobs; feature a diverse, inclusive clean energy workforce; address climate injustices; and protect workers who have powered Massachusetts' economy for decades.

The Commonwealth has legislated important climate goals in the last several years. Now, the hard work of pursuing these objectives begins. Key to operationalizing these goals is ensuring



Laborers' International Union of North America

that investments in Massachusetts' clean energy economy create high-quality careers that sustain families and communities in the state, making sure that climate work is completed by highly skilled and trained workers, and guaranteeing expanded access to these jobs for frontline communities of color. The issue is not a shortage of labor or workers to complete climate work but rather the quality of the jobs and the lack of investments to expand training, access and equity amongst these jobs.

NASRCC Carpenters working on foundations for wind turbines for Revolution and South Fork Wind at the Port of Providence.

In addition to a climate crisis, Massachusetts is facing a crisis of inequality that has intensified over past decades. The Commonwealth has the sixth highest income inequality in the United States (Economic Policy Institute, n.d.). Wages have not kept pace with economic productivity in Massachusetts: productivity increased 112% from 1979 to 2013, but wages only increased 18% (Douglas, 2013). The top 1% make about 31 times more than the bottom 99%; in fact, the top 1% wealthiest residents of the Commonwealth take home 24% of all income in the state (Economic Policy Institute, n.d.).

Levels of wealth and income inequality in Massachusetts are particularly stark when considering race and gender. Eight percent of white state residents live in poverty compared to 15% of Black, 23% of Hispanic, 11% of Asian, and 19% of American Indian/Alaska Native residents (Kaiser Family Foundation, 2023). One marker of achieving the American dream – owning a home – reveals a substantial racial divide in the Commonwealth: 70% of white households own a home versus 37% of Black households and 32% of Latino households (Prosperity Now, 2023). Gender inequality in Massachusetts is similarly concerning, with women earning $0.81 for every dollar that men make. Women ultimately earn approximately $13,000 less per year than men (Calef, 2022).

Mounting inequality in Massachusetts – in income, wealth, race, gender, and more – shows that the Commonwealth is facing two intersecting crises: inequality and climate change. The state's approach to climate change and clean energy thus must mitigate inequality rather than exacerbate it.

Fortunately, Massachusetts has a tremendous opportunity to grow its investments in climate mitigation and adaptation work through the Inflation Reduction Act of 2022 (IRA).

This act provides numerous incentives for: the payment of good wages; the expansion of apprenticeship pathways into vulnerable communities, and the utilization of apprentices from high-quality building and construction training programs; make climate investments in frontline, disadvantaged communities; and leverage clean energy products that spur the creation of U.S. manufacturing jobs (Inflation Reduction Act, 2022).

Prior to the IRA, too many clean energy jobs involved low-quality, low-wage positions that intensified inequality. Families struggled to make ends meet, buy homes, pay rent, and sustain their local communities. Massachusetts can build on the IRA by ensuring that strong wage, training, and job quality criteria apply to all the state's clean energy work. These standards help ensure that workers are paid well, that jobs are done right, and that access to high-quality careers in the clean energy industry is expanded for frontline communities of color. In the Commonwealth, 92% of women apprentices and 86% of apprentices of color are union members, demonstrating union programs' role in building a diverse and inclusive workforce (Callahan, 2023).

States with higher unionization rates typically have more equitable economic and social structures and greater democracy.

For example, states with greater unionization enjoy better access to health insurance, have a below-average rate of uninsured populations, and are more likely to pass laws for paid family and medical leave (Banerjee et al., 2021). Unions help raise wages for all workers, narrow gender and racial wage gaps, improve workplace health and safety, and reduce the number of uninsured individuals (Banerjee et al., 2021). In Massachusetts, the building trades spend over $1 billion annually on healthcare for members and their families and provide retirement benefits for tens of thousands of seniors (Callahan, 2023).

Thousands of people have worked day and night for decades to keep the lights on in Massachusetts, to heat and cool homes and businesses, and to power the Commonwealth's economy.

Laborers' International Union of North America

These workers are union members—who have the protection of a union contract, fair terms and conditions of employment, and wages and benefits consistent with the highly skilled, safety-sensitive work they do. These workers should not be left behind in this transition.

As the Commonwealth implements its climate goals, special attention should be paid to investments that will 1) ensure the safety and reliability of legacy fossil fuel infrastructure through the transition to net zero; 2) create the most jobs in Massachusetts; 3) produce high-quality positions that sustain families and communities; and 4) provide pathways for existing fossil fuel and energy-intensive workers to enter new clean energy industries with comparable pay, benefits, and workplace democracy. This approach will ensure that the gains and burdens of Massachusetts' transition to a clean energy economy are shared fairly.

The Commonwealth has displayed great leadership in its dedication to addressing climate change. It is time for the state to show it is equally committed to reducing inequality, closing the race and gender wealth gap, and building a clean energy economy that allows residents to thrive with good jobs and healthy communities. The following climate jobs recommendations provide a blueprint for Massachusetts to help mitigate climate change, support and protect high-quality jobs, confront inequality, and ensure that frontline communities have access to high-quality clean energy jobs.

These suggestions highlight strategic opportunities to reduce greenhouse gas emissions; create many good jobs; and build stronger, healthier communities throughout the state.

Implementing these recommendations will put the Commonwealth on a path to achieve its climate goals while meeting important job and equity objectives. Bay Staters need to see how executing the state's climate plans will enhance residents' lives by creating high-quality jobs, lowering energy bills, and cultivating a healthier environment. The recommendations in this report illustrate a roadmap to a cleaner, fairer Massachusetts, positioning the Commonwealth as an international leader on climate, jobs, and equity.

CASE STUDY

CONSTRUCTION UNION LABOR IN MASSACHUSETTS

Massachusetts is well positioned to meet increasing demands for construction labor with the growing climate industry. The foundation of the Massachusetts union construction industry is having highly trained and qualified craftspeople, where over $60 million is spent each year by unions and contractors to ensure adequate and proper training. Strong training programs lead to higher standards throughout the Massachusetts construction industry including increased site safety and better work products. The standards in turn ensure projects are completed timely and within budget. Trade training occurs through apprenticeship programs, where there are over 40 joint apprenticeship training centers (JATCs) across Massachusetts operated by the Building Trades Unions and their contractor partners. The programs are two to five years long and offer both classroom and on the job training. The number of apprentices accepted each year is determined by industry demand, where the pool of apprentices accepted in each trade is determined by projected available work in the industry.

The Sheet Metal Workers' recent apprenticeship cycles have seen an estimate of 200 applications each year, and have accepted about 100 new members annually for the last 5 years. The steady influx of apprenticeship applications and new members is not unique to the Sheet Metal Workers.

International Union of Operating Engineers (IUOE) Local 4

The New England Laborers' Training Trust Fund Apprenticeship Program accepted 228 apprentices in 2022. In 2023, Plumbers Local 12 obtained 600 applications accepting 60 apprentices to their program, and the Operating Engineers Local 4 had 404 applicants accepting 40 as apprentices. IBEW 103 also had a high application rate of 2,100 applicants in 2022, with 900 receiving qualifying scores on their aptitude test, and 400 new members accepted into the apprenticeship program.

RECOMMENDATION SUMMARY

BUILDINGS

1. Pass An Act Relative to Healthy and Sustainable Schools
2. Rapidly Scale Union-Built Net Zero Affordable and Equitable Housing Opportunities by 2030
3. Rapidly Scale Thermal Union-Built Utlity Districts by 2030
4. Scale Building Retrofits While Ensuring Cost Effectiveness, Transparency, and Equity

ENERGY

1. Create High Road Labor Standards for 21st-Century Energy Infrastructure
2. Dramatically Increase Renewable Energy Production by 2040
3. Expand and Modernize the Electrical Grid
4. Expand Funding for Community Microgrids
5. Make Massachusetts a Leader in Green Hydrogen Production and Distribution
6. Continue Methane Leak Prevention

TRANSPORTATION

1. Develop an Electric Local, State, and Interstate Passenger Rail Network
2. Expand Public Electric Vehicle Infrastructure While Centering Workers

Building the Clean Energy Commonwealth

RESILIENCE AND ADAPTATION

1. Build Clean, Safe, and Climate-Resilient Water Infrastructure
2. Strengthen Heat Resilience

WORKFORCE DEVELOPMENT AND QUALITY CAREERS

1. Support a Just Transition for Fossil Fuel Workers
2. Ensure Clean Energy and Workforce Standards
3. Increase Funding for High-Quality Pre-Apprenticeship and Wraparound Services
4. Expand Scientific and Technical Capacities in the Public Sector Workforce

BUILDINGS

Buildings represent the second largest emissions sector in Massachusetts, accounting for 27% of greenhouse gasses released in the state (The Cadmus Group et al., 2020). The Commonwealth's buildings are aging and inefficient: nearly two-thirds of the total square footage were built before 1980 with 39% built before 1950 (The Cadmus Group,et al,, 2020). Total square footage is expected to increase 23% by 2050, including 18% projected growth for single-family homes, 50% for large multifamily housing, and 32% for commercial buildings (The Cadmus Group et al., 2020). To avoid locking in carbon-intensive building use, new buildings must be constructed in accordance with high-efficiency and net zero standards.

At the same time, 80% of Massachusetts' building stock in 2050, or 5.9 billion square feet, will consist of existing buildings (The Cadmus Group,et al,, 2020). Less than 1% of current building stock has been retrofitted to be net zero or net zero ready (Built Environment Plus, 2022).[1] The state must take ambitious action to rapidly scale carbon emission reductions in this sector, with a focus on lowering existing buildings' emissions. The Massachusetts Commission on Clean Heat (2022) found that reaching the Commonwealth's emissions targets will require 80,000 residential installations of electric heating equipment per year by 2025 and more than 200,000 building shell upgrades for existing residences from 2020 to 2030.

Steps must also be taken to reduce historic health and economic disparities facing environmental justice communities. Nearly one in 11 state residents has asthma, and rates are higher among Black, Hispanic, and low-income populations (Bureau of Community Health and Prevention, 2023). Springfield, in western Massachusetts, was named the "asthma capital" of the country due to its high levels of asthma prevalence, death rates, and ER visits; at least 40% of these issues are due to home-based health hazards (Asthma and Allergy Foundation of America, 2019).

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[1] Net zero ready buildings are defined as being highly energy efficient (25% total energy reduction vs. the ASHRAE 90.1 baseline) and all electric for building heating operations. Net zero buildings are defined as being net zero ready plus procuring 100% of energy consumption from renewable sources.

Ironworkers, Local 7

Increased climate risks will continue to exacerbate historic health and economic disparities. Nationally, nearly one in five households living below the poverty line lacks access to air conditioning; this population will encounter considerable threats as heat waves intensify statewide (U.S. Energy Information Administration, n.d.b). Coupled with a lack of affordable housing and rising energy costs for low-income residents, equitably decarbonizing the building sector remains crucial to addressing the state's growing inequality.

Thankfully, solutions exist which can simultaneously reduce building emissions and inequities. Deep retrofits (e.g., improvements to insulation, windows, and heating controls) and remediating environmental hazards in buildings can improve efficiency while halving residential and commercial buildings' energy use (The Cadmus Group et al., 2020). Scaling these measures alongside prioritizing local hiring for frontline communities and ensuring high-quality labor standards requires strategic public investment – in affordable housing, efficiency retrofits, and low-emission heating and cooling. Massachusetts must make sure that it creates good jobs as it lessens building emissions by using project labor agreements (PLAs), local hires, and other labor principles on projects receiving public funds. The Commonwealth must also ensure that these jobs go to trained union workers by passing legislation that boosts transparency and holds both subcontractors and contractors to these higher standards. Insulators are trained in the most technologically advanced applications and play a critical role in implementing energy-efficient building plans in a cost-effective way.

Coupled with a lack of affordable housing and rising energy costs for low-income residents, equitably decarbonizing the building sector remains crucial to addressing the state's growing inequality.

SUSTAINABLE AND HEALTHY SCHOOLS

RECOMMENDATION:

Pass An Act Relative to Healthy and Sustainable Schools

1. Immediately conduct energy audits on all public schools, colleges, and universities
2. Pair deep retrofits with environmental health hazard mitigation by 2030
3. Install onsite renewables to meet energy demands by 2030
4. Establish a Healthy and Sustainable Schools Office
5. Prioritize carbon reduction in environmental justice communities first

Ironworkers, Local 7

Massachusetts' public schools offer a sterling opportunity to reduce greenhouse gas emissions, create high-quality jobs, and address substantial health risks facing the Commonwealth's students and teachers. Home to over 900,000 students (Massachusetts Department of Elementary and Secondary Education, n.d.) and 186 million square feet of campus space (New Buildings Institute, 2021), the Commonwealth's public K–12 system requires major upgrades to protect students' safety and reduce emissions. According to a Massachusetts School Building Authority survey, less than 60% of school buildings had been renovated or newly built since 2000, and 8% are over 100 years old (Massachusetts School Building Authority, 2016). The same survey reported that 16% of schools received ratings of "poor" or lower for building conditions.

Schools are especially vulnerable to the effects of climate change. As heat waves become more frequent and severe across the state, schools have seen increasing shutdowns due to extreme temperatures, as many are unprepared to deal with high heat. For instance, less than half of Boston's schools have air conditioning (Gans, 2021). Schools have also recently seen shutdowns due to flooding and extreme weather; at least 68 schools are at risk of flooding from sea level rise (Climate Central, n.d.). Rather than subjecting students to climate impacts and deteriorating learning environments, schools should promote climate resilience. Investing in cooling, insulation, distributed solar, and other upgrades will enable schools to serve as cooling centers during heat waves and as emergency centers in cases of extreme weather.

The state's poor school building conditions pose significant health risks to students. In Boston, over 80 schools have at least one environmental concern, such as water damage and leaks, mold, pests, or improper chemical storage (Massachusetts Coalition for Occupational Safety and Health and the Boston Urban Asthma Coalition, n.d.). These issues can have ripple effects. Over one in eight children in the state have asthma, with greater prevalence among Black and Hispanic children than white, non-Hispanic children (Bureau of Community Health and Prevention, 2023). Asthma influences children's learning environments as well: 41.1% of students with asthma missed at least one day of school in the past year due to breathing problems (Bureau of Community Health and Prevention, 2023). School upgrades must prioritize districts in environmental justice zones to rectify historic injustices and disinvestment in these communities.

Schools can update their facilities and mitigate climate impacts through deep retrofits. Strategies include upgrading building envelopes (e.g., high-efficiency doors and windows), ventilation, and lighting systems along with installing electric appliances and mechanical insulation. Deep retrofits can reduce energy use by up to 50% – generating potentially noteworthy energy savings that can be directly reinvested into schools (National Renewable Energy Laboratory, 2013). Associated upgrades lead to better air quality, fewer hazards, and more comfortable conditions inside schools. To identify prime targets for this work, Massachusetts should mandate statewide energy audits that inspect building envelopes and insulation, assess energy use, outline actions to reduce energy use and emissions, and provide schools with information on finance options, as proposed in the 2023 -2024 bill An Act Relative to Healthy and Sustainable Schools (Bill H.3691, 2023).


Cement Masons, Local 534

Schools should also build out rooftop solar. Massachusetts is already a leader in school solar, ranking within the top five states in the nation with a total of 77,629 kW installed across 309 schools (i.e., 17% of all schools) (Generation180, 2022). The Commonwealth should expand on this progress and install solar on every school wherever feasible. Even with reduced demand from building retrofits, schools will require more than 1 GW of renewable energy. Installing onsite solar will lessen school energy costs and, coupled with battery storage, could transform schools into resilience centers that provide power during extreme weather and grid failures.

Making all Massachusetts schools healthy by substantially reducing their carbon output will create thousands of jobs across various trades. Plumbers and pipefitters, HVAC technicians, electricians, laborers, painters, solar installers, and many others will be needed to retrofit schools and install renewables.

SUSTAINABLE AND HEALTHY SCHOOLS

High-Quality Job Standards:

Where Massachusetts public schools conduct energy assessments, implement efficiency improvements, or install renewable energy sources, the Commonwealth should require contractors and subcontractors to meet high road labor standards. In particular, school projects—and their communities—benefit from the inclusion of pre-apprenticeship programs on the project, registered apprenticeship hiring goals, and local environmental justice community hiring goals. Where appropriate under Massachusetts law, PLAs ensure that the project meets community standards for wages, hours, and other terms and conditions of employment while also ensuring a highly skilled, talented workforce and that the project is completed on time and on budget. These practices will maximize public dollars' economic impacts on clean energy projects and ensure timely, reliable project completion by highly trained personnel.

Cost:

$10.4 billion

Job Creation:

44,881 direct jobs

Emission Reduction:

Transitioning Massachusetts K-12 public schools to net-zero, alone would reduce emissions by 879,131 MTCO2 per year. This reduction would result from reductions in emissions from building operations in the K-12 public school sector and would be considered Scope 1 and Scope 2 emissions. Further analysis must be done on public university and community college Scope 1, 2, and 3 emissions. All work should prioritize utilizing materials with low embodied carbon to lower Scope 3 emissions.

Funding Mechanisms:

The Inflation Reduction Act (IRA) provides a number of opportunities for sustainable and healthy schools, such as the following: $50 million for schools in low-income and disadvantaged communities to monitor and reduce air pollution and greenhouse gas emissions (Sec. 60106); $3 million for Environmental and Climate Justice Block Grants to disadvantaged communities to address harms from pollution and climate change (Sec. 60201); renewable energy investment and production tax credits (Secs. 13101, 13102, 13701); an Energy-Efficient Commercial Buildings tax deduction (Sec. 13303); and the Greenhouse Gas Reduction Fund, which includes a $7 billion Zero-Emissions Technologies Program to support eligible public entities, including schools, in implementing solar and retrofit projects (Sec. 60103) (Inflation Reduction Act, 2022). The Bipartisan Infrastructure Law (BIL) includes a $500 million program to make schools more energy efficient. The MA Fair Share Amendment, passed in 2022, will generate $2 billion per year to be partially allocated to school improvement programs. In 2023, the Department of Energy initiated a $80 million Renew America's Schools grant program for school energy and HVAC upgrades; this program will provide between 20 and 100 awards ranging from $0.5 million to $15 million for schools in rural or high-poverty areas (Healthy Green Schools & Colleges, 2022). The US Department of Housing and Urban Development's Community Development Block Grant program allocates funding to cities and counties to support development of low- and moderate-income communities; several of these funding opportunities, including the Disaster Recovery grants and Section 108 loans, can be used for implementing resiliency and efficiency measures in schools (U.S. Department of Housing and Urban Development, 2022a).

NET ZERO AFFORDABLE HOUSING

RECOMMENDATION:

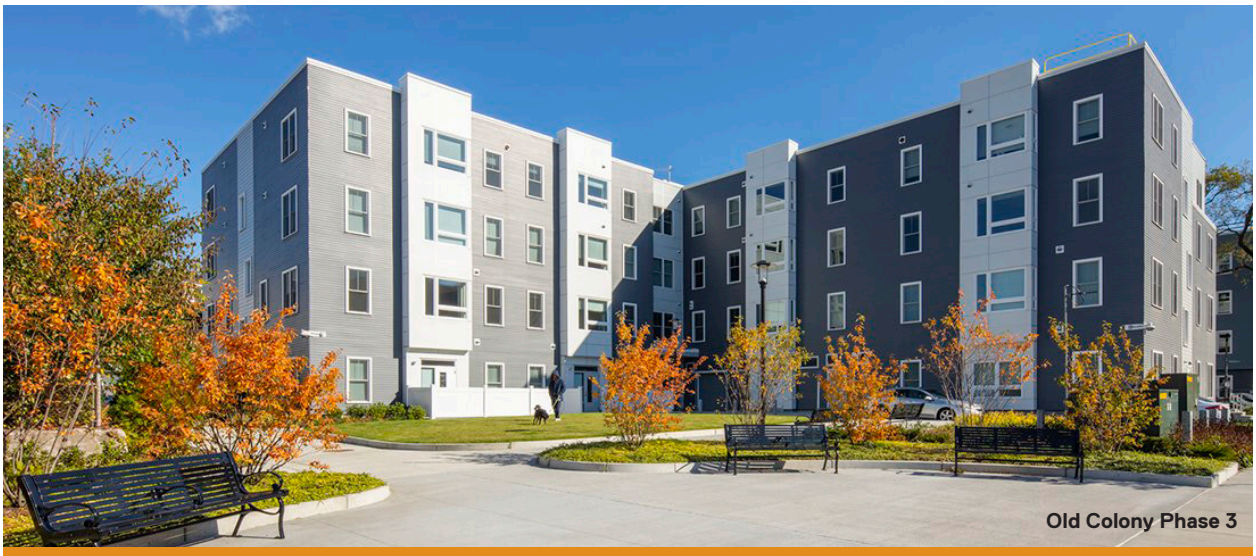
Rapidly Scale Union-Built Net Zero Affordable and Equitable Housing Opportunities by 2030

1. Build out 178,000 net zero and climate-resilient public affordable housing units that prioritize low-carbon construction material
2. Establish "Buy American, Build Massachusetts" provisions on all materials used for affordable housing construction and maintenance
3. Place a moratorium on the privatization of vacant or unused public buildings, lots, or land

Old Colony Public Housing in South Boston with financing from AFL-CIO Housing Investment Trust

The United Nations defines adequate housing as a universal human right (Office of the United Nations High Commissioner for Human Rights, 2014). Massachusetts is currently facing a gap of over 175,000 affordable housing units (National Low Income Housing Coalition, 2023). The state must fill this need for residents while addressing historic racial, gender, and disability disparities in housing security. Governor Healey has begun to commit to equitable housing. On March 29, 2023, she allocated $62 million in funds to build 450 affordable housing units for low-income residents (Governor Maura Healey and Lt. Governor Kim Driscoll, 2023). Policies should also be enacted to rapidly scale the buildout of net zero affordable and climate-resilient affordable housing. Estimates suggest that by 2030, over 2,400 affordable housing units in Massachusetts will face increased risk from sea level rise and coastal flooding, with risk doubling to 4,800 units by 2050 (Climate Central, 2021).

The buildout needs to account for existing and anticipated climate risks and population trend projections related to these risks. Several steps will ensure fewer residents are displaced due to increased climate risks and growing housing inequality: placing a moratorium on the privatization of vacant or unused public buildings, lots, or land.



Old Colony Phase 3

NET ZERO AFFORDABLE HOUSING

High-Quality Job Creation:

When choosing a project delivery method, where conditions are consistent with Massachusetts law, Massachusetts should utilize PLAs to guarantee skilled, union labor in the buildout of all publicly owned and/or funded net zero affordable housing. The use of PLAs on these projects will also allow Massachusetts to work toward its goals of recruiting and training the next generation of construction workers, through pre-apprentice program collaborations and workforce participation goals for apprentices. Establishing "Buy American, Build Massachusetts" provisions will encourage investments in the buildout of local American supply chains, thus creating more American jobs. Mandating public disclosure of workforce numbers and demographics, local hire, pay transparency, and subcontracting on publicly funded affordable housing project installation, maintenance, and operations will further promote accountability. Such measures will jointly guarantee that this massive investment into state housing has direct positive impacts on Massachusetts workers and communities.

Cost: $69.4 billion

Job Creation: 319,065 direct jobs

Emission Reduction:

Buildout of this net-zero housing will ensure no additional Scope 1 and Scope 2 emissions are emitted from this new housing stock. Prioritizing policies that incentivize utilizing recycled and low-carbon construction materials is vital to ensure the build out has low Scope 3 emissions from the embodied carbon of building materials.

Funding Mechanisms:

This investment may blend state and federal funding, including low-income housing tax credits (National Housing Law Project, 2023), the federal Public Housing Operating Fund and Capital Fund (U.S. Department of Housing and Urban Development, 2023), HOME Investment Partnerships Program (U.S. Department of Housing and Urban Development, 2022c), and Community Development Block Grants (U.S. Department of Housing and Urban Development, 2022a). In addition, the Federal Emergency Management Agency (FEMA) Hazard Mitigation fund could be tapped to rebuild affordable housing facing increased climate risk (FEMA, 2023). Massachusetts should also leverage the American Rescue Plan Act (ARPA) (National Conference of State Legislatures, 2023) and BIL (U.S. Department of Housing and Urban Development, 2022b), which offer substantial funding. The AFL-CIO Housing Investment Trust (HIT) is a $6.3 billion fixed-income investment fund that provides investments that require the use of union jobs, create and preserve rental housing – particularly affordable and workforce housing– and generates broader economic benefits for communities (AFL-CIO Housing Investment Trust, 2023).

CASE STUDY

Reducing Emissions and Addressing Inequities Through Funding Energy-efficient Construction and Affordable Housing Retrofits

In June, 2023, Massachusetts Governor Maura Healey brought major progress to reducing building emissions by establishing the nation's first green bank dedicated to affordable housing (Shankman, 2023). The Massachusetts Community Climate Bank will now begin offering loans to municipalities, developers, nonprofits, etc. looking for financial support to engage in energy-efficient construction or to retrofit affordable housing projects (Spinella, 2023). This represents an important step in Massachusetts' commitment to reduce greenhouse gas emissions 85% by 2050 while also centering disadvantaged communities in major environmental justice projects (Spinella, 2023).

In addition to creating quality clean energy jobs (Shankman, 2023), this initiative has begun at a time when access to affordable housing is an increasingly important issue within the state of Massachusetts (Ambrose, 2023). In May, 2023 the state's AFL-CIO Housing Investment Trust (HIT) hosted a discussion for experts and stakeholders to discuss the housing challenge facing MA (Ambrose,2023).

While the Massachusetts Community Climate Bank will start out with $50 million from the state Department of Environmental Protection, it will also serve as a mechanism for receiving federal funds. This was, in part, the reasoning behind the decision to move the green bank initiative across the finish line after several years of bill development, as the recent Inflation Reduction Act has $27 billion earmarked for similar state initiatives (Spinella, 2023). Loans provided by the Massachusetts Community Climate Bank fill a space that traditional banks would not be able to, as loans will need to be low or no interest, and loan recipients could need up to 30-40 years to repay the money borrowed.

THERMAL UTILITY DISTRICTS

RECOMMENDATION:

Rapidly Scale Union-Built Thermal Utility Districts by 2030

1. **Pass legislation to promote the development of statewide union-built district thermal utility networks to:**
    - Ensure local distribution companies own or have financial stake in all geothermal infrastructure
    - Provide funding for local distribution companies and unions to train existing in-house employees on geothermal construction, maintenance and the acquisition of geothermal construction materials and equipment
    - Create thermal utility connections for more than 1.45 million residents with no financial burden on the consumer
    - Conduct feasibility studies on district thermal utilities at all public universities and community colleges
    - Expand heat pump installation through the coordinated bulk purchasing and distribution of 1 million air and ground source heat pumps for residents not connected to natural gas infrastructure
2. **Establish rulemaking on all thermal utility work to include prevailing wage; state- or federally approved apprenticeship requirements; and mandated public disclosure of workforce numbers, pay transparency, and subcontracting**

District thermal utilities serve as one solution to reducing emissions in the heating and cooling sector (Robins et al., 2021). Utilities can connect buildings in a shared thermal network by using ground-source heat pumps to create low-emission heating and cooling. Guaranteeing that local distribution companies own or have financial stake in all geothermal infrastructure and funding for local distribution companies and unions to train existing in-house employees on geothermal construction, maintenance and the acquisition of geothermal construction materials and equipment will ensure that thermal utility work is scalable and cost effective for customers across Massachusetts. The existing unionized natural gas and building trades workforce has direct transferable skills to this industry and will be vital to scaling these networks across the state (Augustine et al., 2019).

Heat pumps are also vital to enabling buildings not connected to existing heating and cooling distribution infrastructure to access low emission heating and cooling. Governor Maura Healey ran on a climate campaign that included a goal to install one million heat pumps by 2030. This effort is meant to focus on "workforce training, customer and installer education, and lower installation costs" (The Maura Healey Committee, n.d., para. 22). It is essential that all thermal work – whether thermal utility installation, maintenance and repair, connection, or individual customer heat pump installation – is performed under regulations that guarantee strong wage and training standards that include public transparency on workforce data. Having a trained in-state union workforce that is skilled in both installation and maintenance and repair is crucial to ensure that these new systems run efficiently, effectively and safely.

THERMAL UTILITY DISTRICTS

High-Quality Job Standards:

The Commonwealth should guarantee that highly trained personnel complete this work to minimize risks to public safety and service. The existing unionized workforce has transferable skills to this industry and Massachusetts should consult with the New England Gas Workers Alliance, Massachusetts USW, UWUA, and IBEW, the Building Trades, UA and LIUNA to institute training requirements aligned with industry best practices. Doing so will lift up programs that prepare workers for lifelong careers in utility work and prevent subcontracting to companies that do not meet these standards.

Cost:

- Thermal Utility Networks: $5.12 Billion
- Heat Pumps: $27.9 Billion

Job Creation:

- Thermal Utility Networks: 14,847 Direct Jobs
- Additional Heat Pumps: 72,540 Direct Jobs

Emission Reduction:

There is a potential to reduce emissions by 21,000,000 Metric tons of CO2e. This reduction would include Scope 1 emissions reducing emissions by limiting burning of on site fossil fuels in buildings.

Funding Mechanisms:

U.S. Department of Housing and Urban Development Community Development Block Grant – the IRA provides a 30% investment tax credit for heat pump projects, with direct pay for governments and nonprofit entities (Inflation Reduction Act of 2022, 2022). It also provides $3 million for Environmental and Climate Justice Block Grants to disadvantaged communities to support cleaner energy sources (Inflation Reduction Act of 2022, 2022). Geothermal projects can also receive grants and loan guarantees from the US Department of Energy Tribal Energy Program grants (Office of Indian Energy Policy and Programs, n.d.), DOE Office of Energy Efficiency and Renewable Energy Geothermal Technologies Program grants (Office of Energy Efficiency & Renewable Energy, n.d.) , U.S. Department of Agriculture (USDA) Rural Energy for America Program grants (USDA Rural Development, n.d.), Federal Housing Administration (FHA) Powersaver Loan program grants (Office of Energy Efficiency & Renewable Energy, 2014), and the U.S Department of Clean Energy Demonstrations Clean Energy Demonstration Program on Current and Former Mine Land grants (Office of Clean Energy Demonstrations, n.d.) .

EXCEEDING TARGETED HIRING GOALS: MGM Springfield

The state can ensure that pathways and opportunities in this new and expanding economy are extended to frontline and other historically marginalized communities by setting labor standards and clear and enforceable participation rates for women and BIPOC workers. Thanks to the help of the Massachusetts Building and Construction Trades, the construction phase of the MGM Springfield Casino not only met, but exceeded targeted hiring goals. The negotiated Springfield host community agreement laid out targets for the design and construction phase to have 6.9% of the workers be women, 15.3% minority, and 8% veterans (Massachusetts Gaming Commission, 2015). The project achieved its broad diversity goals, with over 21% of the work being performed by minority workers, 8.5% by women, and nearly 9% by veterans (Frenier, 2018). Lessons learned from projects which have implemented successful targeted hiring goals can be applied to clean energy projects throughout the state.

REDUCING BUILDING EMISSIONS

RECOMMENDATION:

Scale Building Retrofits While Ensuring Cost Effectiveness, Transparency, and Equity

1. Create a public "Building Carbon Reduction Clearinghouse" as defined by the Massachusetts Commission on Clean Heat
2. Mandate public disclosure of workforce numbers, pay transparency, and subcontracting for all building retrofit projects
3. Set and increase wage standards for all building carbon reduction work designated by public agencies
4. Reinstate the moratorium on all utility disconnections in households that face energy poverty and energy burdens

Sheet Metal Workers, Local 17

In 2022, Massachusetts' building stock comprised over 2 million buildings (Massachusetts Commission on Clean Heat, 2022). Mass Save has been spearheading the state's energy efficiency and retrofit work. However, achieving mass scaling with more direct access to individual consumers calls for a clearinghouse or "one stop shop" for building and energy retrofits. The Massachusetts Commission on Clean Heat (2022) recommended the reform and reconstitution of Mass Save under a new "Building Decarbonization Clearinghouse," which will "serve as an umbrella for all applicable incentive programs, funding sources, and technical assistance" (p. 26). Creating a public clearinghouse will afford building energy consumers (i.e., residents, building owners, and small businesses) more direct support, enhancing equitable access to affordable energy-efficient retrofits. This clearinghouse will offer individuals guidance regarding local, state, and federal funding options to ensure that consumers do not shoulder the cost burden of decarbonization.

This restructuring additionally promotes accountability. Mandating public disclosure of workforce numbers, pay, and subcontracting will heighten public transparency and ensure cost-effective work that benefits Massachusetts employees and communities. As these data are collected and released to the public, legislators can set and increase wage standards within the energy efficiency industry. This sector is funded by public agencies such as Mass Save, future state Climate Banks, Massachusetts Executive Office of

Sheet Metal Workers, Local 17

Mandating public disclosure of workforce numbers, pay, and subcontracting will heighten public transparency and ensure cost-effective work that benefits Massachusetts employees and communities.

Energy and Environmental Affairs, Massachusetts Department of Energy Resources, Massachusetts Department of Environmental Protection, Massachusetts Clean Energy Center, and the new Building Decarbonization Clearinghouse.

Public investments into building retrofits must prioritize frontline and environmental justice communities. The state's existing retrofits do not meet at-risk communities' needs (Massachusetts Commission on Clean Heat, 2022). More than 790,000 Massachusetts households were behind on their energy utility bills as of December 2021, with a need totaling over $670 million (Kowanko & Harak, 2022). The state ended pandemic-related utility disconnection protections in 2021 and now provides limited protections for individuals who are facing financial hardship, experiencing illness, or caring for newborn or elderly family members. (Bell et al., n.d.; Office of the Attorney General, 2023). Until all at-risk households can receive energy efficiency retrofits, the Commonwealth must implement advanced disconnection protections and debt forgiveness programs to ensure that no resident loses utility access.

Emissions Reduction: The creation of a public clearing house to scale access to energy efficiency resources will allow faster emission reduction for Scope 1 and Scope 2 emissions in the building sector of Massachusetts. The new IPCC AR6 Synthesis Report highlights that onsite renewables and efficient buildings, lighting, appliances can reduce global emissions by over 2.5 billion metric tons per year (IPCC, 2023)

CASE STUDY

Community Labor United/Green Justice Coalition Weatherization Campaign

The 2013-2015 Green Justice Coalition (GJC) Massachusetts energy efficiency plan provides a model for partnerships of labor, community, and environmental allies to lead campaigns for equitable and ambitious climate policies. The Green Justice Coalition is a part of Community Labor United (CLU), a coalition of labor unions and grassroots organizations in Greater Boston working to stabilize and strengthen working-class families and communities of color. Between 2012 and 2015, CLU/GJC worked with the state and utility companies to advance several policies for extending energy efficiency programs to low-income communities and communities of color and improving wages and job quality for home weatherization workers.

The CLU/GJC coalition won several policies to expand access to good jobs and weatherization to low-income customers (Grant, 2013). The state agreed to cut emissions from electricity by 2.5% and natural gas by 1%, and created pre-weatherization subsidies estimated to improve weatherization completion rates by 5.3%. A community mobilization campaign, which engaged low-income communities and communities of color to address barriers in participation in weatherization programs, generated a $7.90 of direct utility bill savings for every $1 invested by utilities and weatherization participants. Finally, policy recommendations from CLU/GJC created Efficient Neighborhoods+ (EN+), a Mass Save program to target efficiency retrofits for lower income neighborhoods that expanded access to potentially 1.2 million Massachusetts households.

The campaign also succeeded in improving job quality and job access in weatherization work. The EN+ program will add up to 261 job years in Massachusetts (Grant, 2013). Direct negotiations with major utilities such as NStar and National Grid resulted in strong job standards, with utilities agreeing to responsible contractor provisions requiring disclosure of past violations, preventing wage theft, and strong enforcement mechanisms. CLU/GJC also worked with NSTAR to expand job access by reducing barriers to entry for employees with criminal records as minors.

Cement Masons, Local 534

While the Commonwealth will need to scale its building retrofits much further to meet state climate goals, CLU/GJC's victories in the 2013-2015 energy efficiency plans provide a model for engaging unions, grassroots organizations, and environmental organizations to advance policies that create high-road jobs and expand access to weatherization resources. As CLU/GJC members put it, "The Massachusetts 2013-2015 energy efficiency plan is a success. But, it is a success we can use to chart a course that will help us achieve even greater cost and energy efficiency in the future (Grant, 2013)."

Millwrights Local 1121 working in Barnstable at Vineyard Wind substation

ENERGY

Massachusetts remains dependent on energy sources that produce substantial greenhouse gas emissions. The transportation sector is responsible for the largest proportion; its emissions must decrease by 86% of 1990 levels to meet 2050 state targets (Massachusetts Executive Office of Energy and Environmental Affairs, 2022). The building sector, the second highest emitting sector, must decrease by 93% of 1990 levels to reach 2050 state emissions goals; this sector is followed by electric power, whose emissions must decline by the same margin (Massachusetts Executive Office of Energy and Environmental Affairs, 2022).

Less than 4% of energy consumed within the state comes from renewable sources (U.S. Energy Information Administration, n.d.c).[2] Massachusetts is part of ISO New England, a regional electric grid, and receives approximately 46% of its electricity from gas combustion, 23% from nuclear power, 6% from hydroelectric, 5% from biomass and refuse, 3% from wind energy, 2% from solar energy, and 1.2% from other energy sources. Sources outside New England provide the ISO New England grid with an additional 16% of energy. Therefore, the vast majority of electricity that powers New England is from non-renewable sources; a mere 11% of New England electricity comes from renewable sources supplied within the Northeast and Canada (U.S. Energy Information Administration, 2022b).

Massachusetts has taken some action to confront its dependence on energy generated from fossil fuels. A bill passed in 2021, An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, requires the state to reduce greenhouse gas emissions – by 50% by 2030 and 75% by 2040 (below 1990 baseline levels), with a total goal of net zero emissions by 2050 (An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy, 2021). The Commonwealth is making strides to increase the buildout of renewable energy sources in place of fossil fuels. In 2023, legislation was introduced that would require the state to meet 100% of its energy needs with renewables by 2035. The same legislation indicates that Massachusetts must procure 100% renewable electricity for its residents, state and municipal agencies, businesses, and institutions by the same year (Bill S. 2167). In terms of grid modernization, the state passed legislation in 2022 requiring new projects of this type. Municipalities were granted the authority to

[2] New York State and Canada also supply electricity to the ISO New England grid.

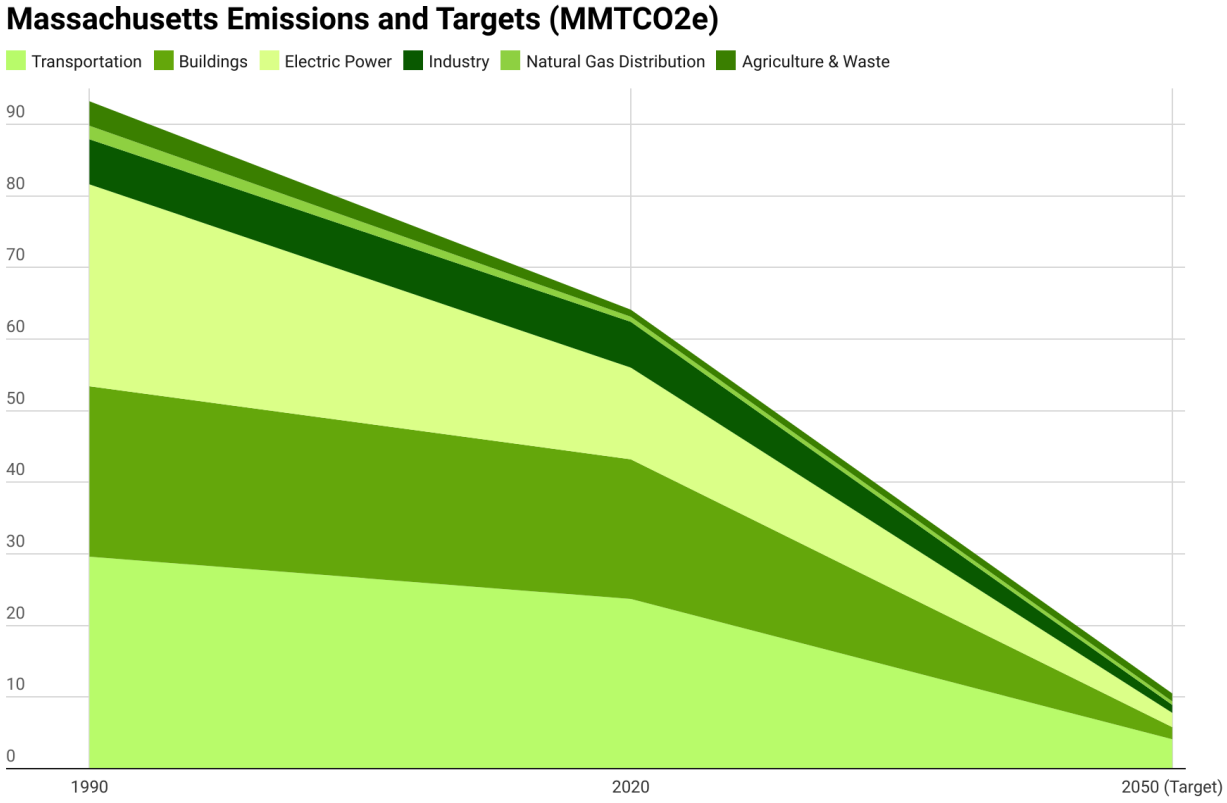


Chart: Avalon Hoek Spaans ah679@cornell.edu, Climate Jobs Institute Cornell ILR • Source: December 2022 Massachusetts Clean Energy and Climate Plan • Created with Datawrapper

limit natural gas hookups, and legislation mandated the procurement of 5,600 MW of offshore wind by 2027 (Bill H.5060, 2023). In the longer term, the Massachusetts Clean Energy and Climate Plan estimates a need of over 50 GW of renewable energy by 2050, including 23 GW of offshore wind and 27 GW of solar (Massachusetts Executive Office of Energy and Environmental Affairs, 2022). Construction has already started on the 800 MW Vineyard Wind farm. Massachusetts has chosen two more projects, SouthCoast Wind (400 MW) and Commonwealth Wind (1,200 MW), as additional procurements, and in 2024 the state joined with Rhode Island and Connecticut to issue a tri-state procurement of up to 6,000 MW of offshore wind (Young, 2024). However, issues have emerged with spiking global energy prices. The state's Department of Energy and Natural Resources also operates an incentive program, the Solar Massachusetts Renewable Target Program. This initiative incentivizes solar projects that interconnect with select investor-owned utilities (Massachusetts Department of Energy Resources, 2023a, 2023b). The incentive structure declines over time, with a total capacity of 3,200 MW; the Commonwealth has set a target of 1,000 MW of storage by 2025.

The clean energy transition will greatly reduce Massachusetts' greenhouse gas emissions and bring tens of thousands of local jobs.

Generous federal funding exists for climate programs in Massachusetts. The IRA includes abundant tax incentives for wind and solar construction along with investments in advanced renewable energy sources, such as $11.4 billion in large-scale renewable projects, a rebate ranging from 50% to 100% for energy-efficient appliances and systems, and a 30% tax credit for installing solar panels or battery storage (Inflation Reduction Act, 2022). Although these state and federal incentives and initiatives are integral to meeting the state's climate goals, they cannot adequately reduce Massachusetts' greenhouse gas emissions to net-zero. They must be implemented at a much larger scale and on a more urgent timeline than currently intended.

Pile Drivers and Divers Local 56

CLEAN ENERGY LABOR STANDARDS

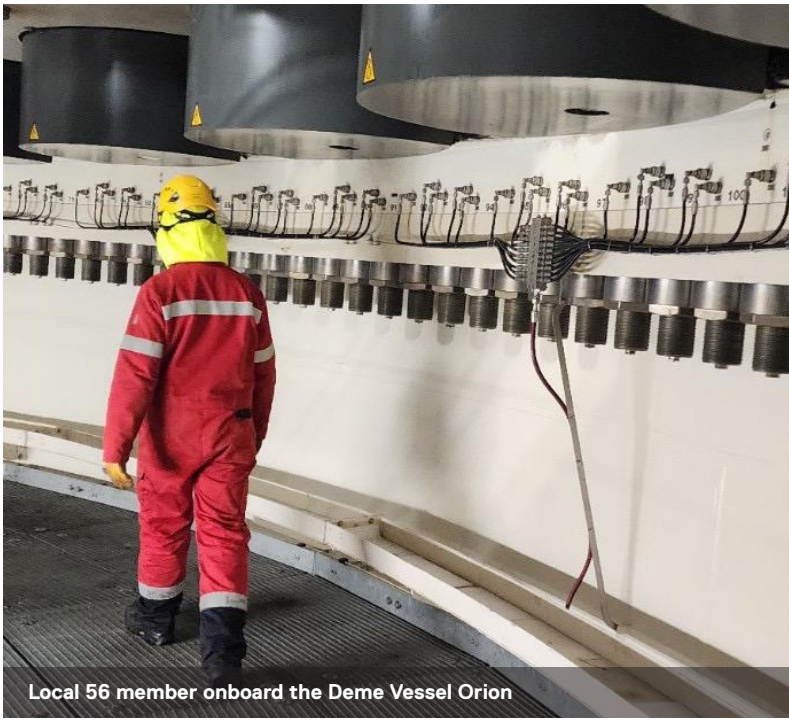
RECOMMENDATION:

Create High Road Labor Standards for 21st-Century Energy Infrastructure

1. Require all public works contracts to support high-quality job creation

One of the most effective ways to build out a clean energy economy with high-quality jobs that center environmental justice and historically marginalized communities is to ensure that all work done on public lands, public works, public buildings, or with public funds adheres to high road labor standards. Any Massachusetts funding related to reducing greenhouse gas emissions, modernizing or expanding energy infrastructure, generating renewable energy, transmitting and distributing energy, or remediating climate change should ensure that recipients and contractors meet workforce development targets specific to the diversity, equity, and inclusion of energy and frontline communities. Funds must be used to create local jobs and pay prevailing wages and benefits. All efforts also need to comply with state and federal labor laws, support high-quality training programs, and include comprehensive plans to ensure labor harmony throughout all project phases. The state can also establish a prevailing wage requirement for all construction and related work on natural gas and electric utility infrastructure that involves public funds or public property.

Laborers' International Union of North America



Local 56 member onboard the Deme Vessel Orion

CLEAN ENERGY LABOR STANDARDS

High-Quality Job Creation:

Invest in Workforce Development for Clean Energy Jobs

Massachusetts can and should take the lead on establishing programs and investments that create good jobs for low- and moderate-income individuals and communities most affected by climate change. For example, the Massachusetts Clean Energy Center can partner with licensed apprenticeship programs and quality pre-apprenticeship programs to make sure that any clean energy and climate change remediation projects funded, leased, or owned by the Commonwealth help cultivate a skilled local workforce. By setting minimum requirements for using apprentices and pre-apprentices, paying prevailing wages, and entering into PLAs – as set forth in theproposed Act Relative to a Just Transition to Clean Energy (2024) – the Center can further direct its resources towards building out a clean energy workforce.

Funding Mechanisms:

States may access $550 million through the BIL's Energy Efficiency and Conservation Block Grant program to finance renewable energy and energy efficiency projects (Infrastructure Investment and Jobs Act, 2021).[3] These federal grants bring their own minimum labor standards, including Davis–Bacon prevailing wage requirements and Buy American provisions for iron, steel, and manufactured products used in projects involving infrastructure work (Infrastructure Investment and Jobs Act, 2021).[4] Similarly, through the U.S. Department of Energy's Clean Energy Infrastructure Program, states may access $97 billion in funds appropriated between the BIL and IRA (U.S. Department of Energy, n.d.a). State resources include bonds, existing department resources, and potential green bank financing.

Millwrights Local 1121 working in Barnstable at Vineyard wind substation

[3] H.R.3684, Sec. 40552.

[4] H.R.3684, Secs. 41101 & 70901.

RENEWABLE ENERGY PRODUCTION

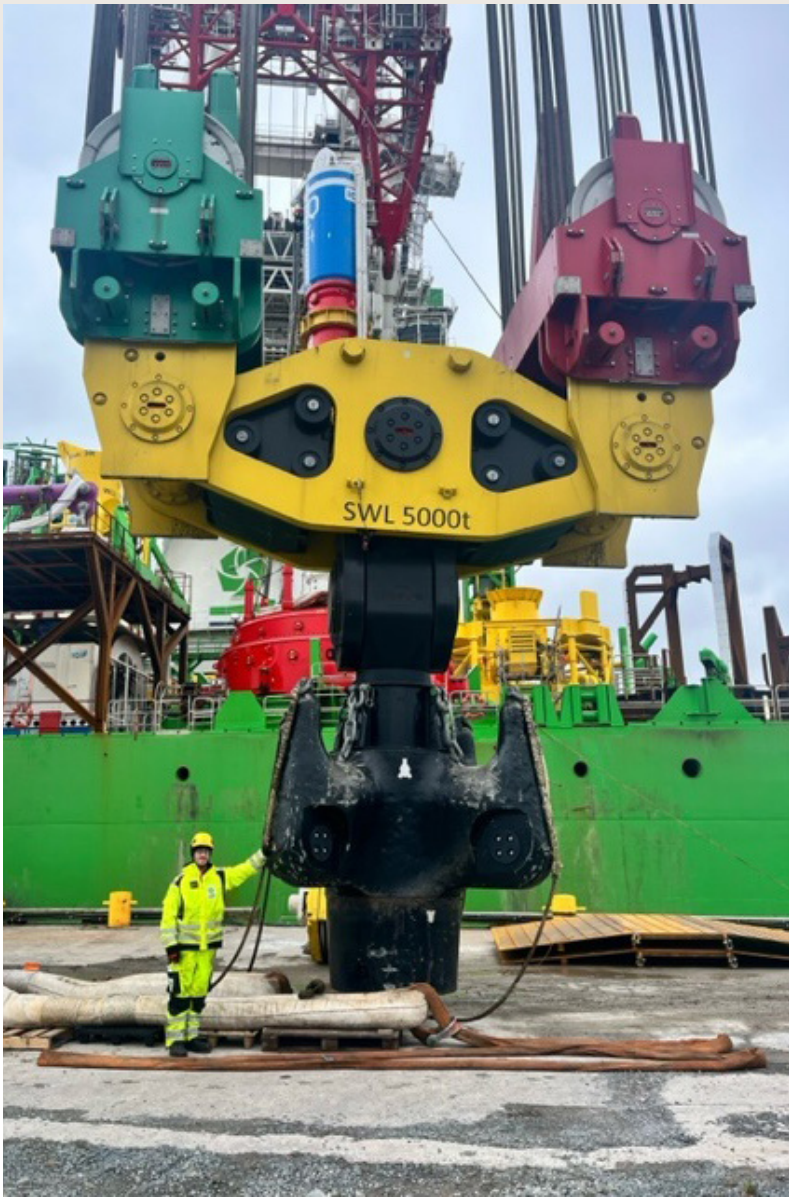
RECOMMENDATION:

Dramatically Increase Renewable Energy Production by 2040

1. Install 20 GW of solar energy by 2030 and a total of 30 GW of solar energy by 2040
2. Install 10 GW of offshore wind by 2030 and a total of 26 GW of offshore wind by 2040
3. Install 4 GW of battery storage by 2030 and a total of 6 GW by 2040

To meet its climate goals and to transition to a fully 100% renewable energy economy, Massachusetts will need an unprecedented build out of renewable energy. This expansion will allow the Commonwealth to supply its electricity from fully clean energy sources while creating thousands of jobs and reducing harmful emissions and air pollution. The state should install 30 GW of solar energy by 2040 and 26 GW of offshore wind by 2040. One way to meet these goals is to build 8 GW of residential or distributed solar, 17 GW of utility-scale solar, and 5 GW of solar energy on brownfield sites. Utility-scale solar energy is an inexpensive form of electricity, costing less than most fossil fuel combustion sources (Lazard, 2021). Brownfield solar, where renewable energy is developed on top of contaminated land, allows for the revitalization of environmentally degraded areas and will ease concerns about siting renewable energy projects (EPA, 2022a). Both offshore wind and solar energy projects will create thousands of jobs statewide, with the greatest potential in offshore wind assembly, construction, manufacturing, and supply chain. Incentivizing the build out of offshore wind component manufacturing under strong labor standards will help establish Massachusetts as a hub for offshore wind.

The Commonwealth should also drastically increase its battery storage goal to 6 GW by 2040. Battery storage will be necessary for intermittency issues accompanying solar and wind power that do not operate around the clock. As fossil fuel infrastructure becomes obsolete, new battery storage will be required to maintain a resilient electrical grid during shifting peak demands.



Pile Drivers and Divers Local 56 member onboard the Deme Vessel Orion.

RENEWABLE ENERGY PRODUCTION

High-Quality Job Standards: As Massachusetts builds out a 100% renewable energy economy, this work must be completed with strong labor standards. Where the state is procuring renewable energy or renewable energy credits from offshore wind projects, it should incentivize those projects that create high quality jobs in manufacturing, construction, and operations & maintenance via labor peace agreements, community benefit agreements, and other high road labor standards. Where appropriate under state and federal requirements, the Commonwealth should also support high road jobs in operations and maintenance, as well as throughout the offshore wind supply chain, to ensure safe working conditions and an uninterrupted supply of labor and materials. To promote domestic manufacturing, the solicitation process should ensure compliance with Buy American Provisions in federal legislation. The bidding process should focus on regional job creation and ratepayers' costs when securing project approval. For the buildout of solar projects, similar to legislation passed in states such as New York and Maine, Massachusetts should require that all renewable energy projects (or sets of projects larger than 200 kW) pay construction and installation workers the prevailing wage to ensure that all workers receive decent wages.

Cost:

Solar	30 GW	$77.3 Billion
Offshore Wind	26 GW	$8.5 billion
Energy Storage	6 GW	$1.04 Billion

Job Creation:

	Total Direct Jobs
Solar	293,664
Offshore Wind	30,634
Energy Storage	3,636

Emission Reduction:

	Regional Emissions Avoided
Solar	33,895,999 MT CO2eq
Offshore Wind	77,315,161 MT CO2eq
Energy Storage	160,358 MT CO2eq

Note these emission reductions would occur in Scope 1 and 2 emissions across the Northeast.

Funding Mechanisms: The IRA provides significant incentives for clean energy production, including investment and production tax credits that increase fivefold with labor standards such as paying prevailing wages and using apprentices (Infrastructure Investment and Jobs Act, 2021). Companies can access an additional 10% credit if they are located in energy communities and another 10% when they use domestically made materials on their projects.[5] All told, the IRA appropriates $11.4 billion for large-scale renewables and creates tax incentives of up to 50% of the cost of qualified clean energy projects. Additionally, the EPA grants funds for Brownfields Job Training to deliver programs that recruit, train, and place local unemployed and underemployed residents in the environmental remediation field (American Cities Climate Change Renewables Accelerator, n.d.b), as well as Brownfield Assessment, Cleanup, and Multipurpose Grants and a Brownfield Revolving Loan Fund (American Cities Climate Change Renewables Accelerator, n.d.c).

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[5] See generally IRA § 13101(b); 26 U.S.C. §45(a) [production tax credit] and IRA § 13102; 26 U.S.C. §48(a) [investment tax credit].

GRID MODERNIZATION

RECOMMENDATION:

Expand and Modernize the Electrical Grid

1. Implement Eversource and National Grid modernization plans
2. Increase high voltage transmission infrastructure to support the growth of renewable energy by 2040
3. Prioritize regional collaboration on renewable energy planning, installation, and distribution

IBEW, Local 104

As Massachusetts builds thousands of megawatts of renewable energy and powers systems via electrified heating and transportation, the electrical grid will need to be expanded. Grid modernization will render the region's electrical systems more reliable and secure while creating thousands of jobs involving utilities, electrical systems, and computers. Eversource and National Grid, which both supply electricity to customers across the state, have published grid modernization plans that would update systems for the clean energy economy (Singer, 2022). Agendas include improvements to monitoring and communication in infrastructure, demonstration projects, and advanced metering infrastructure (e.g., distributed energy resource management systems, analytic platforms, and probabilistic power flow monitoring). However, Massachusetts should approach this implementation with caution to prevent job losses for utility workers. Data from these systems should be made publicly available for monitoring and education purposes.

The Commonwealth must engage in a massive effort to build out, maintain, and replace its transmission and distribution systems as well. These systems provide electricity to customers statewide. Massachusetts needs to prioritize updates to guarantee reliability, safety, and efficiency for all residents – particularly in light of recent severe weather events that have left hundreds of thousands of New Englanders without power (Alanez & Law, 2023; Klein et al., 2022; Sharp, 2023). A primary focus should be on installing substations and transmission lines so new clean energy sources can be distributed efficiently to all areas. Although these projects may cost billions of dollars, they will create jobs across the state for union workers and prompt

the infrastructure updates needed to support a renewable economy for generations.

Finally, with proposed increases to renewable capacity and projects in development, a regional approach should be taken to manage transmission especially offshore wind transmission.

Massachusetts should collaborate with neighboring states to ensure that all interconnections are built responsibly with distribution and transmission infrastructure that prevent possible blockages.

GRID MODERNIZATION

High-Quality Job Standards:

All ratepayer-funded utility work should maintain sufficient staff to ensure safe and reliable gas service, and pay outside contractors at least the prevailing wage.

Cost:

The total cost of grid modernization plans would be $514.3 million by 2026. The cost of new high voltage transmission infrastructure would be $3.72 billion by 2040.

Job Creation:

Grid modernization would create 1,645 direct jobs by 2027. High voltage transmission installation would create 11,902 direct jobs by 2040.

Funding Mechanisms:

The federal government has directed billions of dollars towards transmission upgrades. The IRA includes $2.7 billion for transmission facility planning and the siting of interstate electricity transmission lines (Infrastructure Investment and Jobs Act, 2021). Another $10.5 billion has been allocated to the Grid Resilience and Innovation Partnerships grant program under the BIL to improve grid resilience and flexibility in the face of extreme weather and climate change (Infrastructure Investment and Jobs Act, 2021). This funding includes $5 billion for grants to states and tribes to prevent power outages, $3 billion for smart grids, and $2.5 billion for grid resilience grants.

MICROGRIDS

RECOMMENDATION:

Expand Funding for Community Microgrids

1. Provide $100 million of direct state funding for microgrids in communities across the state with strong labor standards by 2030

Community microgrids provide additional support for the grid system while ensuring community resilience and promoting renewable energy. These grids can be powered by local distributed sources, such as solar installations on rooftops or in nearby areas, allowing groups of buildings to rely on clean power. These microgrids remain connected to the larger grid because they are autonomous but serve as reliable energy sources in case of natural disasters or other emergencies that affect the grid at large. Microgrids are especially beneficial during extreme weather events such as snow storms or hurricanes. They can keep necessary services, power, and transportation running even when statewide systems are damaged or inactive, protecting the state's most vulnerable residents (Clean Energy Solutions, Inc., 2020).

Communities in Massachusetts have already organized to adopt microgrids and have undertaken projects in Chelsea and Chinatown. The state should build off this approach by providing $100 million as part of a state grant program for microgrid funding. Progress could lead to between 8 and 12 additional microgrid projects – especially for public building networks, as has been done in Chelsea. Yet these projects must feature strong labor protections (previously not a guarantee) and ensure jobs for union workers.

MICROGRIDS

High-Quality Job Standards:

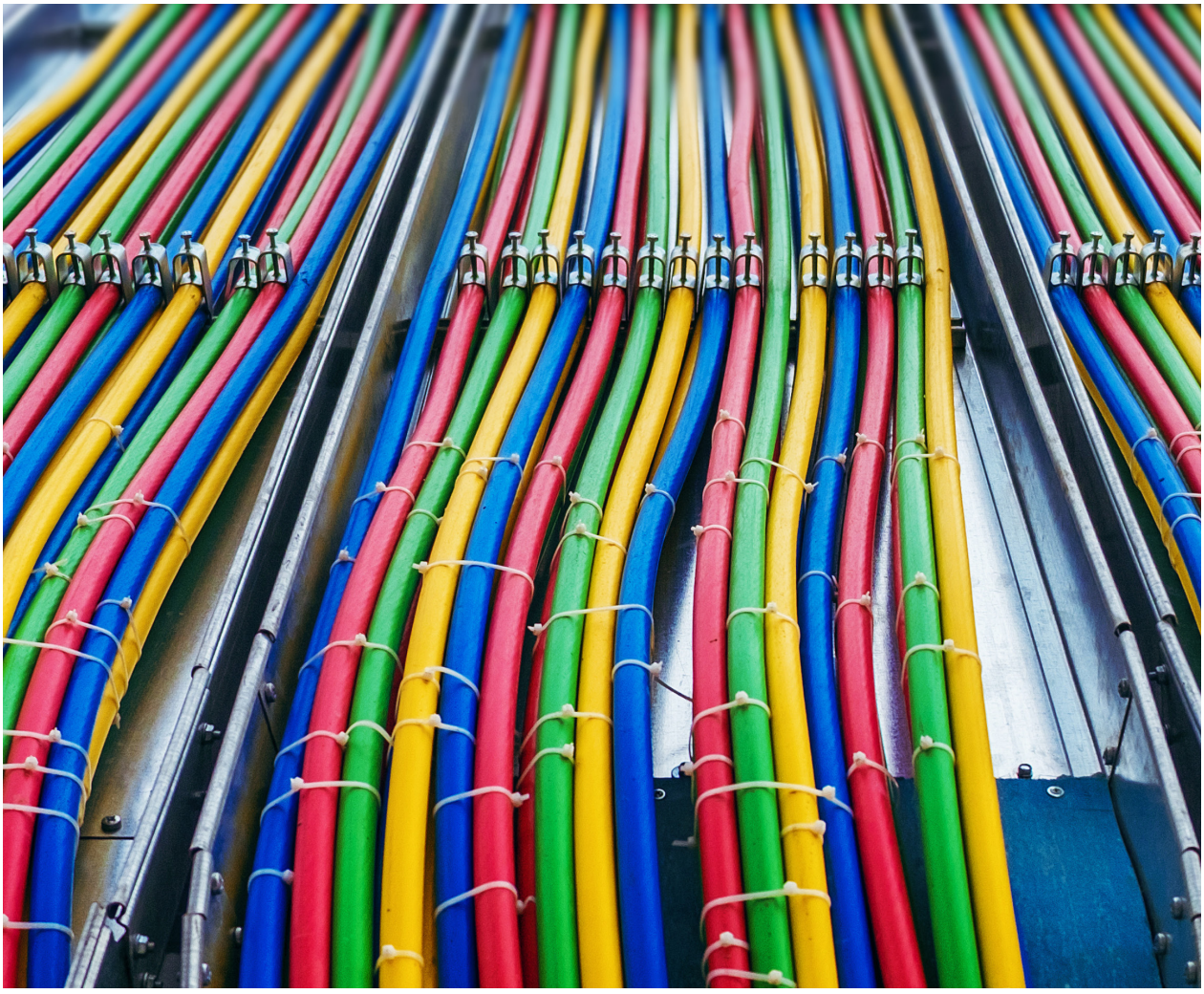
The Commonwealth should consider requiring PLAs on microgrid projects as a condition of receiving state funding to ensure high-quality work staffed with well-trained workers who can carry out contracts safely, efficiently, and without costly delays.

Cost: Total cost of $100 million by 2030.

Job Creation: This project would create 320 direct jobs by 2030.

Funding Mechanisms:

Under the IRA, Massachusetts can take advantage of substantial federal tax incentives that cover up to 50% of project costs when a microgrid is in an energy community and is part of a qualified low-income residential building project or economic benefit project (Infrastructure Investment and Jobs Act, 2021).[6] Additionally, the Department of Energy administers a Microgrid and Integrated Microgrid Systems Program that provides grants to isolated communities and critical infrastructure operators (American Cities Climate Challenge Renewables Accelerator, n.d.a).



[6] 26 U.S.C. § 48(e).

GREEN HYDROGEN

RECOMMENDATION:

Make Massachusetts a Leader in Green Hydrogen Production and Distribution

1. Generate 23.5 trillion BTU of green hydrogen annually by 2040 in Massachusetts

Massachusetts may need to rely on alternative fuels to achieve a fully renewable energy economy. Green hydrogen offers a solution that, when produced in-state with high labor standards, can create thousands of family-sustaining local jobs in construction and installation. Green hydrogen works as a fuel for hard-to-decarbonize sectors (e.g., diesel trucks and large boats) where there are no low-cost alternatives. Substantial green production should occur within Massachusetts to meet the demands of hard-to-decarbonize sectors. Labor should have a voice on this council to represent the interests of working people most influenced by the transition.

The state should supply 23.5 BTU of fuel by 2040 to provide sufficient green hydrogen for decarbonization. A massive buildout of offshore wind could provide an energy source to produce this type of hydrogen. Electrolysis, where electricity is used to split water, is a key means of generating such fuel. Offshore wind can power this process and create thousands of union jobs across the state. However, because electrolysis consumes water, the Commonwealth must prioritize environmental justice concerns about freshwater and the drinking supply.

GREEN HYDROGEN

High-Quality Job Standards:

Massachusetts should require all construction work on green hydrogen infrastructure, and production facilities that receive public funding, to use a PLA where a local contracting authority selects this project delivery method. The Commonwealth should utilize contract terms for public hydrogen procurement that support a reliable, uninterrupted power supply, such as through labor harmony clauses for operations and maintenance workers.

Cost: $2.9 Billion

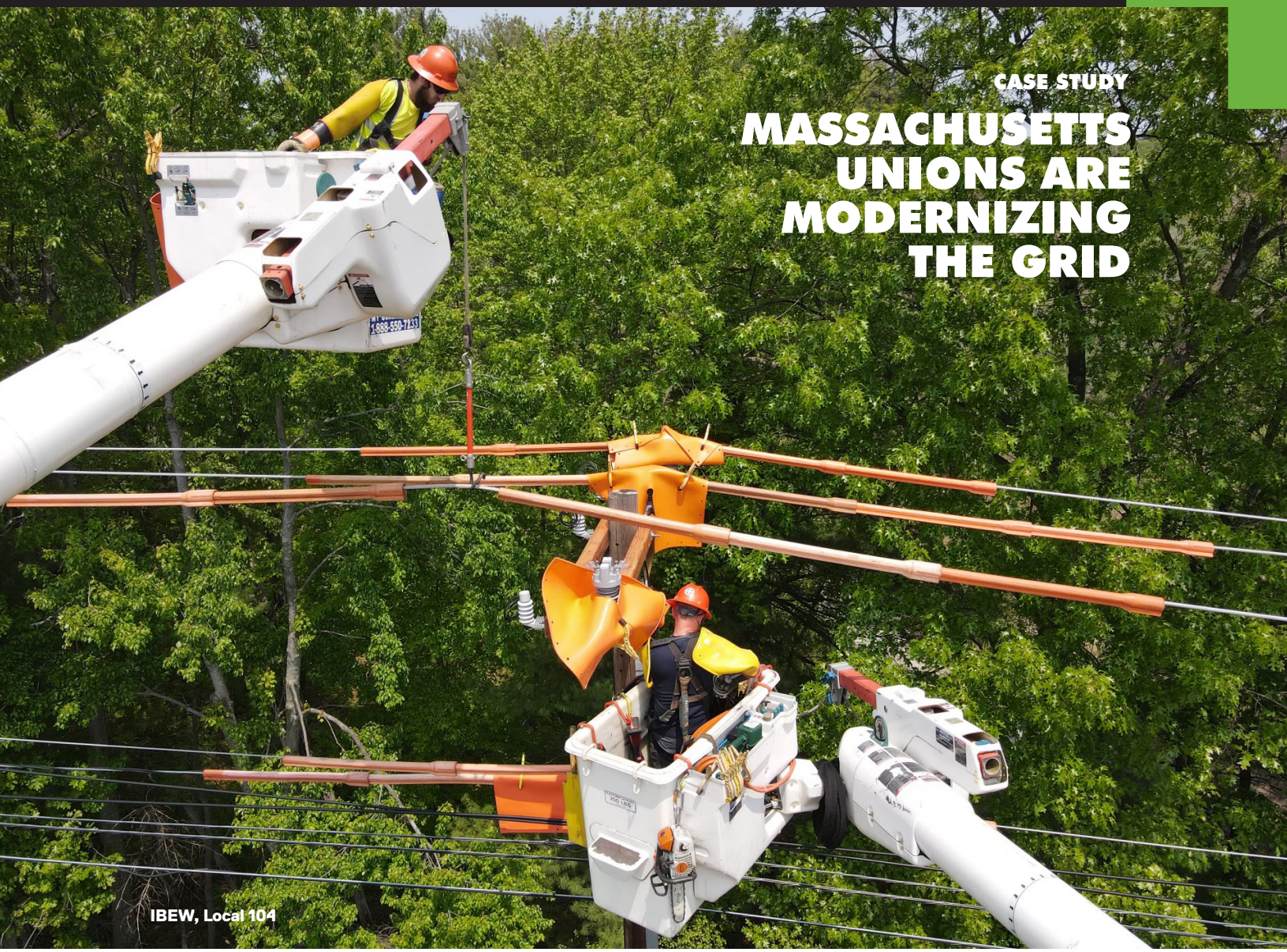
Job Creation: 1,746 Direct Jobs

Potential Funding Mechanisms:

The IRA includes multiple incentives for clean hydrogen production (Infrastructure Investment and Jobs Act, 2021), which can halve costs (Zhou, 2023).

CASE STUDY

MASSACHUSETTS UNIONS ARE MODERNIZING THE GRID



IBEW, Local 104

To ensure reliable and affordable clean energy for all residents, the Commonwealth must rapidly modernize its transmission and distribution systems. New technologies and major upgrades will be required to integrate renewable energy into the grid, monitor and manage electrical loads, and enhance grid security and resilience. Massachusetts union members have extensive experience in installing these technologies and are a crucial part of efforts to modernize the grid (IBEW Local 103, n.d.; IBEW Local 104, n.d.). IBEW Local 103 has led the installation of renewables and EV chargers in the Greater Boston area, and IBEW Local 104 has worked for over 100 years to provide electricity across New England, including the systems that power the MBTA and provide mobility for its millions of daily riders. IBEW members have been installing new grid technologies, such as advanced insulators produced by Lindsey Systems.

These systems allow utilities to monitor transmission towers and forecast line capacity to reduce congestion in the grid, including through high-accuracy voltage and current sensors and hybrid systems that combine specialty sensors and analytic web-based software (Lindsey Systems, 2020). Members also install mechanical systems that can also improve grid resilience during extreme weather events, such as Lindsey Emergency Restoration Structures which can quickly and safely bypass damaged permanent structures. From line workers to construction workers, the Commonwealth's trained electrical professionals will be essential for connecting all its residents to clean, reliable power.

METHANE LEAK PREVENTION

RECOMMENDATION:

Continue Methane Leak Prevention

1. Continue accelerated leak-prone pipe replacement under the GSEP Program
2. Pass *An Act Relative to a Just Transition to Clean Energy*

The Commonwealth has a vast gas transmission and distribution network consisting of 21,000 miles of pipeline(Conservation Law Foundation, 2020). The state's gas infrastructure is the second oldest in the country, with some lines having existed for over 100 years(Seavey, 2021). Estimates indicate that about 5,400 miles of pipe across the state are leak-prone, particularly cast-iron and non-con-cathodically protected steel, and wrought-iron mains (Conservation Law Foundation, 2020). A sizeable portion of the Commonwealth's natural gas is lost through these leaks – about 2.7% of gas (worth approximately $90 million) in the Boston Region alone (McKain et al., 2015)

Gas leaks have major climate and health impacts across Massachusetts because they release significant amounts of methane. Over a 20-year period, methane is 80 times more potent than carbon dioxide at warming the atmosphere (Environmental Defense Fund, 2023). This high warming potential means that methane leaks present obstacles to meeting state emissions targets. Repairs and targeted replacement should focus on leaks that pose the most substantial climate risk and those in environmental justice communities. Over half of methane emissions come from just 7% of leaks, known as "super emitters." Methane leaks are nonetheless often undercounted in greenhouse gas inventories (Sargent et al., 2021).

Pipefitters, Local 537

In the 2018 Merrimack Valley disaster, an explosion from a Columbia Gas line killed one person and displaced over 8,000 people (NBCUniversal Media, 2021). Natural gas leaks are an environmental justice issue as well: people of color, limited English–speaking households, and lower-income residents are more likely than others to be exposed to gas leaks and to experience slower repair times in Massachusetts (Luna & Nicholas, 2022). State schools reported 91 gas leaks in 2021, one-third of which required utility workers immediate attention (Nicholas et al., 2022).

METHANE LEAK PREVENTION

High-Quality Job Standards:

A well-trained gas utility workforce is crucial to transforming Massachusetts' aging gas infrastructure. Thousands of workers build and maintain the Commonwealth's gas infrastructure, including more than 1,600 employees across United Steelworkers' Locals that constitute the New England Gas Workers Alliance. The state should ensure that gas repair and replacement continue to be performed by a highly skilled and trained workforce. Gas companies increasingly rely on subcontracting to nonunion gas workers, often on a temporary basis and with lower levels of training than utility professionals. To promote safety for all Massachusetts residents and existing gas system reliability, Massachusetts must make sure that this work includes strong labor standards. An Act Relative to a Just Transition to Clean Energy, filed in the 2023-2024 legislative session, will help improve the state's methane reduction programs and ensure that there is an available, skilled and trained workforce to adequately reduce gas leaks throughout the transition (An Act Relative to a Just Transition to Clean Energy, 2023).

Cost: $1.8 Billion

Job Creation: 1,996 direct jobs.

Emission Reduction:

There is potential to reduce emissions by 579,138 MT of CO2eq in Scope 1 Emissions.

Funding Mechanisms:

The IRA Methane Emissions Reduction Program provides $1.5 billion for the EPA to fund and provide technical assistance for methane abatement. The Program establishes fees of $900 per metric ton of methane emitted in 2024, $1,200 in 2025, and $1,500 in 2026 and after (Infrastructure Investment and Jobs Act, 2021). The Bipartisan Infrastructure Law (BIL) allocates $1 billion for the Natural Gas Distribution Infrastructure Safety and Modernization Grant Program to modernize natural gas distribution pipelines, minimize incidents and fatalities, and avoid economic losses (Pipeline and Hazardous Materials Safety Administration, n.d.).

TRANSPORTATION

Transportation is the highest emission source in Massachusetts, contributing nearly 44% of the state's greenhouse gas emissions (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Global Warming Solutions, 2022). More than half of transport emissions (59%) are from individuals or small groups traveling in passenger cars, light trucks, and motorcycles; another 29% of emissions are from heavy-duty vehicles, such as short-haul trucks transporting goods (The Cadmus Group and Evolved Energy Research, n.d.). Even as emissions in other economic sectors (e.g., electricity) have decreased in the state, transportation has stayed fairly constant since 1990 (Executive Office of Energy and Environmental Affairs, 2023).

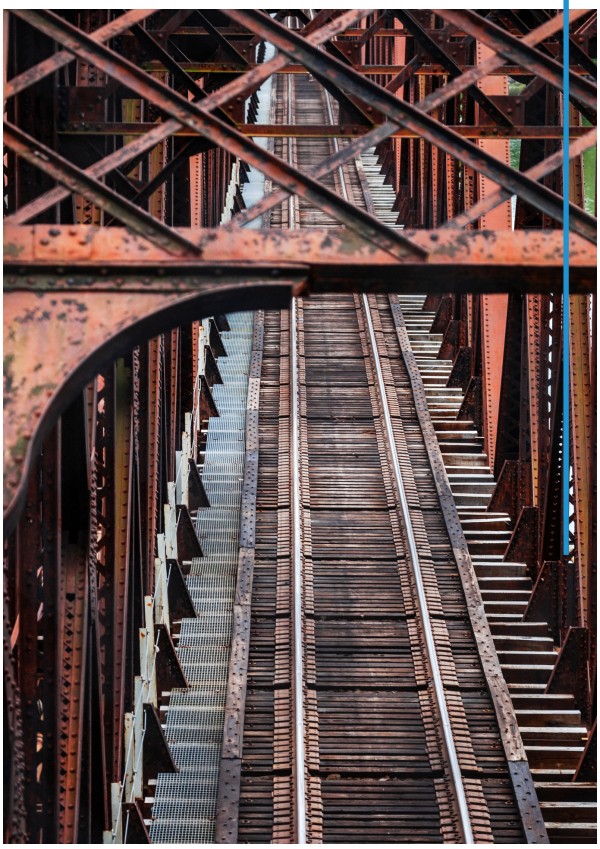
State regulation has improved fuel efficiency in terms of miles per gallon but has only slowed emission growth. Massachusetts has yet to see an overall reduction in vehicle emissions. Bay Staters traveled 25% more vehicle miles in 2019 than in 1990 (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Global Warming Solutions, 2022).[7] Massachusetts is home to over 5 million vehicles (two per household on average), 99.5% of which are combustion vehicles (Alternative Fuels Data Center, 2022). Transportation emissions plummeted in 2020 due to pandemic-induced business closures. However, the pandemic's enduring impacts on this sector remain unclear. As more people move to the suburbs based on work-related changes and affordability, both emissions and vehicle miles traveled could rise in the medium and long term (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Global Warming Solutions, 2022). To get the Commonwealth's many transit authorities back on track and to strengthen their planning for the future, it is critical that they look to the leadership of their workers and their riders for input on operations and policy, which must be considered in the policymaking process.

Reducing emissions and reversing historical inequity in Massachusetts call for transforming how residents, goods, and services get around. Building out more public transit infrastructure would increase connectivity

[7] In 1990, residents traveled 49 billion annual miles; this figure rose to 61 billion in 2019.

to low-income, rural communities, and transit deserts. Free public transportation has been shown to improve ridership (Tu, 2022), such as in Kansas City where the downtown streetcar is free (Brey, 2022) and in Boston which has been operating several pilot programs for free bus service and free bike share rides (City of Boston Transportation, 2022). Additionally, creating a low-income fare for MBTA riders would provide immediate relief to working families, saving them an estimated $50 million a year and supporting reliable, equitable transit ridership (Public Transit Public Good, 2023). A low-income fare has the support of 83% of survey respondents from all types of communities across the entire Commonwealth (MassINC, 2022). Getting middle- and high-income people out of their vehicles and onto buses and trains by increasing convenience and reliability would reduce vehicle miles traveled and increase equity for existing ridership. Installing better EV charger infrastructure could facilitate adoption of EVs over vehicles with internal combustion engines.

The transportation sector is ripe with opportunity for high-quality job growth in Massachusetts. The Commonwealth should lead the buildout of large public transit investments that can produce thousands of positions and affordable mobility options for residents. Investments in public transportation are job-intensive and can lead to myriad types of construction work. The state's Department of Transportation should oversee the buildout of public charger installations with certification requirements and labor standards. It



should invest in job mapping and training to transition its workforce to clean transportation jobs. With the bold commitments outlined in this section, Massachusetts could shift towards the 21st-century clean energy economy that residents deserve.

As the state modernizes its transportation sector, requisite training and services will be needed to transition the workforce. Over 3,000 transit and intercity bus drivers work in Massachusetts (U.S.Bureau of Labor Statistics, 2022c). Federal funds are available for workforce development in this sector. The BIL provides more than $5 billion towards diesel to electric bus fleet conversion, with 5% of these funds mandated for workforce development training (e.g., registered apprenticeships). The Commonwealth's many transit authorities should adopt protections against privatization deals and public-private partnerships as part of their strategy, which serve to extract profits from the public service and can lead to corner-cutting, reduced transparency, and lowered standards. The control of the public transit service should rest in the hands of the people of Massachusetts.

ADVANCED RAIL NETWORKS

RECOMMENDATION:

Develop an Electric Local, State, and Interstate Passenger Rail Network

1. **Electrify and modernize the Massachusetts Bay Transport Authority commuter rail, build an electric passenger rail line between Pittsfield and Boston, and build the New England section of the Northeast Corridor High-Speed Rail network**
    - Local: Boston Regional Rail
    - State: East–West Rail
    - Interstate: Northeast Corridor High-Speed Railway

Improving public transportation in Massachusetts is key to reducing emissions and increasing resilience. Doing so will improve convenience, ridership, accessibility, and public welfare. Targeted investments in rail infrastructure at the local, state, and regional levels should aim to directly enhance Bay Staters' lives while creating high-quality jobs and reducing the state's carbon footprint.

At the local level, the commuter rail by the Massachusetts Bay Transport Authority (MBTA) should be upgraded to meet 21st-century needs. The current system is plagued by reliability issues, and its speed is limited by heavy unpowered passenger cars linked to diesel locomotives. Electrifying these routes could cut transit times and improve reliability: a trip from Worcester to Boston would be shortened by 37 minutes, while one from Providence to Boston would be 23 minutes faster (TransitMatters, n.d.a). The state should pivot towards TransitMatters' Regional Rail Vision, which prioritizes connectivity, reliability, and expediency for everyone in the metropolitan area. Massachusetts should also mandate labor standards on construction and operations work (TransitMatters, 2020). Electrifying and upgrading MBTA commuter rail service requires highly trained workers to install overhead catenary wires, lay down tracks in congested and expanded areas, build stations to serve low-income communities and gateway cities, and replace diesel-powered trains (rolling stock) with electric multiple-unit trains (TransitMatters, 2020). With millions in new and finite federal funding available through the BIL and the IRA, now is an ideal time to procure materials and launch this project. The MBTA should purchase electric multiple-unit trains as soon as funds are available to secure the state's project investment and completion. Constructing new and level platforms that line up with the train at every station should be a priority. This format accelerates service by eliminating trains' need to use stairs for boarding; it also increases accessibility for people with unique mobility needs. These changes will slash travel times, operating costs, and pollution (TransitMatters, 2021).

The MBTA commuter rail electrification process must include flood risk analysis. Resilience measures like anti-corrosion preparation, drainage, and elevation considerations should also be incorporated into construction plans: flooding and sea level rise are projected to reduce the operating capacity of Boston's public transit system by 40% after 2030 (Martello et al., 2021).

At the state level, Massachusetts' Department of Transportation (MassDOT) should establish electrified passenger rail service between Pittsfield and Boston. This line could run through Framingham and Worcester to Springfield, with additional stops en route in places like Palmer. A Boston–Springfield trip would take only 1.5 hours; continuing on through Westfield and Chester to Pittsfield would take 2 hours and 45 minutes (TransitMatters, n.d.b). This alternative to driving would be widely accessible and efficient. It would also reduce emissions by shifting demand away from single-occupancy vehicles. Building out a rail system that stops in Berkshire, Hampshire, and Hampden counties, which have the 2nd–4th highest poverty rates in the state, would provide additional mobility options to people most in need (IndexMundi, n.d.). The state should prioritize worker skills mapping, training, and hiring among Bay State residents, particularly those most affected by climate change and the clean energy transition, when establishing the project's construction workforce. In the meantime, the MBTA should run passenger service between Pittsfield and Boston on existing freight rail lines to start cultivating a ridership base.

At the interstate level, high-speed rail (HSR) presents a massive opportunity for the Commonwealth. An interstate vision for the Northeast Corridor, from Washington, D.C., to Boston, entails an HSR line to ferry passengers through the Eastern Seaboard at unprecedented speeds of up to 220 mph (The Northeast Corridor Commission, n.d.). This line will stimulate the economies of Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Maryland, Virginia, and D.C. directly and indirectly through greater jobs and tourism. As the quickest way to travel through the corridor, the line will reduce emissions from driving and flying. It will also create nearly 1,000,000 jobs with more than 110,000 in New England (The Northeast Corridor Commission, n.d.). Massachusetts should collaborate with involved states to connect Boston and Springfield within this system while prioritizing local and diverse hiring goals, apprenticeship training, and PLAs where the contracting authority selects this delivery method.

ADVANCED RAIL NETWORKS

High-Quality Job Standards:

Massachusetts has a compelling opportunity to support tens of thousands of residents in high-quality jobs for the long term by upgrading its transportation system. This task will simultaneously lower greenhouse gas emissions and improve rider satisfaction. The Commonwealth should support pre-apprenticeship and apprenticeship programs that train workers in new manufacturing, maintenance, and related construction technologies; recruit from frontline communities; and partner with unions representing workers engaged in this industry. Where the Commonwealth selects this delivery method, construction contracts or subcontracts should include PLAs to ensure the work is completed in a timely manner by well-trained personnel. To further minimize disruptions, Massachusetts should consider labor peace agreements, local hire and domestic sourcing as applicable, in its transportation procurement contracts.

Cost:

- The cost of electrifying the MBTA regional rail by 2030 will be $1.5 billion.
- The cost of building out an electric passenger rail from Pittsfield to Boston by 2030 will be $1.93 billion.
- The cost of building out HSR in the New England region by 2035 will be $12.5 billion.

Job Creation:

- Electrifying the MBTA regional rail will create 9,600 direct jobs during construction.
- Building out an electric passenger rail from Pittsfield to Boston will create 12,320 direct jobs during construction.
- Building HSR in the New England region will create over 110,000 total direct, indirect, and induced jobs during construction.

Emission Reduction:

- Electrifying the MBTA regional rail could eliminate 7,881 $MTCO_2eq$/year.
- An electric East–West Rail could eliminate 16,496 $MTCO_2eq$/year.
- HSR service in the Northeast Corridor, connected to Springfield and Boston, could eliminate 2,480,236 $MTCO_2eq$/year.

Funding Mechanisms:

The BIL provides $9.6 billion in direct spending, $2.2 billion for the MBTA, and $591 million for the Regional Transit Authority. The Act also allocates $10 billion to the Consolidated Rail Infrastructure and Safety Improvements grant program to restore and enhance passenger rail off the Northeast Corridor. An additional $3 billion exists for grade separation projects for rail systems. Of the $36 billion available for the Federal-State Partnership for the State of Good Repair Program, projects are prioritized for which Amtrak is not the sole applicant (Congressional Research Service, 2022). At the state level, H5151, which passed in 2022, is an $11.3 billion infrastructure bond bill to capitalize on BIL funds.

CASE STUDY

EXPANDING TRANSIT ACCESS FOR MASSACHUSETTS WORKERS

Improving access to public transport is essential for supporting workers, confronting climate change, and promoting mobility for disadvantaged communities. Public Transit Public Good, a partnership convened by Community Labor United that brings together transit workers and riders throughout Massachusetts to fight for the future of public transit, has been leading the fight for a low-income fare at the MBTA. A recent report from Public Transit Public Good outlined the myriad benefits a low-income fare at the MBTA would provide for Massachusetts residents (Public Transit Public Good, 2023). It would save low-income riders on average $500 each, totalling $30 million saved for over 60,000 benefitting riders and allowing riders to take up to 200,000 more trips. The program would especially benefit low-income people and communities of color who are disproportionately burdened by fares; those below the poverty level spend 8% of income on transit, compared to 2.7% for the median Massachusetts earner. Expanding a reduced-fare program would promote equity and provide immediate benefits to users.

Massachusetts has already demonstrated the benefits of fare-free programs. Starting in August 2021, the MBTA launched a free-fare pilot on Route 28, one of the MBTA's highest ridership bus routes that serves some of the most socially vulnerable areas of Boston – about 95% riders are transit-critical, defined by MBTA as "low-income, people of color, seniors, people with disabilities, or who live in households with few or no vehicles" (MBTA, 2022). The pilot aimed to increase ridership, improve service, improve ridership experience, and benefit transit-critical residents, and it was highly successful. Ridership increased 38%, and approximately 300 previously inactive users traveled during the pilot. Passenger satisfaction increased and waiting time decreased, and the majority of beneficiaries were transit-critical. The MBTA has since extended the free fare pilot to Route 28 and two other routes through February, 2024.

Following the state FY24 budget which included $5 million for the MBTA to develop a low-income fare program, on March 28, 2024, the MBTA Board unanimously approved a program plan to provide low-income riders in over 170 communities in the Boston metropolitan region with 50% reduced fares (MBTA, 2024).

Improving the MBTA's reliability, accessibility, and safety will also require addressing its shortage of nearly 2,800 workers (Massachusetts Taxpayers Foundation, 2023). A 2022 safety inspection of the MBTA by the Federal Transit Administration found serious safety concerns stemming from understaffing, overscheduling workers, inadequate training, delayed repairs, and poor quality control (Federal Transit Authority, 2022). The Commonwealth must expand the essential workforce of transit workers, machinists, operators, and maintenance staff while requiring high-road labor standards to guarantee safety and reliability. The Public Transit Public Good campaign is working to ensure increased investment in the MBTA's staff and to ensure workers are at the center of solutions to the authority's current crises.

ELECTRIC VEHICLE INFRASTRUCTURE

RECOMMENDATION:

Expand Public Electric Vehicle Infrastructure While Centering Workers

Massachusetts has a valuable opportunity to advance transportation emissions reduction and high-quality job creation through targeted investments in its vehicle stock and infrastructure while centering the workers who will carry out this transition. The state should endeavor to electrify through repowering or replacing all its school buses and transit buses by 2030. The Commonwealth should also oversee a massive buildout of EV charging stations in public places and establish a public employee e-bike and EV pricing program.

Massachusetts operates nearly 7,500 school buses and over 1,600 transit buses, minibuses, and vans (Federal Highway Administration, 2023; Office of the State Auditor, 2023). Transitioning this number of vehicles to EVs requires significant planning and investment. It is also necessary to carefully consider repowering or retrofitting diesel buses with batteries and electric drivetrains. This process has been effective elsewhere and is more cost effective on a bus-to-bus basis when certain age and vehicle condition criteria are met (Wachunas, 2022). Each of the state's regional transit authorities should be required to submit a transition plan in the near future to ensure appropriate goal setting.

To meet its emission objectives, the Commonwealth needs at least 750,000 EVs on the road by 2030. Massachusetts has banned the sale of new internal combustion engine passenger vehicles starting in 2035 (Palumbo, 2022; Shankman & Dolven, 2022). This swift increase in EVs will necessitate a massive expansion of charging infrastructure. The state should play a large part in the buildout of chargers in public places: to support at least 50% of its passenger vehicles switching to EVs, Massachusetts should install 35,000 public chargers, at least 3,034 of which should be DC fast chargers (Alternative Fuels Data Center, n.d.a).

Developing an e-bike and EV pricing program that provides greater adoption incentives among public employees will expedite EV deployment and directly benefit many working-class Bay Staters. Preference should be given to locally produced e-bikes and EVs to further catalyze in-state EV production.

ELECTRIC VEHICLE INFRASTRUCTURE

High-Quality Job Standards:

Massachusetts should ensure that no existing jobs are transferred to a contracting entity as a result of this transition. The state should further prioritize local purchasing to foster the local electric bus production industry. Employees and contractors should have access to state (or state-funded) training programs to make sure the work is done safely and to industry standards. For example, all EV charging station installers should be certified through the Electric Vehicle Infrastructure Training Program. The Commonwealth should direct 20% of its EV transition funding to workforce development efforts, including recruiting underrepresented populations into pre-apprenticeship programs. Workers in public operations, maintenance, and transportation should be offered training so they are not left behind amid the transition.

Cost:

- Electrifying the state public bus fleet will cost an estimated $3,669,080,000.
- Building out 35,000 public EV chargers will cost $423,605,092.

Job Creation:

- Workforce development funds allocated as part of the bus electrification effort will support an existing 10,250 jobs.
- Investment in public EV chargers will create 1,313 jobs.

Emission Reduction: 10,541,135 MT CO2eq

Funding Mechanisms:

The IRA includes a tax credit for EV chargers on business properties for 6% of the charger cost (up to 30%) if prevailing wage and registered apprenticeship requirements are met. The IRA also includes $1 billion in funding for medium- and heavy-duty electric vehicles, charging infrastructure, and related workforce training. The BIL permits $5 billion for school bus fleet electrification, $5.6 billion for low- and no-emissions transit buses, $2 billion for bus facilities, and $7.5 billion for EV charging infrastructure. Additionally, the U.S. DOT operates the Bus and Bus Facilities Section 5339 Grant Program, the Low or No Emissions Vehicle Program, and the National Electric Vehicle Formula Program, the U.S. DOE operates the Domestic Manufacturing Conversion grant program for hybrid, electric, and hydrogen fuel cell vehicle manufacturing, and the U.S. EPA operates the Clean Heavy-Duty Vehicles program and the Clean School Bus Program (American Cities Climate Change Renewables Accelerator, n.d.d.).

RESILIENCE AND ADAPTATION

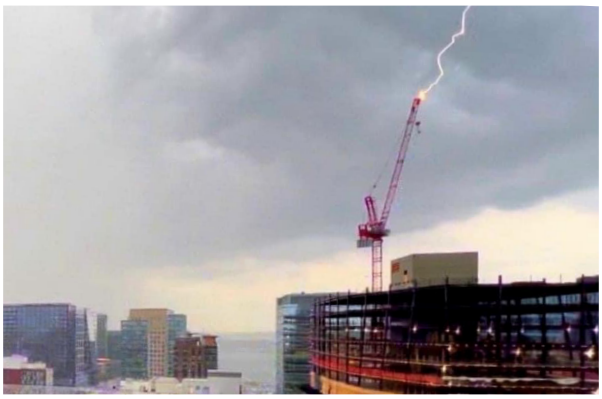
Climate change continues to have immense consequences for Massachusetts. Over the past century, the state has warmed twice as fast as the rest of the nation, causing record-setting heat waves and droughts that are projected to worsen (EPA, 2016). Climate change is also producing severe storms and heavy precipitation, which raise flood risks for more than 400,000 residents living within the 100-year floodplain (Massachusetts Executive Office of Health and Human Services, 2022). These climate impacts tend to hit disadvantaged communities the hardest. Formerly redlined neighborhoods, which are home to primarily Black and Latinx residents, are on average five degrees hotter than other communities during the summer (Metropolitan Area Planning Council, 2021).

The Commonwealth's infrastructure is not prepared to tackle these challenges. Changes in precipitation will strain the state's deteriorating water systems, at least 10% of which are polluted with lead, PFAS, or other harmful chemicals and will cost billions of dollars to repair (Massachusetts Department of Environmental Protection, 2023b). About 15% of homes (U.S. Energy Information Administration, n.d.b) and many public buildings, including 90 schools in Boston, have no air conditioning (Gavin, 2022). A lack of green spaces combined with high pavement coverage creates extreme urban heat islands in cities across the state. Flooding and sea level rise are expected to reduce the operating capacity of Boston's public transit system by 40% over the next decade (Martello et al., 2021). Without ambitious cross-sector investments in resilient infrastructure, climate impacts will continue to threaten Massachusetts residents' safety, health, and economic security.

The state has a framework for climate adaptation through the Municipal Vulnerability Preparedness program, which provides funds for cities and towns to assess climate vulnerabilities and develop resiliency plans.

The program has allocated $100 million in grants to 328 municipalities since 2017 (Mass.gov, 2022). However, Massachusetts has yet to develop a coordinated approach or make the large-scale public infrastructure investments needed to build resilience. Funding has been insufficient to meet the scale of the state's climate impacts. Fortunately, recent federal funds will aid in these investments. The BIL provides $55 billion nationwide to improve water infrastructure and $50 billion for climate resilience projects (The White House, n.d.); the IRA allocates $20 billion for resilience projects (Chyung et al., 2022). FEMA also provides funds for hazard mitigation, including $3 billion through the Building Resilient Infrastructure and Communities and Flood Mitigation Assistance grant programs and a $50 million Safeguarding Tomorrow Revolving Loan Fund program (FEMA, 2022).

Investments in resilient infrastructure can create thousands of family-sustaining jobs. Massachusetts boasts a skilled union workforce of plumbers, pipefitters, construction workers, roofers, and many other industry employees to engage in resilience projects (e.g., repairing water lines, building green infrastructure, and installing cool roofs). The state also features a strong workforce in healthcare, education, childcare, and eldercare that must be supported as climate emergencies become increasingly common. The Commonwealth needs to guarantee that its resilience initiatives spawn high-quality jobs by attaching strong labor standards to these investments: requiring PLAs, prevailing wages, labor peace agreements, and local hiring. Apprenticeship and pre-apprenticeship programs will be similarly essential for growing this workforce and ensuring access to quality careers for people who have been traditionally excluded.



International Union of Operating Engineers

WATER INFRASTRUCTURE

RECOMMENDATION:

Build Clean, Safe, and Climate-Resilient Water Infrastructure

1. Replace all lead service lines and invest in PFAS cleanup in drinking water systems
2. Retrofit wastewater and drinking water treatment plants to reduce contaminants, withstand flooding and heavy precipitation, and be more energy efficient and resilient
3. Implement green infrastructure and permeable pavement to absorb and clean stormwater and to promote groundwater recharge
4. On all public work or work receiving public funds, require PLAs, prevailing wage, and hiring of workers who have graduated from a state or federal apprenticeship program

Massachusetts water systems face the dual challenges of aging infrastructure and worsening climate change impacts.

The state's outdated combined sewer overflow (CSO) systems have been overwhelmed by recent increases in stormwater volume, with 126 million gallons of sewer and stormwater being discharged into the Boston-area Charles river in the summer of 2021 alone (Kuznitz, 2023).

Across the state, 6.8 million people rely on public water from over 1,700 public water systems (Environmental Business Council of New England, 2020). The Commonwealth's oldest water and sewage systems date back to the 1800s, and most have not been upgraded since the last wave of federal investments in the 1970s and 1980s (Water Infrastructure Finance Commission of the Commonwealth of Massachusetts, 2012). Decades of underinvestment have contributed to decaying pipes and treatment facilities and greater health risks for Massachusetts residents. These issues have also left water systems increasingly vulnerable to drought, heavy precipitation, and flooding events.

Massachusetts' drinking water systems contain toxic pollutants that raise residents' health risks, especially

in disadvantaged communities that have seen the highest rates of underinvestment (Centers for Disease Control and Prevention, 2016).

The Environmental Protection Association's 2022 Water Quality Report Card, which scored safety based on bacteria levels, assigned several failing grades to segments of the Boston-area rivers and tributaries (Ellis, 2023). In the Mystic River for example, only one segment, the Upper Mystic Lake,

was assigned an A+ score, with the plurality of scores assigned falling in the D range, and more than half of Mystic River segments received scores in or below the C range. (Ellis, 2023).

A 2016 survey of the state's public water systems showed that the Commonwealth has over 22,000 lead service lines and nearly 13,000 lead goosenecks or pigtails, which connect water mains to a customer's service line (Massachusetts Department of Environmental Protection, 2016). The water systems also have a high prevalence of PFAS, otherwise known as "forever chemicals" due to the difficulty of breaking these substances down. More than 170 water systems have PFAS levels over the legal limit (Massachusetts Department of Environmental Protection, 2023b). Additionally, Massachusetts has 19 combined sewer overflow systems, which transport wastewater and stormwater in the same pipe (Massachusetts Department of Environmental Protection, 2023a). Heavy precipitation can cause these systems to overflow, polluting local water bodies (Young, 2021). Recent flooding in Western Massachusetts left the road system completely overwhelmed, with State Route 5 closed for two days (Li, 2023). Ultimately, as a result of this flooding, nearly 6 million gallons of stormwater and sewage was discharged into nearby Connecticut River (Li, 2023). Overflow into local water bodies raises the risk of gastrointestinal illness as well (Jagai et al., 2015). Addressing these risks will require enormous public investment.

In order to counteract the increasingly common heavy rainfall, a variety of solutions including the establishment of rain gardens, tree trenches, permeable pavements, and bioswales have all been proposed (Ellis, 2023; Hager, 2023; Kuznitz, 2023).

In the Boston area alone, the director of the Mystic River Watershed association has called for a billion dollar investment in clean water (Ellis, 2023), while the Charles River Watershed Association has recommended big box culvert and microtunnel construction projects costing between 30 and 60 million dollars (Hager, 2023).

The EPA Drinking Water Infrastructure Needs Survey and Assessment estimated that Massachusetts will require over $15 billion in capital improvements

Pipefitters, Local 537

for drinking water needs such as upgrading pipes, treatment plants, and storage tanks (EPA, 2023a). The Clean Watersheds Needs Survey projected $8.4 billion in wastewater needs, including $2.9 billion for new collector sewers, $1.9 billion for advanced wastewater treatment, and $1.5 billion for conveyance system repair (EPA, 2023b). Massachusetts has allocated large sums of state and federal funding towards water infrastructure improvements in recent years, including $180 million towards the state revolving fund via the BIL and ARPA (Environmental Business Council of New England, 2020; Pinaud, 2022).[8] However, these investments cover a fraction of the total need and only extend to 2026; the state will need to distribute additional permanent funding for long-term investments in these systems.

Fixing these systems will create various jobs. Repairing and replacing water pipes will require many pipefitters, plumbers, construction workers, and other water system workers. The state will also need large-scale construction work on water treatment plants. Mitigating PFAS levels calls for adding filter vessels to new or upgraded water treatment plants to remove toxic chemicals. In one case, the town of Littleton made a $16 million investment in a new PFAS treatment plant to clean its drinking water system serving 10,000 residents (Moran, 2023). The Massachusetts Water Resources Authority invested $3.8 billion in the Deer Island Wastewater Treatment plant to upgrade facilities and make them more resilient to climate change impacts, including elevating portions of the plant to avoid sea level rise (EPA, 2022b). Because these are public water systems, the state must ensure that jobs are high-quality by requiring PLAs on water infrastructure work. Massachusetts can expand investments in training and pre-apprenticeship programs to grow this workforce.

Pipefitters, Local 537

[8] $55 million for clean water and $25 million for drinking water from the BIL; $100 million through the ARPA.

WATER INFRASTRUCTURE

High-Quality Job Standards:

For work on public water systems, the state should require contractors to meet high road labor standards including selecting PLAs as a project delivery method, where applicable, participating in pre-apprenticeship and licensed apprenticeship programs, and prioritizing hiring from environmental justice communitiess.

Cost: $23.5 billion

Job Creation: 82,041 direct jobs

Funding Mechanisms:

In 2022, the Massachusetts State Revolving Fund allocated $55 million to the Clean Water Program and $25 million to the Drinking Water Program (Environmental Business Council of New England, 2020). The state allocated $100 million from the ARPA and will receive supplemental funding from the BIL, expected to total $1.2 trillion by 2026 (Pinaud, 2022). The BIL also provided $207,533,000 to replace every lead pipe in New England (Skahill, 2022).

CASE STUDY

PUBLIC CLIMATE RESILIENCE WORK: Massachusetts Dam Remediation

In the New England storm of July 2023, which surpassed the rainfall level of Tropical Storm Irene in just a few days, Massachusetts lost over $15 million worth of crops (LeBlanc, 2023). This report followed unprecedented levels of flooding in the Northeast, which shut down several roads and bridges, and also led to nine communities throughout Western Massachusetts facing a state of emergency (Wilson & O'Connor, 2023). Massachusetts is one of many states facing increased flooding risks due to climate change. However, due to its aging infrastructure it is at an elevated risk of further severe outcomes. According to the National Inventory of Dams (NID), of the 4,010 larger dams in the New England region, 533 dams are at risk of failure with substantial hazard potential; over 30% of these dams are located in Massachusetts (Fujiwara & Shankman, 2023).

For dams the NID designates as in either "poor" or "unsatisfactory" condition, and for which failure carries "significant" or "high" hazard potential, there is a present threat of economic loss, and even lethal outcomes (Fujiwara & Shankman, 2023). Failure of these dams may be preventable with remediation efforts and such projects will be critical to climate adaptation progress in the state. Of the dams included in the NID and located in Massachusetts, about 2.2% are federally owned, 15.1% are owned by the state of Massachusetts, and 43.1% are owned by local governments (Association of Dam Safety Officials, 2022). While addressing the issue of remediation, Massachusetts' strong union presence and the majority (60.4%) public ownership of the state's dams (Association of Dam Safety, 2022) present an opportunity to implement public work projects with stronger labor standards attached (Mass. Gen. Laws Ann. ch. 149, § 26.).

The growing availability of public funds for dam remediation can also facilitate labor-centered climate adaptation efforts. In 2021, FEMA's Rehabilitation of High Hazard Potential Dams (HHPD) Grant Program received $585 million of the $3 billion allocated to dam rehabilitation projects in the federal Infrastructure Investment and Jobs Act (Strupp, 2021), and another $11 million through the Bipartisan Infrastructure Law in 2022 (Rehabilitation of high hazard potential dam grant program, n.d.). State funds are also available on an annual basis in the form of grants or loans through Massachusetts' Dam and Seawall Repair or Removal Fund (Dam and Seawall Repair or Removal Program Grants and Funds, n.d.).

HEAT RESILIENCE

RECOMMENDATION:

Strengthen Heat Resilience

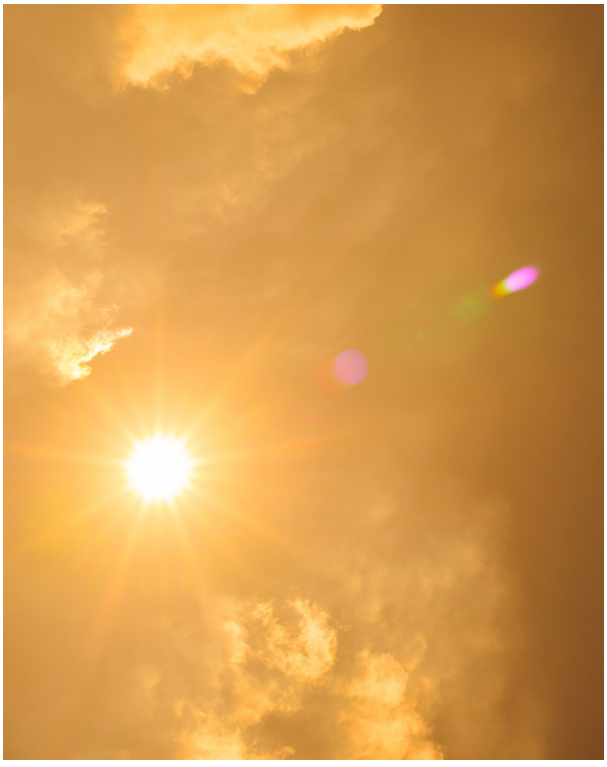
1. Reduce urban heat island through cool and green roofs, cool pavements, and increased vegetation cover
2. Invest in community cooling centers
3. Create stronger heat early warning and response systems
4. Prioritize environmental justice communities

As climate change worsens, Massachusetts will see higher average temperatures and more frequent waves of extreme heat. Annual air temperatures have risen an average of 0.5°F per decade since 1970, putting the state on track to be 1.5°F warmer than today by mid-century (Resilient MA, 2023). Higher average summer temperatures put strains on the state's agriculture, energy infrastructure, and terrestrial and aquatic habitats; higher average winter temperatures can cause early snowmelt and more severe drought. By 2090, rises in heat and humidity could make summers in Massachusetts feel like summer in Georgia today (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Emergency Management Agency, 2022). The state will also see a rise in extreme heat days, defined as days over 90°F. Climate projections show an average of 25 more extreme heat days per year in inland areas and 19 more days for coastal areas (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Emergency Management Agency, 2022).

These temperature changes are most severe in cities, which experience a phenomenon known as the urban heat island effect. Urban areas are hotter than surrounding regions because they have more paved surfaces, which absorb heat. Urban areas also have less vegetation, which provides shade, reflects heat, and releases moisture into the air. Massachusetts cities experience an extreme urban heat island effect, particularly Boston, Worcester, and Springfield (The Trust for Public Land, 2019). The median summer temperature across Boston is 3.4°F higher than surrounding rural and suburban areas, and neighborhoods with the greatest concentration of pavement and the fewest green spaces have an average daily temperature 10°–12°F above the rural ambient temperature (City of Boston, 2022). As heat waves worsen with climate change, these discrepancies – and the associated health impacts on residents – will continue to increase.

Systemic racism and underinvestment in disadvantaged communities have led to a lack of green spaces, air conditioners, and other cooling resources. Thus, communities of color in Massachusetts experience disproportionate impacts from extreme heat. The state reported that census blocks with the highest proportions of minority populations see a 22% higher rate of premature death from extreme heat than the state average, and those with large language-isolated populations suffer 28% more heat-related deaths (Massachusetts Executive Office of Energy and Environmental Affairs and Massachusetts Emergency Management Agency, 2022). In Boston, neighborhoods with the highest heat risk corresponded with the fewest green spaces and the largest proportions of minority, immigrant, or language-isolated populations (City of Boston, 2022).

One way to mitigate urban heating is to install cool or green roofs, which have been shown to cool city surfaces by between 2.5°F and 5.5°F, with even greater cooling (12.5°–14.5°F) in downtown cores (Sharma et al., 2016). Cool roofs consist of a white or light-colored surface painted or plastered onto a building's roof that reflects more sunlight than a dark-colored roof, thereby decreasing the building's temperature. Green roofs are layers of vegetation planted on waterproof membranes on flat roofs. Research from the Boston University School of Public Health found that the cooling associated with installing green roofs on 80% of viable New England buildings could result in 177 fewer annual heat-related deaths across the region (He et al., 2020). Green and cool roofs have multiple benefits beyond cooling. Lower temperatures and insulation effects can reduce buildings' energy needs for air conditioning during the summer, resulting in lower energy costs, emissions, and peak demand while improving grid stability. Green roofs also absorb carbon dioxide, mitigate flooding by capturing 70%–90% of summer precipitation, and reduce stormwater runoff (Green Roofs for Healthy Cities, n.d.). Rooftop solar panels also perform better thanks to reduced overheating (University of Technology Sydney, 2021). Cities and the state can employ a variety of policies to accelerate green and cool roof installation, including grant funding, building code updates, tax credits, and upgrading public facilities' roofs.



Cities can make other infrastructure improvements to reduce urban heat island effects. Installing cool pavements, which reflect solar energy and enhance water evaporation, can result in significant heat reduction. Utilizing permeable pavement also helps to reduce stormwater runoff, mitigating urban flooding as climate change causes more severe precipitation events. Municipalities should also plant trees and vegetation to reduce urban heat. The increased shade and evapotranspiration they provide can reduce peak summer temperatures by 2–9°F (United States Environmental Protection Agency, 2022d).

In addition to building cooler cities, Massachusetts must invest in its ability to respond to heat waves. Cooling centers can provide relief for communities during severe heat events, especially for those without access to air conditioning or other cooling resources. Polling by Boston found that 60% of respondents want to see more cooling centers in their neighborhoods. Public buildings such as schools, libraries and community centers can serve as ideal locations for cooling centers (City of Boston, 2022). Municipalities should invest in these facilities

to ensure they can provide adequate cooling relief during emergencies, including through building envelope and HVAC improvements, increased trees, vegetation and shading canopies, and onsite solar energy and battery storage. Cooling centers are especially important in communities with high vulnerability to heat, including low-income, elderly, and young populations.

Finally, the state should invest in early warning and response measures. The United States Environmental Protection Agency (2023d) recommends that local officials work with the National Weather Service to evaluate 5-day regional forecasts and develop a system for notifying the public of heat waves. Cities can also develop networks of heat and air quality sensors to inform response planning, and they can engage with community leaders and organizations to educate and prepare communities for heat waves. Emergency planning should also address barriers for vulnerable populations to access cooling resources, including comprehensive outreach and education, providing alerts in multiple languages, and expanding transportation access to cooling centers. Overall, Massachusetts must take a coordinated approach across agencies and localities to improve heat resilience and create green jobs.

HEAT RESILIENCE

High-Quality Job Standards:

Installing heat mitigation systems will produce many jobs across the Commonwealth. Skilled roofers and painters will be required to install membranes or coatings. Laborers must install and maintain vegetation on green roofs. The Green Infrastructure Foundation estimates that a $300 million investment in green roofs would generate nearly 1,600 construction jobs and 4,000 maintenance jobs (Lilauwala et al., 2021). Pre-apprenticeship and apprenticeship programs will help develop a robust workforce for installing these roofs. In 2022, Boston allocated $1 million to its Green Jobs Initiative to prepare workers for citywide resilience efforts (City of Boston, 2023). Massachusetts should increase funding for similar programs in conjunction with labor organizations, registered apprenticeship programs, and high quality pre-apprenticeship programs to develop a workforce to meet the growing need for cooling infrastructure. Investments should prioritize local hiring to improve development in disadvantaged communities that experience the worst of the urban heat island effect. For retrofits or installation of cool or green roofs on public buildings or projects receiving state funds, Massachusetts should mandate that contractors or grant recipients meet high road labor standards including PLAs, participating in pre-apprenticeship and licensed apprenticeship programs, and principally hiring from environmental justice communities.

Cost: $3.1 billion

Job creation: 14,643 direct jobs

Funding Mechanisms:

The BIL allocates $50 billion for climate adaptation projects (Georgetown Climate Center, n.d.). The IRA allocates $20 billion for climate resilience, including $837.5 million to improve energy or water efficiency or the climate resilience of affordable housing (City of New York, 2023b; Dirt, 2022). Green and cool roof projects are also eligible for grants under the $550 million Energy Efficiency and Conservation Block Grant Program (U.S. Department of Energy, n.d.b). The Massachusetts Municipal Vulnerability Program, which has awarded $100 million to cities and towns for adaptation and resilience projects since 2017, was allocated $65 million in FY23 (Baker et al., 2022). The same capital investment plan granted $1.7 million to the Climate Ready Housing Program for public housing.

CASE STUDY

CLIMATE CHANGE THREATS TO BOSTON'S WATER INFRASTRUCTURE

Climate change creates numerous challenges for water management, with both severe droughts and heavy precipitation events becoming more common and extreme in Massachusetts. In Boston, this will require substantial upgrades to water infrastructure for drinking water, stormwater, and sewage. Recent research from the University of Massachusetts Boston School for the Environment found that climate change will deplete groundwater levels across the Greater Boston area after 2030 (Knott et al., 2022). Changing precipitation, temperature, and snowmelt could decrease groundwater by up to 28% by the end of the century, which will especially threaten drinking water supplies in Middlesex, Norfolk, and Plymouth Counties. It will also threaten plants, wildlife, and even building foundations.

Boston must rebuild its aging stormwater systems to adapt to climate change. The city has over 650 miles of underground stormwater pipes, half of which were built more than 90 years ago (Wasser, 2021). This system is currently not prepared to accommodate increasing levels of stormwater. The Boston Water and Sewer Commission's inundation model found that the system can handle 5.15 inches of water in 24 hours, but climate change can create storms that bring that level of rainfall in hours (Boston Water and Sewer Commission, n.d). In addition, sea level rise will reduce the effectiveness of sewage pipes by causing backflow into gravity-fed systems and creating sewage overflows.

Boston's threatened water systems demonstrate the need for improved water management and ambitious investment in rebuilding aging infrastructure with trained union labor. The Boston Water and Sewer Commission has identified numerous solutions to improve coastal stormwater discharge, including building pump stations, storm surge barriers, conveyance pipe systems, and tide gates (Boston Water and Sewer Commission, 2023). Other solutions include installing underground storage tanks to hold stormwater, building rain gardens, and improving flood retention in ponds. With new opportunities from recent federal funding, including $52 million in grants from the EPA for stormwater infrastructure (Environmental Protection Agency, 2022), Massachusetts must act quickly to adapt its water systems to climate change while creating family-sustaining jobs.

The city has over
650 MILES
of underground stormwater pipes, half of which were built more than
90 YEARS AGO.
(Wasser, 2021)

'Tools for the Trades' participants at United Association of Plumbers and Pipefitters Local 4

WORKFORCE DEVELOPMENT AND QUALITY CAREERS

Climate change is exacerbated by the growing crisis of economic and racial inequality (Weller, 2023). People's ability to temper the effects of climate change on their lives is closely connected to their economic status (EPA, 2021). Put simply, poorer communities bear a disproportionate burden (Guivarch et al., 2021). Massachusetts ranks 6th in the nation in income inequality, with racial inequities visible in the state's unemployment rate (Economic Policy Institute, n.d.). Overall unemployment is 3.4%, but unemployment for white Americans is 3.1% compared with 3.9% for African Americans and 5.5% for Hispanics (Economic Policy Institute, 2023). Energy burdens further convey economic disparities. The state's overall energy burden, referring to the portion of income spent on energy bills, is 3%; however, the average energy burden for low-income residents is 10% and may be as high as 31% in some areas (Clark, 2022). Similar inequalities apply to the housing market: 45% of Massachusetts households spend 30% of their income on rent, while nearly 25% spend half of their income on this expense (State House News Service, 2022). The rent burden is significantly higher for lower-income residents (Thompson, 2019).

Even as these numbers illustrate the inequities weighing down already marginalized communities, such figures also represent a historic opportunity. Massachusetts is poised to be a leader in the transition to a clean energy economy. According to the 2022 State Energy Efficiency Scorecard, which looks at six policy areas, the state ranked second in the nation for progress and goal setting in this sector (Subramanian et al., 2022). With a federal administration that has set firm clean energy goals and robust federal investments (e.g., the IRA, which incentivizes paying prevailing wages and the use of apprenticeships), now is the time to harness this economic transition for the greater social good. To do so requires thoughtful planning and genuine commitment from multiple stakeholders across the government, labor, community, and business (Wayne & Alcocer, 2021).

Addressing these related crises calls for clean energy spending that 1) ensures high road labor standards and 2) invests in workforce development programs that recruit from and support diverse populations. Target workers should come from frontline communities; Black, indigenous, and people of color (BIPOC) communities; and low-income communities. Efforts must also lead to direct placements in apprenticeships and other high-quality union career opportunities in the clean energy economy.

Reducing income inequality goes beyond simply expanding the number of jobs; it is essential to craft holistic programs that consider the types and quality of jobs created. As indicated, these programs need to recruit from and support historically marginalized communities. Career opportunities such as registered apprenticeship programs that lead to good union jobs must be central to any workforce development plan seeking to alleviate historic inequalities underlying the current economic landscape (National Governors Association Center for Best Practices [NGACBP], 2021). Such opportunities should additionally focus on communities which have historically been excluded from access to high-quality careers. Construction unions have recently broadened pre-apprenticeship programs aiming to support and recruit individuals from historically underrepresented communities. For example, women make up only 10.9% of the nation's construction workforce (including sales office and administrative workers), a mere 4% of whom are tradeswomen (i.e., workers who use tools in construction) (U.S. Bureau of Labor Statistics, 2023). Meanwhile, union-backed pipeline programs (e.g., Build a Life MA and other initiatives) have increased the number of women in apprenticeship programs (Policy Group on Tradeswomen's Issues, 2021). From 2012 to 2022, women's participation as a percentage of active union apprentices more than doubled in Massachusetts, rising to triple the national average (Policy Group on Tradeswomen's Issues, 2021).

'SkillsBuild' Pre-Apprentice at the International Union of Operating Engineers Local 4 (IUOE Local 4)

'Tools for the Trades' participants at the New England Laborers' Training Academy (NELTA)

Ensuring that new energy jobs present high-quality and family-sustaining opportunities for employees must be combined with a dedication to career transition support, training, priority hiring, early retirement, and other safety net measures for current energy workers. These employees, their families, and their communities have built their lives around providing energy so that schools and universities, fisheries, tech companies, government offices, research facilities, and everyday residents have adequate lighting, heat, hot water, refrigeration, and more. Jobs in utilities, transportation, and infrastructure construction are pathways to long-term careers that have historically provided good wages, benefits, and a secure retirement for working-class families (U.S. Energy and Employment Report, 2020). Notably, these careers are accessible to people without college degrees. Industry workers deserve continued protection and security (Manzo & Thorson, 2021).

By expanding investment in quality training programs such as pre-apprenticeships and registered apprenticeship programs — and ensuring labor standards, PLAs, community workforce agreements, and diversity and equity goals on all publicly funded projects — Massachusetts can be a leader in addressing historic economic inequities and building a more just, diverse economy.

JUST TRANSITION

RECOMMENDATION:

Support a Just Transition for Fossil Fuel Workers

As the Commonwealth pursues policies and goals to reduce its dependence on fossil fuels and enlarge its use of renewable energy sources, it must not lose sight of the thousands of workers whose jobs and livelihoods this transition will affect. The state should establish an Office of Just Transition that is tasked with supporting workers displaced by the transition from fossil fuels to clean energy. The office would hold employers accountable for ensuring sufficient staffing throughout the transition, developing plans for retraining displaced workers, and placing employees in related industries. The office should also develop a just transition plan with direct input from workers in the gas and electric utility sectors and ensure that labor has a voice in any related public decision-making bodies.

Furthermore, the Department of Public Utilities should incorporate just transition concepts into its rate-making standards. The Department can establish in-house staffing benchmarks sufficient to provide safe, reliable service during the transition to net zero emissions along with occupational safety training for all employees. Gas companies should be required to supply just transition plans that address workforce development, cross-training, and hiring preferences with renewable energy companies. These plans should additionally outline steps to protect pensions, early retirement incentives, and other methods for minimizing the impact of moving to a clean energy economy.

To best support displaced workers financially, Massachusetts can amend its unemployment insurance statute to provide supplemental assistance to fossil fuel workers affected by the transition to net zero emissions. Employers in the renewable energy industry that hire displaced workers could receive tax credits to further incentivize retraining and re-employment for fossil fuel workers. The Commonwealth should also establish a training fund to support apprenticeship programs that will train legacy fossil fuel workers in alternative energy generation and distribution. Competitive grants should be directed towards programs centered on creating family-sustaining careers for displaced workers.

SkillsBuild Pre-Apprenticeship Program' participants at the New England Laborers' Training Academy (NELTA)

LABOR STANDARDS AND WORKFORCE PLANNING

RECOMMENDATION:

Ensure Clean Energy and Workforce Standards

'Tools for the Trades' participants at United Association of Plumbers and Pipefitters Local 4

Without a clear vision of employment risks for current fossil fuel workers and the needs and opportunities in new clean energy careers, many workers, families, and communities will be left vulnerable to economic disruption. Massachusetts risks missing a historic opportunity to help marginalized communities access high-quality, family- and community-sustaining careers. At a time of unprecedented clean energy investment, the state must develop a comprehensive plan to ensure the most effective means of protecting workers and building a diverse and inclusive workforce.

As proposed in the 2023-2024 session bill An Act Relative to a Just Transition to Clean Energy, The Massachusetts Clean Energy Technology Center should coordinate with the Executive Office of Labor and Workforce Development and the proposed Office of Just Transition to draft and implement expansive and inclusive workforce development plans which specify education, outreach, training, and recruitment into clean energy jobs for various groups: workers in fossil fuel industries; communities at high risk from the effects of climate change; BIPOC and environmental justice populations; and women (2024). In addition, these offices should map and project jobs losses and gains in the clean energy transition while setting standards on minimum working conditions and clear goals for priority hiring on all Clean Energy projects financed, owned, or leased through the Renewable Energy trust fund or any other agency or office of the Commonwealth.

Successful workforce development plans rely on a multi-stakeholder approach that brings local knowledge, technical expertise, and a commitment to success to the table (Eyster et al., 2016). The Massachusetts Clean Energy Center's planning should include representatives from industry-related labor unions, pre-apprenticeship and apprenticeship programs, frontline communities, and diverse voices. This approach can generate inclusive plans for the creation and implementation of grants and technical assistance that will expand construction, operations, and maintenance work while ensuring safe working conditions and family- and community-sustaining wages for all employees in the clean energy industry (Ross & Day, 2022).

PROCUREMENT STANDARDS

RECOMMENDATION:

Leverage State Investments to Drive Good Jobs Through Procurement Standards

Where Massachusetts procures goods and services for the Commonwealth and its residents, the state should support domestic manufacturing through Buy American requirements and incentivize labor peace agreements in goods and services contracts. These measures will propel high-quality clean energy supply chain and manufacturing jobs in Massachusetts.

The state can leverage its purchasing power to engage in bulk purchasing that will drive up demand and create more cost-efficient products for private sector and personal households. In addition, Massachusetts should identify public land lease opportunities and establish funds for grants and other direct investments to support in-state manufacturing. PLAs should be negotiated for the construction and buildout of new manufacturing facilities; labor peace agreements should apply to operations and maintenance work. Expanding union manufacturing and construction jobs can bring economic benefits to Individuals, families, communities, and the Commonwealth as a whole (Banerjee et al., 2021).

'Tools for the Trades' participants at the New England Carpenters Training Center in Millbury

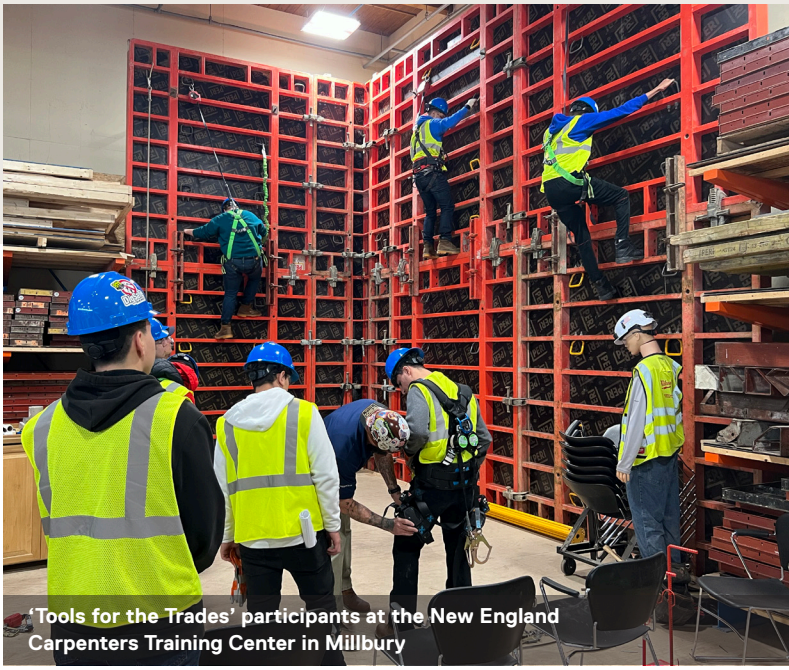
PRE-APPRENTICESHIP EQUITY AND ACCESS

RECOMMENDATION:

Increase Funding for High-Quality Pre-Apprenticeship and Wraparound Services

As Massachusetts builds out clean energy infrastructure – whether through building offshore wind ports, laying cables, growing public transportation, retrofitting schools, installing EV charging infrastructure, building adaptations, or more – many jobs in the clean energy transition will be in construction (Office of Energy Jobs, 2023). While the state works to enact strong labor laws to ensure these positions are high-quality union jobs, projects must display a strong commitment to diversity, equity, and inclusion (An Act Relative to Clean Energy Workforce Standards and Accountability, 2023). Construction work can be best diversified by bolstering investments in high-quality pre-apprenticeships and increasing spending for wraparound services that will truly support historically excluded communities (National Employment Law Project, 2021). These individuals will then have a chance to succeed and thrive. This way, Massachusetts can build a skilled pipeline of diverse workers who can meet the needs of this transition.

The Commonwealth has an established network of successful pre-apprenticeship programs that aim to identify underserved communities, BIPOC individuals, women, youth, and residents of frontline communities.



'Tools for the Trades' participants at the New England Carpenters Training Center in Millbury

Such programs support these people in entering into union apprenticeship programs in the building and construction trades. Apprenticeship pipeline building initiatives such as Building Pathways, Community Works, Tools for the Trades, Skills Build, and Build a Life MA – Northeast Center for Tradeswomen's Equity serve as outstanding examples for the rest of the state (Cannon, 2022). Nevertheless, much work remains: in Boston, African Americans represent 24% of the population but were found to account for only 12%–14% of the workforce on large construction projects (Singer, 2022). Many training programs run for six weeks and have classes that are held during working hours. Individuals seeking well-paid career opportunities may have low-paying or part-time jobs on which they rely to pay rent, buy food, pay bills, or otherwise support their families. Programs that provide stipends, transportation vouchers, meals, and childcare services enable people to venture into a new industry. The need for additional support continues in the early days of apprenticeship, where

additional costs (e.g., tools, work boots, initiation fees, and other unforeseen expenses) can deter workers who are living paycheck to paycheck. Massachusetts has developed, and supports, funding for pre-apprenticeship programs. (City of Boston Office of Workforce Development, n.d.). However, available funding is inadequate compared with the need for outreach and more robust wraparound services that allow workers from underserved communities to fully participate and thrive.

Funding Mechanisms:

The IRA appropriates $2.2 billion for Environmental and Climate Justice block grants, which local governments and community-based nonprofits may use to support workforce development tied to reducing greenhouse gas emissions (Inflation Reduction Act, 2022).[9] The state can also request federal funds of up to $5 million to establish or scale programs that prioritize rural or historically marginalized and underserved communities through the U.S. Department of Labor's Building Pathways to Infrastructure Jobs Grant Program (U.S. Department of Labor, 2023).

SMART Local 17 Training Center


SMART Local 17 Training Center

[9] H.R.5376, Sec. 60201.

PUBLIC SECTOR TECHNICAL CAPACITY

RECOMMENDATION:

Expand Scientific and Technical Capacities in the Public Sector Workforce

To make sure that all state bodies engaged in the transition to a clean energy economy create relevant policies, it is crucial to build out staffing plans that include sector-specific capacity and technical expertise in affected areas (e.g., grid transmission and distribution, building electrification and deep energy retrofits, renewable energy, public utilities, natural resources, adaptation and resilience, environmental quality, transportation, permitting, and planning). This expertise should be equally distributed across Executive Offices (EOs) such as the EO of Energy and Environmental Affairs, the the EO of Housing and Liveable Communities, and the EO of Labor and Workforce Development. Expertise should also apply across departments like the Department of Public Health, Department of Labor Standards, Department of Environmental Protection, Department of Energy Resources, Department of Public Utilities, and MassDOT as well as regional planning commissions and councils.

Instructor teaching students at the New England Laborers' Training Academy (NELTA)

CASE STUDY

INVESTING IN A JUST TRANSITION FOR MASSACHUSETTS ENERGY WORKERS

Massachusetts' transition to a clean energy economy will have significant impacts on workers, families and communities who have historically depended on the fossil fuel industry's economic input, employment, and high quality union jobs and strong economic input from fossil fuel industries. Two recent examples of energy plant retirements in Massachusetts highlight the challenges involved in this transition and the need for significant levels of investment, support, and planning to ensure that workers are not left behind.

In April 2019, the Pilgrim Nuclear Power Station in Plymouth, Massachusetts closed down after operating since 1972. The initial layoff included 300 workers, with a second 300 worker layoff occurring in June 2020. In response to this shutdown, the Massachusetts Executive Office of Labor and Workforce Development applied for $500,000 in National Dislocated Worker Grant (DWG) funding through the US Department of Labor (ISO-NE, 2020). The approved grant provided reemployment services to over 125 employees impacted by the closure, including career planning, comprehensive assessments, resume writing, and job placement (U.S. Department of Labor, n.d.) (T&D World, 2023). UWUA also negotiated severance packages and relocated all qualified employees (Utility Workers Union of America Local 369, 2022). UWUA workers are also conducting the critical work of decommissioning the station and removing hazardous nuclear fuel from the station to safely neutralize the site. While these DOL funds provide important support to workers, Massachusetts must do much more to expand these benefits, identify transferable skills, and implement plans for retraining and placing employees in related industries.

The Mystic Generating Station in Everett, Massachusetts is also planned to fully retire in June, 2024. The 1,413 megawatt natural gas-fueled electric generation plant/station plans to retire its final two combined-cycle gas turbines, Unit 8 and Unit 9, which have operated since 2003. Constellation Energy had applied to retire the station in 2019, but ISO-NE ordered it to keep open until the transmission system could be upgraded. In 2022, ISO-NE approved the Boston Ready Path solution, a National Grid and Eversource grid upgrade program that includes installing new equipment at substations in Tewksbury, North Cambridge, Amesbury, and Haverhill to improve transmission system stability and redirect power flows. UWUA negotiations resulted in positions for employees who wanted to continue working with the company and provided a year's salary, health care benefits, and a pension for employees who planned to retire. UWUA is also conducting the site's decommissioning work, ensuring that trained workers oversee the safe removal of hazardous waste.

CASE STUDY

GROWING AN INCLUSIVE CLEAN ENERGY WORKFORCE: Building Pathways

'Tools for the Trades' participants at the New England Carpenters Training Center in Millbury

The Massachusetts Building and Construction Trades unions and their signatory contractors have a vast training network, operating more than 40 joint apprenticeship training centers across the state and investing nearly $55 million annually to ensure there is a steady supply of highly trained workers trained to meet industry needs (MBTU, 2023). In order to ensure these high-quality career opportunities are meeting the needs of historically marginalized communities and supporting the diversification of the union workforce, the building trades partner with and support a number of successful pre-apprenticeship programs. One such program worth highlighting is Building Pathways Inc.

Dedicated to increasing diversity and expanding opportunities for low income communities and underrepresented individuals in the construction industry, Building Pathways was established in 2011, and since its inception has played a vital role in addressing workforce challenges faced by job seekers in the construction industry (Building Pathways, n.d.). Through their pre-apprenticeship training program they prepare individuals for an apprenticeship and a career in the construction trades. By focusing outreach to populations who have been historically underrepresented in the industry, including women, people of color, and veterans, and providing inclusive training and placement opportunities, they have helped to increase representation in the workforce. The organization also works to ensure there are public policies and industry practices that create demand for the people they train (Building Pathways, n.d.).

The pre-apprenticeship training program covers various aspects of construction, including safety training, trade-specific skills, industry familiarization and job readiness. Additionally, participants receive assistance with resume building and interview preparation, and a mentorship program where experienced tradespeople provide guidance and support throughout their training and career (Building Pathways, n.d.).

Another Building Pathways program to highlight is the Northeast Center for Tradeswomen's Equity. Through tradeswomen workshops, tradeswomen Tuesdays, and other networking and support strategies they work to connect women, and particularly women of color, to family sustaining career opportunities as union building trades members (Building Pathways, n.d.).

By promoting diversity and providing individuals with the skills and support they need, as well as building strong partnerships with labor unions and other industry partners, Building Pathways can serve as a model for how the Commonwealth can continue to grow a more inclusive workforce to meet the needs of the growing clean energy industry (Build A Life That Works, n.d.).

JOB CREATION

RECOMMENDATION	DIRECT JOBS
Buildings	**453,329 total**
Pass An Act Relative to Healthy and Sustainable Schools	44,881
Rapidly Scale Union-Built Net Zero Affordable and Equitable Housing Opportunities by 2030	319,065
Thermal Utility Districts	14,847 Thermal Utility
	72,540 Heat Pump
Energy	**343,547 total**
Dramatically Increase Renewable Energy Production by 2040	293,664 Solar
	30,634 Offshore Wind
	3,636 Energy Storage
Expand and Modernize the Electrical Grid	1,645 Grid Modernization
	11,902 High Voltage Transmission Installation
Expand Funding for Community Microgrids	320
Make Massachusetts a Leader in Green Hydrogen Production and Distribution	1,746
Continue Methane Leak Prevention	1,996

RECOMMENDATION	DIRECT JOBS
Transportation	**23,881 total[10]**
Develop an Electric Local, State, and Interstate Passenger Rail Network	9,600 Electrifying the MBTA
	12,320 Expanding Electric Passenger Rail from Pittsfield to Boston
	110,000 Building High-Speed Rail in the New England Area[11]
Expand Public Electric Vehicle Infrastructure While Centering Workers	1,313 Investment in Public EV
Resilience and Adaptation	**96,684 total**
Build Clean, Safe, and Climate-Resilient Water Infrastructure	82,041
Strengthen Heat Resilience	14,643

[10] Total does not include the 110,000 direct, indirect and induced jobs estimated from the regional HSR line. Implementation must ensure that the portions of the rail line built in Massachusetts include a majority of local workers

[11] Calculation for HSR includes direct, indirect and induced jobs across New England

METHODOLOGY

BUILDINGS

RECOMMENDATION:

Pass An Act Relative to Healthy and Sustainable Schools

Cost Calculation: The New Buildings Institute (2021) estimated total Massachusetts K–12 school square footage at 186 million. The Massachusetts Division of Capital Asset Management and Maintenance (2023) estimated that public higher education institutions total 42 million square feet. The Energy Information Administration's Commercial Buildings Energy Consumption Survey estimated that education buildings in New England have an energy use intensity of 67.4 kBtu per square foot (U.S. Energy Information Administration, n.d.d), resulting in a total estimated energy usage of 4.5 billion kWh for Massachusetts public schools. Electrification and retrofits are projected to reduce 50% of school energy use intensity (National Renewable Energy Laboratory, 2013). At an estimated cost of $15 per square foot of retrofit (Urban Green Council, 2019) and $12 per square foot of electrification (Introba, 2019), total retrofit and electrification costs come to $6.2 billion. The necessary solar is assumed to meet the remaining 50% of school energy needs. Assuming a generation factor of 1,300 kWh of solar per kW installed (U.S. Department of Housing and Urban Development, n.d.) and an already installed capacity of 102 kW of solar on schools,[12] Massachusetts schools require 1,6298 MW of solar to meet remaining energy needs. Assuming the cost per KW as $2,576 (U.S. Energy Information Administration, 2022c), the total cost of solar is $4.2 billion. Note the cost of solar continues to decrease – the IPCC estimates that unit costs of solar energy decreased 85% between 2010 and 2019 (IPCC, 2023) – and cost estimates may change based on the year solar is installed and the supply chain conditions at that time.

Job Creation: For retrofits: 4.7 direct jobs per million dollars invested; for solar installation: 3.8 direct jobs per million dollars invested (Pollin et al., 2021).

Emission Reduction: Analysis by the New Buildings Institute (2021) found that Massachusetts K–12 schools emit approximately 879,131 MT CO_2e per year. Some emission data exist for higher education but further analysis should occur on Scope 1,2,3 emission contribution and energy use trends in Massachusetts public universities and community colleges.

RECOMMENDATION:

Rapidly Scale Union-Built Net Zero Affordable and Equitable Housing Opportunities by 2030

Cost Calculation: Massachusetts has an estimated gap of 175,367 affordable housing units (National Low Income Housing Coalition, 2023). Coastal flooding and sea level rise are predicted to affect an estimated 2,408

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[12] K-12 installed solar is reported in: Generation180. (2022). Brighter Future: A Study on Solar in US K-12 Schools. https://generation180.org/wp-content/uploads/2022/12/BrighterFuture2022.pdf

Installed solar on higher education institutions was determined from reports from each institution.

housing units by 2030 with the number units affected as climate change worsens in 2050 and beyond (Climate Central, 2021). There is an existing commitment of 450 new affordable housing units (Governor Maura Healey and Lt. Governor Kim Driscoll, 2023), assuming 1,199 square feet (United States Census Bureau, n.d.) and an anticipated cost of $325/square foot per net zero housing unit.

Job Creation: 4.6 direct jobs per million dollars invested (Pollin et al., 2021)

Emission Reduction: The buildout must be net-zero to account for Scope 1 and Scope 2 emissions and prioritize utilization of low embodied construction material to account for Scope 3 emissions.

RECOMMENDATION:

Rapidly Scale Union-Built Thermal Utility Districts by 2030

Cost Calculation: Assuming the cost per heat pump to be $27,900 (Dandelion Energy, n.d.) and the cost per geogrid connection per unit to be $3,531 (HEET, 2019)

Job Creation: Thermal Utility Networks: 14,847 Direct Jobs. Additional Heat Pumps: 72,540 Direct Jobs.

Emission Reduction: There is a potential to reduce emissions by 21,000,000 Metric tons of CO2e. This reduction would include Scope 1 emissions reducing emissions by limiting burning of on site fossil fuels in buildings.

ENERGY

RECOMMENDATION:

Dramatically Increase Renewable Energy Production by 2040

Cost Calculation: Where Massachusetts electric capacity was determined using the clean fuels pathway from the MA CECP Excel workbook using raw data from the 2025/2030 CECP modeling analysis (Massachusetts Executive Office of Energy and Environmental Affairs, 2022). The CECP projects installed capacity of each energy source needed to achieve net zero by 2050; these projected installed capacities for each year were shifted forward to account for the IPCC's (2023) latest reporting. The cost of solar is estimated to be $2,576 per KW and the cost of OSW was assumed to be $78 per MWH. (U.S. Energy Information Administration, 2022c & Stehly, et al., 2022). Battery storage installation is spread over a 17-year time period assuming declining cost over time (Cole, et al., 2021)

Job Creation: 3.8 direct jobs per million invested in solar energy, 3.6 direct jobs per million invested in offshore wind, and 3.5 direct jobs per million invested in battery storage. (Pollin, et al., 2021)

Emission Reduction: Solar and wind emission reductions were determined utilizing the EPA Greenhouse Equivalencies calculator (Environmental Protection Agency, n.d.).

Battery storage emission reduction was determined utilizing a sample of existing peaker plant emissions. (PSE, 2020)

RECOMMENDATION:

Expand and Modernize the Electrical Grid

Cost Calculation: The amount of high voltage transmission to support renewable energy growth under a high electrification model was estimated to be 5,263 GW-km (Princeton University, n.d.). The cost per MW-mi was estimated using the median cost of $1,137.40 (DeSantis, et al., 2021). Grid modernization plans were estimated to be $198 million for Eversource, and $316.3 Million for National Grid (Massachusetts Department of Public Utilities, 2021a & 2021b)

Job Creation: 3.2 Direct Jobs Per Million Invested in Grid Modernization and Transmission work (Pollin, et al, 2020)

RECOMMENDATION:

Expand Funding for Community Microgrids

Cost Calculation: Microgrid projects are assumed to cost $7 million, based on a RUN-GJC estimate of $6 million to $8 million for a three-facility microgrid project in Chelsea (Clean Energy Solutions, Inc., 2020). Assuming that 3–6 facilities are connected to each microgrid, a $100 million investment would create 8–12 microgrids.

Job Creation: 3.2 direct jobs per million dollars invested in electricity infrastructure projects (Sierra Club & Political Economy Research Institute, 2020)

RECOMMENDATION:

Make Massachusetts a Leader in Green Hydrogen Production and Distribution

Cost Calculation: Hydrogen Production was determined using the clean fuels pathway from the MA CECP Excel workbook using raw data from the 2025/2030 CECP modeling analysis. (Massachusetts Executive Office of Energy and Environmental Affairs, 2022). The CECP projects hydrogen needed by 2050; these projected installed capacities for each year were shifted forward to account for the IPCC's (2023) latest reporting. Only hydrogen fuel for industry and transportation was included in this calculation. Hydrogen production costs are estimated at $3 per kilogram (IEA, 2021).

Job Creation: 0.6 direct jobs per million dollars invested in green hydrogen production (Pollin et al., 2022)

RECOMMENDATION:

Continue Methane Leak Prevention

Cost Calculation: Total replacement costs for the Massachusetts Gas System Enhancement Program is estimated at $16 billion through 2039, the program's expiration date (Castigliego et al., 2020). Repair costs are estimated at $4,000 per leak (Seavey, 2021). Massachusetts has about 11,624 new gas leaks per year (HEET, n.d.). Because 7% of leaks are "super emitters" that release over half of all gas leak methane (Hendrick et al., 2016), these pipes are assumed to warrant replacement with the other 93% of annual leaks receiving repair

Job Creation: 1,996 direct jobs.

TRANSPORTATION

RECOMMENDATION:

Develop an Electric Local, State, and Interstate Rail Network

Cost Calculation: Boston Regional Rail: TransitMatters (2021), a Boston-based public transportation advocacy group, estimated a need of $1.5 billion in 2021 dollars to electrify and modernize the Boston Commuter Rail service. East–West Rail: TransitMatters (n.d.b) estimated a need of $1.925 billion in 2021 dollars to build an electrified, dedicated passenger rail service between Pittsfield and Boston. Interstate HSR: The Northeast Corridor Commission (n.d.) estimated a need of $12.5 billion in 2021 dollars to establish HSR service between New Haven and Springfield and New Haven and Boston.

Job Creation: Boston Regional Rail: Pollin et al. (2021) estimated that 6.4 direct jobs would be created per million dollars invested in passenger rail development. East–West Rail: Using the same 6.4 direct jobs per million dollars invested multiplier (Pollin et al., 2021). Interstate HSR: The Northeast Corridor Commission (n.d.) estimated 110,000+ direct, indirect, and induced regional jobs due to HSR development.

Emission Reduction: Boston Regional Rail: Using the MBTA's (n.d.a, n.d.b) disclosed emission reductions per ride and ridership data, a total emission reduction of 7,881 $MTCO_2eq$/year was calculated.

East–West Rail: Using the vehicle miles traveled reduction estimate of Scenario ⅘ Hybrid Downeaster from the MassDOT (2021) report on East–West Rail, and the emissions per mile from the EPA (2022c), the reduction of 16,496 $MTCO_2eq$/year was found. Interstate HSR: Using the Federal Transit Administration's Greenhouse Gas Emissions Estimator v3.0, and assuming a 3% reduction in VMT as a result of HSR development, a reduction of 2,480,236 $MTCO_2eq$/year was found (Federal Transit Administration, 2022; Massachusetts Executive Office of Energy and Environmental Affairs, 2022).

RECOMMENDATION:

Launch an Expansion of Public EV Infrastructure Centering Workers

Cost Calculation: Bus Electrification: The number of school buses in the state (7,468) was retrieved from the Federal Highway Administration (2023), and the cost per bus ($400,000) was retrieved from the Alternative Fuels Data Center (n.d.b). The numbers of transit buses (674), short buses (682), and transit vans (254) in Massachusetts were obtained from each individual regional transit authority (Massachusetts Office of the State Auditor, 2018-2023). Costs were acquired from the Sierra Club ($750,000), the NYC Clean School Bus Coalition (n.d.; $240,000), and Kelley Blue Book (2023; $50,000), respectively. (Sierra Club, n.d., NYC Clean School Bus Coalition, n.d., Kelly Blue Book, 2023). Chargers: The Alternative Fuels Data Center's (n.d.a) EVI-Pro Lite tool was used to estimate the need for chargers for 50% of the state's vehicles. Currently registered EVs were subtracted from the total before halving (Alternative Fuels Data Center, n.d.c). The cost per charger by type was retrieved from a report by the International Council on Clean Transportation (Nicholas, 2019).

Job Creation: Bus Electrification: The number of bus drivers was collected from the U.S. Bureau of Labor Statistics (2022c, 2022d). Chargers: The job multiplier of 3.1 direct jobs created per million dollar invested in electric vehicle charger installations was used (Pollin et al., 2022).

Emissions Reduction: Emissions per diesel bus was estimated at 54,000 pounds CO2eq per year (Electric School Buses 2023). Increases to EV infrastructure assume 50% reduction in emissions from personal vehicles (n.d.)

RESILIENCE AND ADAPTATION

RECOMMENDATION:
Build Clean, Safe, and Climate-Resilient Water Infrastructure

Cost Calculation: The 2012 EPA Clean Watershed Needs Survey estimated a $8,352,552,713 spending gap for Massachusetts wastewater infrastructure (EPA, 2023b). The 2015 EPA Drinking Water Infrastructure Needs Survey and Assessment estimated a spending need of $12,244,400 for Massachusetts drinking water systems (EPA, n.d.).

Job Creation: 5.4 direct jobs created per million dollars invested for drinking water, wastewater, and stormwater system construction or improvements (Pollin et al., 2022)

RECOMMENDATION:
Strengthen Heat Resilience

Cost Calculation: Total roof area was estimated using the Microsoft (2022) Building Footprints GIS layer. Comparing these measured building footprints with ground-truth data revealed a distortion of building area which could be explained by application of a correction bias of 5.9, which converts the areas from a planar to geodesic distance. Footprints were summed for priority census tracts with high urban heat effects. Cool roofs were assumed to cost $2.05 per square foot (EPA, 2017), and green roofs were assumed to cost $20.50 per square foot (Rosenzweig et al., 2006). Cool roof area was assumed to be installed on 75% of target census tracts, with green roof area installed on the remaining 25%. The cost of an early warning system for heat risks is estimated to be $210,000 USD (Toloo et al., 2013)

Job Creation: 4.7 direct jobs created per million dollars invested for building retrofits (Pollin et al., 2022)

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