Reducing Emissions in Lowell through Infrastructure and Efficiency First (RELIEF) Workplan

1. Overall Project Summary and Approach

Lowell, Massachusetts, is a vibrant and diverse community of 114,804 individuals. Our community has a proud history as a historic mill town and manufacturing center, attracting a diversity of individuals from around world. According to the EPA's EJ Screen Community Report, 40% of households speak a non-English language at home, 52% of community members are people of color, and 35% of community members are low-income. According to CEJST the majority (72%) of Lowell census tracts are DAC and/or contain EJ block groups. Our proposed **Reducing Emissions in Lowell through Infrastructure and Efficiency First (RELIEF) initiative** is the result of multiple years of effort across our community to address the growing risks to our community from climate change. The initiative will reduce the burden of high energy costs and pollution of current fossil fuel energy systems, while supporting our community in joining the transition to a clean energy economy. RELIEF will improve the lives of our constituents and students by upgrading our school buildings so they are "decarbonization ready" on a pathway to net zero emissions. The proposed upgrades will not only provide emissions reductions but will also help provide relief to those served in our schools, help to "re-leaf" our urban environment, and provide solutions to urban heat islands. RELIEF will continue to partner with our community and labor organizations to ensure this effort delivers multiple community benefits. RELIEF is an ambitious and far-reaching initiative that encompasses all twenty-eight schools within the geographic boundary of the city, reflecting a comprehensive approach to sustainability and environmental stewardship.

RELIEF will significantly reduce greenhouse gas (GHG) emissions and prepare Lowell Public School buildings to be net zero by 2035. The program includes a progressive approach to complete deep energy retrofits of existing buildings; implement infrastructure upgrades to enable renewable energy integration; assess feasibility of decarbonization of heating fuels; implement decarbonization of heating fuels; accelerate restorative planting efforts through implementation of our Urban Forest Master Plan; and allow for meaningful engagement and education of those living in disadvantaged communities in our city. The City of Lowell has gone through comprehensive assessments of our facilities to identify opportunities for emissions reductions.

We also have a **proof of concept for this comprehensive RELIEF approach at the Stoklosa Middle School**. At this facility, we have implemented LED lighting upgrades, weatherization (WX), and retro-commissioning (RCx) of controls and mechanical systems. Since completing RCx in FY 2021, we have seen a 43% overall energy use reduction, 32% electricity use reduction, 51% natural gas use reduction, and **42% GHG reduction.** We are looking to build on this success at the facility through grant funding for solar-enabling infrastructure and potential electrification and replicate the model across our portfolio.

We look to leverage the Environmental Protection Agency's Climate Pollution Reduction Grant (CPRG) funds to fast-track emissions reductions across our school building portfolio. Projections indicate that CPRG funding, when braided with known and anticipated funding sources, can result in a **50% emissions reduction for Lowell Public Schools in the next five years**.

RELIEF will provide a unique and scalable model for other Low-Income Disadvantaged Communities (LIDAC) with older buildings to rapidly decarbonize with the lowest cost, highest GHG reduction measures that also provide resilience, health and economic benefits to communities.

a. Description of GHG Reduction Measures

The RELIEF approach prioritizes cost-effective efficiency measures with significant GHG reductions first: lighting upgrades and controls, weatherization, and retro commissioning (RCx).

Lighting upgrades generally include installing new LED fixtures with smart controls capable of dimming or turning off fixtures based on occupancy or daylight harvesting conditions. Since lighting upgrades provide a rapid pathway to emissions reductions, CPRG funds are requested to complete these upgrades in the 19 Schools where lighting upgrades are incomplete.

Weatherization (WX) may involve repair work to the building envelope, air sealing, weather stripping, roof insulation or wall insulation, depending on needs within the building. These measures not only provide energy savings, but also indoor air quality and health outcomes by reducing introduction of external moisture and environmental pollutants and reducing pathways for rodents to enter facilities. Due to enhanced utility energy efficiency incentives for projects completed before the end of 2024, Lowell is moving forward to complete this work at all schools before the end of the year. This work will enhance the impact of GHG emissions achieved using CPRG funds. No CPRG funds are requested for this work.

Retro-commissioning (**RCx)** is a systematic process for investigating, analyzing, and optimizing an existing building's system performance. The goal of RCx is to get the building back to functioning as it was initially designed while bringing the building up to current code or energy efficiency standards. This often includes upgrading the controls system, either with new controllers or by re-programming existing controls. During RCx, downstream mechanical equipment is evaluated, and proper operation is verified. If minor equipment failures are found (damper, actuators, valve, temp sensors, etc.), they are replaced or repaired as part of the RCx project. In the past year, the City of Lowell experienced a significant cyberattack that rendered existing control systems inoperable. In the Fall of 2023, Lowell began the process of replacing the control systems across our portfolio. The new system allows us to scope out potential RCx opportunities. Due to the complexity and iterative processes involved in RCx, emissions reductions, though potentially significant, have a longer planning and implementation timeline. For this reason, Lowell is looking to implement these projects over the course of the next five years through other funding sources.

Renewable (Solar) Energy development through integrating behind-the-meter solar at facilities. In the Fall of 2022, Lowell released a Request for Information to determine feasibility of solar development across our portfolio. This analysis showed that eleven schools had economically viable solar potential (in addition to the four schools where solar already exists). In July of 2023, Lowell signed a Letter of Intent (LOI) to develop solar across these nine schools and two parking garages. This LOI allowed our selected solar vendor to secure Massachusetts solar incentives and apply for interconnection. Four of schools have received permission to interconnect, and two schools are anticipated to have this permission in the coming months. In order to develop four of these interconnection-ready projects, solar-enabling infrastructure is necessary, including roof and electrical service upgrades that allow for deployment of the solar panels with a partner firm through a power purchase agreement (PPA). The PPA model allows the systems to be deployed more quickly and maintained more economically by firms whose primary expertise is solar development. The addition of onsite renewables offers strong GHG reductions. As such, we are requesting CPRG funding to help create solar-enabling infrastructure at three of our schools. Lowell will be looking to pursue and develop additional solar and solar-enabling infrastructure through existing and anticipated future funding resources.

With the lighting, WX, RCx, and solar projects completed, Lowell will be positioned with the lowest site energy load. This will allow us to explore **Electrification of the HVAC System** with the lowest possible draw for smaller and more efficient system options. Lowell recently worked with our utility provider to complete a high-level feasibility study for electrification options at the Stoklosa Middle School. Because we had already implemented deep energy retrofits at the facility, the analysis indicated that sufficient electrical capacity existed at the facility to decarbonize heating sources, without the need for expensive electrical panel upgrades. The analysis also indicated that the additional electricity use anticipated from displacement of fossil fuel boilers could be balanced by the anticipated solar energy production at the facility. We will be working with the utility to complete additional electrification feasibility studies for our decarbonization-ready schools.

The RELIEF approach will allow Lowell to size new electrified HVAC systems appropriately, take advantage of heat pump technology evolution, and access the potential for networked geothermal expansion. Lowell is part of a nation-leading pilot on networked geothermal systems. By moving aggressively to implement energy efficiency, then installing a proven system of renewable energy deployment, Lowell is maximizing GHG reduction, cost effectiveness, resiliency, health benefits, and leaving the door open for cutting-edge electrification technology. Electrification efforts would be implemented through other anticipated future funding resources. CPRG funding could allow for those efforts to be more cost effective.

The final measure included in the RELIEF approach is **Tree Planting**, which in parallel with other measures, offers GHG reductions, health benefits, and resilience improvements. As Lowell studies net-zero goals for our schools, we must be cognizant that because schools provide emergency shelter, there may be times the buildings may draw on a backup natural gas system until economically viable energy storage solutions can be integrated. There may also be instances where, based on recent updates to the HVAC systems, full electrification may be cost-ineffective for GHG reduction in the near term. In these cases, offsetting our remaining GHG with local, climate-resilient tree species offers a pathway to create net zero schools sooner. In the Fall of 2023, Lowell completed an Urban Forest Master Plan that provides a roadmap for increasing tree equity within the city so that all Lowellians can receive the benefits provided by a resilient urban canopy. Benefits of these efforts include reducing heat islands, ameliorating air pollution, and supporting flood protection, maximizing community benefits beyond the GHG reduction benefit. This element of RELIEF is anticipated to be funded through existing and anticipated future grant sources.

Lowell has begun applying the RELIEF process across our portfolio and we've seen remarkable results. The Lowell High School began new construction and comprehensive deep-energy retrofits for the facility as part of the Core program of the Massachusetts School Building Authority. If all efficiency measures perform as modeled, the facility will reduce its GHG emissions by 38% and overall school portfolio GHG emissions by 7%.

Consistency with PCAPs

Specific GHG reduction measures proposed as part of RELIEF tie directly to the **Greater Boston Priority Climate Action Plan** (GB-PCAP). Section 4. Greenhouse Gas Reduction Measures, 4.1, B3 Net Zero Municipal Buildings. "1. Develop and implement plans (through the Massachusetts Climate Leader Communities certification or otherwise) to transition new and existing municipal buildings to net zero buildings through weatherization, building electrification, and renewable energy deployment. Prioritize decarbonization of municipal buildings serving LIDAC communities." (GB-PCAP pg. 62)

The GB-PCAP calls out the value of both municipal buildings and specifically schools. “Municipal buildings offer a clear pathway for GHG reductions because municipalities own their buildings and can model and inspire similar action by others in the community and invite the public to see elements of their updated buildings. Across the country, schools are among the top energy consumers in the public sector and decarbonization measures also offer significant health and resilience benefits to students (e.g. air quality, cooling in extreme heat).”

The RELIEF project GHG measures also include priority GHG measures under the **Massachusetts Priority Climate Action Plan** (MA-PCAP) as part of the Buildings, Power, and Natural and Working Lands priority GHG measures. The RELIEF measures are included specifically under: Buildings, B1 Increase Building Efficiency, “Renovate/retrofit existing schools and state colleges and universities, through multiple actions for energy efficiency. Include focus on curriculum and community engagement to maximize community learning and awareness of decarbonization efforts.” Power, P2 Implement Building-Scale Renewables. “Install on-site renewable energy: identify suitable properties and install rooftop PV, and under Natural and Working lands N1 Implement Nature Based Solutions, “Increase restorative planting: Increase tree planting projects in urban and suburban areas and increaser reforestation to regenerate and expand healthy forest ecosystems.”

b. Demonstration of Funding Need

Lowell Public Schools serves 14,548 students in grades pre–K-12. District schools include buildings that comprise over two million square feet. EMG completed a facilities assessment report in 2018, and at that time, the total ten-year capital needs for schools were over $116 million—nearly $11 million per year. The estimated cost assumptions embedded in the 2018 analysis likely underestimate the true current capital needs. We recently (2020) replaced the boiler at Daley Middle School at a cost of $1.9 million, while the estimated cost in the 2018 EMG study was $665,736. Extrapolating from this relative cost increase, the estimated current market value of capital needs is likely closer to the $300 million range or $30 Million per year.

Lowell has been aggressively working to decarbonize and improve the air quality and resilience of our public schools. Lowell has been prioritizing upgrades to our public schools, pursuing all available state and federal grant opportunities, working with our utility partner to secure incentives for energy efficiency work, and implementing city capital investments to improve our buildings. See Table 1 for a list of funding sources secured for school upgrades from 2019 – 2024.

Because needs in the schools far outstrip financial capacity to execute, energy efficiency projects have been implemented in a phased manner as funding or incentives have become available. CPRG funding will allow Lowell to achieve greater savings more rapidly by allowing us to sequence the deep energy retrofits (Lighting, WX, RCx) and the solar enabling infrastructure elements to maximize savings while minimizing the project implementation cost.

TABLE 1: SECURED FUNDING 2019-2024

Year	Project	Funding Source	City $	Project Completed
2019	LED lighting Phase I - 3 schools	Green Communities Competitive Grant (GCCG)	No	Yes
2020	LED lighting Phase II - 2 schools	GCCG	No	Yes
	LED Lighting Phase II – 1 school	On-Bill Repayment (OBR)	Yes	Yes
	Condensing Boilers – 6 schools	Massachusetts School Building Authority (MSBA)	Yes	Yes
2021	RCx Phase I – 2 schools	GCCG	No	Yes
	VFDs – 1 school	GCCG	No	Yes
	LED Lighting Phase I – 2 schools	OBR	No	Yes
	Runwise Boiler Monitoring – 14 schools	Utility Pilot Project	Yes	Yes
	Energy Efficient Transformers – 8 schools	OBR	Yes	Yes
2022	Energy Efficient Transformers – 2 schools	OBR	Yes	Yes
	LED Lighting – 1 school	OBR	Yes	Yes
2023	WX – 1 school	GCCG	No	Yes
	Steam Trap Repairs – 7 schools	GCCG	Yes	Yes
	LED Lighting Phase II – 1 school	OBR	Yes	Yes
2024	RCx Phase II – 1 school	Earmark	No	Yes
	RCx Phase II – 1 school	Capital	Yes	Yes
	LED Lighting Phase III – 1 school	GCCG/OBR	Yes	Yes
	LED Lighting Phase II – 3 schools	OBR	Yes	No
	WX – 3 schools	OBR	Yes	No
	WX – 2 schools	Energy Efficiency and Conservation Block Grant (EECBG)	No	No
	Condensing Boilers – 6 schools	MSBA	Yes	No
	Energy Efficient Chillers – 1 school	Capital	Yes	No
	Energy Efficient Chillers- 5 schools	Indoor Ventilation and Air Quality (IVAQ)	No	No
	Solar Ready Roofs – 3 schools	MSBA	Yes	No

Lowell has a strong partnership with National Grid (NGRID), our local utility and energy efficiency program administrator. Through the Community Solutions Memorandum of Understanding, this partnership has enabled many of our energy efficiency upgrades. The initial agreement was signed September 3, 2019, with an update signed on May 13, 2021. This agreement includes a Strategic Energy Management Partnership (SEMP) that sets goals for energy reduction targets. The SEMP allows for enhanced tiered incentives that are tied to energy reduction target achievement. The SEMP also includes an allowance for on-bill repayment of energy efficiency projects where these projects can be paid as a surcharge on the customer's electric bill. By leveraging these tools and financial instruments through this innovative partnership with a private company, we can expand the reach of federal, state, and local investments. Over the past four-and-a-half years, this agreement has provided over $1,000,000 in utility incentives to Lowell to initiate projects estimated to save 3.8 million kWh and 170,000 therms. For projects requesting

CPRG funding (LED lighting upgrades), Lowell has submitted 19 applications for utility incentives, with confirmed incentive commitments of $731,845. Additionally, Lowell has submitted 27 applications for utility incentives for WX, with confirmed commitments of $992,460.

Although we will be looking to braid additional resources to fulfill our RELIEF plan (see Table 3 for more detail), CPRG funding is essential in helping to reduce emissions more rapidly so that we can achieve our net zero goal. Without CRPG funding, completing lighting upgrades alone would likely require over ten years. The CPRG funding will allow Lowell to increase the pace of our planned decarbonization activities. Table 2 below shows how the CPRG funds (G), when combined with leveraged funds (L) already secured, will make the majority of our schools decarbonization ready within the next 3- 5 years.

TABLE 2: USING CPRG TO SUPERCHARGE DECARBONIZATION

School	LED Lighting	WX	RCx	Solar Ready Roof	Solar PPA
B.R.I.D.G.E Program	G	L		N/A	N/A
Bailey Elementary School	G	L	PN	N/A	N/A
Bartlett Community School	G	L	PN	N/A	N/A
Butler Middle School	G	L	PN	X	X
Cardinal O'Connell Early Learning Center	G	L		N/A	N/A
Daley Middle School	G	L	PN		
Greenhalge Elementary School	G	L	PN	N/A	N/A
Laura Lee Therapeutic Day School	X	L		N/A	N/A
LeBlanc Therapeutic Day School	G	L		N/A	N/A
Lincoln Elementary School	L	L	PN		
Lowell High School	L	L	L	L	X
Lowell High School Freshman Academy	G	L	PN	N/A	N/A
McAuliffe Elementary School	G	L	PN	L	X
McAvinnue Elementary School	G	L	PN	N/A	N/A
Moody Elementary School	G	L		N/A	N/A
Morey Elementary School	X	L	X	N/A	N/A
Murkland Elementary School	L	L	PN		X
Pawtucketville Memorial Elementary School	G	L		X	X
Pyne Arts School	L	L		G	X
Reilly Elementary	X	L	PN	X	X
Robinson Middle School	G	L	PN	L	X
Shaughnessy Elementary School	G	L	PN	X	X
STEM Academy @ the Rogers School	G	L	PN	G	X
Stoklosa Middle School	X	X	X	G	X
Sullivan Middle School	G	L	PN	N/A	N/A
The Career Academy	X	L		N/A	N/A
Wang Middle School	G	L	PN	L	X
Washington Elementary School	G	L	PN	N/A	N/A

X = Complete; G = To be completed with CPRG Funds; L= To be completed with secured leveraged funds, PN = partially complete/funding not secured; N/A = no potential for Solar exists

TABLE 3: POTENTIAL FUNDING OPPORTUNITIES FOR RELIEF PRIORITIES

Grant Name	Funding Source	Funding Potential	Connection to RELIEF
AcceliGov Cost-Free Pilot Competition	Leading Cities of Boston, Nonprofit	Technical assistance	Track changes in urban forest
Climate Resilient Schools Grant	Environmental Protection Agency	Technical assistance (secured)	Guidance from EPA on ways to reduce emissions and increase resilience
Energy Efficiency and Conservation Block Grant Program	Department of Energy	$159,570 (secured via formula)	WX at 2 Schools
Environmental and Climate Justice Community Change Grants Program	Environmental Protection Agency	$10 to $20 million	Additional energy efficiency upgrades and/or electrification efforts
Environmental Justice Grant Program for Urban & Community Forestry	MA Department of Conservation and Recreation Urban & Community Forestry	$20,000 to $100,000	Implementation for Urban Forest Master Plan
Green Communities Grant	Massachusetts Department of Energy Resources	Up to $250,000	Additional controls/RCx
Green Communities Climate Leader Grant	Massachusetts Department of Energy Resources	TBD	Solar integration and/or decarbonization activities
Green School Works	Department of Energy	TBD	Solar-ready roof structures
Greening the Gateway Implementation Grant	Office of Energy & Environmental Affairs	$30,000 to $150,000	Implementation for Urban Forest Master Plan
Local Government Energy Program: Communities Sparking Investment in Transformative Energy	Department of Energy	$900,000 to $3.6 million	Additional work around energy efficiency, solar, and electrification
Massachusetts School Building Authority Accelerated Repair Program	Massachusetts School Building Authority	$250,000 and above	Solar ready roof structures
Renew America's Schools	Department of Energy	Up to $14 million	Additional EE measures, solar-enabling infrastructure, and electrification

c. Transformative Impact

Schools, particularly in low income and disadvantaged communities, face barriers to upgrades, including older buildings with significant capital needs, a modest tax base, and limited capacity to develop strategic approaches to pursuing net zero goals. Lowell's RELIEF program offers an ambitious yet realistic path for disadvantaged communities to supercharge their GHG reductions while delivering pollution reduction, cost savings, and resilience benefits to our most vulnerable populations. The RELIEF model builds on three critical partnerships that create the opportunity for our program to scale rapidly beyond Lowell. Lowell will work closely with the State of Massachusetts, the Metropolitan Area Planning Council, and the other Greater Boston Priority Climate Action partner organizations, including Northern Middlesex Council of Governments, to share our model and results with municipalities, particularly municipalities with large LIDAC populations facing historic disinvestment, pollution, financial, and other barriers to pursuing ambitious upgrades to their schools. RELIEF offers a systemic approach that can be easily replicated to prioritize the deepest GHG savings by braiding the funding available to municipalities.

The RELIEF approach pioneers a replicable and scalable program design. It draws on existing funding sources available to municipalities and combines them. The approach front-loads the most cost effective GHG measures with the highest community benefits for disadvantaged communities, creating early wins that build momentum. By following the deep energy retrofit work with renewable energy deployment, utilizing PPAs, RELIEF offers a model that further decreases GHG with little financial burden or project delivery complexity. The addition of solar also further reduces site energy, creating the best opportunity for cost-efficient electrification. Many Massachusetts communities have been resistant to look at electrification of their school buildings because of the high heating load and grid constraints in the near term. The RELIEF approach ensures that school buildings are optimally positioned to take advantage of electrification technologies and will help transform the school market for adoption of these technologies.

Many municipalities do not want to be the first to try an approach. When Lowell leads the charge with this ambitious program that braids multiple funding streams, we can provide our sister municipalities with proof of concept and a clear road map for replication.

We will continue to work closely with National Grid, the utility partner serving our area, as well as other communities in their service territories in Massachusetts and New York. The RELIEF program successes will be shared regularly through the National Grid's existing municipal support programs which include annual municipal summits, an annual energy summit and SEMPs with individual municipalities.

We will also elevate to our state and utility partners barriers encountered by disadvantaged communities based on our experience. Already, our work over the past years has inspired our state and the utility partners to begin planning to expand utility efficiency offerings and technical support for municipal schools in the state's next three-year energy efficiency program plan.

2. Impact of GHG Reduction Measures

a. Magnitude of GHG Reductions from 2025 through 2030: 5,728 MTCO2e

Lowell developed a robust methodology for estimating GHG emissions reductions for the measures funded by CPRG and other sources. The methodology consists of the following: professional energy audits to assess savings potential, cost estimates, and availability of utility incentives; conversion of energy

savings to emissions savings via GHG equivalency calculators; and calculation of annualized GHG savings based on estimated installation dates and measure longevity.

For deep energy retrofit measures, calculations begin with estimated energy savings from energy audits that have already been completed by NGRID Project Expeditors (PEX) vendors for LED lighting upgrades and WX. PEX vendors have been pre-vetted by NGRID for proven capabilities in providing turnkey energy solutions for municipalities. They provide no-cost energy auditing for various energy efficiency measures across the municipal portfolio. Over the past several years, we have worked with a PEX vendor to audit all school and municipal facilities to identify potential opportunities. The audits and energy savings attributed to specific measures are input into NGrid's online portal to determine the availability and magnitude of incentives to maximize the funds we can recoup. Costs, savings, and incentives for lighting upgrades and WX have already been determined based on current conditions. These data are used in budget and GHG reduction calculations. Since both LED and WX are estimated to have a lifetime of 15 years, according to utility sources, it is assumed that savings will continue to accrue for this period vs. the business-as-usual scenario.

For solar-enabling infrastructure, savings are estimated based on renewable energy production made possible by the new roof structures funded through CPRG. Lowell has partnered with Solect Energy, LLC, the solar vendor for the Power Options group buying consortium that serves over 500 organizations in the Northeast. Solect has modeled solar output for systems across our portfolio with Year 1 solar production numbers. Since solar has a long measure life, savings are expected to accrue through 2050 vs. business-as-usual scenarios. However, solar panels are known to have an annual degradation factor of around 0.5% per year in productive output. This degradation factor is included in GHG savings assumptions.

More detailed information on calculations for the proposed measures is found in the technical appendix. Overall, though, with the front-loading of CPRG measures in RELIEF, cumulative GHG savings from CPRG funds for 2025-2030 are estimated to be **5,728 MTCO2e.** When factoring in CPRG grant funds requested, this equates to approximately $1,740/MTCO2e reduced.

b. Magnitude of GHG Reductions from 2025 through 2050: 25,390 MTCO2e

We estimated the magnitude of GHG reductions from 2025-2050 in a similar manner as the reductions from 2025-2030 by using PEX and solar vendor-derived savings numbers and extrapolating these savings numbers for the duration of the measure lifespan. Cumulative GHG savings from CPRG funds for 2025-2050 are estimated to be **25,390 MTCO2e**. When factoring in CPRG grant funds requested, this equates to approximately $393/MTCO2e reduced.

c. Cost Effectiveness of GHG Reductions

CPRG funding is expected to have a cost of $1,740/MTCO2e reduced before 2030 and a cost of $393/MTCO2e for 2030-2050. These strong numbers demonstrate a cost-effective investment for GHG emissions reductions. Because of the longevity of measures funded by CPRG and instruments such as utility incentives and PPAs for solar, CPRG funds can go further in enabling faster GHG reductions. Two factors that could impact the cost-effectiveness of measures are: savings attributed to the recommended measures and changes in material costs.

If savings came in lower than anticipated, this would impact cost-effectiveness, but in the case of Lowell's CPRG measures, this is unlikely. By utilizing LED lighting to lower the wattage per fixture and integrating controls within the lighting installed, we expect reliability in the savings. Lowell has already completed multiple LED lighting conversions across our portfolio, primarily through OBR, and these projects have cumulatively remained cash-flow positive, exceeding estimated savings.

For solar-enabling infrastructure savings, solar vendors like Solect include guaranteed annual production figures for systems contracted. These figures are typically conservative, so that contractual means for under-production do not need to be invoked. Lowell has previous experience in utilizing PPAs for solar savings and, even in 2015, when Lowell experienced over 10 feet of snow during the winter, guaranteed production levels were still met. Additionally, because of the PPA structure and ownership of these systems by a third party, there is a financial incentive to ensure that systems are well-maintained to maximize production. For these reasons, it is possible that actual cost-effectiveness will be higher than estimated due to the conservative nature of the savings projections.

The biggest factor that could affect the cost-effectiveness calculation is changes in material costs due to changing market conditions. Though this is a possibility, especially given continued post-COVID supply chain issues and related ancillary inflationary pressures, the likelihood that such issues will materially impact the cost-effectiveness of recommended measures is limited, particularly because most of the measures will be fully implemented by 2026. Even if there are cost-effectiveness impacts, those same impacts will be felt by other CPRG applicants, leveling cost-effectiveness impact comparisons.

d. Documentation of GHG Reduction Assumptions

Please see appendix for a more thorough explanation of all assumptions and methodologies.

3. Environmental Results – Outputs, Outcomes, and Performance Measures

a. Expected Outputs and Outcomes

Outputs:

The primary outputs from the grant-funded projects will include: number of schools with lighting upgrades completed, number of schools with solar-ready roof structures complete. For each of these outputs, near-term outputs include completing bid specifications, completing the bid process, executing contracts, onboarding the Owner's Project Manager (OPM), and tracking equipment purchases and installation.

Outcomes:

The primary outcomes from the grant will include: annual energy use reduction across the school portfolio, annual cost savings across the school portfolio, annual GHG reductions across the school portfolio, annual renewable energy produced by solar panels across the school portfolio, and annual number of attendees for advisory group meetings and community events. All of the energy use, costs savings, GHG reduction, and renewable energy outcomes will be further broken down into two categories - the overall school portfolio numbers and those at schools specifically funded by the CPRG. This will help illustrate the precise effect the CPRG funds are having on our energy use. Data will be gathered on a calendar year basis and reported on in the quarter following the end of the calendar year. Data will be shared with stakeholders, EPA, and our community.

b. Performance Measures and Plan

Sustainability Director, Katherine Moses, will take primary responsibility for coordinating measurements of outputs and outcomes of the project portfolio. In the first year, the majority of the work will be outputs, including putting together the initial bid specifications, completing the bid process, and onboarding the OPM. Lowell has been tracking energy use, energy reductions, and GHG reductions for over 15 years, through participation in the Green Communities Program with the Massachusetts Department of Energy Resources.

The Sustainability Division for Lowell will coordinate finalizing the agreement with the EPA and developing the bid specifications for LED lighting projects and solar-enabling infrastructure. We will work closely with our partner NGRID in developing these bid specifications to ensure that we maximize the NGRID incentives. We will work closely with the EPA to ensure that our bid specifications include all of the requirements for federal fund use. In each of these bid specifications we will be asking for an OPM who will, once onboarded, provide day-to-day oversight of lighting implementation (under the lighting projects) and day-to-day oversight of the solar-enabling roofs (under the roofs contract).

The Sustainability team will have primary responsibilities for completing reporting requirements, coordinating meetings of school-based teams, facility-based teams, utility partner teams, and OPM teams for each contract. The Sustainability team would take the lead on facilitating community advisory committee meetings, which we anticipate will meet quarterly. This group will not only help determine other community events, once it has been constituted. See Community Benefits and Community Engagement sections for more information on the advisory committee. Table 4 is included in the section below and details the timeline and milestones that demonstrate progress in implementing each GHG reduction measure.

c. Authorities, Implementation Timeline, and Milestones

The City of Lowell has the primary authority for implementation of the GHG reduction measures identified in the grant application. The City of Lowell owns all of the schools where CPRG interventions will be made and has the authority to carry out the measures during the grant period.

Contractors and sub-contractors will need to obtain permits and background checks before commencing work in order to ensure adherence to all regulatory requirements that increase the safety of workers and students in the facilities. The responsibility to ensure compliance with these measures, as well as the authority for these actions rests with the municipality.

The timeline for CPRG-funded RELIEF projects is intended to aggressively pursue the fastest emissions reductions in the shortest period. For this reason, recommended sequencing of work front loads the facilities with the greatest anticipated GHG savings. Based on previous experience, lighting projects can often be completed in a one-month period for larger facilities, like Middle Schools. Smaller schools can typically be completed in a matter of weeks. Roof construction work is better coordinated during the summer months when schools are not occupied. These considerations were factored into the timeline/milestones shown in Table 4 for CPRG-funded projects.

TABLE 4: IMPLEMENTATION TIMELINE AND KEY MILESTONES

Calendar Year/Quarter	2024	2025	2026
Q1		Bid/select/contract with winning vendor for lighting Order materials for lighting Begin design/bid specs for Solar-enabling roofs	Complete LED Lighting for: Sullivan, Shaughnessy, LHS Freshman Academy Contract with winning vendor(s) for solar-enabling roofs
Q2		Complete LED Lighting for: Pawtucketville, STEM, Daley	Complete LED Lighting for: Bartlett, LeBlanc, Moody, Washington
Q3	Finalize EPA agreement Bid/Select OPM for Lighting Bid/Select OPM for Solar-enabling roofs	Complete LED Lighting for: Butler, Greenhalge, McAuliffe Bid for solar-enabling roofs	Complete LED Lighting for: Cardinal O'Connell Robinson BRIDGE Final inspection for all LED lighting projects Installation of solar-enabling roofs at Stoklosa, Pyne, and STEM
Q4	Contract with OPM for Lighting Contract with OPM for Solar-enabling roofs	Complete LED Lighting for: Wang, Bailey, McAvinnue Select winning vendor(s) for solar-enabling roofs	Final inspection for all Solar-enabling roofs Installation of/solar structures Final EPA report

4. LOW-INCOME AND DISADVANTAGED COMMUNITIES

According to CEJST the majority (72%) of Lowell census tracts are DAC and/or contain EJ block groups. These census tracts are: 3101, 3103,3104, 3105, 3107, 3111, 3112, 3113, 3116, 3117, 3118, 3119, 3120, 3121, 3122, 3124, and 3883. Our schools feed from across Lowell, and the pollution reduction and resilience benefits will be felt by all our LIDAC members. Our schools also act as community shelters and gathering locations for various school and non-school events.

a. Community Benefits

Resilience Benefits: Our community has already begun to experience the impacts of climate change. At the beginning of this past school year, we had to close our schools for two days due to classroom temperatures exceeding 90 degrees. Lowell's 2020 Municipal Vulnerability Preparedness and Hazard Mitigation Plan identifies flooding, extreme temperatures, extreme winter weather, and

wind/microbursts as primary risks. Much of Lowell is near the Merrimack or Concord rivers, and EJ Screen data confirms that flood risk puts Lowell in the 80th percentile nationally. In the Mother's Day flood of 2006, schools functioned as community shelters. With the anticipated increase in flooding hazards and extreme heat due to climate change, this project increases resiliency in Lowell's school facilities. The deep energy retrofits that comprise the priority activities in this grant will result in buildings that are better able to maintain temperature with lower energy during extreme weather events. This benefits our schools and broader community by improving the resilience of facilities used for emergency shelters, cooling centers, and other critical services. By addressing building envelopes as part of the RELIEF program, buildings will be able to maintain heating and cooling longer in the case of a power outage.

Combined with our Urban Forest Master Plan, we are also reducing the impacts of flood events and heat islands, creating more equitable access to shade and cooling. Lowell recently applied for and was awarded an EPA Climate Resilient Schools grant, which will bring EPA technical assistance to our team to continue to reduce emissions and increase resilience. Consultants for this program are currently being assigned and a kickoff is anticipated within the month. We anticipate EPA will offer us new tools for engaging across our school community to implement resilience measures that will complement RELIEF efforts.

Health Benefits: The GHG reduction measures in RELIEF have direct health benefits for students and staff. In particular, LED lighting upgrades have positive impacts on well-being and student performance. Weatherization measures can reduce water penetration, moisture and mold, reducing allergens and poor indoor air quality. RCx projects ensure ventilation rates are optimized. Planting trees, in addition to sequestering GHGs, helps to promote improvements in neighborhood-level air quality and provide relief for urban heat islands. These urban heat islands are often located in areas where students travel to and from schools. Lowell is extremely committed to realizing these health benefits in tandem with our energy upgrades and is using EPA's "Energy Savings Plus Health: Indoor Air Quality Guidelines for School Building Upgrades" guide.

Along with the strong GHG emission reduction measures from our project, we know we will have Criteria Air Pollutant (CAP) and Hazardous Air Pollution (HAP) reductions and associated benefits for our local community and for additional DAC across Massachusetts. Reductions in these pollutants have positive health benefits for communities, particularly Lowell DACs who have suffered from high air pollution levels. The Massachusetts PCAP used the AVERT tool from EPA to quantify, at the state level, Criteria Air Pollutant (CAP) including NOx, PM2.5, SO2, VOC, and Hazardous Air Pollutant (HAP). For quantification purposes, the HAPs can generally be approximated by VOCs, mirroring the Massachusetts PCAP. By using AVERT for the New England grid for CPRG-funded energy efficiency and renewable energy in RELIEF, annual estimated reductions are shown in the table below.

TABLE 5: SUMMARY OF CAPS AND HAPS FROM AVERT TOOL

	Original	Post Change	Change
Total Emissions from Fossil Generation Fleet			
SO_2 (lb)	4,272,680	4,272,100	-580
NO_X (lb)	8,742,410	8,741,730	-670
Ozone season NO_X (lb) *click for additional information*	4,520,620	4,520,290	-330
$PM_{2.5}$ (lb)	1,748,910	1,748,790	-120
VOCs (lb)	839,210	839,150	-60
NH_3 (lb)	1,511,020	1,510,940	-80

Energy and Cost Savings Benefits: Lowell is already tracking and will continue to track reductions in GHG emissions, electricity demand, and fossil fuel use. All metrics offer benefits to our community. The reduction in electricity demand and increase in renewable energy capacity is essential in our grid-constrained environment to allow us to continue to move toward full decarbonization of our buildings. This is a core element of our strategic approach. Once constructed, the projects are anticipated to help the City avoid $540,000 in utility costs. This direct cost savings, combined with reduced maintenance costs, will provide a direct benefit to taxpayers by reducing the City's operating costs. School utilities comprise almost half of Lowell's annual utility budgets.

Workforce benefits: The MA-PCAP workforce planning analysis details that Energy efficiency is the area with the greatest potential for job growth across all clean energy sectors in Massachusetts. Investing in new renewable energy facilities also stimulates economic growth by attracting investments and creating jobs across the supply chain. This includes manufacturing, installation, maintenance, and associated services related to renewable energy projects. While our projects would naturally have these benefits, we are also looking to develop aspirational goals and metrics for engaging labor and enhancing workforce development. These are detailed in the Job Quality section below.

b. Community Engagement

The City of Lowell has a history of community engagement and has built multiple strong community partnerships. We are actively engaged with partners including Lowell Public Schools (LPS), University of Massachusetts Lowell (UML), National Grid (NGrid), and many community-based organizations (CBOs), including the Cambodian Mutual Assistance Association, Coalition for a Better Acre, Lowell Housing Authority, Massachusetts Alliance of Portuguese Speakers (MAPS), Community Teamwork Inc. (CTI), and Project LEARN to advance emissions reduction activities and engage vulnerable populations in our community across our energy and sustainability work.

One of the ways we are looking to leverage existing partnerships is through our CBO network. Lowell was awarded the Community First Partnership grant from the Sponsors of Mass Save, which allows us to partner with CBOs and employ an Energy Advocate from the community to facilitate culturally appropriate outreach to engage our local businesses and residents in energy efficiency in their homes and businesses. Through this work, Lowell's Sustainability Division has deepened partnerships with organizations representing many of our linguistic minority communities, as well as low-income families. The City of Lowell has also helped these organizations build capacity through supporting and securing grants to further our mutual goals.

Another key partnership we would be looking to leverage through RELIEF is with UML. UML and Lowell have monthly meetings between our Sustainability teams. Lowell recently partnered with UML and NGrid to launch a networked geothermal pilot in one of our environmental justice neighborhoods. This initiative not only utilizes renewable energy technology, but includes a deep energy retrofit component that mirrors our efforts for RELIEF.

Lowell and UML have also begun to develop a pilot Green Schools Program, starting at the Stoklosa Middle School. The Green Schools program builds a school-based team including parents, staff and students that works through six core pillars (food security; transportation/safe routes/walk-bike; decarbonization planning; curriculum development; waste audit; and a day of service). The school team includes our

Sustainability Director, who supports the team's work on a school-based decarbonization plan. The school-based teams meet monthly.

The City of Lowell has a long history of working collaboratively with LPS to address building needs. The Facilities and Sustainability teams have weekly coordination meetings to discuss opportunities to continue to make our facilities more functional and energy efficient. Monthly meetings are held with upper management of LPS to discuss progress on creating healthier, more energy efficient environments for our students.

Because Lowell's demographics include several traditionally underrepresented communities, meaningful engagement is a top priority and not restricted to this grant application. Our Sustainability Director, Katherine Moses, recently completed a Clean Energy to Communities (C2C) peer-to-peer learning cohort facilitated by the National Renewable Energy Lab and World Resources Institute. The cohort, "Incorporating Community Voices in Clean Energy and Deployment," examined topics such as defining an engagement baseline; building relationships and using data to advance equitable engagement; navigating difficult conversations; addressing structural challenges and formalizing inclusive engagement; and promoting accountability and transparency. The learnings from this cohort were incorporated into an Engagement Roadmap that will be updated to specifically target audiences for all our sustainability efforts, including the Climate Resilient Schools initiative and this RELIEF project.

In preparing for this grant, we have discussed our ideas with our partners, and have reshaped and refined the proposal with their input. In collaboration with our existing partners across various programs, our team is committed to developing a Community Advisory Council for the RELIEF project. This initiative is mindful of not overburdening community members who already face financial and time constraints. The Council will include representation from students, school staff, and community members most affected. Its purpose is to meet regularly and provide valuable advice to the RELIEF team on how to effectively connect with communities and communicate about our projects.

We have included a budget in the proposal to ensure we can provide stipends to community members for their time and also provide support such as childcare, food, and transportation stipends to ensure full participation and alleviate any burdens or barriers to participation. The Council will not only advise the team but also help develop community outreach activities and events to ensure the RELIEF program is a program that our community fully embraces and owns, contributing their ideas and interest as we move forward. We would also look to engage students more directly by training them to lead tours of facilities and highlight the work completed.

5. JOB QUALITY

We are staunchly committed to RELIEF being an explicitly pro-worker project. We are looking to develop and track progress on aspirational goals and metrics for engaging labor and enhancing workforce development. Lowell looks to develop specific metrics in conjunction with municipal decision-makers and the OPM team around registered apprenticeships, people of color, tradeswomen, and local workforce. We would structure bid specifications that provide competitive advantages for businesses that are minority-, woman-, or veteran-owned. Developing and expanding a local "green-collar workforce" in Lowell remains a top priority for our community. As part of our regular programmatic reporting to EPA, we would summarize progress on the metrics created.

6. Programmatic Capability and Past Performance

a. Past Performance

The City of Lowell has a history of successfully managing and completing grants from various sources from non-federally funded agreements. A listing of four of these agreements completed in the last three years is found below:

Table 5: Past Performance References

Grant Program Title	Funding Agency	Brief Description of the Agreement/Projects Funded	Contact from Organization that Funded Assistance Agreement
Green Communities Competitive Grant	Department of Energy Resources (MA)	Completed steam trap repairs, building operator certification training, WX at Stoklosa Middle School, and LED lighting at Stoklosa Middle School	Jane Pfister Grant Coordinator DOER 100 Cambridge St, 9th Floor Boston, MA 02114 Jane.pfister@mass.gov 857-202-9720 (cell)
On-bill Repayment Agreements	National Grid	Allows for repayment of energy efficiency measures (e.g. LED lighting, energy efficient transformers, WX) as a surcharge on utility bills.	Sean McGloin Municipal Energy Efficiency Representative National Grid 939 Southbridge St Worcester, MA 01610 Sean.McGloin@nationalgrid.com 508-414-3240 (cell)
Accelerated Repair Program	Massachusetts School Building Authority (MSBA)	Funded projects for aging heating, roof, and window projects at over a dozen schools.	Evan Levasque Senior Project Manager MSBA 40 Broad Street, Suite 500 Boston, MA 02109 617-960-3017 Evan.Levesque@MassSchoolBuildings.org
Indoor Ventilation and Air Quality	Department of Elementary and Secondary Education (DESE)	Funded for chillers at 5 Schools. In early stage of implementation now.	Nancy Labrie Federal Grant Programs Specialist DESE 135 Santilli Highway Everett, MA 02149 Nancy.H.Labrie@mass.gov 781-338-3536
GAP III Grant	Department of Environmental Protection (DEP)	Funded energy efficient transformers at the Wastewater Treatment Plant. In early stage of implementation now.	Danah Tench Clean Energy Results Program Mass DEP 617-733-3998 (cell) Danah.tench@mass.gov

Each of the funding sources above has various requirements for competitiveness, implementation, and reporting, which the team at Lowell has been able to manage and successfully complete.

b. Reporting Requirements

Each of the funding sources listed has different reporting requirements. Lowell always strives to meet requirements for interim and final reporting regarding milestone accomplishment, funds expended, and challenges encountered. We have also looked to expand grant-funded opportunities through leveraging additional funds; report on lessons learned that may be applied to other communities; and report on data after the agreements have concluded.

For example, in 2019, Green Communities funded RCx projects at two of our schools. Because we submitted the grant application prior to confirmation of utility incentives, we used conservative estimates of incentive potential. When we began applying for the custom incentives for these projects, we were able to secure more than double our initial estimate while adding an additional 50% electricity savings and natural gas savings. These changes also led to lessons that could be applied to other communities in the grant network. We look forward to sharing similar experiences with peer communities funded by EPA.

c. Staff Expertise

In FY 2024, the City of Lowell created a new Sustainability Division within the Department of Public Works (DPW) to ensure that the City of Lowell prioritizes emissions reductions, climate resilience, and a just and equitable energy transition in our community. The structure of this Division includes Facilities and Energy staff under the same division umbrella to increase coordination and ensure longevity of energy interventions through appropriate maintenance efforts. The creation of this division was also intended to increase collaboration to meet infrastructure needs by strategically applying for the unprecedented funding opportunities available through the Bipartisan Infrastructure Law and Inflation Reduction Act.

Sustainability Division members include the following: Sustainability Director, Energy Manager, Energy Coordinator, Energy Advocate, Lowell High School Facilities Manager, Working Foreman, and HVAC Technicians (3). Additionally, the DPW Commissioner, DPW Projects Manager and LPS Facilities Manager would be part of the core team to ensure success for measures implemented under CPRG.

Members of this core team have an average of 14 years of experience in energy- or facilities-related work. Over the past five years, members of this core team have managed **over $40 million in funding for facilities improvements**. Greater detail on members of the core team can be found in the attached resumes.

This team not only provides a deep bench of expertise but has also been recognized over the past year for excellence in implementing energy and climate solutions. In November 2023, Mass Inc. recognized the City of Lowell for **Innovation in the Gateway Cities** award for our efforts to increase participation in residential and commercial energy efficiency programs by hiring a dedicated, full-time Energy Advocate with funding from the Community First Partnership from the Sponsors of Mass Save and the EmPower Innovation and Capacity Building grant from the Massachusetts Clean Energy Center. The 1:1 assistance offered by Victor Vargas, Lowell's Energy Advocate, has **helped hundreds of individuals participate in the Mass Save program for the first time**, as well as provided residents relief from utility bill expenses by making referrals to assistance programs.

In December 2023, the Commonwealth of Massachusetts recognized the City of Lowell as a **Leading by Example** recipient for outstanding decarbonization, clean energy, and environmental efforts. Accomplishments include: **reducing greenhouse gas emissions by 45% from city operations since 2010**; deployment of publicly accessible EV charging stations, and completion of extensive energy projects to make existing buildings "decarbonization ready." Coupled with strategic partnerships with community-based organizations, the City is working to ensure the benefits of the clean energy transition reach the diverse populations of Lowell.

In January 2024, the Sponsors of Mass Save recognized the City of Lowell as one of their 2023 **Climate Leaders** for making meaningful investments in energy efficiency and curbing greenhouse gas emissions. Specifically, Lowell has **achieved over 1 million kWh in electric savings, 40,000 therms in gas savings, and elimination of over 500 tons of greenhouse gas emissions**. We look to build on and accelerate these successes with CPRG funding for RELIEF.

7. BUDGET NARRATIVE

Per NOFO guidance, a budget narrative is attached as a separate document and spreadsheet.