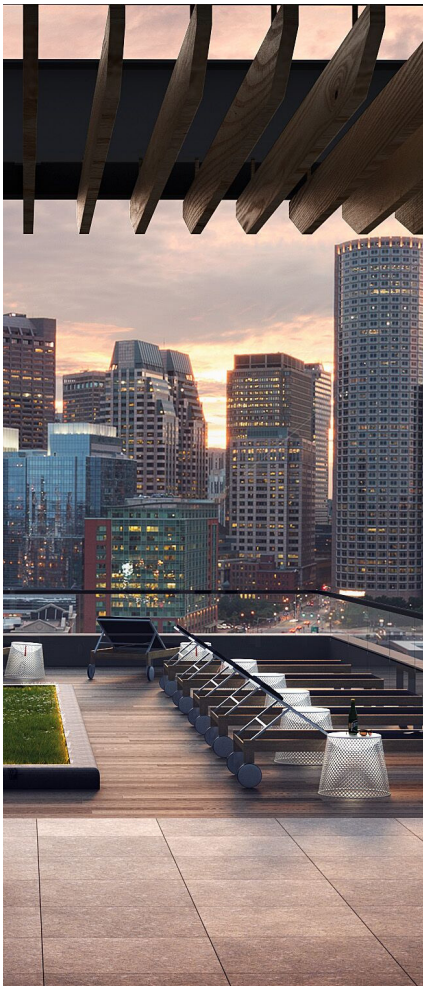

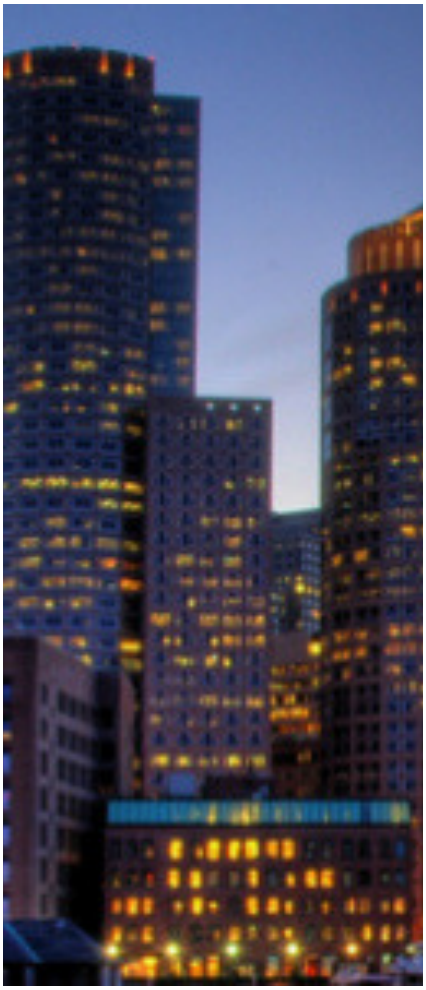

Incorporating Issues of Energy Efficiency Adoption into the City of Boston's Greenhouse Gas Reduction Strategy

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EXECUTIVE SUMMARY

In the fall of 2017, Boston Mayor Martin J. Walsh announced the launch of Carbon Free Boston, an initiative in partnership with the Green Ribbon Commission (GRC) and Boston University's Institute for Sustainable Energy (ISE) centered on achieving carbon neutrality in the city by 2050. This report provides options for accelerating the adoption of energy efficiency technologies and programs in Boston's residential and small building sectors.

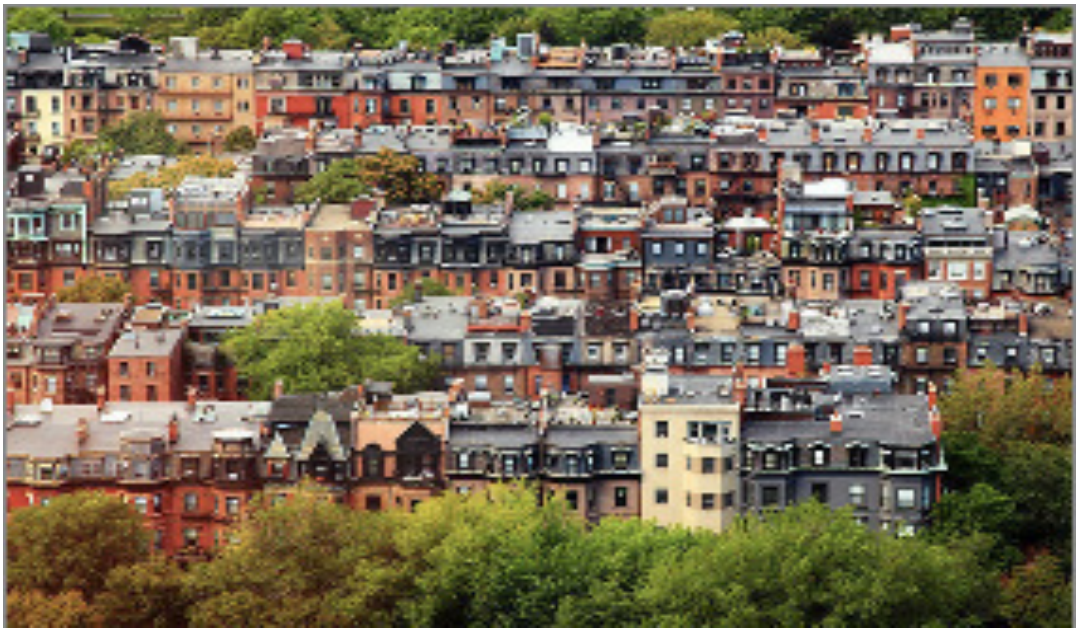
This report will develop potential strategies for the City's consideration by analyzing the current barriers preventing widespread adoption of the efficiency measures in Boston, developing recommendations for expanding the Mass Save and Renew Boston energy efficiency programs, and exploring other policy and community engagement programs for promoting energy efficiency in Boston. A combination of case studies and literature reviews were utilized to generate a list of programs and policies that address Boston's energy efficiency predicament. In addition, stakeholder interviews were conducted to understand the current condition of Boston's residential and small commercial building energy and how stakeholders in Boston currently view energy efficiency issues.

Recommendations are divided into three themes: **Information Sharing**, **Community Collaboration**, and **Programs and Regulations**. These programs and policies vary in complexity, cost, and impact; therefore, each section includes an evaluation and analysis to measure each recommendation against predetermined criteria: feasibility, inclusivity, effectiveness, and equity. By implementing a series of these recommendations, the City of Boston will increase energy efficiency in the residential and small commercial sectors while enhancing goals of equity, inclusiveness, effectiveness, and implementation.

Information Sharing includes designing a web portal, building a community database, and developing an energy rating system. The Massachusetts Department of Energy Resources has already launched the Commonwealth Energy Tool for Savings (energyCENTS) to share the energy-saving and funding opportunities available to Massachusetts consumers. However, it is a state-wide website that lacks some relevant information for Boston residents, and this report outlines some necessary improvements. To increase information sharing, the city should also develop a Home MPG energy rating system for both new and existing residential buildings and require the disclosure of energy performance at time of sale or rental.

Community Collaboration describes strategies that: strengthen the relationships between city agencies, organizations, and utilities; ensure any energy efficiency programs include the perspectives of multiple stakeholders; and integrate energy efficiency into other areas like health and safety. By implementing agency mapping, the Department of Environment would improve service provision by producing efficiencies, reducing overlap, and streamlining services allowing Boston's extensive network of organizations to do more with less.

Finally, **Programs and Regulations** outlines key improvements Boston can make to its existing energy efficiency programs in addition to some new regulatory strategies. The highest priority should be to expand the Mass Save income-eligible programs to serve households with 0-80% of median income. In addition, Boston should consider a few highly effective strategies that require more long-term planning and coordination with the Commonwealth, like enacting a local carbon tax. However, these large-scale interventions are less feasible for the city to accomplish in the near-term.



BACKGROUND AND PROBLEM STATEMENT

In the fall of 2017, Boston Mayor Martin J. Walsh announced the launch of Carbon Free Boston, an initiative in partnership with the Green Ribbon Commission (GRC) and Boston University's Institute for Sustainable Energy (ISE) centered on achieving carbon neutrality in the city by 2050.[1] Carbon neutrality is defined as a state of net zero emissions, achieved through a combination of cutting and offsetting carbon emissions.[2] Currently, 40% of Boston's greenhouse gas emissions come from 50,000 – 60,000 residential and small commercial buildings, making reducing emissions from this particular sector a critical component of achieving carbon neutrality.[3] Acting on this sector's emissions will require the widespread adoption of energy efficiency measures such as heat-pump systems, weatherization, and energy audits.[4]

40% of Boston's greenhouse gas emissions come from 50,000-60,000 residential and small commercial buildings.

Major barriers to adopting energy efficiency include:

- **Split incentive problems:** the imbalance power and interest between landlords and tenants for energy efficiency upgrades;
- **Financial barriers:** the high capital cost of installation for energy efficiency retrofits and heat-pump technology;
- **Information barriers:** lack of awareness of the benefits of energy efficiency, especially in some vulnerable and low-income populations.

Sixty-five percent of Boston housing units are renter-occupied, meaning that split incentives exist between landlords and tenants for energy efficiency upgrades.[5] In 88% of rental households, landlords are responsible for the purchasing of appliances and home improvements, while renters pay for their own energy costs.[6] In these households, while tenants would benefit financially from energy efficiency improvements, they may not have control over their installation. Conversely, while landlords may have the means to install these upgrades, they are not incentivized as they do not directly benefit financially. Additionally, the capital cost of installation is a barrier for energy efficiency retrofits and heat-pump technology, which at present has higher installation costs than conventional heating systems.[7] Lastly, lack of awareness of the benefits of energy efficiency has been identified as a pervasive barrier to adoption, especially in some vulnerable and low-income populations.[8] These barriers disproportionally affect low-income communities, creating inequity in access to energy efficiency solutions.

1 City of Boston, 2017
2 City of Boston, 2014
3 Michael Walsh, personal communication, January 18, 2018
4 City of Boston, 2014
5 U.S. Census Bureau, 2016
6 Bird and Hernandez, 2012
7 U.S. Department of Energy, n.d.
8 Giancatarino, 2013

Boston utilizes two programs to act on these barriers to energy efficiency adoption. **Mass Save**, a state energy efficiency program, offers residential and business rebates and incentives for efficiency upgrades, no-cost energy assessments, and special discounts for low-income households. **Renew Boston**, the city's energy efficiency program, offers discounted to no-cost energy efficiency options for homeowners, landlords, and tenants, as well as free home energy visits. These programs, however, do not have the widespread impact necessary to achieving carbon neutrality by 2050, in total impacting around 1% of the residential and small business sector per year. In addition, both Boston and the state of Massachusetts are ranked first in the nation in regards of energy efficiency (local and state scorecards, respectively) by the American Council for an Energy-Efficient Economy (ACEEE). While both of these programs have been well-developed, they clearly require improvements, expansions, and increased outreach in order to increase their impact.

Current energy efficiency programs only impact 1% of the residential and small business sector annually

Mass Save is funded by utility ratepayers and offers various incentives and rebates for building weatherization upgrades and efficient appliances, as well as fuel assistance and energy assessments. These offers are available for all Massachusetts residents who are customers of the participating utilities, Eversource, National Grid, Unitil, and Cape Light Compact, including homeowners, renters, building owners, and landlords. Mass Save offers no-cost energy assessments for virtually all residential properties.[1] For 1-4 unit buildings, landlords, homeowners, renters, and landlords can apply directly for the no-cost energy assessments.[2] For buildings with 5+ units, building owners and managers can apply directly for assessments or be referred by residents.[3]

The primary low-income energy efficiency program in Boston is Mass Save's income eligible program. The program is administered by the Low-Income Energy Affordability Network (LEAN) made up of various community action agencies. Currently, households in 1-4 unit buildings are eligible for the income eligible program if their income is 0-60% of the state median income. The income eligible program offers a variety of free energy efficiency services for these low-income households, including installation of energy savings products and appliances, evaluation of existing appliances for inefficiency, replacement of inefficient boilers and furnaces, and weatherization updates.

1 MassSave. (n.d.-a). Energy Assessments | MA Home Energy Audits | MA Business Energy Audits. Retrieved April 18, 2018, from https://www.masssave.com/en/saving/energy-assessments/

2 MassSave. (n.d.-b). Home Energy Assessments for Renters (1-4 Units). Retrieved April 18, 2018, from https://www.masssave.com/en/saving/energy-assessments/renters/

3 MassSave (n.d-c). Reduce Your Operating Costs. Increase Your Multi-Family Property's Value. Retrieved April 18, 2018, from https://www.masssave.com/en/saving/energy-assessments/multi-family-facilities-5-units-plus/

For multifamily buildings with 5+ units, at least 50% of households must have income 0-60% of area median income to be eligible for the multifamily income-eligible program.[1] The multifamily program offers many of the same services as the single-household program but takes a whole building approach. Building owners and managers are the contact point for the program, but residents can refer them.

With funding, Renew Boston upgraded 1,750 low-income homes and 700 small businesses, and paid for 6 whole-building low-income multifamily retrofits

Boston also has a citywide energy efficiency program called Renew Boston. Renew Boston was started to administer Boston's energy efficiency grant from the 2009 American Recovery and Reinvestment Act. In four years, the program provided no-cost weatherization upgrades to 1,750 low-income residents and 700 small businesses and paid for six whole-building low-income multifamily efficiency retrofits.[2] Once federal funding was exhausted, Renew Boston switched its primary function to connecting Boston residents to available Mass Save resources. The program still performs some marketing efforts, such as holding energy efficiency workshops in Boston neighborhoods.[3]

Other energy efficiency programs available to Boston residents include the Low-Income Home Energy Assistance Program (LIHEAP), the federal low-income energy efficiency and fuel assistance program. LIHEAP offers these services to households that make 150% of poverty levels or 0-60% of area median income in areas where that is higher. [4]

1 LEAN Multifamily. (2014). Mass Save Low-Income Multi-Family Retrofits Program Guide. Retrieved from http://leanmultifamily.org/sites/default/files/LIMF_Program_Guide_Final_2014.pdf

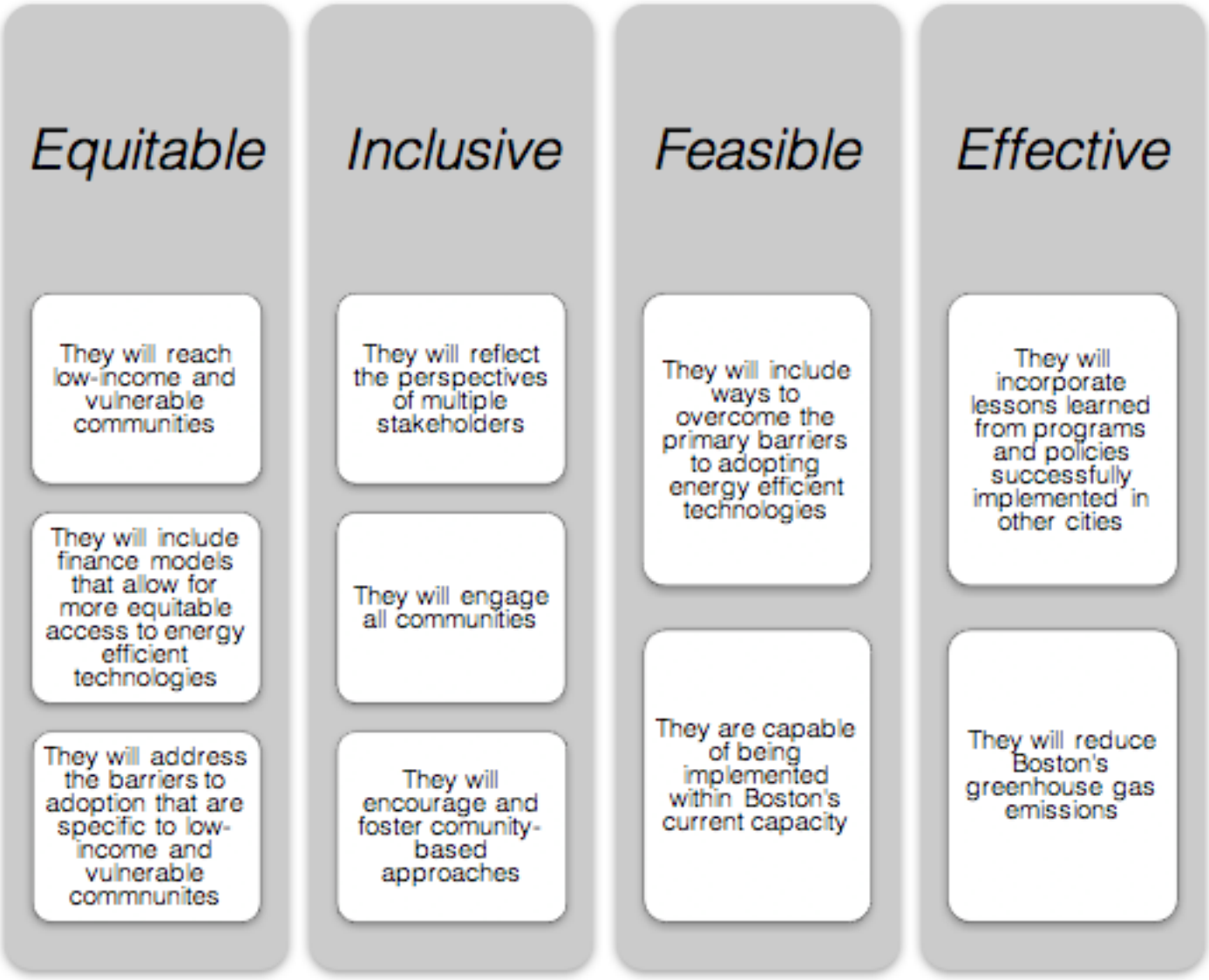
2 C40 Cities. (n.d.). C40: Renew Boston. Retrieved April 18, 2018, from http://www.c40.org/case_studies/renew-boston

3 Renew Boston Workshop. (2017, April 29). Retrieved from http://www.thehubway.com/events/2017/04/29/renew-boston-workshop-brighton

4 Office of Community Services. (2016, January 11). LIHEAP Assistance Eligibility. Retrieved April 19, 2018, from https://www.acf.hhs.gov/ocs/resource/liheap-eligibility-criteria

VISION, GOALS, AND OBJECTIVES

The City of Boston will achieve energy efficiency in the residential and small commercial sectors while enhancing goals of equity and inclusion. Programs and policies will be…



RESEARCH AND METHODOLOGY

This report will recommend options for accelerating the adoption of energy efficiency technologies in the residential and small building sector. This includes an analysis of the barriers currently preventing widespread adoption of the efficiency measures in Boston, recommendations for expanding the Mass Save and Renew Boston energy efficiency programs, and an exploration of other policy and community engagement programs for accelerating energy efficiency in the target sector in Boston. The report findings were developed through the following research methodologies:

- **A literature review** focusing on factors inhibiting adoption of GHG reducing technologies within Boston's residential and small commercial building sector

- **Stakeholder analysis** through interviews with individuals in Boston and throughout the Northeast in order to understand the level of program awareness and barriers to adoption. Sample interviewees include Action of Boston Community Development, Greenovate, Metropolitan Area Planning Council (MAPC), Philadelphia Energy Authority, and Rebuilding Together, NY. A complete list of interviews can be found in the Appendix.

- **Case studies**, comprised of local and global cities addressing energy efficiency adoption within their Climate Action Plans, to develop lessons learned, paying attention to policies designed to address education, training, financing, and equity.

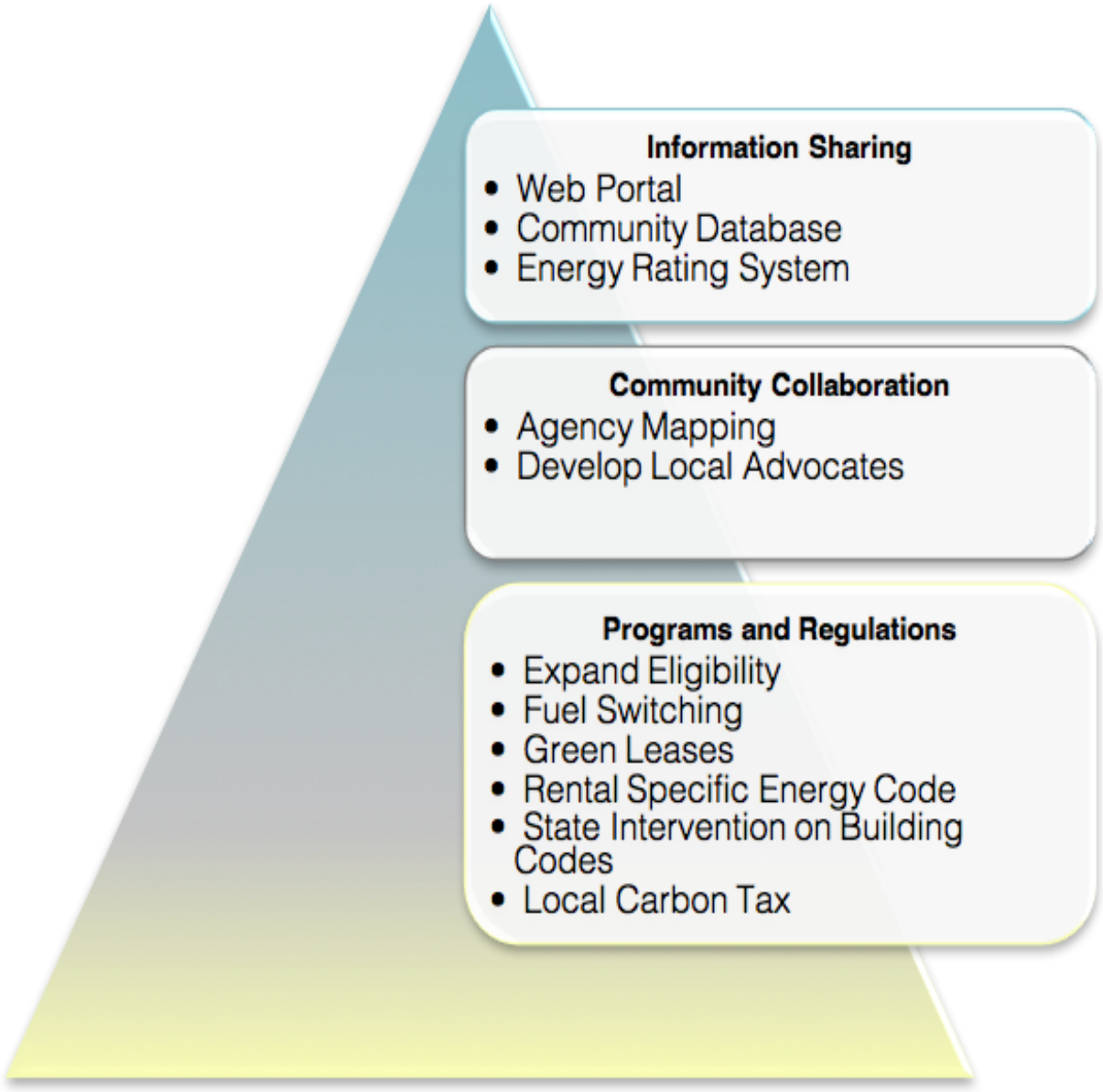
This report offers recommendations divided into three themes: Information Sharing, (2) Community Collaboration, and (3) Programs & Regulations. These programs and policies vary in feasibility, cost, and effectiveness; therefore, each section includes an analysis followed by an argument for prioritization for the city's consideration.

All theme approaches have been evaluated based on the following four criteria: effectiveness, equity, feasibility, and inclusivity.

- **Effectiveness**: The measure of the extent to which the policy will lower GHG emissions in the residential and small commercial sector by increasing program adoption.
- **Equity**: This criterion focuses on how well the program reaches vulnerable communities in both outreach and provision within Boston's residential and small commercial building sector.
- **Feasibility**: The measure of the policy's plausibility of final implementation. Policies which are easily implemented are identified as highly feasible, while policies with more inherent road blocks are considered as having low feasibility. Road blocks to feasibility can include expense or political opposition.

- **Inclusivity**: The social responsibility criterion will measure the extent to which the programs positively impact aspects of social inclusivity and foster elements of community development in Boston's Climate Action Plan.

For each of the criterion, the policies were scored along a scale of low, medium, and high. Final recommendations were formulated based on a combination of which were most feasible for the city to implement without sacrificing the three other goals.



THEME ONE: INFORMATION SHARING

Boston's 2014 Climate Action Plan included six updated energy efficiency actions, including one to develop a website. The website is expected to track implementation, performance measures, and lessons learned. This idea should be expanded upon to include a "one-stop shop" style web portal as well as a community database. To further expand upon this concept of sharing and spreading information, Boston should launch a mandatory energy rating system that discloses a building's performance at the time of sale or rental.

1. Web Portal

A comprehensive online resource will familiarize residents with energy efficiency tips and allow them to customize the recommendations they see based on their own profile. Initial features of the portal should include an energy profile, an overview of energy statistics, and a set of other energy potentials designed to motivate residents to lower their usage.[1] Massachusetts has already launched a web platform called the Commonwealth Energy Tool for Savings (energyCENTS), where residents can search for energy efficiency information by zip code.[2] It provides collective energy saving opportunities for rebates, loans, and financing for electric vehicles and appliances. However, several improvements would make the web portal more effective and extend the available services to more people.

1.1 Improve energyCENTS

Launched by the Massachusetts Department of Energy Resources (DOER), energyCENTS provides residents with a launch pad to the energy rebates, incentives, loans, and tax credits available from Mass Save. Consumers from all three sectors (residential, commercial, and industrial) have access to information on over 250 electric and natural gas rebates and incentives across a span of utilities and entities.[3] Ratepayers can find the link to the rebate or the incentive sponsors website to see more information and applications. Although energyCENTS is a dynamic web platform that provides rebates, funding sources, and opportunities for a home energy assessment, we suggest some improvements to expand its reach:

1 Oracle, (2018). "Oracle Utilities OPower Energy Efficiency Cloud Service." Retrieved from https://docs.oracle.com/cd/E84283_01/files/Energy_Efficiency_Cloud_Service_Overview.pdf.

2 Burgess, Dan, (December 20, 2016) "Baker-Polito Administration Launches Energy Savings Website." Text. Energy Smarts (blog). Retrieved from https://blog.mass.gov/energy/uncategorized/energycents/.

3 Kevin O'Shea (September 5, 2017). "Baker-Polito Administration Launches Energy Savings Website." Mass.gov. Retrieved from https://www.mass.gov/news/baker-polito-administration-launches-energy-savings-website.

- energyCents lacks accessibility to non-English speakers. 37.7% of Boston residents do not speak English; the most commonly spoken languages are Spanish, Haitian Creole, Chinese, Portuguese/Cape Verdean Creole, Vietnamese, and French.[1] The website should be translated into additional languages to reach new populations.

- Utilizing a mix of digital, radio, print, and other social media tools will reach more taxpayers across the residential, business, and industrial sectors. Marketing the web platform through new techniques will increase awareness of energyCENTS and drive traffic to the website.

- The website needs to be updated frequently to avoid links resulting in a "404 not found error". Many links led to expired pages, resulting in a frustrating user experience which could discourage ratepayers from pursuing these opportunities. DOER should utilize search engine optimization and a new, simplified URL in order to reduce difficulty finding the site (the Energy Cents Coalition in Minnesota has a much stronger web presence).

1.2 "One-Stop Shop" Style Website

Online energy efficiency information is currently available on the City of Boston's official website. Residents can find energy tips, programs, and initiatives regarding Boston's carbon neutral goal and links to relevant energy efficiency resources. However, the information is scattered and limited, and it fails to provide residents with a complete picture. The City of Boston should create a user-friendly and transparent web platform covering the components of energy efficiency policies, rebates and incentives, community events, new technologies, agencies and utilities, and other energy information disclosure. The "one-stop shop" style website will act as an intermediary between the different components of Boston's larger energy efficiency goal. This will reduce the time it takes for an individual to gather information, simplify the technical and financial aspects of installing energy efficient technologies, and motivate consumers to adopt energy saving actions.

Through Greenovate, Boston's Department of Environment is tasked with working across departments to develop guides and resources that connect Bostonians with information on processes and tips for local sustainability.[2] Thus, the Department of Environment should be responsible for creating and implementing the "one-stop-shop" style website. The Department of Environment works to foster sustainability and environment action throughout the city through numerous programs, initiatives, and policies. It aims to implement strategies to reduce greenhouse gas emissions and encourage energy efficiency.[3] Funding from federal, state and private funders sources, such as the Massachusetts Clean Energy Center (MassCEC), could help launch the website.

1 "Boston, MA." Data USA. Retrieved from https://datausa.io/profile/geo/boston-ma/
2 Walsh, Mayor Martin J. "2014 Climate Action Plan Update," n.d., 80. Retrieved from https://www.cityofboston.gov/eeos/pdfs/Greenovate%20Boston%202014%20CAP%20Update_Full.pdf
3 Robert Barton, 2018. "Climate and Environmental Planning Fellow for BERDO Programs Spring 2018." Greenovate Boston. Retrieved from http://www.greenovateboston.org/climate_and_environmental_planning_fellow_spring_2018.

Case Study: Alaska Energy Wiki

The Alaska Energy Wiki was established by the Alaska Center for Energy and Power (ACEP).[1] The website was funded by federal, state, and private sources. Their vision is to become Alaska's most frequently-updated energy website. Alaska has the second highest per capita energy use in the nation due to their cold climate.[2] Residential household payments for heating fuel and electricity accounts for a significant part of energy consumption for decades. In response to the state energy policies, the Alaska Energy Wiki serves as a platform to help residents and businesses to learn about Alaska's diverse energy needs and inform them the challenges that energy resources and technologies present. Most important, it accesses information and links to Alaska's energy efficiency programs, technologies, policies, funding and grants, ongoing projects, monthly forums, energy-related projects, state, federal and international level organizations and engaging communities. The Alaska Energy wiki allows each resident and business get involved and continuously informed with frequent updating information and data.

Components of the proposed "one-stop shop" style website include:

- **Policies**: The web portal should summarize all current federal, state, and local policies that impact energy regulation in Boston as well as any programs that target energy use. A summary of past policies and programs should also be included to provide historical context for the Boston's current energy landscape.

- **Energy resources**: Specific resources could include policies and programs related to renewable energy, such as biomass, geothermal, solar and wind, and non-renewable energy such as coal and natural gas. In addition, the website could contain information on policies and programs related to non-resource energy technologies, including alternative fuels, energy storage, diesel hybrid and heat pumps.

- **Programs:** A list of programs in Massachusetts and Boston that assist homeowners and small businesses in reducing energy consumption and cutting energy costs should be available on the website. The programs should include all current and past state programs, federal programs, retrofit programs, and training and education programs.

1 "Energy in Alaska - Alaska Energy Wiki." Retrieved from http://energy-alaska.wikidot.com/energy-in-alaska.

2 "Energy in Alaska - Alaska Energy Wiki." Retrieved from http://energy-alaska.wikidot.com/energy-in-alaska.

- **Energy rebates and incentives:** The website should expand upon energyCENTS by providing more information about incentives and financing opportunities that are available to Boston residents, especially the income eligible rebates.

- **Agencies and utilities:** The website should include information from other relevant agencies or entities, such as Mass Energy, Mass CEC, Institute for Sustainable Energy (ISE), the National Electrical Contractors Association of Greater Boston (NECA), and others.

- **Events:** The website should list all energy-related events in Boston, whether they are hosted by utilities, city agencies, universities, or non-governmental organizations.

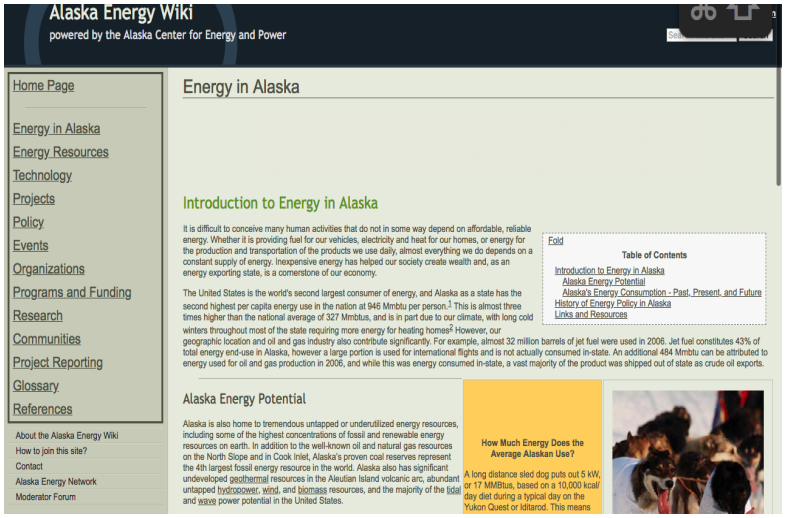


Figure A: Alaska Energy Wiki Homepage

- **Users reviews:** The website should provide users with reviews from people who have taken advantage of any programs to install energy efficient technology. They should also be able to provide feedback on the application process and any programs or services.

2. Community Database

Boston lacks a robust database that collects:

- Total amount of energy consumption;
- Number of residents who have been served by energy efficiency services and programs; and
- Enrolled individuals and how they have benefitted from adopting new technologies.

There is a need for an unbiased and robust data collection platform, as well as increased sharing of knowledge and information across utilities, public programs, non-governmental organizations, and consumers. A community database platform would be a unique tool where energy efficiency services, programs, utilities, and community members could voluntarily share data, build evidence-based knowledge, and increase transparency.

The online platform would integrate building retrofit data into a unified format. Ideally, it would be regularly updated with information and data about energy performance and costs of residential retrofit technologies. Users could contribute information like the annual building energy performance in Massachusetts, including total energy consumptions and savings, budgetary investments, and expenditures to the database.[1] For example, Mass Save could post their Annual Heat Loan Measure Report including the number of heat pump equipment loans and the total loan amount.

Northeastern University's Center for Renewable Energy Technology (NUCRET), the MIT Energy Initiative, and the Institute for Sustainable Energy (ISE) at Boston University could collectively develop a community database and receive funding from state grant and private funders sources.

Through the community database, utilities, organizations, experts, and other relevant users could:

- Share datasets and publications with the energy efficiency communities;
- Build knowledge with other energy efficiency stakeholders by collaborating and sharing datasets and best practices; and
- Support local authorities to improve the energy efficiency policy-making process from planning to implementation and monitoring.[2]

Of course, stakeholders are only willing to share data if they perceive some benefit. For researchers or stakeholders, such as Mass Save and Renew Boston, data sharing is an essential part of the research process. The database may allow energy efficiency services, programs, utilities, communities, and other stakeholders to build upon previous findings to reach further hypotheses.

The community database will serve as the entry point for users to vast amounts of information as well as a tool to promote data collection, information exchange, and collaboration. Creating a shared database provides anonymized historical data structured along major project characteristics (total energy consumed and saved, funding opportunities, etc.). Once implemented, the database would increase transparency and accountability, improve understanding of the impacts of individual technology adoption, and boost the ability to reach underserved households.

1 Mass Save Data. Retrieved from http://www.masssavedata.com/Public/Home.
2 Moschino, Isabella (October 1, 2015). "Location Data for Buildings Related Energy Efficiency Policies." Text. Retrieved from https://e3p.jrc.ec.europa.eu/node/156.

3. Energy Rating System

3.1 Home MPG and Energy Performance Score (EPS)

In recent years, energy performance ratings and labels have been designed and implemented in the U.S. for existing residential buildings.[1] In April 2013, the City of Boston adopted the Building Energy Reporting and Disclosure Ordinance (BERDO) which requires that all commercial buildings over 35,000 square feet and all residential buildings over 35 units annually benchmark their energy and water consumption and disclose that information to the public.[2] As for the residential buildings, Boston engaged non-governmental organizations to publicize a voluntary report under the BERDO.

A cooperative initiative between DOER and Mass Save called Home MPG (miles per gallon) provides a no-cost Energy Performance Score (EPS) that assesses residential building energy performance. [3] The Energy Performance Score (EPS) is an energy performance rating tool for both new and existing residential buildings. It has three components: the assessment, the scorecard (Figure B), and the recommendation report.[4] The EPS rating criteria are determined by a home's size, design, insulation condition, heating and cooling systems, appliances, lighting, windows, and hot water heating. [5]The scorecard shows the EPS both "before" and "after" making recommended improvements and average home score in the community.

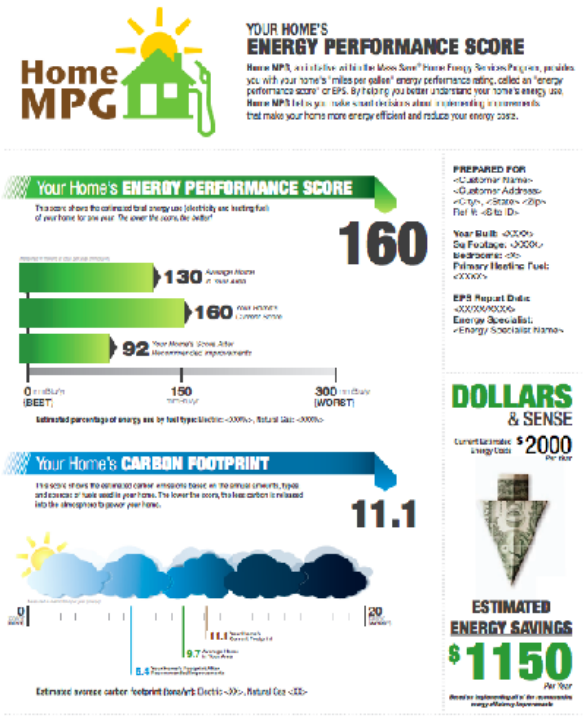


Figure B: Home MPG Energy Rating System

1 Faesy, Richard, Leslie Badger, Emily Levin, Diane Ferington, Ian Finlayson, and Jane B Lano. "Residential Building Energy Scoring and Labeling: An Update from Leading States," n.d., 13.
2 Building Benchmarking, Rating, & Transparency. Retrieved from https://database.aceee.org/city/benchmarking-disclosure
3 Elise Anderson (December 7, 2012). "Home Mpg." Energy Smarts. Retrieved from https://blog.mass.gov/energy/tag/home-mpg/.
4 "EPS Audit." Retrieved from http://masssave.energy-performance-score.com/about
5 "Your Home Energy Score." Retrieved from http://www.mass.gov/eea/docs/doer/building-labeling/csg-resi-score.pdf.

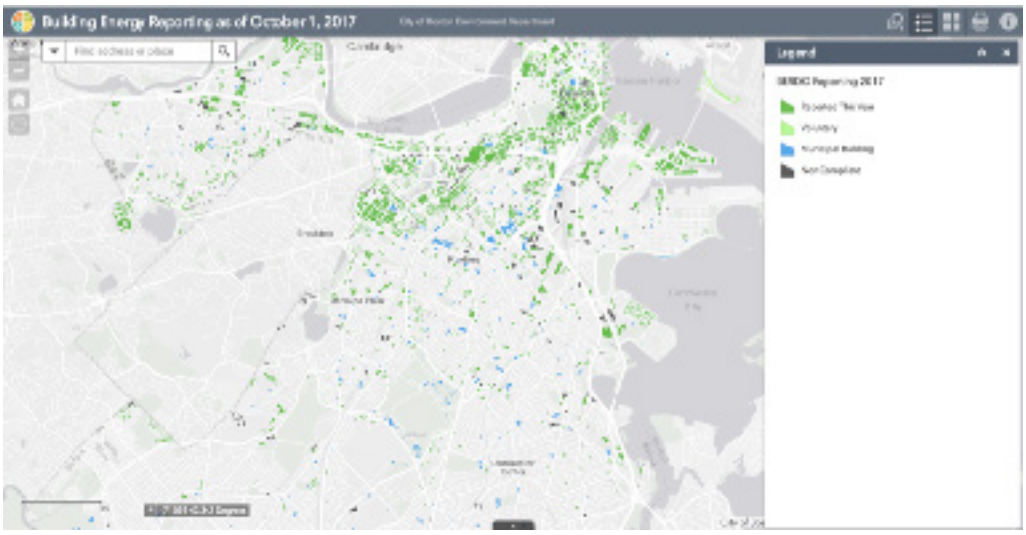


Figure C: Building Energy Use Report (Source: BERDO)

The Home MPG pilot occurred between late March 2012 to March 31, 2014.[1] It covered qualifying homes in Belchertown, East Longmeadow, Hampden, Longmeadow, Monson, Palmer, Springfield, and Wilbraham.[2] At the end of the implementation, approximately 3,500 homes received scorecards, and over 1,800 had signed contracts for insulation improvements.[3] Although the City of Boston was not included in the Home MPG assessment, a separate pilot initiative could be conducted due to the positive outcomes and favorable responses. The experience suggested including the following benefits when adopting a mandatory approach to residential rating system:

- Help homeowners and renters to easily understand the current condition of home energy efficiency;
- Convince homeowners and renters to reduce energy consumption;
- Influence home purchasing decisions; and
- Encourage adoption of energy efficiency measures.

1 Whiteman, Alissa (2014). "Mass Save Innovates with Home MPG," n.d., 12. Retrieved from https://aceee.org/files/proceedings/2014/data/papers/6-858.pdf

2 "EPS Audit." Retrieved from http://masssave.energy-performance-score.com/about.

3 Faesy, Richard, Leslie Badger, Emily Levin, Diane Ferington, Ian Finlayson, and Jane B Lano. "Residential Building Energy Scoring and Labeling: An Update from Leading States," n.d., 13.

3.2 Require disclosure at time of sale or rental

To better inform residents of the building energy condition, the City of Boston should also lead the effort to disclose the energy score during the sale and rent process. In 2008, Massachusetts failed to pass legislation mandating residential energy disclosure at the time of sale.[1] As a result, potential building owners or tenants of either residential or small commercial buildings lack the knowledge of energy performance of the buildings in which they are interested. Boston should restart the legislative process to require both for sale and rental units to have an energy rating. The benefits of this system are two-fold: it encourages investment in building energy performance and it motivates residents to participate.

Case Study: Austin Energy Conservation Audit and Disclosure (ECAD) Ordinance

The Energy Conservation Audit and Disclosure Ordinance (ECAD), was approved in November 2008 and amended in April 2011.[2] ECAD is an ordinance to expose building energy performance and promote energy efficiency upgrades in existing residential buildings and commercial buildings. ECAD requires homeowners in Austin to disclose their home energy performance score before selling.[3] Austin Energy hopes the ECAD rating criteria will promote home energy improvements and increase energy efficiency retrofits in existing residential buildings. However, it does not require homeowners implement home energy improvements. Based on the ECAD rating outcomes, homeowners can utilize the rating results to make energy efficiency improvements that increase property marketability in the residential housing market. Moreover, the rating results can also be considered as an efficient tool for advertising existing energy efficiency measures.

Best practices for implementing the energy rating system include:

- Before listing the property, homeownership and rental units would contact contractors, such as Home MPG, who offers a free EPS rating tool to assess wall insulation, hot water heating, major appliances, heating and cooling systems, windows, and the source of the home's energy.
- Home MPG administrators develop an EPS Scorecard for homeowners and renters.

1 Faesy, Richard, Leslie Badger, Emily Levin, Diane Ferington, Ian Finlayson, and Jane B Lano. "Residential Building Energy Scoring and Labeling: An Update from Leading States," n.d., 13.

2 "Case_Study-Austin_Energy_Conservation_Audit_and_Disclosure_ECAD_Ordinance, Pdf." Retrieved from http://www.energy.ca.gov/ab1103/rulemaking/documents/documents_relied_upon/Case_Study-Austin_Energy_Conservation_Audit_and_Disclosure_ECAD_Ordinance,.pdf.

3 "ECAD for Residential Homes," (October 7, 2013). Retrieved from https://austinenergy.com/ae/energy-efficiency/ecad-ordinance/ecad-for-residential-customers.

- Share those results by publishing the scores in the city's database of housing and real estate information and on the official website of MPG.
- Include the score in the home's "for sale" or "for rent" advertisement.
- The homeowners and renters could provide the rating performance directly to home buyers or tenants. The listing real estate agent should offer buyers or tenants a copy of the home energy rating information and results along with the regular packet of listing disclosures. [1]

By exposing home energy scores, prospective Boston homeowners and renters will receive an accurate and easy-to-understand measure of their home's energy consumptions and GHG emissions. The required disclosure at the time of sale or rental will propel landlords to better adopt energy efficiency technologies in order to score higher and attract more buyers/renters. The ranking system will also spark an interest in the importance of energy efficiency and more tenants and homeowners will participate in retrofitting activities.

Case Study: Home Energy and GHG Rating and Disclosure (HERD) program in Ontario, Canada

To reduce GHG emissions and promote the shift to become an energy efficient province, the Ontario government released and implemented a Home Energy and GHG Rating and Disclosure (HERD) program within Ontario's Climate Change Action Plan.[2] This program requires homeowners conduct a universal home energy rating before selling, and ensures buyers are made aware of energy rating information during the purchasing process.[3] The HERD plan would undoubtedly create many jobs in the energy auditing field, and it would also inject life into the construction industry as more home upgrades are in demand. The advantage of facilitating technologies and retrofit program would influence increasing number of homeowners.[4]

1 Stephen Fitzmaurice (May 8, 2017) "Want to Sell Your Home? New Mandatory Fee. Portland." Real Estate Agent PDX. Retrieved from https://realestateagentpdx.com/want-sell-home-new-mandatory-fee-portland-2018/10405.

2 Russell Underhill "Home Energy Rating and Disclosure - What You Need to Know! - Real Estate Blog." Century21.ca. Retrieved from http://www.century21.ca/russell.underhill/blog/Home_Energy_Rating_and_Disclosure_-_What_you_need_to_know.

3 Russell Underhill "Home Energy Rating and Disclosure - What You Need to Know! - Real Estate Blog." Century21.ca. Retrieved from http://www.century21.ca/russell.underhill/blog/Home_Energy_Rating_and_Disclosure_-_What_you_need_to_know.

4 "Home Energy Rating and Disclosure in Ontario (HER&D)." Ecohome. Retrieved from http://www.ecohome.net/content/ontario-s-home-energy-rating-disclosure-plan-herd-great-news-home-buyers.

Evaluation & Analysis

	Effectiveness	Equity	Feasibility	Inclusivity
Web Portal	Low	High	High	High
Community Database	Medium	Medium	Low	High
Energy Rating System	High	High	Medium	High

Developing a web portal is the most feasible option of the three presented in this section. Greenovate Boston has already laid the groundwork for delivering this type of service, as outlined in the 2014 Climate Action Plan. Through the web portal, hard-to-reach communities would have access to energy efficiency plans by searching online for programs, policies, rebates, financing opportunities, and local events. However, the portal is a limited option because while it helps engage community members and raise awareness for energy efficiency programs, there is no guarantee that people will take action. Installing all season heat and cooling and retrofitting are expensive endeavors and require strong financial incentives and rebates to ignite action.

A completed energy rating system would reach both homeowners and renters in Boston and would therefore reach the key demographic and be very effective at reducing GHGs, but it is a less feasible approach for the City to take. Successfully implementing the energy rating system not only requires substantial financial and political support, but also the backing of real estate developers.

Launching a robust community database would be laborious due to the challenges associated, such as data security, data management, and data quality. Mass Save and utilities may be reluctant to share data on individual users due to privacy concerns. This approach also requires considerable financial and technical support, while only delivering few direct impacts on GHG emissions since it serves more as an educational resource.

THEME TWO: COMMUNITY COLLABORATION

The American Council for an Energy Efficient Economy (ACEEE), has developed energy scorecard reports at the national, state, and city level identifying how differing regions are stacking up in their energy efficiency efforts. Since 2015, the ACEEE has developed three annual reports ranking 51 large U.S. cities in their efforts to meet climate action goals, and for the past three consecutive years, Boston has ranked first.

Boston is at the top of the ACEEE climate action rankings, but scores low on community initiatives

However, the city has struggled on scores associated with community-initiatives. Information collected from stakeholders in interviews supports the ACEEE's claims that Boston's community-wide initiatives could be improved upon to propel the city forward on its climate action goals.[1] The city could profit from energy efficiency collaboration that increases program adoption within the housing and small commercial building stock of low income neighborhoods. To meet this end, Boston needs to implement programs and policies that are inclusive and equitable. This will ensure the city's aging building stock is properly absorbed into the future of the energy efficiency movement by supporting those who are most in need and incorporating other community development programs in areas like health, safety, and job placement. Incorporating the following approaches into the Climate Free Boston report will increase community engagement, improve the city's rankings and score card ratings, and ultimately reduce GHG emissions.

1. Agency Mapping

A more holistic approach to community development and energy efficiency can be achieved through inter-agency collaboration between CDCs, Housing, Health, and Workforce improvement organizations. Agency mapping is a collaboration technique that graphically captures the relationships between organizations, agencies, and stakeholders. As a guiding and instructional tool, it helps a larger programmatic vision come to fruition by:

- Developing a sense of shared understanding amongst all stakeholders;
- Identifying levels of interaction and influence between organizations eliminated agency silos; and
- Pinpointing areas of opportunity by determining gaps and overlaps in service provision.[2]

1 eschwass. "The 2017 City Energy Efficiency Scorecard." Text. ACEEE, May 8, 2017. Retrieved from http://aceee.org/research-report/u1705.

2 "Collaboration Mapping A Facilitation Guide. Pdf." Accessed April 19, 2018. Retrieved from https://usaidlearninglab.org/sites/default/files/resource/files/collaboration_mapping_facilitation_guide_formatted_201507_0.pdf.

COMMUNITY COLLABORATION

Successful collaboration brings organizations with shared interests together, removes redundancies, shares best practices and lessons learned, and defines shared challenges. The visual result of agency mapping provides a baseline for a goal-oriented strategy identifying the priorities throughout the implementation process (Figure D).

In a 2017, a study utilizing the results of the National Survey, "Implementation of Energy Efficiency and Sustainability", investigating the causal effects of both inter- and intra-local collaboration tools on the success of urban sustainability efforts revealed that collaboration management tools enhance implementation of green initiatives outcomes. Interestingly, the study also found that governmental administrative capacity in itself does not directly impact the implementation of green practices, but it does permit the possibility of increased collaboration.[1]

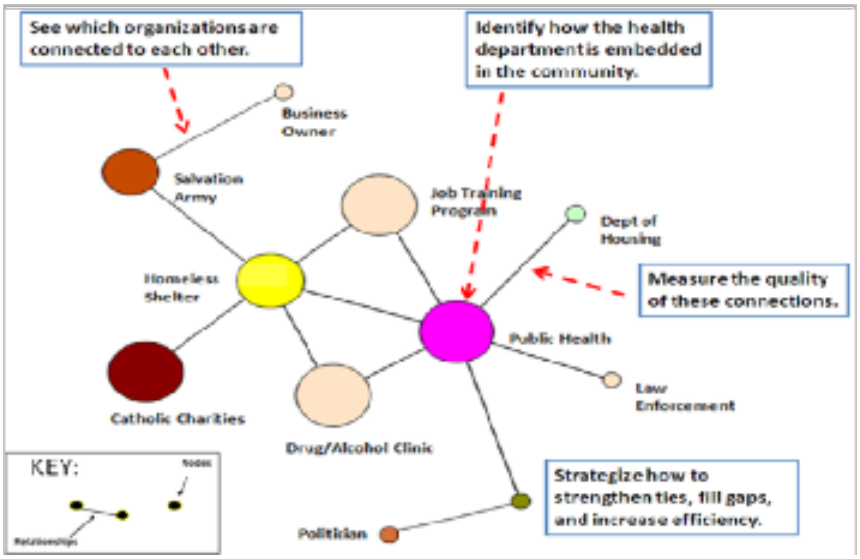


Figure D: Figure A: Agency Map (Source: Partner Tool)

To date, the City of Boston has succeeded at connecting various city and state organizations; however, there is a need for greater connectivity with "street-level" organizations within the city in order to provide effective service provision and meet the city's goals.[2] Based on the stakeholder analysis, improvements in energy efficiency

program adoption could be gained by identifying the interactions between organizations such as: Co-op Power, Boston, Boston ABCD, Boston Private Industry Council, Boston Housing Authority, Boston Planning and Development Agency, CDC of Boston, Climate Action Business Association, and Massachusetts Climate Action Network. Therefore the development of an agency mapping, including all organizations involved in energy efficiency service provision, will identify communication linkages connecting organizations by mission goals and deliverables focusing on community development and energy efficiency.

1 Swann, William L. "Examining the Impact of Local Collaborative Tools on Urban Sustainability Efforts: Does the Managerial Environment Matter?" The American Review of Public Administration 47, no. 4 (May 1, 2017): 455–68. Retrieved from https://doi.org/10.1177/0275074015598576.

2 Boston Redevelopment Authority. "2016 Boston Community Energy Study". Retrieved from http://www.bostonplans.org/getattachment/d52c36d5-2b1a-40e3-b4cd-3d4fa01ed4e6.

Implementing this policy means the City of Boston would appropriate and secure the necessary funds to develop an agency mapping or network analysis of all agencies, organizations, and stakeholder groups as a first step to engender a greater and more connective collaboration of efforts. Energy efficiency efforts should not be a standalone solution and should be properly connected with other health and community development solutions.

2. Develop Local Advocates

Community-based initiatives can engender individual ownership and responsibility for actions to reduce energy consumption. In 2012, the European Union adopted the Energy Efficiency Directive as it was feared EU Member states were not on track to achieve the 20% energy reduction target by 2020. To support and better inform the directive, the European Environmental Agency in 2013 conducted a landscape analysis of available literature with the purpose of identifying the relationship between consumer behaviors and energy efficiency practices. The analysis shows that community-based initiatives are successful in developing change and maintaining effort over an extended period. The success of these community-based initiatives lies in the focus on energy awareness at the community level, which develops new social norms and helps shift behavioral habits as residents want to better align with the efforts of their community.[1]

Community-based initiatives are successful in developing change and maintaining effort over an extended period

A number of cities are formulating community-based initiatives to raise awareness of energy efficiency. This approach connects organizations and individuals throughout the community to develop and implement a range projects to reduce energy consumption and increase energy efficiency. Community-based initiative groups can vary in size from 10 to 100 individuals, and in one instance in the UK, over 1,000 group members.[2] Successful community-based approaches develop local advocates who can assist in efforts of behavioral change aimed at reducing the overall energy consumption. To encourage community buy-in and validate community perception, workshop groups are typically formed by individuals residing in the same neighborhood, workplace, or community. A great example of a local community-based initiative is Rebuilding Together's Nation Rebuilding Day, wherein local affiliate organizations coalesce hundreds of volunteers to undertake building home improvements for low-income neighborhoods.[3]

1 European Environmental Agency, 2013, "Achieving Energy Efficiency through Behavioral Change: what it takes".Retrieved from https://www.eea.europa.eu/publications/achieving-energy-efficiency-through-behaviour. ISSN 1725-2237

2 European Environmental Agency, 2013, "Achieving Energy Efficiency through Behavioral Change: what it takes". Retrieved from https://www.eea.europa.eu/publications/achieving-energy-efficiency-through-behaviour. ISSN 1725-2237

3 Rebuilding Together. "National Rebuilding Day". Retrieved from http://www.rebuildingtogethersf.org/programs/national-rebuilding-day/

Case Study: Rebuilding Together NYC - Deep Dive Brownsville

Rebuilding Together NYC is a local affiliate of a national nonprofit organization which strives to transform the lives of low-income New Yorkers by improving the safety and health of homes and revitalizing communities. For the past twenty years, through collaboration of government and corporate partners and volunteer efforts, Rebuilding Together NYC has provided services to NYC's five boroughs at no cost to program recipients.[1] In 2017, Rebuilding Together NYC joined with local community partners in the development of a neighborhood initiative housing, workforce development and community renovation project called Deep Dive: Brownsville.[2] By centralizing efforts on a targeted community Rebuilding Together NYC has been to develop a network of local advocates who have become leaders of change within their community. In addition to improving the general health and safety of New York homes, Rebuilding Together NYC has collaborated with the Solarize NYC campaign by providing free roof repairs in order to assist in improving the Cities Energy Efficiency.[3]

Another profound impact of community-based initiatives is the inherent potential to improve an individual's sense of ownership and responsibility of their actions as they relate to energy efficiency. A local network that aims to bring community members together and fosters local individuals to become leaders in dialog regarding energy efficiency issues faced by their community can have a lasting impact on program adoption in hard to reach neighborhoods. This may best be seen in success of PUSH Buffalo's work force development in the Green Development Zone.[4]

1 Rebuilding Together New York City. "About". https://rebuildingtogethernyc.org/who-we-are#about
2 Rebuilding Together New York City. "Deep Dive: Brownsville". https://rebuildingtogethernyc.org/what-we-do#deep-dive-brownsville
3 Rebuilding Together NYC Phone Interview March 16, 2018
4 Hart, Skye, and Sam Magavern. "PUSH Buffalo's Green Development Zone: A Model for New Economy Community Development," n.d., 46.

Case Study: PUSH Buffalo, Green Development Zone – Leadership Training

People United for Sustainable Housing (PUSH) Buffalo, is a nonprofit organization that combines community organization, policy advocacy, and neighbored redevelopment to bring about a more environmentally and economically sustainable community.[1] In 2008, PUSH Buffalo established the Green Development Zone (GDZ) in Buffalo's West Side with the goal of transitioning the 25 square block neighborhood from fossil-fuel economy towards greater energy efficiency. The West Side community is racially diverse, comprised of a large immigrant and refugee population with 40% of the residents and 60% of the children living in poverty.[2] In addition, by providing green affordable housing within the GDZ, PUSH Buffalo supports creates many new jobs within the community. By partnering with local organizations such as Youth Build, the Center for Employment Opportunities, and the Outsource Center, PUSH Buffalo is able to supplement its construction workforce with individuals who would typically be at a disadvantage for employment. This approach improves community trust and the legitimacy of PUSH's actions as workers return and educate their neighbors on the program. Additionally, by providing work opportunities for at-risk youth within their community, PUSH is instilling values of community leadership and engagement in the next generation.[3]

"There are lots of silos in Boston, lots of climate groups. There's not a single place where all efforts are coordinated. We're all working toward one big goal with scattered objectives."

To date, the City of Boston has been successful at utilizing the Renew Boston program and Greenovate staff to coordinate community informational workshops to communicate program goals to the broader community.[4] These community-based communication efforts have helped the city engage 40,000 homeowners, landlords, and renters in a range of services connected to the No-Cost Home Energy Audits.[5] Conceptually, the energy efficiency workshops focus on the individualized incentive available for homeowners, renters, and landlords, and how the City will achieve a clean, safe, and healthy environment. While these results are promising and a necessary first step in increasing community engagement, they are limited in their ability to draw the community into larger programmatic goals.

1 Hart, Skye, and Sam Magavern. "PUSH Buffalo's Green Development Zone: A Model for New Economy Community Development," n.d., 46.
2 Hart, Skye, and Sam Magavern. "PUSH Buffalo's Green Development Zone: A Model for New Economy Community Development," n.d., 46.
3 Hart, Skye, and Sam Magavern. "PUSH Buffalo's Green Development Zone: A Model for New Economy Community Development," n.d., 46.
4 Greenovate Boston. "Events". Accessed on April 15, 2018. http://www.greenovateboston.org/events
5 Vaz, Jeff. "Renew Boston Energy Efficiency Workshop Featuring Mayor Walkh". Greenovate: February 3, 2017. http://www.greenovateboston.org/renew_boston_workshop_recap

COMMUNITY COLLABORATION

Developing community-based initiatives targeted at consumer energy awareness in conjunction with the City's ongoing efforts to improve energy efficiency program adoption will be extremely effective and help develop new community advocates and strengthen social values. This community-based initiative program would ideally be facilitated through a collaboration with organizations like **Rebuilding Together Boston** and **Boston's Private Industry Council**.

By studying the success of Deep Dive Brownsville, Renew Boston can coordinate efforts with the Cities local affiliate of Rebuilding Together to develop local advocates in Boston's Climate Action Plan. Since 1991, Rebuilding Together Boston (RTB) has completed over 350 home and building retrofits with an aggregated value of over $6.5 mission and involved over 20,000 local volunteers in the process.[1] In coordinating efforts with RTB's largest program, National Rebuilding Day (NRD), the City would be able to engage and coordinate with hundreds of local community advocates and volunteers in the repair and restoration of the Boston's building stock. The intent would be to combine the City's No-Cost Energy Audits, weatherization, and appliance and energy efficiency upgrades with the efforts of community members through RTB to strengthen the overall importance of community-wide engagement.

"Community trust" is the bargaining token for program adoption to become more effective in low-income and vulnerable neighborhoods throughout Boston. Resistance to the marketing of local energy efficiency programs and services can be tied to an inability to relate with certain concepts. Through its extensive community outreach, Push Buffalo, in coordination with the Green Jobs – Green New York (GJGNY) Act, has been able to leverage energy efficiency referrals with contractors in exchange for a commitment to high road employment practices like living wages and the employment of disadvantaged workers.[2]

The Boston Private Industry Council (PIC) is a nonprofit supporting Boston's workforce development by connecting both youth and adults with necessary education and employment opportunities aligning with the needs of local employers. At their core, the organization cultivates local advocates by providing meaningful employment, developing life-long behavior change and lifting individuals from poverty. As the City endeavors to transition its industry and community to a more energy efficient and sustainable future, it is important to ensure its residents are poised to become a workforce capable of delivering that change. The Boston PIC supports several "school-to-career" and "disconnected youth" programs in an effort to provide financial independence for the future workforce of Boston.[3] Through coordination with Boston's Private Industry Council and Renew Boston, the City could establish opportunities for disadvantaged employees and youth while simultaneously developing new community advocates for energy efficiency programs.

1 "The Giving Common - Rebuilding Together Boston Inc." https://givingcommon.org/profile/1083794/rebuilding-together-boston-inc/.

2 Hart, Skye, and Sam Magavern. "PUSH Buffalo's Green Development Zone: A Model for New Economy Community Development," n.d., 46.

3 The Boston Private Industry Council. "Overview". Accessed April 18, 2018. https://www.bostonpic.org/about-us/overview

Evaluation & Analysis

	Effectiveness	Equity	Feasibility	Inclusivity
Agency Mapping	Medium	Medium	High	High
Foster Local Advocates	Medium	Medium	Medium	High

Agency mapping lays the groundwork for developing future local advocates

Agency mapping should be prioritized because the efforts and results gained through this process would lay the groundwork for the development of local advocates and the overall Climate Action Plan. Developing an agency mapping or network analysis is likely to be effective in reducing GHG emissions in Boston's residential and small commercial building sector, as it would improve service provision by producing efficiencies, reducing overlap and streamlining services allowing Boston's extensive network of organizations to do more with less.[1] The effectiveness of this approach could be compounded as it could also improve data collection and gathering through improved outcomes of collaboration. The 2017 ACEEE Scorecard report identified cities with strong programs and policies encouraging community collaboration in energy use tracking benefit from improved benchmarking efforts.[2]

Agency mapping scores well on accounts of equity and inclusivity. At its very core, collaborative mapping seeks to identify as many plausible community actors in the service provision process. By design, it seeks out programs that advocate for community development and it helps to channel resources to programs supporting vulnerable communities.

1 Tong, Catherine E., Thea Franke, Karen Larcombe, and Joanie Sims Gould. "Fostering Inter-Agency Collaboration for the Delivery of Community-Based Services for Older Adults." The British Journal of Social Work 48, no. 2 (March 1, 2018): 390–411. https://doi.org/10.1093/bjsw/bcx044.

2 eschwass. "The 2017 City Energy Efficiency Scorecard." Text. ACEEE, May 8, 2017. http://aceee.org/research-report/u1705.

COMMUNITY COLLABORATION

This is a moderately feasible program since it will require a bolstering of staff and resources in order to collect and properly analyze the aggregation of data. Extended staff time will be necessary to collect contact information, mission statements, resources, and programs for all involved actors. Finally, the development and delivery of a single resource in the collaborative mapping would carry a cost burden; however, the knowledge base it would build will pay extreme dividends in community development. Ultimately, improvements in energy efficiency adoption in Boston's residential and small commercial sector are only as good as the efforts from which they are derived.

A community-based initiative that develops and fosters local advocates to change resident behaviors as it pertains to energy efficiency adoption is moderately effective, as they are most effective when implemented in conjunction with a larger program. However, community-based initiatives can provide a local resource for energy discourse and support the Boston Climate Action Plan. Coupled with information sharing efforts, and/or improved programs and regulations, a community-based initiative can help transform resident behaviors and aid in the City's larger efforts toward carbon neutrality.

This is also only moderately feasible because it will require an initial field analysis of stakeholder values and political influences to ensure all parties identify with a common set of values and goals. In terms of social inclusivity, a community-based initiative is on par with the implementation agency mapping as it ultimately is designed to encourage and engage the broader community by means of neighborhood advocates.

THEME THREE: PROGRAMS AND REGULATIONS

Finally, there are key improvements Boston can make to its existing energy efficiency programs in addition to some new regulatory strategies. The highest priority should be to expand the Mass Save income-eligible programs to serve households with 0-80% of median income. In addition, Boston should consider a few highly effective strategies that require more long-term planning and coordination with the Commonwealth, like enacting a local carbon tax. However, these large-scale interventions are less feasible for the city to accomplish in the near-term.

1. Changes to current energy efficiency programs

The main energy efficiency program in Massachusetts is Mass Save, which is only impacting 1% of Boston's residential and small commercial buildings. Fortunately, several simple changes can be made in order to improve its effectiveness.

1.1. Expand eligibility for Mass Save low-income energy efficiency programs

Stakeholders interviewed identified low-middle income households with 60-80% of area median income as a gap in coverage for Massachusetts energy efficiency programs. Households in this income bracket living in 1-4 unit buildings are eligible for some enhanced incentives including no-cost insulation and increased rebates for some efficient appliances. However, there is not a similar low-middle income option for 5+ unit buildings. These households would be better served if Massachusetts expanded the Mass Save income-eligible programs to serve households with 0-80% of median income for both 1-4 unit and 5+ unit buildings. This expansion would help to tackle the gap in coverage and better reflect the high cost of living in Boston.

Massachusetts would not be the first state to do this; there are other low-income energy programs that define low-income as 80% of area median income. For example, California's low-income solar program, SASH, is offered to eligible households with 0-80% of area median income.[1] Additionally, the state of Colorado created a separate energy efficiency program, the Colorado Affordable Residential Energy Program (CARE), to serve residents with 60-80% of area media income, as this segment was considered a gap in coverage.[2]

1 Go Solar California. (n.d.). Retrieved April 19, 2018, Retrieved from http://www.gosolarcalifornia.ca.gov/affordable/sash.php

2 U.S. Department of Energy. (20176, February 23). Better Buildings Residential Network Peer Exchange Call Series: Making an Impact: Low-Income Energy Efficiency Programs. Retrieved from https://www.energy.gov/sites/prod/files/2017/03/f34/bbrn_Summary_Low-IncomePrograms_022317.pdf

1.2. Fuel switching: allow ratepayer energy efficiency funding for fuel switching

An important part of emissions reduction efforts in Boston is strategic electrification, which involves switching fossil fuel based transportation and heating fuel sources to electric.[1] Under current rules in Massachusetts, ratepayer funded energy efficiency programs cannot provide funding for "fuel switching" from oil or natural gas to electric heating systems. This means that while residents can receive incentives for electric heat pump systems if they already have electric heating, they aren't able to receive incentives to switch from oil or natural gas heating to electric heating.[2] The rules surrounding fuel switching in Massachusetts have been identified in literature and stakeholder interviews as a barrier to expanding the electrification of heating systems, particularly for low-income households in Boston, who are more likely to use oil heating systems.[3]

This change is currently under consideration with Massachusetts House Bill No. 1724. The bill would add a clause allowing ratepayer funding collected by electric distribution companies and municipal aggregators to go to "programs that result in customers switching to a different heating fuel, provided that the program increases efficiency".[4] This would allow those living in homes with oil or natural gas heating systems to switch to electric heating systems. This would make switching to electric heating systems more affordable to more households and create more households able to switch to heat-pump systems.

2. City-level recommendations to address split incentives

Split incentives are a persistent barrier to achieving energy efficiency gains in rental properties. Split incentives occur in rental agreements where the renter is paying for energy, while the landlord or building owner has responsibility over building renovation decision-making including energy efficiency upgrades. In this scenario, renters would be incentivized to reduce energy consumption by investing in energy efficiency because they stand to gain financially, but they don't have control over the installation. Meanwhile, landlords have control over the installation of energy efficiency upgrades, but don't directly benefit financially as they are not paying for energy costs so they are not incentivized to do so. Another difficulty is that renters are more likely to be living in a space short-term and therefore are not incentivized to invest in energy efficiency upgrades which has benefits that accrue over a long-term.[5] This section will overview several proposed solutions to the split incentives energy efficiency problem in rental properties.

1 NEEP. (2017). Northeastern Regional Assessment of Strategic Electrification. Retrieved from http://www.neep.org/sites/default/files/Strategic%20Electrification%20Regional%20Assessment.pdf
2 NEEP, 2017
3 Stakeholder interview with City of Boston representative present at ISE meeting
4 Mass. Legislature. (n.d.). Bill H.1724. Retrieved from https://malegislature.gov/Bills/190/H1724/BillHistory
5 Bird, S., & Hernandez, D. (2012). Policy options for the split incentive: Increasing energy efficiency for low-income renters. Energy Policy, 48, 506–514.

2.1. Encourage green leases

"Green" or "energy-aligned" leases have been proposed in literature as a solution to split incentives in literature.[1] A green lease is any lease that includes some environmental factors that are agreed upon by the landlord and tenant. Green leases written to specifically encourage energy efficiency upgrades and combat split incentives generally include a "pass-through" clause. Pass-through clauses allow a landlord to "pass-through" some of the capital costs of energy efficiency retrofits to tenants rent, limited in amount to the expected energy bill savings seen by tenants to prevent their energy costs from increasing.[2] For example, the NYC Mayor's Office of Long Term Planning and Sustainability released a model pass-through lease provision, which limits the pass-through amount to 80% of predicted annual energy savings, based on an analysis that found that actual energy savings from energy efficiency retrofits are generally within 20% of predicted energy savings.[3] With this pass-through clause, if the tenants' energy cost went down $100 per month after energy efficiency retrofitting they would pay at most $80 more in rent per month to pay back the cost of the retrofits, resulting in $20 in savings per month.

Green leases with pass-through clauses have traditionally been used in commercial leases, where the capital energy efficiency expense is treated like an operational expense to be paid monthly by the tenant.[4] In recent years, they have been increasingly proposed as a potential solution for residential properties as well. A recent analysis by the San Francisco Bay Area Planning and Urban Research Association (SPUR) looked at the potential of green leases for residential rental housing. The study proposed that a green lease program could be supervised by the San Francisco Rent Board and projected that such a program would be cost effective, resulting in annual savings of 200 tons of CO2 emissions at a cost of $40/ton (the cost of a ton of CO2 emissions is generally estimates around $100).[5]

1 Bird & Hernandez, 2012
2 NRDC. (2011). Energy Efficiency Lease Guidance. Retrieved from https://www.nrdc.org/sites/default/files/CMI-FS-Energy.pdf
3 NYC OLTPS. (2012). The Energy Aligned Clause. Retrieved from http://www.nyc.gov/html/gbee/downloads/pdf/eac_overview.pdf
4 Institute for Market Transformation. (2016a). Making Efficiency Work For You. Retrieved from http://www.imt.org/uploads/resources/files/Making_Efficiency_Work_for_You.pdf
5 SPUR. (2009, May 1). Create a residential "Green Lease" program. Retrieved from http://www.spur.org/publications/article/2009-05-01/critical-cooling/option-7

Case study: Cleveland Energy-Aligned Leasing Program

The Institute for Market Transformation (IMT) and the Cleveland Council of Small Enterprises (COSE) conducted a 2-year pilot study focused on improving energy efficiency in small businesses in Cleveland, Ohio. The recently conducted study worked with 60 small businesses in the city, providing energy education, green leasing resources, and financing options.[1] Businesses from different neighborhoods, including traditionally disadvantaged ones, were recruited and bought-into the pilot study by COSE, a trusted local actor with small businesses.[2] The IMT did not release aggregate energy savings from the pilot program, but did put together a resource guide for small businesses improving their energy efficiency and several case studies with key lessons learned from the study.[3] The IMT estimates based that green leases can result in savings of up to $0.51 per square foot on utility payments and can reduce energy consumption in office buildings 11-22%.[4]

Research shows that with the right resources, small businesses are willing to invest in energy efficiency. Boston could perform a similar pilot study of providing green lease resources, including sample lease language, to residential and small commercial landlords as part of Renew Boston's energy efficiency work.

2.2. Implement rental-specific energy code

For full adoption of energy efficiency upgrades, there is a need for some kind of regulatory change beyond the programs previously described. For energy efficiency, this can be done with stricter building energy codes for both new construction and existing buildings.

1 Institute for Market Transformation. (2016b, May 18). Engaging Small Business Landlords & Tenants on Efficiency. Retrieved from http://www.imt.org/news/the-current/new-guide-to-engage-small-business-landlords-tenants-on-building-efficiency

2 Sledd, A. (2016, May 20). Big efficiency for small and medium buildings. Retrieved from https://www.greenbiz.com/article/big-efficiency-small-and-medium-buildings

3 Institute for Market Transformation, 2016a

4 Institute for Market Transformation, 2016a

Case Study: SmartRegs – Boulder, CO

Boulder's SmartRegs program is the nation's first and only established rental-specific city energy code. The program, established in 2011, set a requirement for all rental housing to achieve a certain energy efficiency standard by 2019.[1] The city has created both a prescriptive and performance pathway for achieving the required efficiency standard. For the performance pathway, a building energy use assessment is preformed by a Residential Energy Services Network (RESNET) assessor with a Home Energy Rating System (HERS) rating of 120 required for compliance with SmartRegs.[2] For the prescriptive pathway, a checklist of efficient building measures was created specifically for SmartRegs that can be easily adapted to evaluate different building types. Buildings are assessed using a point system with values assigned for different items on the checklist. To achieve compliance with SmartRegs a score of 100 points had to be achieved, roughly equivalent to a HERS rating of 120. Once the compliance check is completed, the checklist doubles as an easy-to-follow list of the steps property-owners need to take to achieve SmartRegs compliance. [3]The program will be enforced by the rental licensing process. If rental properties have not passed a compliance check by December 31, 2018, they will be denied rental licenses until they pass.[4] By 2017, over 15,000 out of 20,000 total rental units had been brought to SmartRegs compliance.[5]

The SmartRegs program was paired with EnergySmart, a county-level program to provide energy advising and auditing services. EnergySmart is meant to serve as a "one-stop-shop", helping property owners through the process of energy efficiency retrofits. The program is available to all eligible property owners in Boulder County but provides targeted services for achieving SmartRegs approval. The first step of EnergySmart advising process is a no-cost energy audit (for rental properties this is the prescriptive checklist or performance energy assessment). Property owners are then assigned an energy advisor who helps them interpret the results of the energy audit to create a retrofit plan, find a trust-worthy contractor to perform the retrofit, and attain all applicable rebates and financing. This EnergySmart program was supported by a grant from the DOER's Better Buildings program for the first 3.5 years, and then local funding afterwards.[6] By 2015, the program had served over 3,500 commercial customers and over 13,500 residential customers.[7]

The specific effects of these programs on building energy use were not measured, but a modeling study by the Consortium for Advanced Residential Buildings (CARB) found that buildings with no previous energy efficiency improvements taken to compliance with SmartRegs with the prescriptive pathway could see energy savings of 23-52%, energy cost savings to residents of $361/year and greenhouse gas reductions of 28.1%.[8]

1 http://eta-publications.lbl.gov/sites/default/files/mi-policybrief-3-16-2012.pdf
2 Lawrence Berkeley National Laboratory. (2012). Boulder, Colorado's SmartRegs: Minimum Performance Standards for Residential Rental Housing. Retrieved from http://eta-publications.lbl.gov/sites/default/files/mi-policybrief-3-16-2012.pdf
3 Gichon, Y., et al. (2012). Cracking the Nut on Split-Incentives: Rental Housing Policy. Retrieved from https://aceee.org/files/proceedings/2012/data/papers/0193-000251.pdf
4 Antczak, A. et al. (2016). Boulder's Pathway to Sustainability Lies in Being Bolder. Retrieved from https://aceee.org/files/proceedings/2016/data/papers/11_838.pdf
5 City of Boulder. (2017). Boulder's Climate Action Plan. Retrieved from https://www-static.bouldercolorado.gov/docs/CAP_document_2017_updated_FINAL-1-201709121536.pdf?_ga=2.232497951.1429449897.1524099298-1202929.1521818287
6 City of Boulder, 2017
7 Antczak et al., 2016
8 Gichon et al., 2012

Longer compliance periods (8 years in Boulder) give property owners enough time to prepare for major changes. Also, financial and technical assistance provided by the city can be the key to successful implementation. It is also helpful to identify an intervention point; rental property owners in Boulder will be denied a rental license if they do not reach the required energy efficiency level by 2019. This is an easy-to-enforce point of compliance that yields successful adoption. However, SmartRegs was feasible because energy codes can be amended by municipalities in Colorado which is unfortunately not the case in Massachusetts. In order to implement this alternative in Boston, the Commonwealth will need to allow some jurisdictions to amend building energy codes as long as they adopt stricter requirements – this has been done in many states, including California.[1]

3. Long-Term Interventions

There are additional programs and regulations that are more long-term interventions for the City of Boston's consideration, but they require intervention at the state level and are therefore more difficult to implement. In order for the recommendations outlined in this section to be successful, Boston will need to work with state government or conduct an analysis in order to determine the correct next steps.

3.1. Encourage state action to strengthen building codes

In order to optimize efficiency and costs, upgrades and investments should be made during renovations or at the time of sale. Additionally, requiring energy upgrades at these key times leads to a steady stream of energy retrofits projects throughout Boston, thus stimulating growth for contractors. Broadly speaking, Boston would need to work toward updating building codes to mandate that energy efficiency upgrades take place either during major renovations or, if more appropriate, at the time of sale.

The difficulty lies in determining which upgrades should be required and at what scale. In their most recent climate action plan, Cambridge included an action to require upgrades at the time of renovation or sale of property. For next steps, the climate action plan recommended further study to determine which specific actions to require at time of renovation, time of sale, or both. At the same time, they will undertake an analysis to compare the different approaches in order to measure the impact of these proposed requirements (performance improvement or GHG reductions over time). Boston could partner with Cambridge on this study or use their results to shape plans for their own requirement.

1 International Code Council. (2018). Code Adoption Process by State. Retrieved from https://www.iccsafe.org/gr/Documents/AdoptionToolkit/HowStatesAdopt_I-Codes.pdf

3.2. Local Carbon Tax

Switching from natural gas to electric heating is not economically viable at current prices. There is a need to make natural gas heating more expensive to reflect the cost of externalities from CO2 emissions impacts.

Case Study: Boulder "Climate Action" Tax[1]

In 2007, Boulder enacted their "Climate Action" Tax (CAP Tax), based on amount of electricity consumed. They also established different rates for residential, commercial, and industrial sectors. The CAP tax is levied on city residents and businesses and is based on the amount of electricity they consume. Tax rates are different for each of three sectors, listed here with their average yearly amount: residential ($21), commercial ($94), and industrial ($9,600).

Boulder's City Council promoted the tax with extensive outreach and communication efforts, which led to increased public support. The tax was approved with 60% of the vote. Boulder estimates the CAP tax garners $1.8 million in revenue each year.

After five years of the tax, the city released information that only 41% of the money collected went to service delivery; 32% was spent on personnel. However, the tax was still renewed by public vote; at that time, Boulder officials stated they would like to move the tax toward supporting the commercial sector.

City officials have cited difficulties working with the utility on the CAP tax, but they state their biggest success has been at increasing community awareness. The tax keeps energy consumption at the front of resident's minds, leading to an increased interest in energy efficiency technology.

The Boulder case study offers a good lesson in communicating how funds will be allocated. In the beginning, personnel costs will be high due to staff costs needed for developing programs and tools. If Boston should move toward a tax, they should plan for upfront costs to be higher for personnel.

1 City of Boulder, 2017

Evaluation & Analysis

	Effectiveness	Equity	Feasibility	Inclusivity
Expand eligibility	High	High	High	High
Fuel switching	High	High	Medium	Low
Green leases	High	Medium	Medium	Low
Implement rental-specific energy code	High	Medium	Low	Medium
Strengthen building codes	High	Medium	Low	Medium
Local carbon tax	Medium	Low	Low	High

The majority of the recommendations outlined in this section are effective at lowering GHG emissions and would therefore contribute to the City's overall climate neutral goals. However, they vary greatly in terms of feasibility and inclusivity.

Boston should first work toward expanding eligibility for Mass Save low-income energy efficiency programs since it would be the easiest to implement and ranks high on all other criteria. There is a precedent set for this action by other municipalities, and it would increase the number of people eligible, therefore reaching new populations. Fuel switching and green leases are two "low hanging fruit" alternatives that would simultaneously decrease GHG emissions and increase outreach.

The long-term interventions would be great options for reaching the greater goal of carbon neutrality but are more difficult to implement and require further study in order to be effective. The best next step would be to establish a task force dedicated to exploring these issues or to partner with the local city of Cambridge in order to increase progress on both sides of the Charles River.

CONCLUSION

Choosing which strategy to employ depends on what the City ultimately wants to prioritize. Some strategies, like fuel switching and green leases, will be extremely effective at reducing greenhouse gas emissions, but do not involve community collaboration. Other options address issues of inequity but might not have as big of an impact on greenhouse gases. Ultimately, given Boston's lofty carbon neutrality goals, the more feasible recommendations should be prioritized:

- Develop a web portal
- Implement an energy rating system for selling and renting
- Agency mapping
- Expand eligibility for Mass Save low-income energy efficiency programs

There are many benefits to quickly picking off these "low-hanging fruits." The City will be taking highly-visible and measurable actions, which will build momentum and satisfy critics who wish to see more movement on energy efficiency. At the same time, many of these "easier" strategies lay the groundwork for more complex solutions down the line. For instance, implementing agency mapping will make it easier to develop local advocates since it pinpoints any gaps in service delivery and draws clear lines to individuals who yield influence in their community. Several of the recommendations outlined in this report can be tied together. For instance, the web portal could include a link to the community database, and the results from the energy rating system can be used as evidence to push for stricter building codes.

In general, energy efficiency goals need to be linked with Boston's larger goals for universal change. Research clearly shows that the city is operating several successful programs, but yet still struggles to reach target populations. Trying to enact such a large-scale behavioral shift in low-income and vulnerable communities, whether they are residents or small businesses, requires increased outreach and coordination in order to spread awareness and increase knowledge of the available energy efficiency upgrades and programs.

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APPENDIX

List of Organizations Interviewed
Action for Boston Community Development
Amherst College - Climate Action Plan
Brookline's Climate Action Committee
Climate Action Now (CAN)
Emerald Cities
Greenovate Boston
Local Initiatives Support Coalition (LISC) Boston
Metropolitan Area Planning Council, Boston
Massachusetts Climate Action Network
Northeast Energy Efficiency Partnerships (NEEP)
Philadelphia Energy Authority
RE:NEW London
Rebuilding Together New York
Salem Alliance For the Environment (SAFE)
Talbot Norfolk
The Energy Co-op, Philadelphia
Worcester Community Action Council