CREATING A VISION FOR TRANSFORMING ENVIRONMENTAL JUSTICE NEIGHBORHOODS INTO GREEN COMMUNITIES

A project of students of the Boston University course "Research for Environmental Agencies and Organizations".

This work is an outgrowth of research originally performed for the US Environmental Protection Agency's Civil Rights division and presented to the National Environmental Justice Advisory Council in the summer of 2018. Following the presentation one of the NEJAC members, an official of the Boston Public Health Commission, asked for further elaboration of what cities can do. Boston is the primary focus but it is intended for use by any city to improve the lives of citizens in highly impacted areas. In the process of doing the work, students came to recognize how much the city has already done and drafted the following letter to the city government.

Dear Boston,

We would like to thank you for taking initiative in making Boston a greener city. These crucial steps are often put on the back burner by other cities but they are key to enhancing the quality of life of citizens and making cities sustainable for future generations. Boston has advanced recycling programs, public transportation, bike lanes, implementation of the governor's Environmental Justice Executive Order 552, playgrounds, access to renewable energy, implementation of community gardens, decarbonization planning, community choice aggregation, and more.

However, as wages gaps continue to increase we urge greater attention to greening in lower-income areas. Areas like Mattapan, Dorchester, Roxbury, Hyde Park, and Brighton require different tactics. Here, choosing to drive a Tesla or buying new, up-to-date appliances may not be an option. We ask you to read our research about environmental justice: environmental policy which addresses the needs of all types of people, taking their resources and the conditions of their daily existence into account, and consider implementing more strategic methods to achieve real justice for disadvantaged, highly-impacted communities. Many of our suggestions are to build on top of existing programs while some suggest adding new ones as well. Our research tells us that the goal of transforming EJ neighborhoods into green communities is achievable.

Sincerely,

BU Environmental Justice Research Team

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The course is GE 532 of the Earth and Environment Department and is taught by Richard Reibstein. Students work individually and as teams on research tasks that benefit the environmental or public health missions of governmental agencies or nonprofit organizations. Class projects are posted at www.bu.edu/rccp. Questions or comments concerning this report may be shared with Rick Reibstein, rreibste@bu.edu. The class, Research for Environmental Agencies and Organizations, will consider further projects related to this issue.

Summary

Cities can transform impacted neighborhoods by investing in urban greening, which should include:

- tree planting, maintenance and retention
- green roofs
- increasing and improving parks as cultural amenities
- developing brownfields
- urban gardening
- farmers' markets

They can help citizens become more energy efficient and to use clean energy sources, including:

- improving and expanding programs for residential building energy efficiency
- improving access to community solar and community choice aggregation, as well as individual solar and other clean energy sources, such as air source heat pumps
- providing cleaner transit options, such as electric buses and bike programs

These activities will have significant health benefits. For example, better insulation and sealing of air leaks can be performed with attention to reducing lead and asbestos exposures, and with improved ventilation (using indoor air monitoring equipment). It can address water damage that would otherwise cause mold and pest infiltration, reducing the need for pesticides.

These activities will also improve the durability and desirability of the built environment, which can lead to problems of higher rents or purchase costs. Cities should couple efforts to improve EJ neighborhoods with initiatives to counter the effects of "eco-gentrification", such as rent stabilization, affordable housing assistance, and enforcement of landlord-tenant law.

Cities should implement increased monitoring of exposures, in order to better understand the impacts already suffered and to better inform development practices. For example, if a proposal for a new facility includes significantly increased emissions from diesel engines, a source of toxic particulate matter, environmental review should include monitoring of current and future particulate matter levels to supplement the more general monitoring currently performed. Cities can begin to build a more robust and meaningful database of existing air quality conditions this way. By combining these observations with water and public health data a better picture of cumulative exposure can be created.

Cities should implement affirmative engagement, reaching out to involve citizens in decisions that affect them, and not expect that the posting of public notices in the newspaper is sufficient to inform the community. In areas where English is not fully understood, translation is necessary. Community representation can be fostered through small grants or stipends.

Cities should not restrict themselves to protecting already highly-impacted citizens from additional impacts, but should institute concerted measures to develop local economies, targeted at cleaner industries that can provide jobs without adding to the cumulative burden already experienced. These efforts should include workforce development efforts that match the needs of local businesses with the capacities of local educational facilities and students.

This report includes a novel proposal, developed by Aseel Alharthi and Lydia Silber, for an income sharing arrangement program that pools investments by many companies to provide educational opportunities.

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Overview of Urban Greening and Environmental Justice

Urban greening is the process of improving the urban environment and quality of life by making cities greener, cleaner, and more efficient. Environmental justice communities are those most impacted by pollution, poor housing, lack of fresh food, adequate public transit, and populated by those with the least political power to bring about improvements. Any effort to help people in such neighborhoods should focus on urban greening as an effective strategy for reducing impacts and improving the quality of life.

Urban greening can help neighborhoods in many ways. It can provide health benefits, help with energy efficiency and energy use, provide jobs, mitigate CO2 emissions, alleviate food deserts, enhance the sense of community, and give people access to more reliable transportation. Urban greening includes parks, green spaces, street trees, gardens, but also cleaner transportation, more energy-efficient buildings, green roofs, farmers' markets, composting. A core idea of making cities more beautiful and environmentally appropriate is that pride of place and public use increase, which should improve safety and local economies.

Green-infrastructure such as parks, gardens, trees, shrubs, green walls and roofs, and other types of vegetation can significantly improve the physical environment of cities, mitigate climate change by providing numerous ecosystem service, and provide cities with an abundance of ecosystem services. Trees absorb excess carbon dioxide and their shade cools the city, reducing the urban heat island effect (Shmaefsky, 2006). Urban greening can also reduce energy usage throughout the year by lowering the temperature of cities in the summer and both insulating and sheltering buildings from winds in the winter (U.S. Environmental Protection Agency, 2008). Trees and vegetation have the ability to filter water pollutants, address stormwater runoff, and reduce soil erosion, and therefore work on replenishing groundwater supplies, protecting bodies of water from urban runoff, and reducing the risk of flooding. Furthermore, parks and green spaces often include protected reserves, such as wetlands, that provide habitat for wildlife (Boone et al., 2009). On average, every $1 spent on tree planting results in a value of $3.80 returned in ecosystem services, carbon storage, air quality (Daigneau, 2013). These benefits, however, are localized and can only be felt within close proximity to the park or green space. To spatially expand these benefits, planting street trees throughout the city can mitigate the urban heat island effect, filter air pollution, and sequester carbon on a wider scale (Pincetl et al., 2012). Assistance in creating rooftop gardens can provide similar benefits to increased tree canopy cover, such as reducing the heat island effect and sequestering carbon (Johnston *et al.,* 2010).

Parks, green spaces, trees and improved built environment all yield aesthetic value to nearby communities, making proximity to these spaces more desirable. As a result, there is a statistically significant correlation between property values and green spaces, benefiting property owners. However, "eco-gentrification" can occur, leading to higher rentals and driving out residents.

Housing reforms and improved landlord-tenant law can mitigate this effect. This is covered in greater depth below.

Urban greening should include improving the built environment along with the spaces in which they exist. Buildings in low income areas are older and less energy efficient, and present many unaddressed hazards such as mold, radon, lead paint. Massachusetts is a national leader in energy efficiency programs (according to the American Council for an Energy Efficient Economy), and Boston's Weatherization Assistance Program is highly respected, but more can be done to link energy efficiency to housing renovations that reduce health risks. (More on this below, in *Residential Building Energy Efficiency*). In addition there are obvious disparities between sidewalk quality in low income and high income areas in the city of Boston (Irons, 2018). Adding street lights and sidewalks makes neighborhoods safer and increases the likeliness for people to walk, reducing greenhouse gas emissions (Jacobs, 1961). In Boston broken sidewalks can be reported through the Boston Government website, the Boston 311 website and app, and the Commonwealth Connect app. However because continued sidewalk disrepair is widely visible a greater public awareness of these tools is in order. A similar program exists in Los Angeles called Safe Sidewalks LA where low income folks with disabilities can have their sidewalks repaired for free.

Painting roofs and roads white increases albedo, the reflection of energy rather than its absorption, cooling the area, and decreasing the need for air conditioning. LA has begun painting its roads white and it is common for homes in Greece to be painted white for neighborhood cooling (Pearce, 2018). Green infrastructure for stormwater management, such as bioswales and rain gardens also provide offsetting of the urban heat island effect (Resilient Boston, 2017).

Transit is an important element of urban greening, to provide options that reduce fuel emissions and make life easier for residents. Low-income areas are often hardest hit by storms and other disruptions, and have the highest number of people who are dependent on public transportation.

Important to the development of effective programs is the engagement of residents in decision-making, which increases the sense of commitment to a place and to others in the community, improves the relationship with government agencies, and enhances the chance that development will meet local needs.

Green development also involves understanding how to take advantage of tax and financial programs to bring clean jobs into communities hard-hit by unemployment and harsh living conditions, and implementing better monitoring of those conditions, so as to avoid adding to already-overburdened neighborhoods.

These are just some of the components of an effort to transform environmental justice areas to green communities, and what we have presented herein are just some of the aspects of what that effort should involve. We hope that this work will inspire others to realize that this transformation is doable, and would be an investment that would pay for itself in many ways. We hope to continue

our work on this and to work with others as we grow in understanding how to best undertake this worthwhile task.

URBAN GARDENS AND FARMERS' MARKETS

Many low income areas are faced with the issue of living in food deserts. In fact low income areas have half as many grocery stores as wealthy areas and less access to fresh produce leading to food deserts (Treuhaft and Karpyn, 2010). This leads to people not having access to proper diets which prompts unhealthy diets. Eating poorly leads to health hazards such as diabetes and heart disease. The Trustees of Reservations currently operates 60 urban gardens in Boston (Gardens Property Guide), and some – but not many - are in EJ communities such as Mattapan, Dorchester, and Brighton. What this non-profit organization, and organizations like City Growers, or the B-corporation Green City Growers, have demonstrated, can be expanded. Support for more gardens in EJ areas could be provided, and for areas such as Allston Brighton, that have large student populations (see Goldrick-Rab, 2018, for the finding that "36% of university students were food insecure"). Assistance with testing soils and bringing in clean soil could be provided, organization of use by residents of the gardening space, and policing to protect it. Urban gardens can become public gathering places and opportunities for education about healthy food, as well as providing a chance for people to grow their own and save on food expenses.

The city could take also action to assist communities in hosting farmers markets, (which may be co-located with urban gardens), and to help ensure that these will accept food stamps (Pritchard, 2017). Dorchester now has a Winter Farmer's Market – an outgrowth of initiatives by the Codman Square Health Council that began in 2008 "as a result of residents outraged by the lack of healthy food options in the community."[1] In 2010 the health center worked with healthcare providers to launch the Veggie Prescription Program (or Veggie RX Program), by which "patients of the Health Center would receive vouchers that could be redeemed at the Farmers' Market in Codman Square that provided their family with fruits and vegetables for the week."

The most recent Farm Bill includes the Gus Schumacher Food Insecurity Nutrition Incentive Reauthorization Act of 2018, which increases grants to organizations to help low-income consumers of SNAP (food stamps) buy fresh food. (Schumacher, former Commissioner of Food and Agriculture in Massachusetts, and Undersecretary of Agriculture under Clinton, was crucially important in fostering innovation in getting good food to low-income populations, and helping local farmers find ways to sell directly to those who want to eat fresh, local food).

Cities may be able to help organizations tap federal assistance, but can also follow suit and provide it directly. Having more community gardens will benefit the environment by reducing waste and emissions from packaged and non-locally sourced food (reducing emissions from transportation, the need for preservatives and refrigeration), create green jobs, and promote health.

[1] http://www.codman.org/services/farmers_market.html

Wholesome Wave (Schumacher was a founder) in Connecticut promotes the ideas of doubling the value of food stamps for fresh produce and prescribing fresh food to people in need of it for health reasons. Cities can use programs like these in coordination with urban gardening to help alleviate food deserts in EJ communities. The Boston Public Market at Haymarket and the Copley Square farmers market are a beginning - more is needed to benefit more of the city's residents. Several town farmers markets in Massachusetts accept food stamps, in Amherst, Orleans, Easton, Roslindale, Quincy, and Springfield. Those who take part in community/urban gardens can also sell produce at farmers markets by applying to become a vendor (the city can boost this by waiving fees for low-income residents).

PARKS

Besides offering beauty and peace, parks provide a public space to host social programs or events (sports tournaments, protests, religious observances, ceremonies, etc.) that allow community members to interact. They have great potential cultural value. This level of interaction is particularly valuable to young people and the elderly (Walker, 2004). Parks provide community space for city residents to practice their culture and engage with other cultures. The shared space in the public park can provide a sense of social togetherness and can increase community cohesion. In cities with high immigrant populations, community spaces like parks *can reduce the erasure of home cultures and welcome citywide diversity*. Research on parks in low-income neighborhoods found public spaces encourage residents to leave their apartments and socialize (Coley, Kuo, & Sullivan, 1997). This form of social capital is an important asset to communities regardless of race or class.

A city that focuses on transforming blights areas or deserted lots, or development that focuses on increasing parks, reaps benefits such as cleaner soil, better stormwater management, increased oxygen emission and carbon sequestration, reduced soil erosion, as well as the improvements that go with making neighborhoods better for residents, such as improved health and reduced crime.

Cities should include maintenance of parks as a priority. Parks in environmental justice communities tend to be poorly maintained, less equipped, less safe, and have greater incivilities (e.g. vandalism, graffiti, excessive litter, etc.) (Vaughan et al. 2013). If not properly maintained, green spaces can worsen social divides. One study found minority and low-income residents are three times less likely to be park users, especially females, the elderly, and African Americans (Lindsey, Maraj, and Kuan 2001). The "Green Wall" phenomenon describes how parks placed adjacent to racially and socioeconomically different communities can become barriers between the two groups and a catalyst for social exclusion (Lindsey, Maraj, and Kuan 2001). Simply creating new parks is not enough: cities should also operate programs to ensure they fulfill their purpose of uniting and improving cultural life.

The Trust for Public Land (TPL) analyzed the 100 largest U.S. cities to calculate how well each city meets the need for parks. Boston ranked 13th on the list due to its high level of park access (population within a ten-minute walk of a public park). Parks cover approximately 17.4% of the city area. (See Figure 1).

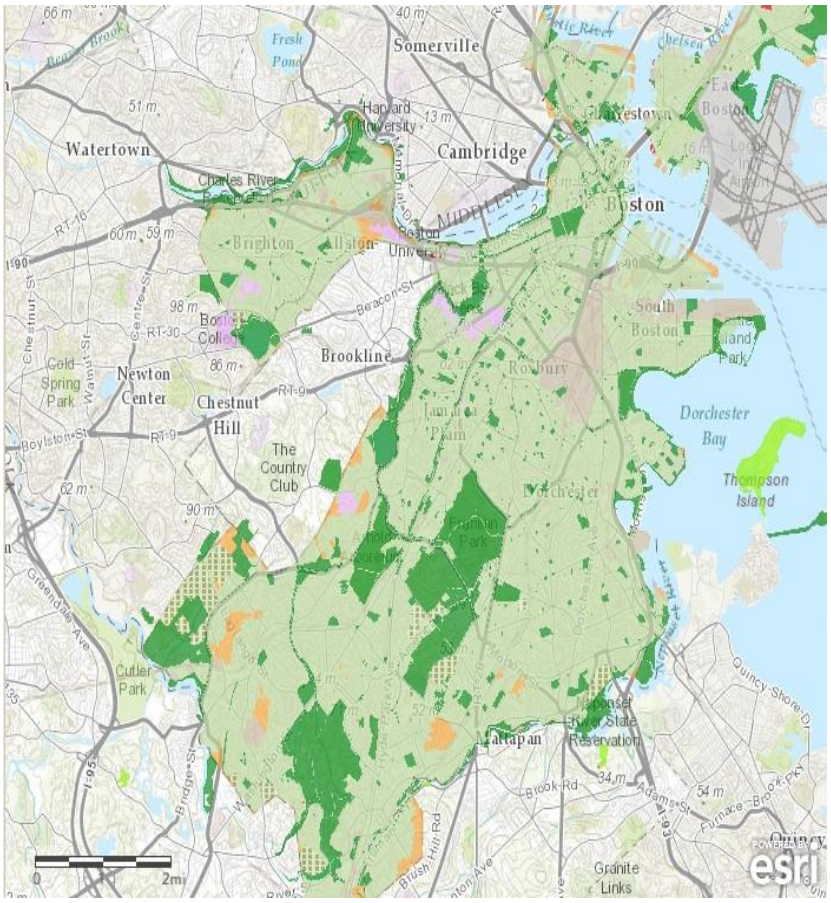

Figure 1. Map of Boston's Parks. Dark green areas represents parks; light green areas represents places well serviced by parks; orange and red areas represents places with a "high need" and "very high need," respectively. ESRI.

The quantity and quality of Boston's parks are impressive, but the City of Boston can increase the quantity of parks further by transforming deserted lots[2] or developing brownfields into green spaces. There are almost 40 open space sites and 5 community garden sites owned by the Boston Planning & Development Agency available for acquisition, ranging from 470 to 667,000 sq ft. Would they be used for parks if the city did not act to bring about that result? There are more than 3,000 contaminated sites in the city listed on DEP's waste site list that have received a Response Action Outcome,[3] meaning that cleanup has reached an endpoint. Not all are available for development, but an investigation by students for sites a local composting cooperative might use found several essentially available locations which appear to be clean enough for development, but for them to become parks, cities would likely have to take action.

In addition to developing new parks, cities can also improve groundskeeping of existing parks and mitigate the disparities of park amenities in impacted neighborhoods. Planning for not only the environmental impacts but also the social impacts of new urban greening initiatives can transform these actions into restorative tools to remedy ongoing systemic racism while mitigating the effects of climate change and improving public health. Simple fixes, like installing streetlights and

[2] http://www.bostonplans.org/work-with-us/bpda-owned-land

[3] https://eeaonline.eea.state.ma.us/portal#!/search/wastesite

improving the accessibility infrastructure (e.g. sidewalks), can go a long way in improving the safety and security of parks.

City-sponsored events and programs can increase attendance and thus safety. Examples of park programs include: sports tournaments for kids and adults; active classes (e.g. yoga in the park); horticulture activities; food, art and/or cultural festivals; educational events (e.g.), farmers' markets and urban gardens. The shared space in public parks increases social cohesion, and this end can be furthered if cities also use the opportunity of park development to engage the community in the decision-making process that plans these events.

Parks and green spaces provide residents with an inexpensive, often free, apparatus to promote a healthy lifestyle. A study in Cleveland found a correlation between attendance in parks and improved health and for adults 50 and older. The park users reported feeling "renewed" after visiting the parks and had fewer visits to physicians (Payne et al., 1998). Urban green spaces have also been linked to reduced ultraviolet radiation exposure, cardiovascular morbidity and mortality, obesity, risk of type 2 diabetes, and healthier pregnancies (WHO, 2016; EPA 2008). Green spaces and trees also have beneficial impacts on mental health: many studies demonstrate the positive effects of nature on wellbeing, primarily for child development. Contact with nature is restorative, psychologically relaxing, and can help alleviate stress (Hartig, 2007; Hartig et al., 1991). A nationwide study found that even residents who did not frequent parks reported receiving benefits from them, due to the opportunities available to children (Godbey, Graefe, & James, 1992).

TREES

Low income areas lack trees in comparison to wealthier areas (Jennings and Gaither, 2015). Therefore these areas are missing out on the benefits that increased tree cover has to offer, such as mitigation of the heat island effect which ultimately cools homes, (allowing them to use less energy), improved air quality benefiting health, reduced noise pollution thus reducing stress, carbon sequestration, and better storage of stormwater (reducing runoff and erosion). Links to reductions in ADD in children, reductions in crime have been found. In low income areas each family on average had one child with asthma which could be improved by greater air quality via planting trees (Pacheco *et al.* 2014).

Boston has pledged to increase tree canopy by 35% by 2030 in order to increase these benefits for the city. There are also adopt-a-tree programs which help increase tree canopy. It is necessary to have tree maintenance programs to keep trees healthy. Programs that utilize community partnerships, such as Speak for the Trees and Boston Natural Areas Network, complemented by tree wardens and certification initiatives for arbor technicians, are key to achieving the goal of increasing urban trees.

Benefits. The costs of tree planting and maintenance are far outweighed by the benefits, that result from environmental and energy cost savings, and increases in property values. Figure 2 shows a

benefit-cost analysis for five U.S. cities (McPherson et al., 2005). Health and quality of life improvements are not included in this analysis except as they are part of property value increases. It should be recognized that low-income neighborhoods are not receiving the same benefits from replanting and retention policies, often due to a lack of representation within community governing bodies or lack of financing. Tree retention has been proven to deliver numerous benefits to neighborhoods, including reduced energy consumption, watershed management, and aesthetic advantages. Combined, these factors can increase the value of the surrounding real estate. For example, a study from the University of Washington found that homes adjacent to naturalistic parks and open spaces are valued at 8-20% higher than comparable properties, effectively leading to increased property tax revenues for the community (Wolf, 2010).

Energy savings are an important economic co-benefit as trees provide immediate shade and cooling, reducing the demand (i.e. cost) of AC units. The savings on energy costs are greatest when trees are pruned to the location specific height that will allow sunlight during the winter, and shading during the summer. This allows the sun to aid in building heating in winter, and building cooling in the summer (U.S. Environmental Protection Agency, 2008).

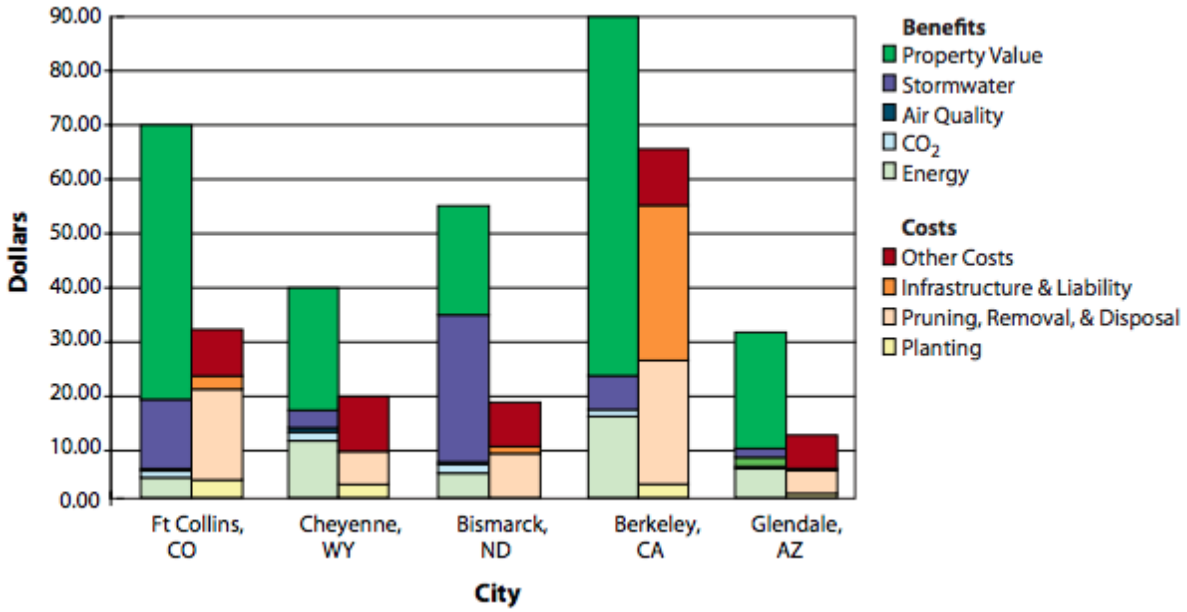

Figure 2. A summary of the relative significance of tree planting benefits and costs in five U.S. cities (EPA 2008). Net benefits were positive for all five cities ranging from $21 per tree in Cheyenne to $38 per tree in Ft. Collins. Blue and green categories indicate benefits; red, orange, and yellow indicate costs.

Equitable Distribution. The environmental, social, economic, and health benefits of urban greening are dependent on proximity to the green spaces. Street trees are an efficient and inexpensive method of spatially expanding these benefits to all communities. However, careful attention must

be paid to the dispersal of street trees to ensure an equitable distribution. Figure 3 shows a GIS spatial analysis of Boston's urban tree canopy cover by census blocks. There is a clear disparity in areas like East and South Boston; these areas have the most to gain from street trees.

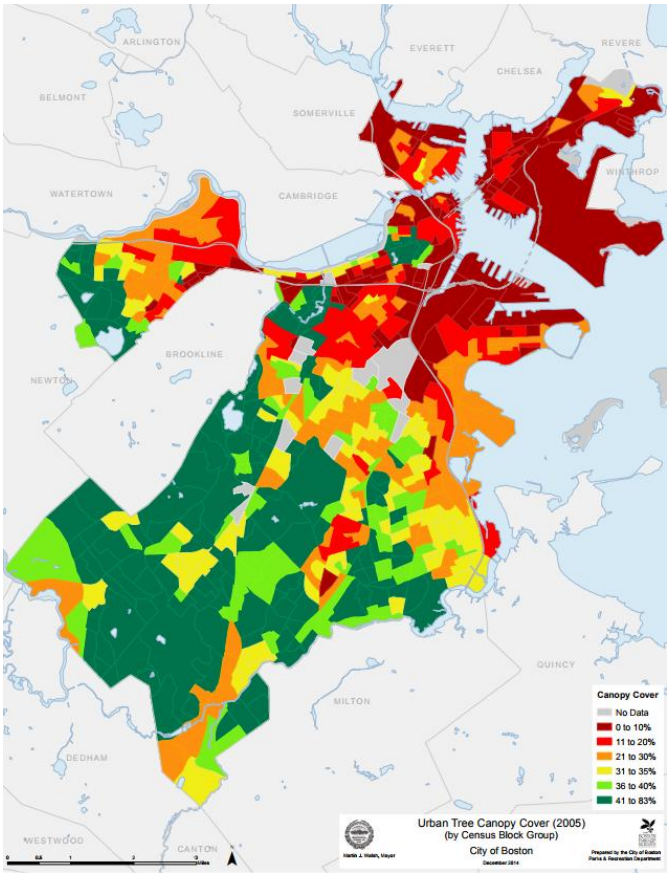

Figure 3. Boston Urban Tree Canopy Cover in 2005.

Maintenance. Even after planting, street trees require long-term care and maintenance. Without adequate planning, urban greening will fail to provide all of its potential climactic and health benefits to their full potential. For example, New York City's Million Tree Campaign faced high rates of tree mortality for a number of reasons, such as: traffic congestion, building development, and planting trees too close together. Nine years after planting, 26.25% of trees were dead (Lu, et al., 2010).

Long-term partnerships with community stakeholders (e.g. community centers, municipal planners, private developers, etc.) are crucial to success. The City can implement new or boost existing programs (outlined below) to ensure Boston reaches its tree canopy goal.

Tree Wardens. Massachusetts General Law mandates each town and city have a tree warden (since 1899). The tree warden is responsible for pruning of trees for safety and health; removal of trees that are dead or dying (from storms, insects, disease, or old age); identification of appropriate planting sites; planting new trees; creation or updating of a tree inventory, often on computer; assessment of trees for potential hazards to public safety; oversight of utility arboricultural operations; preparation of budget presentations; supervision of town tree workers; creation of bid proposals for contract tree work; inspection of contracted tree work; conduct of public meetings and tree hearings; and writing grant proposals (Massachusetts Tree Wardens and Foresters Association, 2018). This is a big task for a single tree warden for the entire city of Boston, especially with an incoming 30% increase in tree canopy cover. The City can hire multiple tree wardens to ensure the health and safety of Boston's tree.

Adopt-a Tree. Boston's Adopt-a-Tree program is a 2017 Greenovate Boston initiative. Residents can select a tree to be planted in Mattapan, South Boston, or Roslindale and are then held responsible for the care and maintenance of the tree. One way to entice residents to adopt a tree is to have them choose the type of tree they would like to plant. In addition to issuing the trees free of charge, cities can further incentivize adoption by distributing tree kits that include a guide for tree care, gardening gloves, a tree guard, watering can, soil cultivator and other resources to lessen the burden of tree care. Cities can promote awareness and encourage participation by adding signs near the trees displaying information about the program and the adopter.

Certification for Arbor Technicians. The Tree Care Industry Association (TCIA) certification is an example of the fact that there are professional arbor technicians. TCIA is also a management resource for tree care companies and professionals, to keep up with professional development. TCIA offers a number of tree care courses such as Tree Care Safety Specialist training, Chain Saw Specialist training, Electrical Hazards Awareness training, and many more (TCIA, 2018). Cities can mandate tree care specialists become TCIA certified to ensure the best management practices are used when planning and caring for the trees. Cities can offer tax deductions, credits, subsidies or other financial incentives to tree care companies per certified arborist.

Partnerships. Success of these programs is more likely if there are partnerships with the impacted communities and other stakeholders. There are many organizations[4] in Boston dedicated to greening the city. The city can hold a series of conferences or workshops to unify these groups and strategize a concerted effort for reaching the tree canopy goal.

Speak for the Trees Boston (SftT) is an example of an organization that can be an important asset in successfully reaching the proposed tree canopy cover. SftT is collecting an inventory of street trees in Boston and mapping them on a publicly accessible app. They also hold workshops in neighborhoods with low canopy cover like Lower Roxbury/South End to teach community members how to identify and measure trees for the tree inventory. They also analyze the quality of the trees and share up-to-date information. SftT's objective is "to ensure trees are efficiently planted and strategically placed in communities that need them the most." This group is comprised of experts in the field dedicated to urban greening. SftT also advocates for improvements to city ordinances related to tree planting and maintenance (i.e. SftT can serve as insightful advisors to improving city ordinances).

SPEAK FOR THE TREES
Boston

[4] Such as: Speak for the Trees Boston, American Forests, Boston Food Forest Coalition, HomeHarvest, Farmers Collaborative, H.E.R.O Nurturing Center, EastieFarms, Boston Natural Areas Network.

Tree retention is an increasingly important issue to address within environmental justice neighborhoods. The Greening of the Gateway Cities program is just one example of a city initiative to increase tree canopy in targeted environmental justice neighborhoods in Massachusetts. The program sets goals to plant new trees or retain existing trees, saving energy within the Commonwealth, helping Boston meet its commitment to reducing its CO2 emission levels by 80 percent by 2050.

In addition to the city driven program, cities should also work closely with civil society organizations to meet replanting and retention goals. For example, the Boston Tree Party campaign incorporated urban agriculture projects and nutrition education in Northeastern EJ neighborhoods with the support of local municipalities. The engagement of environmental and community organizations should be recognized when creating retention and replanting programs.

Figure 4 is an illustration from the Groundwork Lawrence initiative that demonstrated partnership with several relevant agencies, explaining the benefits of planting trees.

Figure 4: A table showing what planting trees can do to benefit Lawrence, MA (https://www.groundworklawrence.org/greenstreets)

PUBLIC TRANSIT

Better transport can save people money, improve air quality, reduce greenhouse gases, and improve public health. Often low income areas which are typically on the outskirts of cities will not have access to reliable public transportation and bike lanes, and when cities have little to no public transit there is low class mobility (Kanter, 2015). There is also the positive impact of reduced greenhouse gas emissions with the increased utilization of mass transit or biking/bike share programs. Planning for improved transit for EJ neighborhoods should include the full panoply of options. Clean transit planning should also include public recommendations and conversations. Communication ensures that EJ communities have a voice in where the newest bike lanes or electric bus routes should be added.

Electric buses. Because EJ areas often suffer from poor air quality and high rates of asthma, they should be selected as priorities for receiving new electric buses, which will reduce emissions of diesel particulates and other air pollutants. In Boston alone more than 300 MBTA buses are reaching their 12 year lifespan and will soon need to be replaced. Electric buses are being considered as replacements, although not necessarily in environmental justice neighborhoods (Dharmaraj, V. and Power MB, 2018). Electric buses provide a plethora of benefits including minimal wear on the engine, little/no energy loss during idling, and the opportunity to be fueled using renewable energy (Kuhne, 2010). On top of these benefits, electric buses also reduce daily tailpipe emissions compared to diesel buses and can increase their energy efficiency while decreasing energy costs by up to 63% when buses (especially school buses) are monitored while being charged (Mass DOER, 2018). All of these benefits provide incentives for a city to get on board with transitioning to electric buses, especially as old buses are phased out.

The Chicago Transit Authority has found that electric buses provide a direct return on investment. Chicago added two electric buses to its fleet in 2014 and awarded a contract to add 20 new all electric buses to their fleet. The original electric buses showed a $24,000 savings in fuel costs and $30,000 annual savings in maintenance costs (Chicago Transit Authority, 2018). Electric buses will not just be a good decision on economic grounds but will help Massachusetts achieve its Climate Action Plan to cut greenhouse gases by 80% in 2050 (Mass.gov, 2018).

Bikes and other new alternative forms of transportation are part of the transportation system (Geoghegan, 2016). The most energy efficient form of transportation is biking, which is also cheap and provides daily exercise (Berger-Schauer, 2015). In the U.S. biking is mostly utilized by wealthier people, however, this is not the case in the rest of the world (Shaheen, 2014). Bike lanes and bike share programs are not just for wealthy neighborhoods, or recreation. Memphis, for example, has had an initiative to create more bike lanes in order to help low income populations and became the first city to have a bike lane that crossed the Mississippi River (Anderson, 2013). Many blue bike docks have been implemented and separated bike lanes have been popping up in Boston, however, they are generally in higher income areas. In New York City also has a popular and widespread bike share program, Citibikes, which offers daily, monthly and annual passes for a

range of potential customers and is marketed as "faster than walking, cheaper than a taxi, and more fun than a subway" (Citibike, n.d.).

ECO- GENTRIFICATION

All of the actions in this report will improve property values and the desirability of neighborhoods, increasing rents and making it harder for low-income families to remain. Therefore preemptive actions to protect them from the effects of gentrification are necessary, such as rent stabilization and affordable housing options, as well as increased job training and local economic development to increase opportunities.

If this effort is not made coincidental with urban greening, environmental injustices and socioeconomic and health disparities may be unintentionally worsened. Improvements to green infrastructure (such as upgraded sewage infrastructure, more parks, increased tree cover, safe and energy efficient buildings) can cause higher-income populations to move in and drive up prices, forcing out low-income populations.

For example, the price of residential property 2,500 feet from Pennypack Park in Philadelphia is about $1000 per acre, but properties 40 feet from the park average $11,500 per acre (Hammer, Coughlin, & Horn, 1974). Similarly, a study conducted in Boulder, Colorado found property values decrease by $4.20 for every foot of distance from the greenbelt (Correll, Lillydahl, & Singell., 1978). Higher property values result in higher property taxes as well, affecting both low- or fixed-income owners and lessees. (Crompton, 2001; Conway, Kahle, & Wolch, 2002). Efforts to green urban neighborhoods should strive to simultanously meet the three pillars of sustainability: environment, economy, and equity, if their benefits are to reach low-income populations.

Example: Greenpoint, NY. Once a heavily industrialized zone, Greenpoint is now one of the most rapidly gentrifying neighborhoods in New York City. The oil and gas industry dominated the region for much of the 20th century, and emitted unsafe levels of toxic compounds into the air, soil, and groundwater. An oil spill in 1978 worsened the environmental quality of the neighborhood. The Newtown Creek, a body of water adjacent to Greenpoint, became heavily contaminated and then a Superfund site. Greenpoint became known for being heavily toxic. Since the early 1990s, clean-up efforts have made significant progress in improving the quality of life and environmental health in Greenpoint. The neighborhood established new parks and green spaces, built a waterfront boardwalk, and cleaned the Newtown Creek (though swimming is still highly discouraged). As a result, property values increased and the region became increasingly gentrified. Renting prices have increased 78.7% since the early 1990s; average household income increased by $53,550. This stark increase drove out many of the original local Polish community (where the Polish community comprised 75% of the neighborhood, only 10% of region remains Polish). Trendy shops and restaurants replaced many local businesses that could not afford the rising rents. (Etherington, 2016; Rosenberg, 2018).

Rent Stabilization. Rent stabilization is intended to protect tenants in privately owned residential properties from excessive rent increases by mandating reasonable and gradual rent increases. The intent is to find the right balance, so that tenants are not subject to unreasonable increases in rent, and landlords receive a fair return on their investment. A common criticism of rent control is that the property owner does not get a fair return on investment due to the limitation on rent, and though housing experts claim the research does not back up this claim, the criticism has had effect. According to a recent *New York Times* article, 37 states have enacted laws preventing cities from implementing such laws.[5]

However, there is new thinking about the value of rent stabilization. University of California Berkeley's Haas Institute for a Fair and Inclusive Society recently published *Opening the Door for Rent Control* (Nicole Montojo, Steven Barton, Eli Moore), which found that landlords in California are reaping windfall benefits, as prices are beyond what a "fully competitive market" would provide. Fixing the "dysfunctional" housing market would also have significant benefits for the overall economy. The report found that "If all California renters paid only what they could afford on housing, they would have $24 billion more each year to spend." In addition, a lack of affordable housing exacerbates homelessness and excessive commuting, adding to environmental and social degradation.

Rent control (a term often used for a strict forms of stabilization) can have unanticipated effects. Landlords may excessively increase rents where they can in order to balance out what they cannot increase, and housing turnover can suffer as well. Long-time residents may benefit while new entrants to the market place experience higher rents.[6]

However, it is important to revisit the issue of rent stabilization, ensuring best practices to protect landlords as well as tenants' interests, to find the balance that best serves both, for this will serve cities and the environment in which they function.

Community Land Trusts (CLT). One tool to slow the effects of gentrification and keep property values at an affordable level is to establish land trusts. The CLT is a private organization that permanently obtains and preserves the land for the community. This way, residents own the building/land and can collectively determine affordable housing rates. On average, CLT communities make approximately 60% of the area's median income. If a resident chooses to move out, the CLT ensures the next resident will have similar means, preserving economic diversity in the region.

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[5] "Why Rent Control is a Lightning Rod", Conor Dougherty, Oct. 12, 2018.

[6] See, for example, https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2018/11/28/rent-control-is-making-a-comeback-but-is-that-a-good-idea

Crescent City, New Orleans is a successful example of a CLT that preserved affordable housing in the development frenzy after hurricane Katrina. Though the CLTs are becoming more prominent nationally, the main shortcoming is actually procuring the property rights. Cities should make this process as easy as possible and can stimulate this course by allocating funding for affordable housing (tax abatements, community development block grants, low-income housing tax credits, etc.) (Adler, 2015).

Housing Cooperatives. Limited equity housing co-operatives are another instrument to ensure long-term affordable housing as nearby properties appreciate. In this case, the co-op acts as a business corporation where residents share ownership of the property. These co-ops allow the locals to manage the market, collectively manage their own facilities, and hire their own staff. In order to ensure affordability for the next low-income resident, the co-op restricts resale price. The main barrier preventing an escalation in housing co-operatives is the lack of funding. Wicker Park, a neighborhood of Chicago, successfully implemented a limited equity housing cooperative model and successfully maintained affordable housing, thanks to the Chicago Community Loan Fund, who financed the project. The City can provide funding in the form of financial subsidies to ensure the success of limited equity housing cooperatives. (Chicago Community Trust Staff, 2018; Levy, Comey, & Padilla, 2006).

Community Development Corporations (CDCs). Community-Wealth.org, a project of the Democracy Collaborative, has collected information on CDCs, noting that these nonprofit, community-based organizations are focused on "revitalizing the areas in which they are located, typically low-income, underserved neighborhoods that have experienced significant disinvestment." In addition to working on affordable housing, they also become involved in "economic development, sanitation, streetscaping, and neighborhood planning projects, and oftentimes even provide education and social services to neighborhood residents."

The Massachusetts Association of CDCs describes its mission as creating "a high performing and adaptive community development sector that is supported by private and public investment and sound public policies. We advance racial and economic equity by creating healthy communities where everyone lives in housing they can afford, benefits from economic opportunities and can fully participate in the civic life of their community." CDCs use the Community Investment Tax Credit in developing affordable housing and other projects. MACDC's latest strategic plan notes that "There is no single answer to our housing challenge", and that there is a need for "a variety of tools that target different sized developments, different income tiers and different tenures, including both rental and homeownership." Not only do new affordable residences need to be built, but it is important to preserve existing affordable housing and to remove affordable housing from "the speculative market" that artificially inflates housing prices.

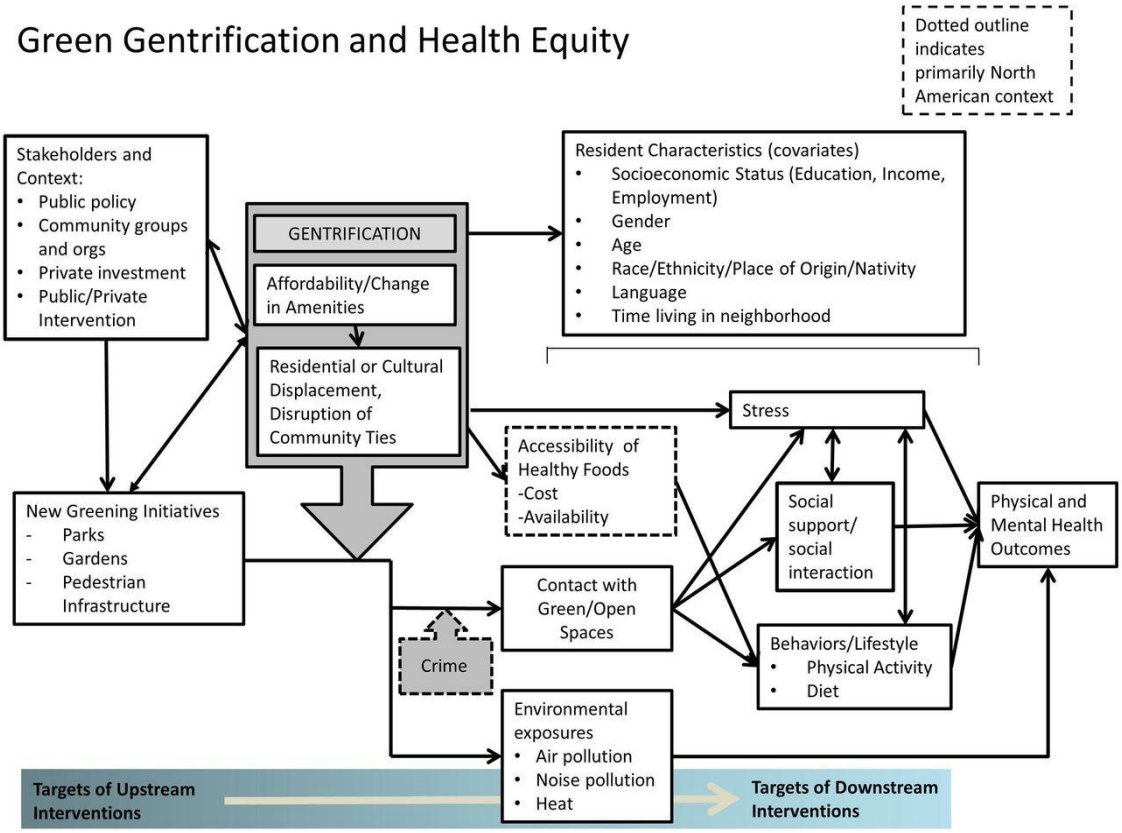

Figure 5. A flow chart of how aspects of green gentrification interact (Cole 2017).

MONITORING

Because EJ neighborhoods are heavily burdened with pollution, it is important not to add to that burden with new development. In order to understand how a new project might add to the burden, it is important to do two things: estimate how much impact the new project will have, and how much that will add to what is already creating risks. Environmental impact analyses, required of many projects under the federal National Environmental Policy Act and the Massachusetts Environmental Policy Act, give communities the chance to understand what a new project might cause (but communities have to be aware of the availability of this information and to be engaged in monitoring it). However, existing environmental monitoring is not sufficient to enable accurate assessments of the existing levels of impact, so that a cumulative impact assessment can be performed. Increased community and individual monitoring of pollution in various forms can benefit environmental justice communities by providing this needed information.

Local monitoring and testing of air quality, such as for particulate matter, volatile organic compounds, or heavy metals can help pinpoint areas of particular interest relevant to public health, which can be used to plan improvements, and take preventive and protective action, as well as to

assess the additional burden that proposed developments might cause. It can direct government agency attention to areas and sources that should be controlled and monitored in the future.

Knowledge of the most pollution-concentrated areas may be used target efforts to inspect, and reduce pollution from specific activities. Increased monitoring, to better assess environmental conditions is necessary to improve public health and ensure that development does not increase pollution, so environmental justice and economic development can work in unison to improve the quality of life in disadvantaged communities. With improved understanding of air quality, for example, a community with high rates of asthma and respiratory ailments can take action to prevent new sources from locating in the area.

Because efforts to keep polluting industries out of EJ neighborhoods is a crucial strategy for preventing even worse conditions for residents, it is important to couple this effort with initiatives to attract and develop businesses that do not add to existing burden. This is discussed below in the section on Clean Development.

Air Monitoring. Air monitoring is currently performed on a regional level, and is not sufficiently precise to understand the existing impacts in many environmental justice communities. This impairs the ability of such communities to determine the relevance of air pollution to existing public health problems and to the potential impacts of proposed developments. Because the price of instrumentation has been reducing in recent years, it is possible for increased monitoring to be performed.

The Massachusetts Department of Environmental Protection has published their Annual Ambient Air Quality Monitoring Network Plan on their website including their reasoning for the location of monitors. Current monitoring appears not to adequately cover areas with high EJ populations[7] and higher asthma prevalence based on comparisons of graphics published in the past decade. Communities working to independently collect data on particularly important areas for air pollution such as particulate matter and carbon dioxide can help to cover these gaps, and share the information with government officials.

The EPA has provided guidelines for selecting an air monitor and collecting air quality measurements that allows communities to monitor in the most effective way. ("How to Use Air Sensors: Air Sensor Guidebook"). These guidelines include determining the test subject prior to purchase, consulting with experts on location and monitor details, conducting monitoring at various locations and times, and repeating trials. The guidelines do not include specific suggestions about location, but rather outline the process of purchasing and acquiring meaningful data from an air monitor. The EPA has also funded grants for community monitoring in the past[8], specifically funding monitors and sending experts for monitoring toxics in communities across the United States. Details of the research were published in a report that describes potential causes of the

[7] View a map of EJ communities in Massachusetts: https://www.mass.gov/files/documents/2016/07/up/ej-2010-state-with-inset.pdf.
[8] View the report: https://www3.epa.gov/ttnamti1/files/ambient/airtox/CSATAMfinalreport2013.pdf

pollution. This program ended in 2013, and reviving the program would allow for affordable monitoring and valuable data on pollution. Cities could ask the EPA to revive the program, as the need for affordable monitoring is still very necessary.

Examples of accessible monitors in today's market include the Foobot Indoor Monitor[9] for Air Quality. This instrument costs $200 and can collect data on VOC and particulates. Another example is the Temtop M2000[10] which measures concentration of PM 2.5 and PM 10 as well as Carbon Dioxide and HCHO. Both monitors are available for $200 on Amazon.

Air monitoring that can make a difference in public health includes testing of indoor air quality, which is the category of air pollution many consider most likely to be of harm. Studies show that the home is a central cause for asthma, a disease which has disproportionately affected low-income residents, including within the New England region. Families that must spend a large portion of their income on housing do not have the resources to improve their already inadequate housing, which can lead to exposure to inadequate air quality. Environmental tobacco smoke, allergens, carbon dioxide, radon, and volatile organic compounds all have higher concentrations when there is poor ventilation. Research has increased in recent years, but there is currently sufficient evidence to conclude that young people in low-income communities are at serious risk of adverse effects from air pollution (Guarnieri & Balmes 2015).

Soil Monitoring. The presence of lead in soil exacerbates the serious public health problem of lead exposure and creates a hindrance to urban gardening. Testing of soil for lead is necessary can help with both of these. Identifying the presence of significant levels of lead in the soil provides information on where to bring in fresh soil or plant grass and bushes to contain it. The increased awareness can lead to safer practices, such as taking shoes off before entering living areas.

If garden soil is contaminated, then plants not intended to be eaten can be used, and some, such as sunflowers, will remove contaminants from the soil (the process of phytoremediation, Blumenthal). Fresh soil, including compost, can be added where edible plants are grown. Such programs have been used to foster urban gardens even where lead testing has shown the presence of high levels. The USDA has an expansive network of extension programs which offer soil lead testing for a minimal price ("National Institute of Food and Agriculture"). Some of these programs also offer guidance and training in urban agriculture. The availability of this inexpensive opportunity should be broadcast in communities so that people will check their soil.

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[9] See the Foobot Monitor on Amazon: https://www.amazon.com/Foobot-Quality-Monitor-Homeowners-Renters/dp/B06Y8VLCH8/ref=asc_df_B06Y8VLCH8/?tag=hyprod-20&linkCode=df0&hvadid=238389219112&hvpos=1o2&hvnetw=g&hvrand=4262732988085043160&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9002029&hvtargid=pla-391044355382&psc=1

[10] See the Temtop M2000 on Amazon: https://www.amazon.com/dp/B07DHYG2VK/ref=sspa_dk_detail_3?psc=1

Water Monitoring. MassDEP will test water for the presence of lead and they routinely test households that are at high risk for contaminated water. Personal kits can be bought for less than fifty dollars to test for lead and copper. Contaminated water can have significant effects on public health, so monitoring should be conducted to detect the possibilities of issues.

Other state and local governments should also offer testing for lead in water and conduct testing routinely in households that are at high risk for contaminated water. Community organizations or individuals should notify government organizations if they test for lead and find it in their water supply. Taking these steps can notify government organizations as to the areas where lead is showing up, which can help plan remediation and public education.

Noise Monitoring. Evidence from research into the effects of environmental noise pollution demonstrates serious health impacts. Beyond poor sleep, annoyance, and impaired cognitive abilities, environmental noise pollution can lead to increases in heart rate and blood pressure, as well as increased incidence of other serious cardiovascular conditions, including stroke (Munzel et al 2014). Research is still ongoing, and more effects could become evident in the future. Monitoring and mitigation in cases where noise levels are dangerous may very well gain recognition as a necessary part of programs to address public health issues in cities.

Several apps are available for mobile devices to measure sound levels. Monitoring noise helps ensure that the community is not being placed at risk of hearing loss and decreases the annoyance of constant sound that decreases quality of life. The National Institution for Occupational Health and Safety (NIOSH) has created a free app with instructions for use. This application is available for iPhone and Android devices at no cost.

NIOSH guidelines outline ranges that can be considered detrimental to hearing health. Measurement technology can also be purchased to replace or supplement the phone technology. The applications for mobile use have not been accepted within the guidelines for government use (Kardous, et al), but they can still be used to determine the best areas to use more expensive and precise equipment. Mobile apps will also likely improve over time. Measuring sound within local workplaces ensures that no workers are being placed in danger of hearing loss.

NIOSH suggests an 85 dB(A) over 8-hour exposure limit for occupational exposure. But for the environmental noise that residents experience, a 1974 EPA report recommended a 70 dB(A) over 24-hour average exposure limit. One difference in the exposure limits is that the EPA addresses annoyance and hearing loss, whereas the NIOSH limit is for hearing loss alone. Another difference between EPA and NIOSH limits is that EPA's is for environmental noise for all people, who may be hearing noise around the clock, while NIOSH's is for workers, and applies to the 8-hour workday.

COMMUNITY ENGAGEMENT

To transform Environmental Justice communities, there are many factors that must be managed in order to allow neighborhoods to reach their potential level of sustainability. Without the involvement of community members however, a push towards a future with street trees, urban parks and improved monitoring of harmful chemicals might not be achieved. Political will for the changes that will improve lives can result, however, if members of Environmental Justice communities are better informed about what they can ask of government, and the processes by which government approves development, and what resources they themselves can muster. Residents can be more empowered to ask questions and take action relevant to their health and their family's health in regards to the environment around them. The goal of increasing civic engagement involves fostering the constructive participation of groups and individuals in addressing issues of public concern and promoting the quality of life in the community.

The National Environmental Justice Advisory Council recommends:

1. All stakeholders should have the opportunity for meaningful involvement in redevelopment and revitalization projects.
2. City can establish a community liaison to implement a coordinated approach to public outreach for settings where redevelopment and revitalization issues are complex.
3. When appropriate, the city should encourage an initial neighborhood demographic assessment and a projected impact assessment regarding displacement at the earliest possible time in a redevelopment or revitalization project. A similar assessment at the project's end should be carried out to measure changes and assess impacts. Such assessments may be facilitated as a requirement for EPA grant applications.
4. State, tribal, and federal environmental agencies should be encouraged to find creative ways to participate in local land use planning, process, and government. For example, where state and/or federal permits apply, conditional permit issuance may be encouraged (NEJAC, 2014).

Proactive Informing. Before members of communities are able to participate in giving their voice in legislation and local government, they must be informed about legislation, regulatory actions, proposed developments, and policies that may impact their health and the health of their environment. While public notices in newspapers are useful sources of information that can educate citizens about issues, these notices may be ineffective, in that people do not see the postings in the public notice sections.

It is important that members of Environmental Justice communities are aware of any proposed projects that may be detrimental to their health. Awareness of potential threats to the health of individuals, families, and the environment can be encouraged by a variety of methods. Information concerning the health of citizens in newsletters can be written in languages that are most widely-

spoken by the people living in those communities, and local government meetings and public forums can be advertised in the languages that are most prevalent in EJ communities.

Information regarding public forums and meetings that encourage community involvement should be widely distributed in areas containing the most foot-traffic and largest congregations of citizens, such as in community and health centers, schools, public parks, libraries, grocery stores and access points to transportation, such as bus stops. Pamphlets, flyers, and newspaper articles detailing these political events should be posted in easily-accessible locations and written in the aforementioned languages of most prevalence.

Information regarding public forums can also be made accessible online through social media. Online programs, such as coUrbanize, that allow community members to voice opinions about proposed projects, encourage participation in government and provide planners with immediate and representative feedback. Given that members of these communities may not have phone or Internet access, however, it is important that the information regarding local government meetings can be accessed in alternative locations, and that meetings be organized so that they are convenient to residents.

Environmental education can play a significant role in informing community members who may not be aware of the impacts that proposed projects and policy could have on their health and the health of their environment. Youth engagement with schools, adult workshops and training, volunteer opportunities for students, summer programs and community gardens are ways in which citizens can be educated in the importance of sustainability and sustained environmental health.

Community Information Representatives. When actions that could potentially affect the health and well-being of members of these communities are proposed, it can be someone's role to identifying this legislation and inform members of the community about any issues that may affect their health. This role can be supported by funding or grants. Cities could provide or seek funding for community representatives to provide this function. Communities provided with an informed representative who seeks out notices of new developments and resources that can be used to help aid the community would be better able to take advantage of new opportunities, participate in public deliberation, and comment on proposed actions to better protect their own environment. Their representative could communicate with citizens directly, perhaps in their primary language, to educate them about how they can have a voice in pending affairs or projects that may have negative impacts on the health of the community, or to know of incentives and resources that can better their lives. The efforts of the information representative to collect input to provide to decision-makers will help the city make wise choices that reflect the needs and desires of affected populations, and to avoid conflicts that result from developments that residents don't want, and the negative perception that they are impositions.

Boston Involvement and Education. The city of Boston, for example, has created programs for civic engagement concerning health and environmental awareness. The Boston Public Health Commission (BPHC) offers workshops and training on health equity and community outreach through the Community Health Education Center (CHEC). The Health Equity Advisory Committee

(HEAC) is an advisory committee comprised of ten Boston residents, including health professionals, social workers, and community organizers that guides the BPHC in the development of policy matters and inclusive community engagement practices. These organizations enable community leaders to be involved in the political process as these leaders can advocate for the needs of community members and communicate to them the importance of environmental education. Boston can continue to develop these efforts through increasing partnerships with nonprofit organizations, strengthening community awareness of environmental health and more actively involving citizens in the political process that improves their wellbeing.

CLEAN LOCAL ECONOMIES

Environmental justice is often characterized as efforts to restrict pollution; however, preventing polluters from locating in disadvantaged communities can be seen as antithetical to economic growth and to increase unemployment. In order to avoid this, cities can couple the effort to prevent and/or control pollution in highly impacted areas with efforts to develop clean local economies. Cities can use tax, business and workforce development programs to change the perception of environmental justice efforts so that they are correctly viewed as part of a constructive economic policy.

There are several tax incentives that EJ communities can take advantage of in order to draw investments into low-income areas. Cities can use these incentives to benefit disadvantaged communities, and the programs should be adjusted and developed further so that more communities can benefit. In order to maximize benefits to low-income communities, provisions can be added to incentivize hiring local workers as development increases.

The New Market Tax Credit (NMTC). This program offers an opportunity to draw investment in projects within low-income communities. This program has created opportunities for loans to businesses within EJ communities. In order to reap the benefits of this program, communities can work with community development entities (CDE). These organizations apply to the Community Development Financial Institution Fund for NMTC allocation awards. These awards amount to the ability to hand out tax deductions to investors in low-income communities. The CDE then goes on to accept program's applications for NMTC funding and coordinate the investments while also helping collect additional funds to complete these projects. Cities can take steps to enhance partnerships and the effective targeting of funds by the CDEs to local organizations and businesses involved in the development of sustainable local communities. Most projects cannot be solely funded by a program like the New Market Program, however, in working with Community Development Entities, communities can learn more about ways to develop their projects so that they qualify for funding.

The process of economic development could be further aided by an increase in funding to the program as well as making the program permanent. The Program was instituted in 2000, but has not been made permanent and was only able to grant allocations to 73 out of 230 applicants for the 2017 calendar year. Applicants asked for a total of $16.2 billion, but the fund has only been afforded

$3.5 billion in allocations by Congress ("3.5 Billion"). Cities can join with each other in advocating for program expansion.

The NMTC program[11] has financed over 5400 businesses, and generated $8 of private investment for every $1 of federal funding. These results are strong, but they would prove stronger if the funding were increased and more projects were funded.

Our conversation with a Boston-based CDE suggested that the program creates barriers for entry of new CDEs because rewards allocations are largely based in reputation and history. If the program is expanded, it may be effective to work with CDEs concerning ways to adjust the program and allocate awards to programs and new CDEs.

One example of success of this program in Boston would be the Melnea Hotel[12] in Dudley Square, one of the poorest neighborhoods in Boston. This program was funded in part by the New Market Tax Credit and now offers jobs to the community and vitality.

Preferences for Green and Local Employment. One option that could galvanize clean development would be to grant preferential treatment to projects that have a green agenda, such as green infrastructure projects or construction of green buildings. Another option would be to offer preferential treatment to programs that have a plan to distribute the majority jobs to local workers and workers facing historical barriers to employment. By taking these steps, the program can take steps towards increasing employment, environmental justice, and diversity in employment in addition to the economic development that it has already provided.

Tax Cuts and Jobs Act. A similar program offers an opportunity for investors to spur investment in qualified opportunity zones (QOZ's), census tracts specified within the Tax Cuts and Jobs Act of 2017 (Siglin 2018). This program may prove less helpful to truly needy communities. The program in the TCJA lends preferential tax treatment on capital gains liabilities to investors. This incentivizes investment in for-profit investments, as opposed to the NMTC, that works with for-profit *and* non-profit projects. Some worry that this will draw investment to gentrifying areas, rather than the slower developing areas that have been revitalized by New Market Tax Credit.

The Federal Low Income Housing Tax Credit. This program works in a similar way to the New Market Tax Credit, by supplying a tax break. The incentive grants a dollar for dollar reduction in federal taxes for owners of affordable housing during the initial ten years following the units being placed.

[11] For more information visit the CDFI Fund website https://www.cdfifund.gov/programs-training/Programs/new-markets-tax-credit/Pages/default.aspx.

[12] View the website of Affirmative Investments, a Boston based CDE, and some of their successful projects: http://www.affirmativeinvestments.com/neighborhood-catalysts/

The Transformational Development Initiative. The Commonwealth of Massachusetts also incentivizes investment in low-income communities with the Transformational Development Initiative[13] run through MassDevelopment. This initiative was launched in 2014 and encompasses several programs that can galvanize development in low-income communities. Programs within the initiative include TDI Assistance, Investment, Cowork, Local, and Fellows, among others. TDI Assistance and Fellows both allow training for communities either by sending an expert to aid in expanding development capacity (Fellows) or funding market analysis and development strategy planning (Assistance). TDI Investment involves an equity investment which grants MassDevelopment a controlling ownership interest in any company, as well as other privileges. TDI Cowork provides funds to accelerate the pace of new business formation, job creation, and other activities in Gateway Cities. TDI Local supports local market development with small grants to increase community engagement and build community identity.

CLEAN JOBS DEVELOPMENT

Our recommendations concern workforce and economic development, distinctly different topics that require thoughtful combination. Addressing each separately but in a synergistic manner yields a better and realistic outcome than simply providing funding for one or the other. In our discussion with experts we heard that one problem of past efforts was a mismatch between the needs of companies and students. These recommendations are informed by the goal of developing a workforce companies will use, and improving economic opportunities for lower-income individuals and the city of Boston. In the examples below we work out various forms of programs that attempt to achieve a better match between the capabilities of students and companies that need educated workers.

One way cities can enhance green job opportunities for the residents is to institute *income sharing agreements*. These are partnerships for workforce development between institutions, private companies and students. Such partnerships, designed for green jobs in particular, represent an opportunity to achieve both economic and local workforce development, as well as green transformation.

1. *The Company-Student Program*

This program targets students of low-income areas by giving them the opportunity to apply to universities with company-required majors. The student is required to major in a company-required major. For instance, a company is in need of *Environmental Science* majors for future positions. To ensure students are enrolled in company required-majors, private company employers are required to provide a list of fields/ majors they need for potential job seekers. This allows for the public to know the jobs that are in demand for the next couple of years. Moreover, it

[13] Visit the MassDevelopment webpage detailing the Transformational Development Initiative to learn more. https://www.massdevelopment.com/what-we-offer/key-initiatives/gateway-cities/

addresses the concern of employees needing to fill positions and types of occupations, but are unable to because of a skills gap. This partnership would ensure future employees are able to meet the company's expectations for the job once a student graduates.

There have been several companies in the United States that have funded or reimbursed a partial or full amount of university tuition for their part-time and full-time employees. Some of these companies are Starbucks, UPS, Bank of America, Deloitte, Intel, and many others. Instead of having companies fully or partially fund *current employees'* education, we propose a program that allows for companies to fund potential employees' education *before* they begin their higher education. This is called the Income Share Agreement. During their final year of high school, students would apply to the program as well as universities in the field they would like to pursue in the future.

A proposal for funding the education of future employees using the Income Share Agreement

- Students apply to the Company-Student Program through the company's website. If a student meets the requirements, they would be accepted into the program.
- Once a student is accepted into the program and their school of choice with their company-required-major, the student is required to sign a binding-contract with the company agreeing to:
  - Graduating in the period of 4 years. Note: Students can extend graduation date depending on a concerning and documented need to postpone (ex. medical, family death, etc.).
  - Reporting grades after each semester to the company to ensure students are meeting requirements to maintain a specified GPA stated by the company.
  - To work for the company after graduation.
- Once a contract has been begun, the company will begin funding for the student and the student will be considered an employee as of the start date of their education.
- The company would provide a monthly stipend to cover expenses, health insurance and fund their education. During their time in school, they should be provided a stipend that meets the State's average living costs. Once a student graduates and begins employment in the workforce, the student is paid the expected yearly salary of a recent graduate for their field.

Income Share Agreements are relatively new and minimally utilized, but the thought process behind this model has the potential to be effective if properly implemented.

Applying the Concept of Income Share Agreements for Affordable Tuition. For this model to work to improve job opportunities in EJ areas, there should be access to information about this opportunity that is widely dispersed among people of low-income areas, and people applying to such a program should have access to and be aware of other financial mechanisms provided to them by either governmental or other outside sources, so that they can put together a package of funding that works.

The program has several components. The primary objective of each of these components when combined to make the model displayed below is to allow for prospective college students to push their debt into the future, rather than take it on in the present where it might be an unsupportable burden. The program works by taking from future incomes of those prospective students so as to allow for a kind of grace period to be had before money must be paid back. Rather than have immediate debt, one would not have any debt to pay until one secured a job, from which 3-5% of future income would be taken and cycled back into the Income Share Agreement for others.

The two graphics below detail the financial mechanisms behind Income Share Agreements and how they are traditionally used (Figure 6) versus how they could be used (Figure 8). The traditional ISA model that typically is applied to students can arguably also be an impactful way to close the skills gaps of low-income neighborhoods when applied to workers in training programs.

Income Share Agreement models for both affordable tuition and training programs are most promising in this moment in time for environmental justice communities because of their ability to generate a positive feedback loop. Jobs are then being created and people are constantly being added to the workforce by cycling money in this way. They also manage to perpetuate economic development within targeted areas, such as EJ communities. ISAs have been around for several years but may just need to be applied in various ways to reach their full potential. See Figures 6 and 8.

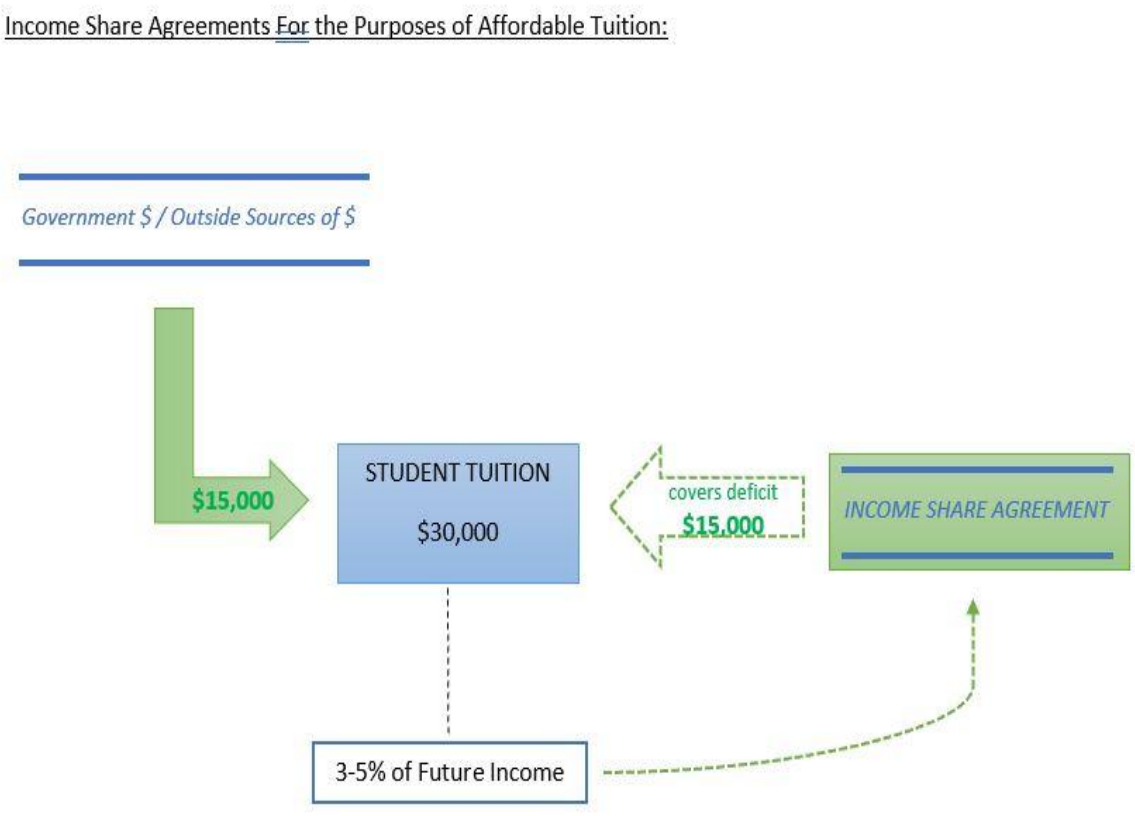

Figure 6: Income Share Agreements for Purposes of Affordable Tuition.

Company Sponsorship Pooling Program. We propose a modified model, that we name the Company Sponsorship Pooling Program, in order to mitigate risk in investment. The inspiration behind this model comes from both ISAs and sponsorship programs. The Company Sponsorship Pooling Program works by having several companies pool together money into a kind of Special Purpose Vehicle.

A worker in need of training would be sponsored by that pooling program and would secure a job in the future if all goes according to plan. Once a job is secured, 3-5% of that worker's future income would go back into the pooling program for a select number of years. There will not necessarily be a need for a loan guarantee, which is provided in the example above (Figure 6), most likely by the government. The pool provides for circulation of received money back to the original investing companies, which may be sufficient. Though sponsorship programs were created for people applying to college, this model can be widely applied to those in need of training, to high schools, and to prisoners for reentry into the workforce after their sentence is served. Government could help to stimulate the creation of such pools by providing tax breaks and/other incentives (including loan guarantees, if helpful). See Figure 7.

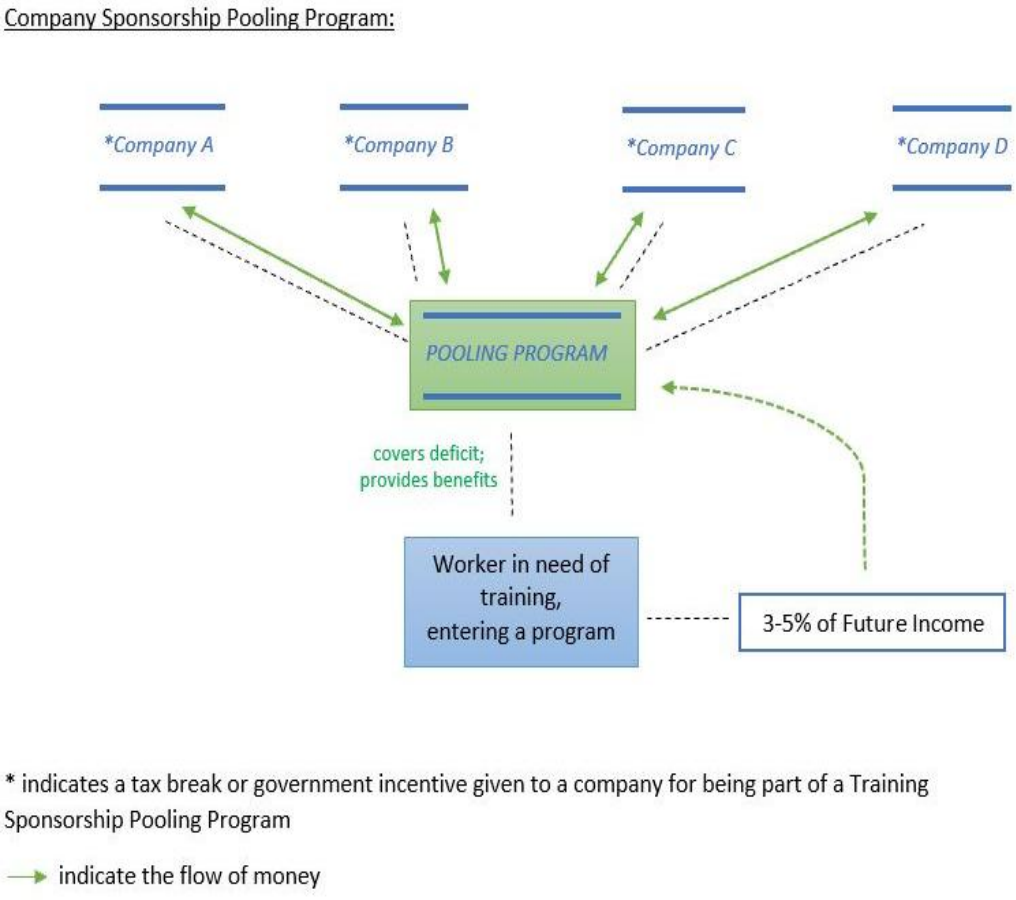

Figure 7: Company Sponsorship Pooling Program

The Non-Credit Training Program. We propose a Non-Credit Training Program implemented by educational institutions to help marginalized people have access to clean jobs in lower income areas. This particular program would target low income area individuals who did not complete high school as well as non-traditional students. The Non-Credit Training Program would be a partnership between a University and a private company that has an interest in preparing prospective students with the necessary skills for specified jobs through a time-frame. Those successfully completing the program would have a guaranteed job and the opportunity to work for the company.

Allowing a deep employer engagement guarantees positive outcomes for both employers and potential employees, especially from lower-income neighborhoods. An excellent example of this program can be seen implemented by Bunker Hill Community College and Eversource, where a public company and academic institution worked together in designing a workforce that included recruiting and hiring locals. Eversource requested that Bunker Hill create a program where Bunker Hill would train their students to meet the requirements of this specified program. Bunker Hill created a list of demands that included that those chosen must be from the local area and meet certain requirements. The institution and the company both made decisions on how they would work together to ensure diversity, while meeting both of their needs.

Implementing an employee-based cohort that explicitly states the skills and demands an employer needs filled substantially benefits all in the long-term. It creates a career pathway for potential employees and demonstrates a certain preference without discrimination. This program is a training program that can also be applied towards credits if the non-traditional student chooses to pursue higher education.

Benefits. We believe that this program will yield a win-win outcome and create numerous benefits for all stakeholders as explained below:

- **Students/ Potential Employees** will benefit from avoiding the financial burden of student loans or other financial concerns that will deter them from receiving a higher education or graduating in a reasonable time. Moreover, prospective students will benefit from training in their future field with the necessary skills. Most importantly, prospective students benefit by having a guaranteed job.
- **Employers/ Private Companies** will benefit from having their job positions filled and ensuring their employees meet their specific expectations and requirements.
- **Universities** will benefit from having a high graduation and employment rate, while also creating a partnership with employers in ensuring their graduates meet the job markets' expectations of skills.
- **The government** will benefit from ensuring work development and economic growth is increasing and improving in lower income areas and minorities.

Income Share Agreements for the Purposes of Affordable Training Programs. This model takes the same logic and basic format of the first model. Rather than focusing efforts on the younger members of environmental justice communities, this model is more applicable to those that were unable to complete high school-level education. There are currently training programs in the U.S. that are funded by government money. We propose allocating more money toward specific training programs that are willing to implement ISAs. See Figure 8.

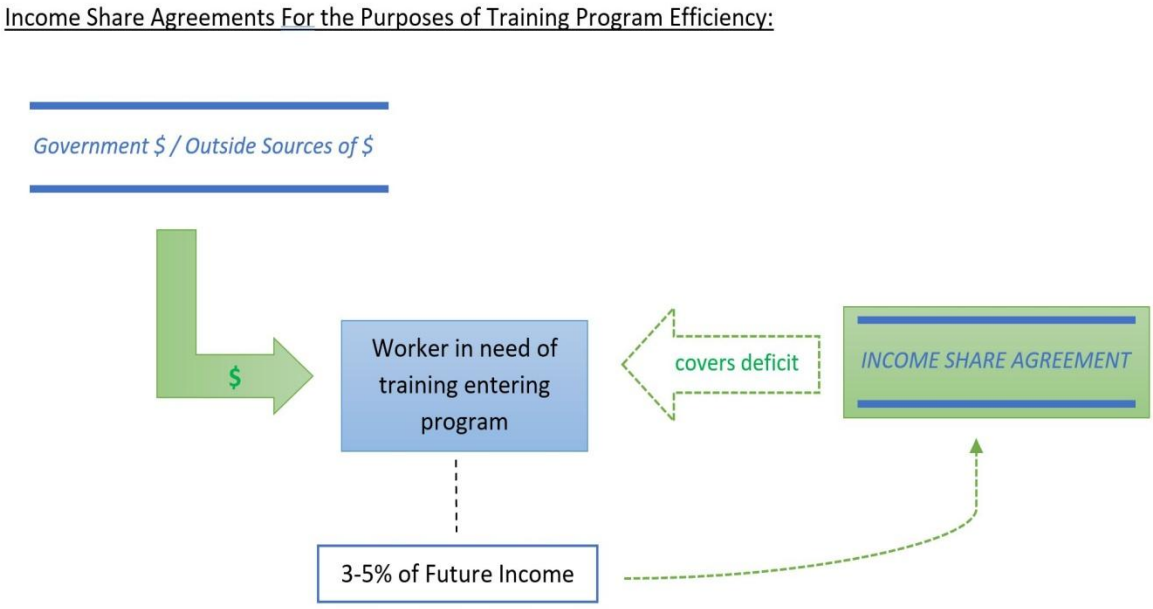

Figure 8: Income Share Agreements for Purposes of Training Program Efficiency

Potential Problems. It is necessary to build flexibility into these programs so that people do not feel trapped by their commitments.

- *If a student chooses to switch majors:* In the Company Pooling program, students are able to do so without breaking their contract, by shifting the contract to another company in the pool. With the Company-Pooling program, another company in need of the student could take part in the Income Share Agreements (ISA) and the pool would refund the original company. The program could be designed with flexible approaches to ensure no losses from all parties involved.

- *If a student decides they want to drop out of the program/ university*: This would mean they are breaking their lease. In this situation, they would be required to refund the amount the company has invested in them. They could be assisted in this by a government loan guarantee to ensure there is not excessive financial burden on the student and the employer does not incur any financial losses.

- *If a student decides to leave the company before four years of the mandatory time*: The student is required to work with the company for at least four years. If a student decides to leave the company before four years, they are also required to pay the company back for the remaining time the company has invested in them through the government loan guarantee.

Benefits. The ISA model presents an opportunity for designing new approaches to workforce development in areas of high unemployment. If designed to attract the participation of companies producing clean products or engaged in environmentally preferable activities, it can have the triple effect of helping in develop clean jobs and local economies, and helping the disadvantaged to obtain the education they need.

- *Students/ Potential Employees* will benefit from avoiding the financial burden of student loans or other financial concerns that will deter them from receiving a higher education or graduating in a reasonable time. Most importantly, many students would be helped to obtain college degrees and a guaranteed job with the expected income of a recent graduate in their field.
- *Employers/ Private Companies* will benefit from having their job positions filled years in advance. Moreover, they benefit from ensuring their employees meet their specific expectations and requirements. Employers could also receive tax breaks for taking part in this program.
- *Universities* will benefit from having a high graduation and post-graduation employment rate, while also creating a partnership with employers in ensuring their graduates meet the job markets' expectations of skills. This means attracting prospective students to attend their universities, since these students are guaranteed to be prepared for the job market in their chosen field. Ultimately, institutions will benefit from increasing the efficiency of educating their students.
- *The government* will benefit from ensuring work development is increasing and improving in lower income areas. This will also yield a significant economic growth from implementing this program.

Residential Building Energy Efficiency

Low-income residences have long been considered to be a priority focus for energy efficiency attention, as these buildings are often in poor repair and funds for tightening the building envelope are scarce. This perspective was confirmed by experts we spoke to, even in Massachusetts, which has ranked first in the nation for 8 years in a row, and Boston has been ranked the most efficient city. The Commonwealth has reported high levels of utility savings driven by strong energy efficiency standards and ambitious environmental goals. The Commonwealth also leads the nation in residential building energy efficiency. Its Weatherization Assistance Program (WAP) designed for the low-income sector has had high participation and has proven cost-effective. Yet even here there is much discussion about how to do better.

Experts we consulted gave credit for the progress thus far to community action agencies and other non-profit organizations that help low-income groups to know about the service and then navigate the process. (A Low-Income Energy Assistance Network (LEAN) assists these organizations and coordinates with utilities). For example, experts from other parts of the country noted difficulty in coordinating between services that help with repairs (before installing insulation, leaks need to be fixed), but in Massachusetts, although a significant amount of homes have deferred weatherization because of the need for repairs, substantial assistance has been provided to overcome this obstacle.

In addition, instead of partial subsidies, the WAP has provided 100% funding for low-income retrofit projects. This removes obstacles such as an inability to fund the remaining costs, and the issue of the "split incentive", in which landlords not paying for energy have no interest in making their buildings more energy efficiency, and tenants who would like to reduce costs do not have the legal right to retrofit the property. The provision of 100% funding was said to be a substantial reason for the success of the state's low-income housing energy efficiency effort.

In the Commonwealth's 2019-2021 Three-Year Plan, Program Administrators overseeing the WAP have proposed an additional investment of over $200 million for further improvements, including to extend 100% funding to include moderate income groups. The Plan will increase focus on "the hard-to-reach" population, such as non-English speakers. To reach communities which have historically low participation rate in energy efficiency programs the PAs propose a program of increased marketing, trainings, and other outreach.

One of the community action agencies, Action for Boston Community Development (ABCD), has had a penetration of rate of more than 80%, weatherizing around 15,000 out of 18,000 family addresses in their targeted map in Boston. ABCD hopes that expanding the eligibility of the moderate income bracket (60%-80% of the median income) will allow substantial new progress. In the meantime, to overcome the split incentive problem between the landlords and renters, ABCD has been putting more efforts into communicating with the landlords. Collaborations with landlord associations and landlords have increased their knowledge of the programs and thus their willingness to accept weatherization in their buildings. ABCD is also expanding outreach designed to address the diversity of the population, offering program information in Chinese, Vietnamese, Haitian Creole,

and Spanish. To further improve the quality of weatherization program, ABCD's next three year plan has added a new monitoring aspect. ABCD has hired a consulting company, New Ecology, to develop new benchmarking tools to assess the progress of retrofit projects, and estimates that they have realized 5%–8% of saving during the weatherization work through improved monitoring.

While Massachusetts has achieved many successes in residential energy efficiency, there is more space for improvements and expansion of services. Conversations with experts in the field resulted in a number of recommendations for improving the service and reducing emissions and losses from residential buildings.

Recommendations for Program and Policy Improvements

Expand Full Funding to Moderate Income. One obstacle, verifying income levels, can be reduced by including moderate income customers. Because household income fluctuates from year to year, households are not used to keeping track of their income and providing evidence for evaluations, individual incomes or numbers of household residents can change at any time; and current data from census may not be representative of the income groups, qualifying for low-income assistance can be difficult. Yet many who belong in the moderate income group, who cannot easily show that they qualify as low-income, or who fluctuate between the groups, need the assistance of full funding in order to weatherize. Although there are people in the moderate income group who have managed to weatherize with current subsidies, this is considered by many to be the exception rather than the rule. Many experts told us that the assumption that only those who can show they are in the low-income group need full funding is not helpful, and support the expansion of 100% funding to moderate income customers. We heard this from government officials, from the Low Income Support Corporation (LISC), the Green Justice Coalition (GJC), and others.

More Outreach to Small Landlords. One of the major barriers we have found is the split incentives between landlords and renters, and the general obstacle of gaining landlords' support. For the 0-60% income bracket, the funding is not a problem because projects are fully paid for by housing programs, but landlords are still skeptical of the funding and the idea of construction taking place. Renters may also be hesitant to reach out to landlords for personal reasons. For example, if renters have more people living in their homes than declared on the lease, this will be found out during the home audit for any weatherization program and potentially get them in trouble for violation of lease. Some landlords may also consider any confrontation about home improvements as a complaint and force the renter to leave. To reach more homes, it's important for landlords to understand that these programs are of no cost to them if their residents are within the eligible income bracket and that these retrofits will improve property values, the living standards of the residents, and potentially save money on heating bills.

Targeting landlords – especially of small multi-family homes (6-8 units) with concerted outreach, can help, with loans to minimize the amount landlords need to pay upfront, and to help them understand the long-term savings on heating bills, even if paid by tenants. Experts we spoke to felt that many landlords needed direct contact from programs such as LISC, which can explain the loans

that are available to assist in paying for weatherization retrofits, and the benefits from taking action.

Increased Engagement with Hard to Reach Populations. In addition to rocky relationships with landlords, language barriers and recent immigration policies may create another barrier. This can keep eligible groups from applying out of fear or lack of proper communication. Government programs may be of help to these residents, but if they aren't comfortable reaching out for assistance, it must be brought to them. A related difficulty is that many renters move frequently, making it difficult for programs to decipher which neighborhoods still need to be focused on.

Increasing the number of languages in which information is provided can help, suited to the existing population, increasing the number of translators available to attend house visits or work in customer service, and increasing engagement with the public such as at community centers or libraries, and through websites and social media platforms.

Increasing Funds for Pre-Weatherization Repairs. Another group that has major barriers to receiving full support from these projects are residents with homes that need renovations before being deemed eligible. Programs like ABCD, WAP, etc. have limited funding available for each home to fix small leaks, cracks, etc. Furthermore, the funding given to environmental departments and organizations to assist with small fixes must be shown to be the most cost-effective means, which can function as an obstacle to some projects. Sometimes if multiple renovations are required the required time frame for completion might also become an obstacle, and weatherization delayed for months or years, if homeowners or residents cannot pay the upfront cost.

Some homeowners with mold, large roof leaks, or old knob and tube wiring (which prevents the installation of insulation that could become a fire hazard in contact with it), require additional funding from external sources: There is not yet a direct state program to refer these residents to potential funding sources or organizations, so these households may never get the required renovations. Although Massachusetts provides significant assistance in obtaining funds for repairs needed to enable weatherization, there remains a sizeable portion of housing with projects deferred because of the lack of funding for repairs. Removing "caps" on how much is allowed for any given home, where appropriate, would help. Expanding such funding would increase the number of households that have issues related to public health, such as mold, to have improved indoor environments, in addition to reduced emissions.

Increased monitoring. Monitoring allows for residents, homeowners and landlords to review the effectiveness of their retrofits and notice potential fixes, which avoids potential energy and heating bills wasted. The goal of ensuring that the program is cost-effective has been met by requiring each project meet cost-efficiency standards before approval. But it is also important to review the installations and to take a look at costs after installation. Monitoring can help residents and owners understand how to best maintain their homes over time, a key to success in reducing emissions.

Fund related clean energy options in the home. Funding can be provide to homes in addition to improving building envelope that can further improve their energy efficiency. Other energy efficiency retrofits are needed, such as for more efficient refrigerators, lighting, battery-run products, building energy management systems, air-source heat pumps, efficient furnaces, installation of solar energy, community solar, and community choice aggregation. Subsidies and other programs exist for these but utilization can be boosted with targeted outreach, coordination, and increased assistance.

Marketing to Homes and New Construction. A challenge that has been highlighted by some organizations we've spoken with lies in finding which homes and neighborhoods still need weatherization efforts, which may be difficult to determine because of high mobility of the residents in certain neighborhoods. It has been recommended that increased research concerning where outreach has succeeded and review of existing data should be a priority. For new construction currently being done, organizations such as LISC recommend changes in policies to focus and invest more on Passivhaus and other efficient home design which aims to lower the ecological footprint of the buildings in the first place. This also involves training, hiring trained architects and construction workers who know how to design and build these homes to be energy-efficient. Such design bypasses the need for energy efficiency retrofits later in its life cycle, decreases the energy consumption, and increases the value of the building ultimately.

Monitoring Toxins, Improving Air Quality in Homes during and after Retrofits. The home is a source of toxic exposures that can be prevented, directly or indirectly related to the work performed by energy efficiency programs. The choice of insulation is one example, where some forms, such as spray foam, have toxic elements. In air-sealing, exposures in areas such as attics and basements that are not well-ventilated may endanger workers who are not fully suited with supply-air protection (typical for whole-house installation but not for air-sealing). Isocyanates used in spray-foam can be powerful sensitizers while workers may not be monitored for exposure. Other issues concerning insulation involve flame retardants, formaldehyde and the emission of powerful global warming gases at the end of life. Installers, owners and residents should be fully informed about toxic constituents of insulation before making the choice of material. Other issues involving toxic risks caused or exacerbated by renovation include disturbance of asbestos fibers, which must be contained because they may become airborne; lead paint, release of other coating materials, PCBs from old caulking, pesticides, and mold. Workers performing renovations in homes built before 1978 are required to have training in lead-safety, but should also be trained to recognize and address these other issues. Resources for addressing these issues should be provided to residents and building owners.

If insulation is performed well using non-toxic materials, there are still concerns about the indoor air quality, which may deteriorate because of the reduction in air flow. A program that reduces the draftiness of buildings should be coupled with efforts to reduce chemical usage in indoor environments, increased attention to off-gassing and particulates from materials used inside the home (and in renovation), and improved ventilation to reduce these risks and increase the amount of fresh air provided to residents. Ventilation that is effective at accomplishing these aims includes:

- Whole-house (both push and pull ventilation)
- Smart ventilation (that turns off when not needed, as with occupant sensors)
- Heat- and humidity-exchanging (in order to reduce energy losses)
- Fail-warning (so that when the ventilation is off people know it)
- Quiet (so that people are not motivated to turn it off)

Ventilation may reduce the energy efficiency gains by an amount that is not insignificant, but if coupled with heat-exchange and maintained (including the duct system, intakes and fans) the gains in health protection should outweigh the losses.

Creating Strong Relationships between Public Health and Energy Efficiency Programs. Our conversations frequently elicited observations that there is limited coordination between public health and weatherization programs. Leaking roofs need to be fixed in order to allow for the installation of insulation, but they also cause mold and pest invasions, which leads to the often excessive use of pesticides. Those who work in homes for purposes of making them more energy efficient can play a role in making them healthier for residents. While the energy efficiency programs typically attend to issues such as lead paint and asbestos, there is more that can be done to ensure that the improvement of homes for energy reasons also works to improve public health. As homes are weatherized, problems of indoor air quality can be exacerbated, necessitating attention to sources of volatiles and particulates, and ventilation. Referrals of individuals with asthma to existing assistance programs and to information about how to reduce exposures should be emphasized as part of the overall effort. Weatherization planning should include evaluation of existing ventilation, which may be improved through simple correction or proper maintenance, and assistance for system repairs should be provided when needed.

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